Oral History of Kumar Malavalli

Interviewed by:
Dal Allan

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Allan: Welcome Kumar.

Malavalli: Thank you, Dal, it's been a real great pleasure seeing you after such a long time.

Allan: I was wandering through the files, the history in the ENDL Letter recently, and trying to figure out 'when did we first meet?.' It was at a standards meeting, and that would have been back in the—

Malavalli: Eighty-seven?

Allan: Yeah, '86, '87 time frame.

Malavalli: Exactly. That was great, I met you for the first time when you were still talking about something to do with the high speed networking protocol for the computing devices. It was not so much for storage, it was the closely knit high speed computer network, that you were talking about. I was attending FDDI [Fiber Distributed Data Interface] committee meetings, to find out what they were doing in 100 megabits per second and learn the LAN [Local Area Networking] protocol, because at Canstar [Communications in Canada], where I was working at that time as you know, we were developing a technology called Hubnet. It was the brainchild of the University of Toronto, it was also 100 megabits per second, and the LAN protocol was totally different. I just wanted to know what FDDI was all about, what it was doing, to compare notes. After seeing you at several meetings I came to know that you were going to start a group, to start a committee to develop a next generation high speed protocol for the computer communication, mostly within the data center, not so much outside of the data center.

Allan: That's right, FDDI started at Univac. It was based upon the stories I'd heard about IBM having a new channel based on the Cambridge Ring, and we needed to use something to hook up our storage controllers. FDDI went to committee because Univac chose not to pursue it, and the committee turned it into a high speed network. The synchronous mode, which was for storage, disappeared. That's why we started a separate group to say, *"look, let's throw away the ISO model, let's go for storage."* At the time, you had what I thought was a better solution than FDDI at Canstar.

Malavalli: I knew you did, and invited you to Canstar. Remember? You came and gave a lecture on different protocols, some— do you recall that?

Allan: That's right, that was when I was in preacher mode. The interesting thing was, 98 percent of an audience would throw tomatoes, and there would be one or two people who'd say—

Malavalli: It makes sense.

Allan: Yep. And that's where we really started, a small band, which went out, basically saying, *"you can't do storage on a LAN. You've got to do it on something faster, and more suited to the environment."*

Malavalli: And also, if you recall, Dal, either you, or somebody brought it up. What we do should be agnostic to the already existing protocols, because we can't go to the customer and say, it's a fork lift upgrade, and although we've got something really good, it's not going to fly. We made sure as a group, that it was agnostic to the data transfer protocol. At the lower end, we said that it should be able to run SCSI protocol, at the high end, it could play HIPPI [High-Performance Parallel Interface]. There were a lot of problems: connectivity problems, distance problems. All those different issues had to be taken care of still, coming up with some system, which was agnostic to all the existing protocols.

Allan: Yes, and that was, what shall I call it, rather radical.

Malavalli: Exactly.

Allan: And then there was the possibility that it might carry networking as another protocol. We couldn't even mention that, because it would have got us into a lot of trouble.

Malavalli: Trouble, I know. Yeah.

Allan: Canstar was in Canada, and you went to school in India. Did the two degrees you get done in serial or in parallel?

Malavalli: In serial actually. I went to school in India. I did a Bachelor of Science with a major in physics and mathematics, then I got to liking theoretical engineering, so I took another degree. I went to school again and did a Bachelor of Engineering [BE]. It's equivalent to BS here. So I did both the degrees, and then soon after that, I got a job as an electrical engineer with a German company called AEG. And then [as a result of experience in] that company, I managed to go to Germany for my practical training in electronics. After having lived there for nearly three years, I wanted to migrate to the United States. At that time, I couldn't get the visa, because there was a recession in [the US] in [that] year 1974. [as an alternative]-, I decided to [move] to Canada. I went to the [Canadian] Embassy in Bonn, the capital of Germany [at that time], and then [the officer at the Embassy] said, you have no problem getting the green card [equivalent of Canada]. The equivalent of a green card actually, we used to call it pink slip, but that means a different thing here. I got a pink slip so that I could migrate to Canada, and then I worked for three different communication companies. I was a little blessed. I was the right man at the right time, because I [got a chance] to work for a company called ITT Communication in the PBX [Private Branch

Exchange]area, for data and voice [communication on phone systems]. I next moved to Amdahl Communications in Canada and that gave me exposure to Wide Area Networks [and Telephony]. That's why, when you see some of the aspects of switching that Bent Stoevhase and I introduced [in Fibre Channel], they came from telephony [background]. All that came from my experience at Amdahl in Wide Area Networking communications. After [Amdhal] I moved to Canstar to be in charge of Hubnet, which we talked about, and Hubnet led me to the standards committee where I met you. The rest is history.

Allan: Right. AEG, was that also a Telefunken at the time? Were they also—

Malavalli: No, it's a process control company. I started my career in the process control and I had a real intention, a very high intention, a fantasy even, toward communication technology. I wanted to move to the communication technology, that's why I left Pilkington Glass in Canada, which was purely based on the process control. I moved from process control to communications when I joined ITT.

Allan: When I think of process control, it's really like a mini-network, isn't it?

Malavalli: Mini- [closed loop]network, and process control to manage and control [parameters] [with]feedback [mechanism]. There's a control system for different parameters like pressure, temperature, [and] those kind of things.

Allan: So you went from what we'll call the micro-net, to the macro-net.

Malavalli: [Macro]-net, exactly.

Allan: And if you remember, ICL, in England, had the Macro-LAN which was their first attempt at a Storage Area Network, and so I guess we all followed similar paths in that regard, didn't we?

Malavalli: Absolutely.

Allan: Different companies, even.

Malavalli: You know, that's why we gelled so nicely. Although we came from different sides of the industry, we had some common threads, and like in micro-net to macro-net, we're all networking. Whether you're networking the computer or storage, the idea is the same, but the parameters are slightly different. When you are doing Internet Protocol, it's a totally different requirement in the data center as it is for high speed storage network, and for that we developed Fibre Channel.

Allan: I could find nobody who believed there was a huge difference between an interrupt driven system, a network where everybody wants to be equal, and storage, which is primarily based upon moving data. The one is short bursts, lots of them, the other is long bursts and 'stay out of my way.'

Malavalli: Absolutely. Incredible, and that's very true, Dal. Another aspect that comes to my mind when you look at Internet Protocol for the real LAN environment, it's a peer to peer and everybody is equal. When we came to the computer network within the data center, it was a master-slave paradigm, and we had to mix both of them in the Fibre Channel. We combined them into a hybrid kind of network, which took care of both peer to peer, and the master-slave which is very important to carry SCSI [protocol for Storage].

Allan: Do you remember the meeting at which there was a political concern that master-slave was not to be used anymore as a term in our standards, and the guy from AMD got up. Were you at that meeting?

Malavalli: Exactly, and I think that was in Rochester. Someone came and said you can't do that, that is blasphemy, but I know we had the last laugh anyway.

Allan: Yep, the guy from AMD got up, and he happened to look like a linebacker and said, *'we all know what master-slave means, but the connotation is neutral in this environment.'* Nobody argues with a 250 pound linebacker….

Malavalli: Exactly, absolutely. And another interesting thing, if you recall, we not only took from good points on the LAN, and the computer network area within the data center, but we embraced a lot of good things from telephony. Login [in Fibre Channel], for example, is purely an equivalent to signaling.

Allan: Do you remember the disaster of isochronous and FDDI, because they wanted to do voice? It just didn't fit.

Malavalli: Exactly. Absolutely..

Allan: And nobody seemed to realize that a 256 byte buffer solved the problem cheaper than changing the interface.

Malavalli: That's another thing. We were faced with the problem of handling large blocks of data, and in IP the 2K packet was not sufficient, and that's why we created what is known as a Sequence, the Sequence is equivalent to packet, in terms of Local Area Network philosophy.

Allan: Everybody felt at the time that we were really stretching to go to 100 megabytes a second, very few people realized that HIPPI, which was previously known as High Speed Channel, already existed. It was such a niche market.

Malavalli: HIPPI was point to point and had two cables, one for output, one for input, and it was not dual transfer [in both directions].

Allan: That's right, but it was an established speed. In order to map everything across, we had to go at the fastest speed with no loss. Those things were very difficult to sell.

Malavalli: Very difficult to sell and also, if you recall, we created... you were the one instrumental in starting the Fibre Channel Association, so of course you know why it exists. You planted the seed, and what you wanted to know, what is the business use for this? We developed very good technology and very good protocol, but how can we commercialize it? I think it was in the Fibre Channel Industry Association, where we coined the term Storage Area Network, and that storage was the application. That's key, and along with the storage, we dragged the service as well.

Allan: Gadzoox, who are no longer with us, Seagate, and a controller company whose name doesn't come to mind [Interphase], put together a sales package as a cheap entry into Fibre Channel. They wanted to call it SAN, and in this same timeframe Tandem already used that term for a Systems Area Network.

Malavalli: Systems Area Network.

Allan: And the answer was, *'we don't care.'* SAN was picked up by the Association, it became the marketing phrase. The use of Systems Area Network disappeared because Tandem was bought by somebody who was bought by somebody and it just went away. SAN is there today, but it [Fibre Channel] wasn't the first use.

Malavalli: Can you imagine that in 1988? You know, it's incredible looking at this list of attendees [in the handout to prompt discussion items] and recognizing all the names of the people who attended the initial meetings of Fibre Channel. At that time, who would have thought that we were going to build an ecosystem, an ecosystem of different components? One company couldn't have made it happen, somebody was doing a disk drive, some company was doing the Host Bus Adapter, some company did the switch. There was Brocade and Ancor Communications, if you recall, and they all were needed, otherwise there wouldn't have been an ecosystem. Not only ecosystems, but also components in the transceivers, the cables, connectors, all those things. There was an incredible synergy in the committee that gave rise to the industry, because today we have an 80 billion dollar industry. Who would have

thought that the group, piddly little group, you started in 1988 would give rise to a 70, 80, 90 billion dollar industry?

Allan: Well, we were fortuitous. There was no other alternative, so we started with a clean sheet.

Malavalli: And also disruptive. Fibre Channel was disruptive.

Allan: Yes it was. But for six months, nobody had a proposal. All we did was listen. We listened to the PHY people come in and tell us about their parts, we listened to the protocol people come in—

Malavalli: But Gilley Elston [physical] [Giles Frazier / Joe Mathis] [Protocol]. [They] did a great job in Austin. They gave us the basics for the protocol.

Allan: For six months we listened, and then sat down and wondered what to do. And that's when, like you said, the multiple disciplines, listening to experts who couldn't understand each other unless it was through an intermediary, so to speak. Then we split the group up into the guys who knew what they were talking about at the physical level, and the guys who knew what they were talking about at the protocol level, and we ran in parallel.

Malavalli: That was one thing. Another challenge for us is that we had to create a lot of tangential things. It's not enough if you had switches, you had to have the host bus adapters, if you had a component, how do you manage it? A simple solution like the Name Server. We had to redo the whole name server concept which existed in the internet. We could not take this from the Internet Protocol and update. We had to modify that to suit the Fibre Channel environment.

Allan: Yes, can you imagine what it would have been like, had we adopted ARP (Address Resolution Protocol)? It wouldn't have worked for us. We would have had a flurry of so much activity - it was really a case of desperation.

Malavalli: Absolutely. We had to go to the drawing board every time, because we couldn't adopt anything that was already available.

