Interview of Donald C. (Don) Loughry

Interviewed by:
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Don Loughry: Let's just talk online for a second, in terms of clarifying the focus. I can speak to the issues of the process of developing standards and some of the interactions, company-wise, technology-wise, process-wise, and we can use 802 as an example. It's probably the most significant one in my life, although I also did one prior to that which is also very significant, but it was much less networking oriented. It was IEEE 488.

James Pelkey: Which is the funny one?

Loughry: 488 is the bus that connects instruments, so I've been involved in every meeting that ever was up until October of last year, when I basically resigned from that activity.

Pelkey: But if we can stick with 802?

Loughry: I'll stick with 802; that's fine.

Pelkey: But if you want to draw from your experience in the others --

Loughry: Oh, I will. I can't help but do it. It's part of my life. You want to focus on the impact of standards on companies?

Pelkey: I'm interested in how technology gets to the marketplace, in terms of the flow of ideas and who comes in contact with whom, and the role of standards and standards bodies, and the process of innovation and how we manage innovation, and are standards an inhibitor or an accelerator of technology; the de facto/de jure arguments. I'm interested, obviously, in the process of -- because this industry is a function of the people, how the interactions of people and events -- in IEEE, people complained that while it was presumably just individuals, that in fact some organizations just stuffed the meetings in order to be able to get votes to come their way. If you could characterize some of those early meetings of 802, in the '79, '80 period of time. LANs were a hot topic.

Loughry: Ok. Let me just start spinning a story, and if I'm off in the wrong direction then just interrupt. I guess I would start prior to 1980. February of 1980 is when 802 got started officially in San Francisco, but prior to that time, Maris Graube and several others, myself included, had tried to get LAN development done in another committee, X3T9. Now, that committee felt that it was not appropriate to develop LANs. They were just a small possible blip on the horizon, and it was not a very interesting subject, not worthy of standardization. This was also true of IEEE 488 circa 1972, when I tried to get what is now IEEE 488 and IEC 625 started in X3T9. They also were more interested in mainframe channel level interfaces and device level interfaces, and a mere little instrument interface was not of interest. In both cases, then, we went to another organization -- it happens to be IEEE; it didn't need to be but it was a convenient one, so the message here is that committees, like anybody else, tend to get enamored with their current work and their priorities are set, and then have a very difficult time coming up for air and getting visibility on the long term. They're focusing on the now imperatives, not the long-term benefits -- at least what they perceive are the now imperatives. Human life -- it's not a criticism of any particular, it's just life.

Pelkey: Yes. And X3T9 was ANSI.

Loughry: Yes. It's now ASC -- Accredited Standards Committee -- but it's all under ANSI, but IEEE is also under ANSI, so you can't say that X3T9 is ANSI and IEEE is not.

Pelkey: Right, because ANSI, or ASC, is presumably one of the bodies that --

Loughry: If you want, I can show you, later on, overheads that will detail that --

Pelkey: That'd be great.

Loughry: -- but for the sake of the tape recorder. Remind me to come back to that. So now we start off -- there's a perceived notion that local area networks were beginning to come of age, and at that time it was known that what eventually turned out to be the DEC/Intel/Xerox Ethernet spec was being written. It was not yet public by any manor or means, but it was thought that that was a pretty good possibility for a local area network standard. Here are three large companies that feel that this is an important arena. They were pouring a lot of resources into it, plus the fact that at that time in history, there were some 80 local area networks, proprietary, so there was a lot of evidence throughout the industry, not just those three giant companies, that there was a lot of activity, technological activity, but they were also aimed at office productivity; I think more office than the manufacturing floor, but then later there were turns of events that turned it toward the manufacturing floor temporarily. So, the first meeting of 802 got started in February of 1980 up in San Francisco.

Pelkey: Now, were you -- did you participate in the MITRE conferences that were held?

Loughry: Negative. I did not.

Pelkey: Were you aware of those things going on?

Loughry: Well, I was aware of work that NBS had requested MITRE and BBN and others to do work on, some of the transport layer protocols that were then emerging as part of OSI, so I was aware of some of that. I was not participating actively.

Pelkey: How did you come to know about those activities?

Loughry: Well, I came to know about those because of my involvement in the X3 world, in so far as their developing the transport layer protocol and where did all that come from. Then, Rob Rosenthal and folks like that, but again, I was not an active participant in those at all.

Pelkey: But during the X3T9, there were multiple meetings in which the advancing issues, relative to LANs, fell on deaf ears, and there was a recognition that something new had to be done?

Loughry: Yes.

Pelkey: Who was in the group that said: "We've got to organize a special meeting?"

Loughry: Well, probably Maris -- Rob Rosenthal and Maris Graube probably are the two key people that said: "We've got to do something," so they, I think, of all the people that I am aware of, were the two that really said: "Hey, let's do something." Maris, I'm not sure of his motivations, other than he just felt very strongly it needed doing, and clearly Rob Rosenthal, because he viewed NBS's role as getting industry together -- the fatherly role, or the ombudsman, or something role, to getting the forces of industry together to serve both government -- NBS, DOD, Department of Commerce; need within the government community -- but also just a US role in general. So I think they deserve a lot of credit for beginning to put this

stuff together. At the first meeting in San Francisco, we did have people like Metcalfe, Bob Metcalfe, and John Shoch, clearly the fathers, or close thereof, relative to Ethernet. So we had some really key players. Also, some interesting phenomena: I think there were 15 to 20 folks from AT&T and Bell Labs and less than 10% knew each other, so they had all learned of the subject and they just appeared on the horizon. That was my first experience of really seeing a lot of people from other companies present. The meeting was attended by at least 150 or so people, as I recall; I could be off a little bit. We began to split up into groups.