Allan: A lot of the architecture, like you said, was heavily influenced by you and Bent and others who were out of communications, and said, *'look, let's have destination switching.'*

Malavalli: Exactly, exactly.

Allan: That was radical for storage, we weren't talking about eight devices on a bus, we were talking about a 24 bit address base.

Malavalli: And also hierarchical. You know, Domain, Area and the port. That was the brainchild of Bent Stoevhase, he came up with the addressing mechanism. We needed that addressing mechanism before we could have the Name Server, we had to build a translation between physical address to worldwide name, and symbolic name — we had to do all kinds of translation.

Allan: I've actually got the date when you and Bent presented that concept. It was March 21st 1991. *"Kumar and Bent made a proposal on partitioning the 24 bit address field. This concept has been resisted in the past, because previous proposals had not been comprehensive, and appear to be conveniences that suited individual manufacturers."* That was the day.

Malavalli: Exactly. That was the foundation for the switching, the connectivity.

Allan: It was a marriage of two disciplines, the discipline that came from the Wide Area Networks of the phone company and the closed area networks of the storage systems.

Malavalli: Absolutely. The mixture of telephony and closed circuit networking, that gave rise to Fibre Channel which I view as disrupting. You can succeed when there's a disruption and that disruption is accepted by the masses. That's when you have a home run.

Allan: Yes, and it's kind of interesting that every now and then we had, what shall we call it, crises in the process?

Malavalli: Arguments over this and that.

Allan: Yes, we did, like in 1992 when along came a proposed loop alternative, which was SSA, and—

Malavalli: Exactly, that was a compromise.

Allan: The first presentation was a good closed solution, and the second presentation was of a completely different system, because IBM had made it general purpose to compete against the Fibre Channel Loop. Looking back, that helped fine tune the Loop model, because it made everybody re-examine what was being done at the storage device level.

Malavalli: Absolutely, absolutely. Otherwise we wouldn't have had the disk drives based on anything that was a non-loop. [That in turn] got [us the] disk drives. That actually— we got a pull— because we got a pull from the other side of the network [the] disk drives were possible, because of the loop, and we were able to kind of develop the switches [on] the servers side, the host bus adapter, that created, when we were pushing a little bit, but that created a pull. And also there's a funny anecdote I can tell you about loops versus switches. When we started Brocade, the very first meeting, [when] started the meeting we were thinking, what to do. We had to connect devices, storage and the host devices, but what do we do first? Shall we do the loop, take the low hanging fruit, the cheaper to do and cheaper to sell, or do the switch? Then actually we went out — we toured all over the country to feel the pulse of the future prospective customers. They all said, *'don't follow the Ethernet model.'* I'm talking about the connectivity, not the disk drive side. Don't follow the Ethernet model. In the Ethernet model what happened was you had point to point, then came [loop], [and] then came the switch. There was a long transition period between the [loop] and the switch, — and then the performance was not a big [thing], the performance and the error, what shall I say, error separation and all those things were not really required. But here, we had to [right at] the protocol make sure that we protect each device from other [in case of fault] [for error separation]. So, here, there was no transition. People went [directly from] point to point, actually to the switch. Gadzoox made a totally different strategic decision, they went with the loop first. Then they tried to do something which is neither [fowl] nor [fish], a loop switch, but they were too late. The market had already accepted switches, that's why Brocade took off and Gadzoox failed.

Allan: When you saw it take off, Sequent was your biggest customer.

Malavalli: You're absolutely right. Sequent, to our good luck. We were not the first one that Sequent went after. Sequent was already trying Ancor switches, a Class 1 switch. It was circuit switch based, and did not work for Sequent for whatever reason, I'm not pointing the finger, but for whatever reason, they had problems, it did not work. We went there, and gave the presentation. We [Brocade] were a packet switch, you know, Class 2 and Class 3. We did not do Class 1. Class 2 and Class 3 was what we wanted to do in the switch, and then we told them [about the switch and] we gave them the prototype. They tried it alongside, it worked, then they pushed [Ancor out and] they got us in. They were the first one, Sequent didn't call it Storage Area Network but they were the first one who created a Storage Area Network for us, and connecting quad processor, Intel quad processor, multiple quad processors, and with the storage and the mass storage devices, controllers. They were the first. That's what gave us the real— opened the door for us in the industry.

Allan: Did you ever hear the Burlington Coat Factory story, they see—

Malavalli: Yeah, they were the first customer.

Allan: They were the first customer.

Malavalli: Exactly, you're absolutely right, they were the first one.

Allan: The CIO told a great story at Gartner Group [Conference]. He was on after me and said something like, *'I've got to tell you, we are a cheap company. I have to explain every nickel. The board isn't happy when I spend money. Sequent came along, and told me, "you don't have to pay for this unless we get two to one performance." And I thought, "ah, they'll never hit that. There will be at least six months of free use of the system. Next day they ran the numbers. First day of operation, 3.2:1. You can imagine what the board said when I told them that. That was great, but six weeks later, the rep came back, and said, "how does everyone like the system?" So I told him it was great. Then he said, "what would happen if the switch went down?" I had to buy a second switch."* It was…

Malavalli: Well an upsell right there.

Allan: Immediately. As soon as they had the performance, they needed a second switch within weeks, because they couldn't go back. At one point, your highest market share would have been, I think over 90 percent.

Malavalli: Ninety percent. Even today, Dal, you know, Brocade, even today on the Fibre Channel [side], switch [side], they command 75 percent of the market, even today. And people who said, who predicted the demise of Fibre Channel, I don't know where they are. That's Brocade's cash cow, even today.

Allan: It's remarkable, isn't it?

Malavalli: Remarkable, and still, even now, when they released their 16 gig, you know, the ports are gangbusters.

Allan: Now we're sitting here, what, a decade later, a decade and a half later. We've gone from 1 to 16—

Malavalli: Unbelievable. We started with quarter speed, remember, when we started—

Allan: We started at 25 Megabytes per second, because we could build it.

Malavalli: So that we could build it, and you know, some— and another, you know, funny story. I talked to Sun Microsystems, as they were the first one to implement. They used it as a purely SCSI replacement, point to point. They would [connect the] server with the storage device using fiber, just for the performance That was it. When I went and talked to their CTO, I forget his name. A German guy, I forget

his name, and he said, no, it's not a network, it's a point to point, it's a SCSI replacement. They would never do a switch, they missed the boat. Sun missed the boat.

Allan: If you remember, Adaptec was in Fibre Channel with Bob Snively, then at Sun Microsystems there was Bob Snively. And where did Bob wind up? At Brocade.

Malavalli: Brocade, finally, exactly, he wound up at Brocade, and he was a good proponent of our switches. That's a very interesting twist.

Allan: Yeah, he rode the horses that were implementing Fibre Channel.

Malavalli: Exactly, exactly.

Allan: And like you said, Sun didn't embrace it, and Bob jumped ship.

Malavalli: Exactly, Bob jumped ship, and you know, remember, they had a consortium for Fibre Channel Systems Initiative?

Allan: Yes.

Malavalli: The FCSI thought that with a very close knit network, they could run the market. Who are the leaders? Not IBM, I mean, in the networking side I'm talking about, not HP, not Sun. It was Ancor, Gadzoox, and of course Brocade.

Allan: Yeah, it's kind of interesting, if you remember, Kurt Chan was at Gadzoox. Well—

Malavalli: Yes. He came from HP though.

Allan: He came from HP. But— and you got to know him very well, because you were part of HP for a while. You were talking about Canstar, you came from Canstar, through an Alcatel Communications acquisition, through an HP systems acquisition. It must have been brutal at times, because your strategy had to have been all over the place.

Malavalli: Oh, it was all over the place. Another thing, what happened was, Kurt Chan came from a loop background, and [at] Canstar, we had a prototype [switch]. To start the story, the beginning of the story, at Canstar we had the prototype, quarter speed, again. And not ready for general availability. We took the

prototype to Sun, HP and IBM. They all liked it, and HP liked the technology, and said, "*okay, we like the product, but instead of becoming a customer, we'll buy you.*" They acquired my group within Canstar [and] created a separate division called Canadian Networks Operation, in North York, Canada. That's how we became part of Hewlett Packard. But the thing is, that was good and bad. We were all happy, saying that we were going to have unlimited supply of funds to take the technology to the next level, and build a one gigabit per second switch, and also add an E-port, because [the] first switch had only an F-port. We couldn't [connect] multiple switches, because the standard was still in development at that time. So [we wanted to] finish [the] development of E-port standard, and then implement E-port on the switches, so that [we] can create a fabric. And that was my goal when I was heading the technology part of Canadian Networks operation. But everything totally changed. People [within HP] were moving to the loops, more loop than switch, and we were not getting any funding, because we had to compete for the same R&D dollar like anybody else within HP, and we were like, you know, we were neglected often.

Allan: You were in the boondocks.

Malavalli: We were in the boondocks, and—

Allan: And HP Roseville did Tachyon.

Malavalli: Except that's for— you know, it was very frustrating, Dal, within HP, thinking that you can do something, you can take the product to the next level, you can capture the market, but you couldn't because there was no money, although we were part of a big brother like Hewlett Packard. That's what prompted me and Bent to go out and start a company. We started looking for funding within Canada. Canada doesn't have a culture of venture capitalism, and it's very different— it's all debt financing. There's no [equity] financing existing in Canada at that time. Then, you know, a very strange thing happened when Ed Frymoyer, who had worked for HP, retired to become consultant, and then he introduced me to this venture capitalist called Seth Neiman, who was a junior partner of Crosspoint Ventures in Los Altos, and he invited me— I was in India. I was with HP, I took a vacation, I was in India when Ed called me, "*Seth wants to meet with you, listen to your story about Fibre Channel switches.*" And then I came back to Canada, from Canada flew to California, and then we met for dinner in Stanford Shopping Center, in Indian restaurant, Gaylord. Seth was a very smart guy. [i] said, "*I [do not] have business plan.*" I just had to, based on my HP and Canstar and Fibre Channel committee experience, tell him, this is what you can do. This is the market potential if we did that. I told him, just based on that, he said, "*I believe you, I trust you, but I want you to meet my bo*ss." He was a junior partner. Rich Shapiro was his boss. Then I met Bonderson, Paul Bonderson I knew him before through the Fibre Channel System Initiative time, they had included us because we were a switch company, although it is between HP, Sun and IBM, to be a part of that, because [requirement of] the switch. And so..., Paul Bonderson also showed interest in leaving Sun Microsystems. He had a lot of experience in the storage side of the business, and I had experience in switching side. We joined together and then met with Rich Shapiro, and he liked it. He said, we'll give you the money, 1.4 million dollars, to start the company, but he told me, you

have to move from Canada, otherwise I won't give you the money. Then I [left with baggage], [after resigning from HP], and then I moved [to California], we started [Brocade in]1995, August 18th.

Allan: What did your wife say when you went home?

Malavalli: She said, I trust you, but it's very risky, because I had a good job in HP and I had stock options, and I had to walk away from all those things. And she supported me. She supported me. She said, you are taking a risk, but I know if it doesn't work out, you can always get a job somewhere.

Allan: It's worth its weight in gold.

Malavalli: Yeah. That was the major addition, because we didn't even know how big was the market at that time.

Allan: But the feeling was there.

Malavalli: The feeling was, the feeling was there. You know, talking to particularly—— you know, where I got the strongest notion that it's going to take off, in the Fibre Channel committee. When I came there, you have a lot of conversation in the corridor. That's where most of the things happen. You know, not in the committee rooms, outside, talking, and there was a feeling it's going to take off, because there's a need for this particular technology.

Allan: One of the other things I found while digging around was that, at Gartner Group in early 1995, Nick Allen said everybody except IBM is adopting Fibre Channel as a high end system. I think that was the first time I saw anybody predict anything good, because we'd been rubbished as a non-networking culture that couldn't make it.

Malavalli: Absolutely. They were— Cisco said that we were going to go out of business. You know, Andy Bechtolsheim is another funny story. When we started Brocade, Crosspoint Venture gave us 1.4 million dollars, and we had a VP of sales called Roy Sardinia. He came from Sun, he's a good friend of both Andy Bechtolsheim and Bill Joy, founders [of Sun Microsystems]. He convinced them to put some money, about quarter million dollar each, you know, they, really and truly told me, Andy said *"I'm investing in this company, not because I believe in the technology, because Roy is my friend."* That's the reason they invested, and then they made—

Allan: Of course, he was smiling later, right?

Malavalli: He was smiling later.

Allan: He had good friends.

Malavalli: He said *"It's not going to work, that everything is going to be IP, why are you doing this?"* You know, Cisco laughed at us.

Allan: Well, Nick Allen in 1994, had been saying that same thing. *"Ethernet is ubiquitous, there is no reason for anything else to make it."* He flipped in that one year; it was a very strong transition period, just about the time you got funding. Your timing was excellent.

Malavalli: Timing was excellent, the timing was excellent. Of course, I know he [Seth] went with my word and based on the trust factor, [he went]. [Seth is]quite intelligent enough to have made other due diligence. I'm sure he might have talked to the Gartner Group also. I would be surprised if he hadn't done that.

Allan: Yeah, he might have checked beforehand because when a major group like that changes course, people listen.

Malavalli: Exactly, absolutely. And I also, you know, I should give credit to Brenda Christensen. I invited her to be VP of Marketing, she joined; she was there [Brocade] for nearly three years, after which she left before we went public because of a difference of opinion. To give her credit, she and I, I traveled with the VP of Sales and the VP of Marketing, both of them, all over the world, just to evangelize the technology and the product. Brenda had a very good knack of making Brocade look bigger than it was and it's so important, marketing is so important. We had very good marketing. You know, it's not that we [had]— not only we had good technology and a good product to support that but also we [created hype]. She helped us.

Allan: Well, the interesting thing is that in the marketplace, the first thing people knew about Fibre Channel was on the storage side — as you said, disk drives adopted it.

Malavalli: Exactly.

Allan: And the FCLC (Fibre Channel Loop Community) started, headed by Seagate, and they basically gave space from what they had bought at Comdex that FCLC could never have gotten. We had that private room.

Malavalli: Absolutely. I remember Comdex, exactly.

Allan: Yeah, and the buzz in that room; it was a destination.

Malavalli: Exactly.

Allan: And it was from there that we got the other half which was real hardware.

Malavalli: Exactly.

Allan: And people always wanted a faster disk drive.

Malavalli: Absolutely. And then also what helped us was also another thing. You know what we did in Brocade that helped us Dal; we had to tell the people, customers, that it is based on a standard, it's not proprietary. If we had gone there with "Here, I have a proprietary protocol," we couldn't have done it. That's where standard [committee] and its work [in that] were very critical. I'll tell you exactly how we did that in Brocade. First of all, we used to do some marketing, see what is important; like for example, the protocol, routing protocol that we did; that was very important but we got [the] proposal together with the engineers. We got the proposal and then we vetted [it] among the engineering group to make sure there are no gotchas. Within the engineering group, it was all very cooperative. And then I had set up, I don't know if I have told you, we had what is known as Brocade Technology Group, BTG, we were running the BTG, every month we used to run a meeting hosted by Brocade. Most of the committee members would come to that meeting except our competition.

Allan: Yes.

Malavalli: We used to have— both the partner and would-be customer and we used to open it— it looked like a mini working group. They used to find fault. They used to give us feedback and all those things. We took all of that before we would bring the proposal to the standards committee. And it was easier to get it through within the standards committee.

Allan: Yeah, because you've been brutalized already.

Malavalli: Brutalized by the same people and they can't say "*We did not know.*"

Allan: That's right.

Malavalli: So that also helped us in several cases [like] the Name Server and the protocol, what is it called? It's a particular acronym; the routing protocol.

Allan: Oh yeah, it'll come to me. It's buried down there.

Malavalli: Buried down. It's taken out of the IP but again we had to modify to suit Fibre Channel system because we could not take the IP routing protocol.

Allan: Well, the interesting thing is if you look at the first 10 years everything was against what existed. And if you remember, we had a Security Header.

Malavalli: Oh absolutely; assuming that someday…

Allan: Assuming that someday we'd need it and then it was taken out. One year later it wound up back in there based on the internet model; so we've got the internet model driving security now.

Malavalli: Exactly.

Allan: So we've actually flipped and I think it's a function of size. There was nothing to protect when we started.

Malavalli: Exactly.

Allan: Any new idea would work.

Malavalli: Absolutely.

Allan: And we beat it to death and we may be changed it and modified it but…

Malavalli: We kept enough room to play around in the header.

Allan: That's right. But then, when you have a five, ten billion dollar industry, the risk of being radical becomes too high.

Malavalli: Too high, exactly.

Allan: And so now it's a much more conservative process in which we adopt security protocols which are known to work.

Malavalli: Exactly.

Allan: And they're also familiar to people.

Malavalli: Absolutely.

Allan: But the game has changed; now you've got to be good at two things, not just one. You've got to be good at internet and the way that security works and transport that to Fibre Channel.

Malavalli: Exactly. It has to be transparent.

Allan: And that's a very difficult engineering job.

Malavalli: Exactly. Now, it's much harder. You are right, you can be very radical and, if it deviates from the way the people think in terms of transporting data it hurts the installed base. We've got to be very cognizant now— because there was no installed base at that time to worry about.

Allan: Yeah, it's easy to run when you've got nothing on your legs, there isn't a ball and chain called compatibility.

Malavalli: Exactly.

Allan: And that's what's interesting now. It's a different group of people developing the future.

Malavalli: And are you still very active in the committee?

Allan: No.

Malavalli: How long since you've being going there?

Allan: I attend once in a while but I'm not active. It's a case of reading the writing on the wall. When you realize you don't know what they're talking about you don't need to go any more; and that's what happened on security. It's a very different ball game and when we started we were all using our combined experiences to come up with hybridizing, amalgamating and such like concepts. It's not a concept anymore; its development and there's a difference between being an entrepreneur and a manager.

Malavalli: Exactly, manager, exactly. Now it's all management.

Allan: Management.

Malavalli: And just increasing the speed in the field.

Allan: That's right. When we started we were all entrepreneurs in a standards committee.

Malavalli: Entrepreneurs; yeah, thinking out of the box.

Allan: Yes.

Malavalli: Exactly.

Allan: And some of them [ideas] were pretty hairy when I look back at them.

Malavalli: Definitely. Only one regret that I have in the Fibre Channel standards [committee is] early on we could have done it. The problem was not so much in the standards committee a little bit, opposition in standards committee but mostly within HP and I couldn't— because of that opposition I could not do anything in Brocade; the Class 4 thing, you know, that's the only regret because that's what[would have given] the quality of services right from day one.

Allan: Yes.

Malavalli: Right from day one if we just— then we also had a VC_ID remember? The Virtual Circuit ID; we are including within [the] DID and that would have been really revolutionary; that actually came from [the] telephony [concept].

Allan: Yes, it had a very clear origin in the communications side.

Malavalli: You could send multiple streams of data between the two physical ports using Virtual Channels. For example, if you're connecting and on the tape drive and you're on the disk drive in this <inaudible> and the same network then you could do separately, you can control separately. You know, I forget the name, but Gary Warden started a company I had supported. He got frustrated because nobody else was— he did the switching himself. He had the switch; it was working. I've seen it; it [was] functional. He put it in the edges. In the middle, use the Brocade switches, he put it in the edges and then he controlled it so well and he showed the product—, you know, he ran one of the movie clips and when the congestion happened then it was flickering [without] the [virtual] channels. [when he] dedicated one [virtual] channel for the clip being played, with the inclusion of the [virtual] channel, [with] the [conjestion]— he included the traffic on rest of the port; nothing happened.

Allan: Interesting, isn't it?

Malavalli: It was incredible. It failed. It died because of no support in the industry.

Allan: And that's the killer, isn't it?

Malavalli: That company died. He had started a company based on thae [Virtual Circuits].

Allan: If it's too radical, you need a 10-year sales period.

Malavalli: Exactly.

Allan: And the other thing that that when you look back at the regrets, I remember the day the committee voted for a 24-bit address instead of 32 and it was like…

Malavalli: Absolutely, 32 was an incredible…

Allan: And it was to save time. It was like *"We're doing this at 100 megabytes a second, who cares?"*

Malavalli: I know.

Allan: The original numbers [100 Megabytes per second] that we met were based upon a 64 byte header, a 64 byte trailer, and a 2 kilobyte frame.

Malavalli: 2112 bytes or something?

Allan: Yeah, so it was 2048 plus the 64 and so, that's why we've got funny numbers; they're not even, round gigabits. We had to carry 100 megabytes a second plus overhead.

Malavalli: Exactly.

Allan: And we argued over 8 bits in the header?

Malavalli: I know. I remember, I remember. And we were for it. You know, [Canstar], at that time was for it but we, you know, we were outnumbered but that was one of the regrets.

Allan: Yeah, and we've all got those.

Malavalli: You know, another regret of marketing is that we did not, as an industry, promote Class 2. Class 2 with ACK zero [would have given] Class 3 [results with] better control. The Class 3 came from [Kurt Chan, Seagate]— and those groups coming from HP, they promoted Class 3 and became [standard] —and now it's too late. [Now everything is] Class 3.

Allan: Well, do you know the unfortunate side of that? Seagate had designed one buffer and they thought that the ACK would chew up the whole buffer.

Malavalli: Exactly.

Allan: Seagate didn't need to recognize or keep the ACK because recovery is the responsibility of the host.

Malavalli: Exactly.

Allan: Going Class 3 was based upon an invalid assumption.

Malavalli: Exactly.

Allan: That's from the outside looking in; so it might not be the right reason.

Malavalli: And it's coming from the SCSI world.

Allan: It was not understanding Class 2, the design engineers on Tachyon were LAN guys; they didn't use ACKs.

Malavalli: Exactly.

Allan: Mix that with the Seagate and we wound up…

Malavalli: I know. That's another regret not getting Class 2 with ACK_0, the number of ACKs would be less; every sequence would be ACKed instead of every frame.

Allan: Right. And so we've had three deaths in Fibre Channel when you think about it: Class 1, which was a basically solid connection, standard channel.

Malavalli: Solid connection, exactly.

Allan: Class 2, too complicated; we can't understand it, which was probably— there were other causes but I think that was a big factor, don't you?

Malavalli: Big factor, exactly.

Allan: Class 3 made it because it was familiar to so many implementers, especially the guys who had LAN background. And Class 4, which could have been the VM of channels.

Malavalli: Absolutely.

Allan: VMWare is the…

Malavalli: Exactly.

Allan: And look where they are today. They're going back to committee asking for billions of addresses in…

Malavalli: SCSI; unbelievable. You know, these are three regrets. You know, 24-bit [versus 32 bits] the Class 2 and the Class 4.

Allan: Yeah.

Malavalli: Class 4 for the switches not so much for the disk drives.

Allan: But then, you say "Okay, those are my regrets." We've only got $90 billion of industry, right?

Malavalli: Just $90 billion and it's still going strong. [It is not dead] still.

Allan: So, it succeeded despite itself and when we look back at it we met a market need. Brocade came in at the right time at the high end with the solution to performance woes and people have been chasing ever since.

Malavalli: Exactly. And also we had choices that was [Host Bus Adapters] like Emulex and QLogic and they all came. There were a good number of [Host Bus Adapters] to pick from, you know, that also helped.

Allan: It was synergistic, wasn't it?

Malavalli: Synergistic, very synergistic.

Allan: Everybody saw an opportunity.

Malavalli: Exactly; it's an ecosystem. You know, one company couldn't have done it. That all happened at the right time to provide the system level solution to the customers.

Allan: And then we had the companies like Adaptec which sold their Fibre Channel side.

Malavalli: They never adopted Fibre Channel. They just religiously were opposed. Some other companies like Sun and Adaptec, they religiously— you know that's what happened. When you become fanatical about technology you're going to lose unless you adopt. You've got to have technology which solves the problem not because you're fanatical about it.

Allan: Go back to 1990; we were a bunch of fanatics, right?

Malavalli: I know we were, we were, and we were; [we resisted] the ATM [bigots]; remember at [the early days]? The ATM was going to do everything. We were going to get killed by ATM. Then IP, we were going to get killed by IP. Nothing happened.

Allan: There's one thing that is very difficult for technologists to understand, and that is the 30,000 foot view.

Malavalli: Exactly.

Allan: ATM, because it was based on isochronous thinking, wanted to have very small packets but if you stretched out the speed capability of [transmitting] parts, it was ramping at an incredibly high rate. The speed of processing on a circuit board wasn't.

Malavalli: Wasn't, exactly.

Allan: So if you just took three generations, there wasn't enough time to process 32 bytes.

Malavalli: Absolutely.

Allan: It was a death knell.

Malavalli: So many interruptions.

Allan: Yeah, you couldn't process small packets, it was a death knell because they started from the wrong end. Like you said earlier, if you start from the wrong end, you dig your grave and they were at the wrong end. They could have solved it with a buffer.

Malavalli: Exactly; or get a large enough pipeline.

Allan: And [if it stays in] the pipeline, it works.

Malavalli: You fill the pipeline— when initially it might take a little longer but when the pipe is full it becomes…

Allan: That's right. Now, how much of a business do you see in what I would call "the long distance recovery" because at one point in time there was talk about it, and one of the companies was absorbed. I think eventually by Brocade or was it Ancor which became QLogic, but they were talking about doing datacenter backup over physically long distances and they were looking at an international backup strategy.

Malavalli: Exactly, and actually I had supported a company called Light [Sand] Communication that's exactly what they were trying to do that. They had developed a chip which had three ports. One was the SONET port for wide area connectivity and a Fibre Channel port, 8 gigabit at that time, and then IP. So the timing, you know… It [long distance backup] is still very valuable, very much needed but I think the timing was not right. That's why the company failed but definitely there's a big need, I strongly believe that there's a big need.

Allan: So there could be a phoenix arising from the grave here?

Malavalli: Exactly, rising from the grave; that's going to happen. I don't know why standards committee is not pushing it so much, I don't know because I'm not involved in it. In fact, BB1, BB2, they started it— I don't know what's happened to BB side of the standard.

Allan: Yeah, like you said, it's one of those mysteries. You need a champion, first of all…

Malavalli: You need a champion.

Allan: And unless you've got a champion that people can get behind, there's desire but no impetus.

Malavalli: Exactly.

Allan: In looking back at Brocade, when you see the people that you worked with, you could evidently identify who were the followers, who were the leaders, and who to pick.

Malavalli: Absolutely.

Allan: And so, you had a handful of people that you just gave total responsibility to?

Malavalli: Absolutely, absolutely, not looking over their shoulder. We had excellent engineers. To start with, it's an engineering [play]. You know, we had to have the best technology, best developers, both

software to do the name service, the management service and routing protocol and all those things. And also good ASIC designers because it was a very ASIC intensive and we had two engineers which Paul Bonderson brought from Sun Microsystems, Dave Banks and Paul Ramsay, excellent engineers. What we did, Dal, was as a strategy, for every engineer that we hired, we gave them two development systems. One at work, one they could take home. If they wanted to get up in the middle of the night — they didn't have to come to work. They can do that at home. And that really helped us a lot. When the first switching chip came, first incarnation that came, it worked the first time; that's very rare in the industry. Dave Banks, the designer, simulated the design to death, everybody did because of the availability of two systems and before it went to tape. And the LSI Logic [connection], also another strategic thing that we did was to use LSI Logic as [our] foundry;] and early on, even before we designed the first chip, we invited them, we [enticed] them and we encouraged them to be an investor in the company. They were the only corporate investor. We took the money not because of the money itself; because we could get the highest priority when we [went] for [the] tape, we [did not] have to wait. That's [how] we got the tape, we got the highest priority; when they were given the file for the taping, they did it immediately. When it came back it worked the first time. Actually, that helped in time to market.

Allan: That same strategy was pursued, I assume, by Brenda to make an alliance with a key contributor to the system…

Malavalli: Key contributor, exactly.

Allan: …so that when a Host Bus Adapter was sold your switch went with it.

Malavalli: Absolutely.

Allan: When you sold a switch the Host Bus Adapter went with it.

Malavalli: Exactly, absolutely, absolutely. And also by doing the Brocade technology [group] that I [talked about], not only it [helped] in getting our proposal into the standard but also in the sales cycle time when we went back and sold them what they told us they wanted.

Allan: So, if you look at it, there's technology, there's sales and I'll call it strategy rather than marketing.

Malavalli: It is strategic marketing.

Allan: It's a strategic thing.

Malavalli: Yes. All important for success of a company because you've got to [fire] on all the [as they] say eight cylinder [but] I say 12 cylinders; you've got to fire on all the 12 cylinders and that's the only way the company succeeds but you've got to have a strong technology to start with.

Allan: Now, the day Brocade went public it was kind of euphoric.

Malavalli: Euphoric, exactly.

Allan: How many people actually chose not to stay more than a year after that date? Was there a big departure?

Malavalli: No, no, not big. You know, a lot of people stayed for nearly close to a year and a half [and two]; [the] people started leaving after two years. A lot of people stuck around. There is also another side of the story. A lot of people who joined— there were a lot of people who were ready to join and— sorry, who could have joined did not join because they thought we were not going to, you know, [jell], because; I'll give you an example with Rich Taborek.

Allan: Yes?

Malavalli: With Rich Taborek, you know, I told him "Come and help me in architecting and [come and join]. He said "No, I just [can't]." He didn't. Then Steve Wilson came next. Now, Steve Wilson, I took Steve Wilson; [the rest is] history, so there are cases like that. And then there are some people who left six months after they joined thinking that Fibre Channel was not going to take off. They didn't have belief, not [just] in the technology itself; [but] in the market. And those people who stood through the IPO; then they stayed for a year, year and a half, most of them. Then after two years they started leaving. Yeah.

Allan: They started enjoying [life].

Malavalli: Exactly.

Allan: How long did you stay?

Malavalli: I stayed until 2003. Now, 2003 I left to start InMage; that's what I'm [running now]. I think I'll talk to you about that sometime later but not part of this discussion. InMage, I started in 2003; I didn't want to get into any kind of conflicting scenario that's why I left and [it is good]. But the good thing about it Brocade invested in InMage, in the second [round], they led the second [round]. So Brocade [is one of] the investors in InMage. So I'm still [running] it along with; I'm also involved with a few [other] companies

on the board level but this one, the InMage I have operational role as the CEO and the Founder and I'm also investor. I gave the seed money. I know how hard it is, not to get the seed money, having started Brocade so I gave the seed money. And then after [Hummer Winblad]; they're one of the venture capitalists [in San Francisco]; they and I together [closed the series A}. [Series B] was led by Brocade; we [all did the pro-rata] investment. [Series C} was led by Intel capital. Intel is an investor.

Allan: Well, you must get a lot of pleasure from having been on the begging end to becoming an angel and having people begging…

Malavalli: I don't know why they're called angel, I don't know but that's the term they use and I have to use it too.

Allan: Yeah, but you've still got the strong memory of being cap in hand trying to find a listener.

Malavalli: Exactly, exactly. I mean, it's fun, it's fun because I don't have to do it— well, I could have retired like my other co-founder and other engineers [and] other employees of Brocade but then [the thing is] you get up in the morning and you go to work and you're still part of the technology and, you know, you're on your feet all the time and that, actually, that is healthy; mentally it's very good. And then also you get to work with [younger generation]. We are all [old] but I would like to say how the [younger generation]; they think totally differently than us in terms of entrepreneurship. They're also entrepreneurs but, you know, right now, if you look at the new breed of entrepreneurs, they take the infrastructure for granted. They take the bandwidth for granted. They take the switches IP protocol [granted]; there's no science behind it any more. Science is all done. Very few companies build; the majority of them. they go into "How can I use the existing infrastructure, learn some application and make quick money like social networking. you know, like Facebook?" Those kind of companies, the [youngsters] are more interested; that's unfortunate. There is no science in the entrepreneurship.

Allan: Yes. The applied research is not taking us forward; it's the basic research on which we jump when people find out that they can do something radical that nobody even thought about before. We don't have enough basic research.

Malavalli: Exactly.

Allan: We've lost the Bell Labs and…

Malavalli: And the Bell Labs, you know, IBM, HP labs, they were all [fun]…

Allan: IBM; it was too expensive because you don't see the payback for 30 years.

Malavalli: Exactly, you know, exactly. The time to revenue is too long so that—so that probably someday the pendulum will swing back. Right now entrepreneurship has totally taken a different direction.

Allan: If you look at the networks, you watch a TV show you say "I like that," the probability of it being there in four weeks or six weeks is pretty low because they don't get time to build an audience.

Malavalli: Exactly.

Allan: And that's the same parallel; immediate bang per buck.

Malavalli: Absolutely, absolutely.

Allan: And it means that the giant leaps forward are going to be fewer and further apart.

Malavalli: Exactly.

Allan: With people coming to you, how many come in with a concept that is radical rather than evolutionary?

Malavalli: Very few, very few. Evolutionary, mostly evolutionary; very rarely come across radical.

Allan: And how do the radicals come across; do they come in with business plans or are they simply not well thought out?

Malavalli: People with radical ideas, they don't come with a business plan; they came with radical ideas and then you've got to see whether that can be commercialized. And if there's a business reason to do that, then you'd help them to build a business plan but most of the people who come with a business plan with clear cut goals are evolutionary because, you know, it's an evolutionary thing. The delta is very small for opportunity or it's a land grab thing. For example, if you have an idea, you can win two ways. Because it is disruptive, you have strong IP and you succeed and then create wealth. Another way of doing it, like Facebook and Groupon and other companies, you have the land grab and you don't have IP but you use the existing technology but get [as many subscribers] as possible [as] the first one. If you have millions of subscribers it's very difficult for somebody else to come in and replace you; that's the attitude now.

Allan: How many times did you think Amazon was going to fail? It seemed like they were always losing money, never getting any traction and then one day it just went around that corner but it was several years, wasn't it?

Malavalli: Several years and plus and if you notice Amazon they'd do something disruptive, you know, disruptive not in— see the disruption can happen in several ways. It could happen in the product like we did in Brocade and IBM did that and Cisco did that in the router and all the stuff but that happens in the product and the technology. The disruption can also happen in the way the people do business. So, if you enable that there's also disruption. Now, for example, Amazon is very big, you know, [that is] not very much publicized; but they've got the best public cloud, like today Amazon [for] a lot of people [ph] [they] revolutionized the way companies can start up.

Allan: Yes.

Malavalli: And before, if you want to start up, I need to have servers. I've got to buy servers. I had to buy storage. I had to subscribe to some kind of WAN technology and all those things that are so capital intensive. Right now, I don't need that. I can go to the cloud. I can develop my program. I can use the computing power and the storage power of the service offered by Amazon and then when I'm ready with the product then I can invest. Right now, to start a company, capital-wise, is much less compared to what it used to be; that's the revolution.

Allan: Yes. Well, I remember Pfizer telling the story that they had been bankrolling FedEx bang, bang, bang and they did not go in on the last round.

Malavalli: Exactly.

Allan: That's when it hit.

Malavalli: Exactly, exactly.

Allan: So, the multiple rounds is where people get discouraged and lose faith. You know, one more time back to the well. And so that must be extremely difficult as an investor making the judgment call when you know you're holding the executioner's axe.

Malavalli: Exactly, exactly.

Allan: And you have to fish or cut bait and that's got to be extremely difficult for anybody.

Malavalli: Yeah, you mitigate the risks. The way to mitigate— you're not the only investor. Like for example, InMage, I am the only one investor. Your risks can be mitigated by sharing the risk, you know, so that's one thing. A second thing is you are doing the pro-rata investment. If you need a second [round] [you are] not putting the whole money; you put in pro-rata, that way you can get more money. More money does not necessarily mean success but, you know, you can have more reserves to do the right thing; that will help you. So, with that, you can mitigate the risks not only by sharing the capital but also providing enough financial resources to run the business, for the operation of the business. So that way then each time if the entrepreneur comes back to the well, you'll make a decision whether to pull the plug or invest pro-rata. You get to make the decision collectively as opposed to on your own; so again, its chances of failure are a little bit lessened.

Allan: How many rounds did Brocade need?

Malavalli: Brocade, we had the first round [1.3Million], it was the seed money, first round was about six or seven million dollars and [Mohr] Davidow came in and joined Andy and Bill Joy and Crosspoint Ventures in the first round. Then we had a second round, [and then the] third round. We didn't need the fourth round but the existing investors knew that we were going to succeed, you know, we were going to be doing IPO after a year, they forced us to take money. They [created the] fourth round and gave us the money.

Allan: That's got to be unusual.

Malavalli: Very unusual. We didn't need the [money]. Usually if the companies cannot succeed after [C] round, there's something wrong; there is something wrong. Either somebody is going to come, [at the D round], [and] wipe out all the initial investors; they are coming for [bargain]. All the initial investors' money is gone.

Allan: So, let's jump from the investment community and technology and take a look at social structure. You've become, what shall I say, you've expanded your horizons, so to speak, to include culture and social change in an effort to bring change to areas outside of technology.

Malavalli: Yes, absolutely. You know, I was fortunate enough that I could do that. It came by creating wealth for the company, to the society, and to myself in the process. So now we have— you have ability to give back to society in terms of donations to different organizations. I'm more leaning towards the programs that give good education. I created— I don't know whether you heard about it. I created, [I endowed] chair for storage technology in UC - Santa Cruz. [Professor Darrel Lang] is the professor and also I'm on the board of Cal State- Hayward,[that is] Cal State - East Bay, in the education side. [At] UC-Santa Cruz, also I'm on the foundation— the foundation board. [Also] I created international schools in India. They're truly international. The syllabus comes from [Switzerland] called International

Baccalaureate, the IB schools. And that is international. I did it as an experiment in India. It was very successful. And that's based on the profit. They take the profit and [in] the same campus [we] created a school, which is offered free for the people who are needy. So it's a Robin Hood principle. And then that one— I did [it in India] because— that's where I tried. It worked. It doesn't have to be [in] India. It could be anywhere in the world. It's an international school. And all IB schools all over the world follow the same principles— same syllabus. So that's one thing I did. And also another thing that I want to mention, based on what happened in Fibre Channel [committee], what happened in Brocade, what happened in the storage area networking industry, and the Silicon Valley Engineering Hall of Fame that recognized [me] _somebody named me [for it]. There are a lot of people who could have got that award, but somehow they named me. And I got it [the award], also.

Allan: Well, it's nice to see it on the wall, isn't it? It's a good feeling, though.

Malavalli: I mentioned— I should have invited more people, including you, but I didn't do it. Not an excuse for forgetting, but anyway. I called some of the people [who] came. [Horst Truestedt] came. Carl Zeitler came and [Rich Taborek came]. Those three people came to that function.

Allan: You must have enjoyed.

Malavalli: Enjoyed it, yeah. And also, I'm going to let you know because— I'm trying to have a small get together for [old ANSI acquaintances] and friends sometime in October, November time frame. Here, I'd like to have a get together. They're all getting old, you know.

Allan: That's why we're doing this. The museum's got a program of oral history.

Malavalli: I lost contact with you. I'm glad to know that you're still doing [ENDL]. That's another thing, I have [to] make a comment on ENDL. That was one of the great publications that synthesized what is cooking, what's happening in industry. That was particularly for startups, that was so important as to where the market is— to know where the market is going.

Allan: Thank you.

Malavalli: Really. [At Canstar, we were subscribing

Allan: That's right.

Malavalli: They didn't allow me to do it, but [still at canstar we subscribed].

Allan: It's still ticking.

Malavalli: Still ticking.

Allan: Still ticking, yeah. Ralph Weber does most of it.

Malavalli: Who does that?

Allan: Ralph Weber.

Malavalli: Ralph Weber, yeah exactly. He joined you a long time ago.

Allan: Yes, he came out of DEC on SCSI days.

Malavalli: You're also very much involved in that?

Allan: No, my primary activity now is the SFF committee, which of course, we're doing the transceivers and the connectors for Fibre Channel, for Ethernet, and such like. So, I'm at a different avenue. And the other people know a whole lot more than I do. But it's a lubrication society. You've noticed that. It's a network, right? It's who you know that matters.

Malavalli: You scratch my back; I'll scratch yours.

Allan: And if you know somebody who knows more than you, get him.

Malavalli: That's another principle we adopted. Don't have ego, particularly founders make that mistake. They think they know it all. You can't know everything in depth. You're good in something; if you're not good at another thing, get somebody to complement you. That's the only way [to] succeed. Bent [Stovhase] and I worked perfectly.

Allan: Yes, I was disappointed to see Bent leave.

Malavalli: I know, really, that's a strange case that one fine day [he] disappeared. I don't know where he went. He was living in Toronto in a house there. And one week before that, I called him. I talked to him. And one week later he [did not respond] no email, no [voice] mail, nothing, just [gone]

Allan: Gone.

Malavalli: Nobody knows where he went. I think he went back to Denmark. That's my guess.

Allan: His presentations on switching and his experience were like opening up a door.

Malavalli: Absolutely, he was brilliant. I really enjoyed; we worked together as a team very [well].

Allan: How long were you together?

Malavalli: Oh, well since Canstar; Canstar days and Brocade, he was there for two years. Two plus two, about five years.

Allan: Five years. And he was a strong influence.

Malavalli: Yeah.

Allan: During that five years he was a strong influence.

Malavalli: He was a strong influence. He was incredible.

Allan: Well, the thing is I've never quite understood what you did under Alcatel. I never could figure out what they were trying to do with you.

Malavalli: They were good in letting me and my team do whatever we wanted because they were not very serious, they had some extra money they were spending on us. They really didn't know what to do with us. That's why they sold us to HP.

Allan: Okay.

Malavalli: It was a pet project. Fortunately, I had the support from Doug— what is his name? Doug Mitchell. You met him when he came to [Denver]. Doug Mitchell.[a] phenomenal guy. He died a few years later, the prostate cancer. And he's the one who allowed me to do this skunk work on Fibre Channel. And really thanks to him; that was another turning point. If I did not have his support, I couldn't have done that in Canstar.

Allan: What you're looking at is *"who are the people who affected me?."* You went to university twice. Was there any one guy that ever stood out that was sort of outside the box of a lecturer, somebody who could inspire you? Or was it—? I tried to find one in my college background, and I never have. But I know other people have had people who inspired them. Did you ever have any like that?

Malavalli: No, I didn't—no, nobody inspired, but they [were all] good; see at that time, my background [was] electrical engineering, what I did there was totally not directly related to what I did later in my life, until I went to Germany. That's when I started getting influenced by people. In India, I just went to school. And did my duty to study and then passed the exams. <laughs>

Allan: Did you ever have application test in high school that they gave you and said this is what you should be? You ever have anything like that?

Malavalli: No application. We had a lot of lab work, no application, lab work and [working] with [Synchronous] motors, Induction Motors, and transformers, and all the— set up experiments to find out how each thing works, like how the [Induction] motor gets started, how does it work? What do you measure? And how do you measure the voltage? And then how do you measure the current, and those kind of things? The very mundane things. I wouldn't call them applications. That's one thing I wish that I had more application oriented education, but it was— only when I came to Germany and I was with two German engineers, they were very influential.

Allan: Well, they would have taught you discipline.

Malavalli: Discipline; discipline and also practical usage of technology. They were particular— but they were still kind of control system using Siemens logical blocks. They [are just] like having [AND] gate and [NAND} gate [blocks].

Allan: Yes.

Malavalli: Use the blocks to create a control system for a particular application. That's where I started using it for application, either to change the way we do things electronically, or creating new applications. For both, they [opened] the doors for me. That really helped me a lot in Germany when I was with them. That's when I started really appreciating the practical use of technology. Until then it was very theoretical. In India, very theoretical.

Allan: I've been looking back because a museum question to ask was what influenced you in high school and university. I had to go to school. You had the same experience. Some people in high school found their future. And the futures we found weren't there when we were in high school.

Malavalli: No, no I didn't find— to be honest with you, I didn't find my future in university studies, nor even high school.

Allan: How could they give you a test to figure out what sort of engineer you should be, when the kind of engineering that people are doing wasn't civil engineering anymore?

Malavalli: Absolutely, absolutely.

Allan: It used to be you could build bridges, but if you couldn't build a bridge…. Electrical Engineering, or engineering of electronics was new. It was very difficult.

Malavalli: It was very difficult. And as I said, only after I started working as a trainee engineer in Germany, I got the exposure to the applications [as] how to use the technology for the application.

Allan: Well, that vectors us into along comes Fibre Channel, along comes people who figure out who to use it. So there's the applications that were pioneered. And some of things that people did with Fibre Channel must have surprised you.

Malavalli: Absolutely, there were fundamentals— before going to application, I would like to talk about some of the fundamentals— the parameters. You could call it problems or parameters, but they were there, people didn't know how to get around them. They would get by without solving them. They actually left certain applications [unsolved]— for example, one of the things Sequent wanted to have inside the data center, they could not— they did not have any high speed network [Intel] clusters

Allan: They were shoulder tapping.

Malavalli: Shoulder tapping, exactly.

Allan: Which is a waste of time. Hey, the disk's on your side, would you give me this?

Malavalli: Exactly.

Allan: Multiple transfers.

Malavalli: Multiple transfers, exactly. Here [switching], anybody could share anything. They [Sequent] were the ones who actually lead the industry, [at least] as far as Brocade is concerned, in terms of how to

use the technology for sharing. See, there are four fundamental problems in sharing. I'm sorry, three. I don't know why I said four, but there are three. One is number of connections, limited. Second thing is it was shared. Anything that you do, it was shared. And the third thing is the distance. Distance which— that's why the fibre came in the picture and all kinds— tied to several contributors in the community who gave us, not only a technology, but also affordability of the technology. And so, those are the three reasons. And either all of them or two of them, one of them are the reason for different applications to take off. I'll give an example, the post-production studio. These were the early adopter of our switches. In the Hollywood post-production studio, they were doing the editing. They were doing editing in a serial fashion. They were several editors. They would do the editing on a particular film separately and then join them together in a proper sequence to create the regular [movie]. We said we have a network. You put it on a Fibre Channel switch. You connect all the post-production studio stations. And then you have a common storage that's where all the clips are stored, different movie clips are there. And each editor could access different parts of the clip and edit it. You see it's a cooperative form of editing. That was enabled by using this [switch] technology and also having a very high speed network between the servers, which are giving the application to edit. And they stored data and video files. So that's the reason— and the same thing happened in financial institutions because the transaction— number of transactions was increasing day by day. Shared network and other forms of interconnectivity were not enough because there was a separate network— then SCSI based, or [Hippi] in some cases based, mostly SCSI based storage. And then you had a very high speed network for the server. But still, the multiple transfers, again. When they combined in one network they could give. as you earlier said, performance availability— continuous availability. They duplicated the network. [Instead of] one switch; you have two switches doing the same thing. If one breaks down, you can switch over to the other one. You could do all those things. So that created another application in the banking industry. Even the automotive industry, you see because we started getting customers such as Porsche [in Stuttgart], and BMW. They all became our customers because CAD design, again. Multiple people can be designing at the same time.

Allan: The Europeans adopted first in the auto industry?

Malavalli: Yeah. Auto industry, Europeans adopted first. For different reasons, one the sharing aspect, and then high speed, and then [in]several cases, distance because you have one designer sitting here, another designer sitting in another building in the campus, how do they access the data when they're sitting somewhere else without causing any performance hiccup?

Allan: I don't know if you remember Don Tolmie coming in for the first HIPPI justification?

Malavalli: Yes.

Allan: We called it HSC (High Speed Channel) then. He said *"these guys crunch numbers. They pour out reams of numbers. And they can't tell what happened until they see it on a screen."*

Malavalli: Visualization, I remember. That's another— that's a very high end— see these are all high end, these applications were the early adopters. We needed early adopters to validate the technology, and also to say that it's performance. But it was still high cost. That question came, how do we make it ubiquitous? How can we bring it down from high end to the small and medium scale industries? That's when the pressure from companies like Dell came on us [Brocade.' For example, the very first switch that we sold to Dell, it was costing them three thousand dollars per port. They said *"we can't afford. We can't sell it in the mass market."* They gave us a tall order, they said *"we're going to give you a big order. We're going to go with you only if you bring down the cost by one third— to one third, a thousand dollars."* And that put us [on] a lot of pressure. We went back to the drawing board; we integrated more things on the chip. We had to create a new chip. They gave us enough time. They gave us six months. We also had to package it differently. We were only making 16 port switch chips. We made it 8 port, they [Dell] didn't need more. By doing different parts and making more integration and better packaging, with all of those things, we reduced the cost to one thousand dollars.

Allan: And the market changed.

Malavalli: The market changed. And also, in the more integration there were some cases when not everybody wanted fibre. That's what Fibre Channel is famous for, people thought fibre means it's only fibre. That's why you know there was a controversy— no, no, not a controversy, there was a debate on why call Fibre Channel Fibre Channel? It's not only for fiber, and why is it spelled BRE not BER?

Allan: Actually I can answer that one.

Malavalli: Okay, I think I know, but I want to know, but I know the right answer, I'm sure you have.

Allan: It was Don Tolmie [then Chair of T11]. He came in one day and said that the ANSI editors decided we had to spell it fibre, it was FIBRE because that's what ISO wanted.

Malavalli: Because it is Queen's English.

Allan: I think it's French. I don't know.

Malavalli: No, Queen's English.

Allan: Queen's English is FIBRE?

Malavalli: BRE.

Allan: Okay.

Malavalli: That's what I was told. As I said, I started using it because it's Queen's English. The Queen's English and Oxford dictionary spell fiber as BRE. I don't know how true, that's what I was told.

Allan: Let's see, check the history. It was December 5th, 1989. *"Don Tolmie had been told by the ANSI editors that the working documents will now spell fiber ER as fibre RE."* He advised the editors, *"this is the proper spelling."* And so, we started 1990 with Fibre Channel.

Malavalli: Now the fiber means— it could be optical fiber or copper. It could be either or, right?

Allan: Yes.

Malavalli: That is a little bit controversial and confusing.

Allan: I remember we wordsmithed it as a pair of signals or something similar. It's so ubiquitous, it could apply to anything, that was the definition.

Malavalli: We [Brocade] also, in terms of packaging, an E_Port had the fibre port and in a lot of cases in the low end market [copper for] all the other ports— if you want to build a fabric, E-port, [for] switch to switch [connection] normally you need the fibre; Multimode not plastic. And that way, we also reduced for the cost. And then the volume also, you know what happened [down the road] when we started selling, the volume went up, it [price] came down further because. it [is] just by shear volume.

Allan: Well, I can tell you like the other side of your Dell story, which is that we were over in Europe at Dusseldorf. And—

Malavalli: That's where I was.

Allan: Okay.

Malavalli: I used to live there.

Allan: And the CTO of Dell was on the same panel at CeBit in Hannover and said *"Everybody thought we were silly when we introduced selling storage online. We figured it'd take a few months to get to a terabyte order. It took six days."*

Malavalli: Wow.

Allan: And it was like wow.

Malavalli: You know you are absolutely right to that fact; another thing what happened with Dell, the industry changed. It was not just our trying to reduce the cost, another factor that helped us was increased volume. Internet happened in a big way. Netscape happened. Netscape— because a browser was available. Until the browser was available the Internet was accessible to only a few students at university and the scientists. Next moment you had a web GUI— it's actually a web GUI. When Netscape happened, they used to call it by different name, Mosaic. It was called Mosaic, came from University of Illinois - Urbana. That's where Andreessen came from. And he started the company. But when Netscape happened, the browser was available to common man, the usage went [up]. When the usage goes up, people store a lot more data. And the amount of data being transferred between persons, between the users— and also between the companies increased. That means, connectivity and distance, they became important. So, more number of users needing such kind of high speed networking at the back end went up. That also added to the fact that price came down.

Allan: The price coming down has always led to changes in the market.

Malavalli: Exactly.

Allan: We started [Fibre Channel] with a dream that the disk drives would be connected by a switch and we never got there in the early years. Technology wouldn't take us there until Vixel came along.

Malavalli: Exactly.

Allan: And then Emulex bought Vixel, and then the switch came on the backplane.

Malavalli: Exactly.

Allan: Then along comes ATA on a PC. And what's it using? It's using direct connections.

Malavalli: The switch.

Allan: And so—

Malavalli: Direct connections, point-to-point links.

Allan: Point to point links, but they could be switched.

Malavalli: Exactly.

Allan: And they feed directly in/out of the box into a switch because that's what the data path is, because they're all hooked up on the SAN. And it's just applied itself separately. So, people pick up. In fact, looking back, Schelto van Doorn led the physical group. And if you'll remember we investigated all kinds of things. We just listened, plastic, whatever else. And then in walked Ron Soderstrom one day.

Malavalli: That was a turning point, a real turning point. I remember he brought the CD-Rom lasers, which are commercially used. He said okay you can use them. And that drastically brought down the connectivity cost for the fibre.

Allan: We went from thousand dollar lasers and being impossible to build a product which needed a whole bunch of lasers to— oh yeah, I'll take a few….

Malavalli: Oh, really.

Allan: Do you remember his lab?

Malavalli: Yeah. I went there. I went to IBM. And the Rochester Lab had tons of CD-ROMs.

Allan: It was running MTBF on CD-Rom lasers.

Malavalli: Exactly. I remember going to his lab. There are so many turning points and that was one. And Host Bus adapters also became cheap. That's another area where there was competition between multiple companies. They were all new. Plus, again, integration. And integration not only in the protocol chip level, but also getting low priced— low cost lasers. Not only on the port side, on the switch, the port cost came down. It was also on the Host Bus Adapter side, so entire system price came down.

Allan: Let's see. Qlogic came out with a SAN in a box, right?

Malavalli: SAN in a box, exactly. SAN in a box.

Allan: You could pick it up at your corner store was the impression. Just take it home and build yourself a SAN.

Malavalli: Exactly. I remember. Yeah, another area was where a lot of the management software was introduced i.e. the operation cost came down. See it's not only capital cost, the operating cost came down too. More automation was put in. it's also very important for a customer to buy, not just one time cost, but how much does it cost to use it and operate it. And that came down because of integration. That's where the software, management software came into the picture. And also, some of the testers— I don't know which company they were — there was one company. I forget the name of the gentleman, Hungarian guy. He had a company for the testing— test [eauipment] he used to make for Fibre Channel products. And he put in some—

Allan: Finisar?

Malavalli: Pardon me?

Allan: Finisar?

Malavalli: No. Finisar came later on, but before that there was— it started [with an A]. He was in— somewhere in Menlo Park [or Redwood City].. But anyway, I don't remember his name right now. So he came up with the— some of the modules— monitoring modules. So that he could monitor online, feed it to the management server. So that he can predict if something was going wrong before it fails. So all those things— the operations— the cost to run the system came down. That's also very important factor.

Allan: How long do you think it took for the infrastructure to get built? Are we looking at a two, three, or four year period because—

Malavalli: You mean from the stand point—

Allan: From the time you first shipped, how long was it before you felt that the infrastructure was there to ship anywhere?

Malavalli: Okay, we— 1995, we started the company. '97 we shipped the product. We released the product— we launched the product in Boston. And then I remember going with Paul Bonderson and Brenda to meet the analysts. In 1997 it was shipped to Sequent and we made the general availability, but still very low volume at that time. Volume started kicking in in 1998 when we got HP, we got Dell,we got all the Japanese companies. Fujitsu is the biggest customer of all in Japan for us, and NEC, and Hitachi.

Here we had IBM and Compaq at that time. Compaq was our customer, it became part of HP. We started out with an OEM-based model, and still today. The VARs sell to the end users and we started exciting some of the VARs in 1999, so we started getting the traction into the end user through the VARs. One of the banks in Germany and post-production studios. Also some of the health care establishments because they have a lot of electronic medical records they want to access and multiple doctors accessing the same records on different part of the database. And all those things started coming through. [In] 1998, we started in some volume.

Allan: VARs are a very vastly underestimated part of the market because they're application engineers and application programmers who take a product into an environment that is getting it for the first time.

Malavalli: Exactly. Exactly. So the applications really started off with the early adopters, and they didn't mind the cost. Then because of all the reasons that we discussed, we started reducing the cost. And then small to medium scale businesses also started adopting. It's a full circle, again, because they started volume and the price came down further. It's a circle.

Allan: Which application surprised you? Were there any that came in from left field that said to you *"boy I didn't think it would work there, or was any good for that?"* Were there any left field ideas that you saw being implemented by people capitalizing? Or do you think it was just simply—

Malavalli: Simply horizontal because wherever there was a lot of data, not only in terms of volume of data, but also [the dize] of the files, media files and some of the medical files. Wherever you have large volumes of data to look at and access, and the speed is important, and the connectivity is important because it's vertical [independent]. It is [horizontal] not for one particular— that's the beauty of this network is— it can be used anywhere. Now, it's making moves in the cloud now— cloud infrastructure. They are also introducing virtualization. See again Class 4 [thing]; we went outside of the switch.

Allan: Looking back, you mentioned IBM Texas. It was the people who came in and started using the term cloud for a few years. Remember? IBM Texas was editing the document because we didn't know what to call this 'thing.'

Malavalli: It was just a cloud.

Allan: And we called it a cloud. So we had all these drawings of—

Malavalli: Then it became the switch.

Allan: Yeah and then it became a fabric.

Malavalli: Fabric or the cloud, exactly.

Allan: Yeah.

Malavalli: But it was more localized, it was not virtualized, that was the difference. It was a physical fabric which we called a cloud, but now, it's all virtual. That's the main difference between the two, but the concept is the same. It's sharing, more sharing. When we did that, the cloud was owned by the customer. Most of the customers own either a small fabric or a large fabric. now, the fabric is moving into the cloud, a public cloud, where the users don't [own] the infrastructure. The infrastructure itself is being used as a service, but the concept of cloud was there [in Fibre Channel] right from day one.

Allan: IBM was a strong supporter, then jumped off the ship, pursued SSA, became hostile, and the committee lost all of the contributors. Years later IBM jumped back on board.

Malavalli: One thing I would like to understand is how come— we didn't lose the contributors from IBM Austin.

Allan: We lost the contributors from the [Poughkeepsie] laboratory, like Bryan Cook, and other IBM laboratories. The guys who had been envisioning in their heads for a long time, had big systems experience, and been very major contributors. We lost them. But then IBM came back from Poughkeepsie for ESCON [Enterprise Systems Connection]. There was a lot of politics in there. How threatened did you feel by SSA at the time it was being touted?

Malavalli: It was not directly— the only fear I had was because SSA was the disk side of the business, not so much of the switch side of the business. Our market would have been reduced to the high end.

Allan: Oh, okay.

Malavalli: That was the only threat, I didn't have any fear that that market for Fibre Channel was going to go away. The disk side of it— that's what would definitely have hurt the overall market, but not to eliminate the whole market. So yes, there was a little bit of concern that if the disk drives didn't go with the Fibre Channel Loop, then we would lose that side of the market.

Allan: So you'd have been interfacing the SCSI systems and SSA systems instead of Fibre Channel Loops?

Malavalli: Some kind of gateway. You would have had to build a gateway between Fibre Channel switch and…so we were saved from doing that.

Allan: It certainly was an interesting experience.

Malavalli: Absolutely, and I haven't regretted, and if I were to repeat that experience Dal, I would work with the same people, no doubt about it. I would do the same thing, everything that we did in the standards committee and building of the industry. [Three things that] I regret not doing are— 32 bits that you just mentioned and Class 2 and the Class 4. I should have pushed Class 4 a little bit more.

Allan: Do you think that was a comprehension issue?

Malavalli: Yeah, comprehension issue because you had to be in a telephony or at least some relationship with the telephony aspects. Until then it's [value] was hard to comprehend. A lot of things that were from telephony, they were all adopted, but I wish we'd adopted even more. Signaling is an important thing in telephony. Without signaling, [even] going off hook is signaling, right. Everything [entire profile is embedded in] the dial tone.

Allan: Do you see anything changing, though? I think we're stable now.

Malavalli: We are stable. I would never go to Class 2, or Class 4' [it will stay with] Class 3. We will only see speed [and the feed] increases. And they [the committee] might do more on the security, more on the security side. And they tried to do— that was a political thing, I think. They tried to do FC-LE—sorry, it is FCoE—that is a failure. That is neither fish nor foul. Companies such as CISCO tried to bring in IP, but still it's Fibre Channel. And they're using IP as the pipe. I heard, I don't know [have firsthand] experience, I heard from people that it is [FCoE] not taking off.

Allan: The old block chart had all of those things that could ride on top of Fibre Channel, remember?

Malavalli: That's the other way around because we had FC-LE to do FC-IP [Internet Protocol], we had FCP, that is a SCSI protocol. And one other thing that I would like to bring out, I tried very much— but I needed support. I needed support not so much from the people who were coming to standards committee then, but from the industry, from the vertical applications. What I would have done at that time is a protocol called DICOM [Digital Imaging and Communications in Medicine]l. That is for all the film and video used in the medical technology. You have CT scan, your MRI, your X-ray, all of them, when they transmit electronically, they use the DICOM protocol. The DICOM runs on IP, so DICOM uses a very large packet. That's another vertical we could have done, I tried to bring some people like from Siemens Medical, and GE Medical et al. I tried but I couldn't— toward the end of my career in the standards

committee, I couldn't do it. What that would have changed, that would have added another application. All the medical records, instead, say— take the raw file and put it directly on Fibre Channel. Now why not? Why go through multiple protocols and lose the performance? That is just another mapping, just [like] FC-IP, and FCP, FC DICOM is just a map.

Allan: They just didn't see it?

Malavalli: They didn't see it. In fact, I had presented a proposal for it, but it did not go too far. That was toward the end.

Allan: You needed one company.

Malavalli: One company to champion it. That would have opened up the medical side.

Allan: That's an industry that's kind of slow to change.

Malavalli: Yeah, slow to change. But now a lot of things are happening. Telemedicine is coming up.

Allan: You've got a startup on that?

Malavalli: Yeah, I've got a startup, though not a startup, it's an advanced data product [company]and it's called TeleVital. What it does is—- it's a hosting company. Host the application, which connects remote clinics— remote equipment like ECG, EKG, and sugar level monitoring, and all those things, sends the vital data using the communication network to the remote hospital, so that the doctors can see in real time without patient and doctor going to the other side and then give the diagnosis, it's not a procedural thing, mostly for diagnosis.

Allan: What you're saying is a guy sitting in the hospital who is the best heart surgeon in the country can be advising either the patient or the patient's doctor across the country or across the world?

Malavalli: Across the world, exactly. That's what we do. We are doing it right now.

Allan: And is that, what shall I say? Is that a profit oriented venture, or will it become one?

Malavalli: Profit oriented. See, the market was not ready in the United States because of insurance, because of the malpractice insurance that doctors have to pay because it is not recognized. Telemedicine

was not possible then, right now, [about] 30 to 32 states recognize it now. So we went to India, India is where we are selling, but now we want to bring it back here.

Allan: Okay.

Malavalli: Now the market is ready. The market was not ready when we started the company and started using it for that application. Even there, tons of Fibre Channel could be used in a big way. We've got tons of data coming, not only for the EKG-ECG, [they are wave] forms—-they don't need too much bandwidth. It can be almost real time. If you have large video files like MRI and X-ray and CT scan and others, then you need to wait, they use DICOM and DICOM is running over IP. That could have been avoided. Those equipment outputs could have been directly connected to fabric through a Host Bus Adapter.

Allan: Do you see a possibility of somebody choosing to do that someday?

Malavalli: First of all, you have to find a mapping protocol, right? Nobody has done that. Somebody has to champion that in the standards committee. If you know someone, they could do that.

Allan: I think once again it's a case of what you said, *"I was in telecom. I understood telecom. I came across. I saw storage. I could see some synergy."* You need somebody from the DICOM area to come across and say, *"Ha, I think I see synergy."* They have to have that idea. It has to be somebody from that side, application driven.

Malavalli: Application driven, they have to force that. And also when you develop the standard, there are some intricate design features that you have to be cognizant of. Just because we did the FCP, we cannot just try to make the mapping. You've got to know how the system DICOM works and be able to…, you've got to have expertise. That was lacking when I tried.

Allan: Now, when you're looking at the remote monitoring of patients and diagnosing of patients, are there multiple companies in this area competing with you? Or are you looking at you being the only one right now?

Malavalli: We're the only one. Right now, we are the only one. One other thing, when they say telemedicine, it is different thing to different people. Telemedicine could be just take the X-ray thing, electronically send it to India so that somebody can review it and send it back. That is not real time but that is also telemedicine. A lot of companies do that as cost cutting measures because it's cheaper to send it electronically, because of the time difference, you can take advantage of the time offset.

Allan: All right, the Fed Ex approach, the fast delivery works but it's not realtime, it's not interactive.

Malavalli: At the remote clinic they can set up EKG-ECG. The patient goes there, hook him up or her with these machines, and then in real time they send the data. If it is DICOM, from an X-ray machine or if it is MRI, it's not real time. There is a little bit of store and forward because of the [bandwidth] problem. But then it gets close to real time, and that can be sent directly when the doctor is available, it can be scheduled around the doctor's time. For example, there could be a patient in India, that patient may want to have an expert opinion. They could send the file on the network and a doctor could see. Second opinion, you can get, they're used for second opinion. That's what they're doing in India.

Allan: All right.

Malavalli: But here? Now this year we are trying to bring back.

Allan: You've just brought to mind— socialized medicine comes to mind. If you could crack one country, England, Germany, Canada—?

Malavalli: It'd be cheaper. You could reduce the cost.

Allan: You've got a single point of support of an entire country's medical system. Just one of those needs to hit.

Malavalli: Absolutely, absolutely. Here, the question of trust on telemedicine and also insurance issues that we face, it's all…. There's no technical problem, it's not a technology problem.

Allan: You lived in Germany. I was impressed with the medical system there when people were telling me what they had. It was just..

Malavalli: Great system to have. Great system there [the socialized]medicine is incredible. And you can cut down the cost. And also, it also helps incentivizing— you know you can use the technology— we have not done that, yet. Another area where you can reduce the cost using Fibre Channel technology is to— you have the big hospital like Kaiser's can have data center storing, archiving all this data, or [for] any [short term] retention. It doesn't have to be archival. Can keep all the data and different doctors can view different parts of the record and also share that with your pharmacy, share the same data— and of course under security, share that with labs. And you don't have to have multiple systems. If you go to doctor, he or she [will have your record]. [and] Then if you go to another hospital, they have another set of same

record. Then you go to pharmacy to get your prescription, they have your record. And you go to the lab to get your tests, and they have [another copy]— there are multiple copies. And that's where the cost is.

Allan: And Kaiser doesn't have a single system?

Malavalli: They have single system, but that is okay for them.

Allan: It's unique to them.

Malavalli: It's unique to them. And Kaiser is not shared by [Veterans] Hospital, for example. There have to be common depository somewhere, with, of course, back up and disaster recovery [and]everything that's associated with that. But, the only authorized person can access the data. That system doesn't exist. That is. we can say— there is one Harvard research paper today. And it says, if you centralize the electronic medical record between all these institutions, between the hospitals, the doctors, and the labs, and the pharmacies, you can save at least 14 to 15 billion dollars.

Allan: That's with a B.

Malavalli: Yeah, B, big B.

Allan: B. You just named a bunch of people that I can't imagine wanting to share anything with each other.

Malavalli: Exactly, that's the—

Allan: That's the problem right there. It's your—

Malavalli: Health care costs can come down drastically. And the price of drugs, of course. Another area. Canada sells drugs at a lower [price level]…I'm going off the subject here. Sorry.

<laughter>

Malavalli: Have to come back to Fibre Channel, the story, and then the medical application.

Allan: We don't have to cover just Fibre Channel. What we need to do is sort of explore opportunities.

Malavalli: There is a mapping of a DICOM on Fibre Channel, you can influence all these— oh, I'm sorry.

<crew talk>

Malavalli: Just imagine if that protocol exists, mapping, and if you can influence Siemens, Toshiba, and GE Medical, all of them to put Fibre Channel port on all their equipment like CT scan, and MRI, and all the stuff, they can be connected directly to the switch. And through the switch, they can go to the storage.

Allan: I think you've just named two issues. Desire to change and desire to lower costs by sharing. The third one's political, which is desire to do it because there's the feeling of control of the market from all of these players. Like the pharmacy, it wants to keep it's own records.

Malavalli: And they charge you for that. If they centralize it, you get charged but that charge is only partial. Then they have to share not only the profit, but also share the amount of money charged to the patient. It's political. The technology is there.

Allan: And you're taking on bureaucracies.

Malavalli: Yeah, I know. This health care debate that we are having, they're going after the wrong issues, not reducing the cost.

Allan: Politicians?

Malavalli: Politicians.

<laughter>

Allan: Actually, do you see any political ambition? Can you see yourself doing something?

Malavalli: No, no I'm not a politician, clearly.

Allan: Well, put it this way. You're doing a bunch of things in India. You're doing some things here. You're doing a lot of what I'll call social work and such like.

Malavalli: Telemedicine, I believe that, although it's for profit, it's going to help the society. Also, I'll give an example. In India we're trying to equip the ambulances with that telemedicine equipment through the wireless. It also works with wireless because all the wave forms, they don't need too much bandwidth. We are not sending films. If it's just a wave form—

Allan: It's an emergency response system.

Malavalli: So if you have it, the paramedics can use that under the instruction from the doctor in the hospital before you take the heart attack patient to the hospital. That golden hour is so important. [If you] Do the right thing, you can save a lot of lives.

Allan: You see on TV shows about an ambulance attendant being unable to do something unless he can reach the doctor, right, to get authorization?

Malavalli: What if they're stuck in the traffic? They're stuck in the traffic, that's one thing. And second thing is not doing the right procedure before the patient is brought to the hospital. Those are the two things. A lot of people die because of those two things.

Allan: So, you're looking to find the right nerve to pinch.

Malavalli: Yeah.

Allan: That would get a market reaction.

Malavalli: Exactly.

Allan: Because that would be a market reaction. I can save your life if you're in the back of the ambulance because the doctor's telling the guy what to do.

Malavalli: Because of the telemedicine. Because of the technology.

Allan: Even if you're stuck in traffic, you can still live.

Malavalli: On the other hand, on a global picture, use the technology, particularly Fibre Channel with direct connectivity from the equipment we generate medical images to reduce the cost and increase the performance.

Allan: It's interesting. Listening to you here, I think what you're saying underneath is *"until I had the ability to be independent I couldn't consider doing these things that I'm into now because if you're working too hard you can't do social things except in your spare time."*

Malavalli: Absolutely.

Allan: So now, it's a second career of pursuit of different things.

Malavalli: Different things, exactly.

Allan: They're not hobbies. They're actually pursuits of something else.

Malavalli: Exactly, that is possible because of succeeding in terms of science and of creating wealth. I wouldn't call it making money. I would call it— the difference between making money and creating wealth, making money is making for yourself. The creating wealth is a bigger vision. And you create wealth by creating a company, creating industry. And then in the process, you make money for yourself.

Allan: Well, what I find interesting in that statement is when you were talking earlier about education. Unless you have a strong education, it's very hard to rise above any kind of opportunity which is right there in front of you because one, nobody will hire you until you know how to use education. So, education is that way up for people anywhere. And in any country, city, whatever, where people are uneducated, it's very difficult for the city to succeed.

Malavalli: That also has a direct effect on the country's GDP. Just imagine if you go to country where the literacy— where they have low numbers of educated people, obviously GDP won't be high. GDP has a direct correlation with the education of the masses.

Allan: Is that where the sister city thing came in?

Malavalli: Yes. Sister cities came in. Sister city came in— we thought [of] two things. One, there are different problems in the countries to be solved. They can be solved cooperatively. And also, there's also similarity between Bangalore and San Francisco. San Francisco, the gateway for Silicon Valley, where the entrepreneurship, innovation, they all happen. Thinking out of the box. Same thing in Bangalore, [which] has the same culture and environment. So that's one thing. So if you bring those two cities together, then you can solve other problems by having a think tank between the two countries.

Allan: And where did the art museum fit in? Were you always an art lover, or did this come because of leisure, or your wife?

Malavalli: Because I said— I told myself, art cannot be neglected because the heritage and the culture can be maintained by preserving the art. And when they asked me to chair the gala we brought the exhibit from Royal Albert Victoria museum, [London] in October, called Maharaja. It's all the different articles collected by this museum, and also donated by different maharajas to the museum. It's not just the jewelry. It's not just the expensive items that they had, but it also tells you the history of before the British rule and during the British rule. How there was an interaction between the British and the Maharajas, the kings of India. So that actually depicts the Indian history. They asked me to co-chair the gala to raise the funds and then to have a kick off of the exhibit, which came from U.K. I accepted along with two other co-chairs and that got me really involved in the area of art. That's how I got dragged in. and I liked it. That gives a little bit of deviation from what you do in technology and other business related areas. So this one is— this completes the circle.

Allan: If you were a collector of art and your house was gallery and such like, that's one thing. But what you're saying is *"I really wasn't tuned that way until somebody kicked me in the head."*

Malavalli: Exactly.

Allan: And *"now I'm really excited."*

Malavalli: Exactly, that's what happened. And then they asked me, because we had a very successful gala. We raised enough— we raised the fund on that night and we did the campaign well to get the visitors. See, they [the museum] was looking for more visitors because that's their biggest revenue source. Not only they help to preserve the art, but also they want to run— they don't want to die. They depend on the visitors, the entrance fee. Just last week we finished, a hundred thousand people came in. That really got me excited. And then they asked me to come on the board. I went on the board, it just happened. I happened to be in the right place at the right time. It just happened.

Allan: This museum has also tried to revamp itself to encourage people coming with the new exhibits and everything because you need attendance.

Malavalli: Absolutely.

Allan: So, what role do you see this museum playing?

Malavalli: This museum is a very large museum. They have mainly dedicated to Asian art, Japanese, and Korean, and Chinese, and Indian, of course. So they would like to be the best Asian art museum in the world. They're the best in the U.S. right now. And also promote, on an ongoing basis, programs to show the culture from Asia, not only for the present generation, but for the future generations to come so that they don't forget— they don't know what their heritage while still being American. They have the goal to have ongoing programs. That's what they raise [the fund] for, and then they have CDs of exhibit. After this [exhibit go out] of the museum, something else comes from somewhere. Or they may have their own exhibits.

Allan: Did you go to the Tech Museum's Genghis Khan exhibit?

Malavalli: Yeah, that was beautiful.

Allan: That was kind of impressive because Genghis…

Malavalli: If you are interested, it [Maharaja] is still going [on], [On] April 8th the exhibit is moving to Richmond, Virginia. It's a traveling exhibit. So it's very good.

Allan: Is that the future, traveling exhibits? So that you can invest all of the effort to collect, basically, something for people to see and instead of one place, you have to take the mountain to Muhammad.

Malavalli: That is one reason. Another reason is you can't have all different kinds of collection in one place. But still you should be able to give variety to the visitors. So you have your own exhibit. You concentrate on one. But you can diversify by getting the travel exhibit from other sources.

Allan: So, in effect, you are co-sharing. The independence develops independent things, but then you have to move them around to make money.

Malavalli: Exactly.

Allan: And to reach a wider audience.

Malavalli: Absolutely, absolutely. So that's the whole principle. And also, there is a lot of technology creeping in, I was amazed to see some of the graphic artists, they use technology to do the art, and particularly in contemporary art. Sometime you don't understand what they mean, what the artist means if you look at the piece of art. A lot of technology is going into the art, as well.

Allan: Oh, so it's semi-interactive in the sense that you can interact with the exhibit to understand why is that ugly thing—? Or why is that beautiful thing there?

Malavalli: Like Dali, if you go in and see Dali, why is the human head is not in the right place? I'm not talking about that. I'm talking about the actual process. The actual process that is used to produce the art, there's a lot of technology going into the pictures. That's what I mean. That means they had to store it. That's all images. And they're produced electronically using— of course, you've got to have human talent. At the same time, you've got to have—

<crew talk>

Malavalli: What does it mean? Time is up?

<crew talk>

Malavalli: That's a very unexpected twist that took place when I went on the board of Asian Art Museum.

Allan: So have you bought any art as a result of that?

Malavalli: No. I had bought some art even before that. I am not big collector, but I do have some art pieces and paintings and sculptures. But not to be able to say that I'm a real big art collector. I have some collection, but now I can appreciate some of the nuances, when I talk to some of the curators there who come, I learn something new. And I won't look at some piece of art from that angle until I talked to those people. They come from totally different world.

Allan: That's rather exciting. If you were to look at the ten years beginning '95 and that intensive focused effort with one objective, market success. Lot of issues—

Malavalli: Development, marketing, sales—

Allan: But it doesn't sound like there were any disasters along that way other than just keep trucking.

Malavalli: There were no disasters. Only in one point in time we had the financial management was an issue in Brocade. But you solve the problem by pulling the plug and changing some personnel. So that's the one— except for that, we didn't have any major disaster.

Allan: We move on from there. What we're looking at is in some respects, many people would say a pretty easy road because you didn't almost fail. People remember the crises more often than they do the hits. You come along and you make it through, and now you've got a second path going. Which one was more enjoyable? Looking at what you're doing now, versus what you were doing in let's say 1998, the feedback is so totally different because of your life's focus so I know it's hard to say. Were they equally enjoyable? Was one more rewarding? Or is it simply a case of it's just one more day? It's a different world for me?

Malavalli: I can never say it's equal, although I enjoyed them both. They're not equal, they're different. In the first instance, when I was building Brocade and a market sector, and we had… [success], you rightly said that. The one thing then, failure was not an option. We could not afford to fail. So that fear was there in the back of your mind. Although we succeeded, thank goodness. In the second part that you mention, it's still the excitement. You are doing different things, not the same things, different things. You're not afraid of failure a second time. You're doing it because you like doing it, not because you have to do it. That's a big difference, but still it's exciting. Creating Brocade was very exciting because it's your baby you created, and you got it to— put it on path of success. You can't blame anybody else but yourself if you had failed. At the same time, it was exciting because there was a fear of failure, and today, that [feeling] is not there.

Allan: You're almost sounding like a tennis player who's been trying to win a Grand Slam, or even win a big event, all his life, then he gets it because as you say, there's that thing is that you're always striving, always striving. Can't fail. Can't fail. No striving. Suddenly, it does change. It is there.

Malavalli: Then because you've no fear, you do the right thing. Generally you succeed.

Allan: All right, I'll put it another way. On the way up, you compromise to succeed.

Malavalli: Exactly.

Allan: Once you've succeeded, you don't have to compromise anymore.

Malavalli: Exactly, that's very well put.

Allan: All right then.

Malavalli: That is very well said.

Allan: Okay, let's end on that note.

Malavalli: Okay, thank you, Dal.

END OF INTERVIEW