Pelkey: Was that the Jack Tar Hotel?

Loughry: Yes. Again, we said right at the beginning that we were going to be OSI compatible, and we said that we would be as compatible as we knew how with the emerging architectures and that we thought our focus was going to be on layers one and two, the physical and data link layers, and that we were not really going to do much above that, but we would have to deal with the interface to the network layer. We recognized that that was a key element. So we definitely intended to fit into the picture. Jim, I'm going to say lots of things I would not like to be quoted on, but I'm trying to give you background.

Pelkey: I appreciate, and that's why --

Loughry: There were people there -- for example, Arpanet folks were there. They were obviously very knowledgeable, they had products on the market, they had done a lot of the basic work. They made a corporate decision. They participated in the first meeting and maybe another meeting, but not more than three to six months worth, because they felt that they didn't want to expose their technology, they didn't want to let go of it, they knew what they wanted, they weren't going to wait for a standards committee, etc., so they really opted out of the standards activity, because they thought that they were a big enough force, and I think time has indicated that they weren't that big enough force, but they thought, with some good reason, maybe, that they were big enough. They just didn't realize how explosive this interest and environment was for local area networks, because we then began meeting monthly -- well, not monthly, I guess every two to three months -- with some ad hoc meetings in between, and by the summer of '80, it was a pretty well organized group, and we were then split in terms of the physical media and DLMAC, which was -- well, the combination was data link and media access, or something like that, which was unique to local area networks because it was a broadcast mechanism, and prior to that time, X.25 and OSI didn't really consider broadcast as a concept. It was all connection-oriented, not connectionless, so connectionless concepts were foreign to the work going on prior to this time. Because of the technology, then, technology began to drive the standards, relative to acknowledging connectionless broadcast technology.

Pelkey: I want to make sure we deal with this connectionless versus connection-oriented, because that was a very important concept, in terms of networking and communications; those two domains, those two views of the world.

Loughry: Definitely, and what we now have beginning to emerge is the computer world going one way and the telecom world already having gone another way; the connection-oriented world and the connectionless world, because you didn't want the overhead of establishing connections. When you were all in one room, why would you need to connect? You were there. So that's continued to cause interesting challenges, and does to this day, how we merge those two together; merge the technologies together, merge the standards together, and merge the industries together, and that's a key factor which isn't totally resolved let.

Pelkey: Absolutely not.

Loughry: Certainly ONA and a few other things haven't done it.

Pelkey: And at that point in time, In February of 1980, was there a key group that sat up on a panel with everyone else in the audience? How was the meeting organized?

Loughry: Well, Maris can maybe recall more of the details. I've, I guess, forgotten the real details, but I think -- Maris and I knew each other pretty well, so when I volunteered to chair a media sub-task force, that was great. We looked for some key leaders, and that's one of the challenges. Now we get into the standards process, that people were stepping forward that had never led any standards activity before, and people are technically trained -- this is one of the weaknesses in the standards community -- that people are technically trained, but they are not trained as managers. They're not trained to resolve, negotiate, arbitrate, and get consensus, and this is one of the interesting challenges that the standards world has. So a few people stepped forward. I've forgotten who all did, but it was basically the people that, personality-wise, were outspoken, willing to stand up in front of a group, get shot at -- that didn't bother them at all, so they stepped forward. They were not the most able people, and ultimately, their assignments were changed, but after a lot of frustration by a lot of people. In the May, June time frame, at a meeting in Washington, DEC, Intel and Xerox presented their Ethernet solution. They made a strategic blunder. They basically said: "Hey, we have an answer. We have THE answer," is sort of the way they stated it. I was not at that particular meeting. It's about the only one I missed, but basically, it backfired. They didn't understand what they had to do to sell something, that you just don't lay a solution and expect 100 other companies to say: "Rah," especially of the likes of some we might name that are rather large. So then the dust began to settle a little bit, and it wasn't until September of that year that the Ethernet Rev. 1 was actually produced; September 30th, 1980. By that time, there was a real need to begin to put this thing together in an orderly fashion. A lot of people from DEC were playing leading roles, as were Xerox and Intel. HP had made a decision that we were going to go with CSMA/CD because it satisfied real needs, it was proven technology, and it was the simplest of what appeared to be the emerging technologies: token ring, token bus, and CSMA/CD. So, for those decisions, we made a very early decision. We were not -- there was the three companies to begin with.

Pelkey: And when did you come public with that, in terms of people seeing that HP was tending toward CSMA/CD?

Loughry: Well, not for another six months or so, in terms of press releases, however, at that time then, I was playing a very leading role. I didn't have this title, but I had the function in a then embryonic division, an operation -- but in a public arena -- then we were doing all we could to get CSMA/CD to come into being, and in the fall of '80, there clearly was a shoot-out. People figured they had it wired for token -- for the token approach, token bus or token ring -- and there was a critical meeting in December of '80 in Arizona at which we were beginning to put up objectives, we were beginning to decide what performance you'd get out of these things, and the token folks had thought that they had it all over CSMA/CD; in heavily loaded systems, CSMA/CD would come unglued. We, at HP, had done a lot of work, simulated and actual testing of breadboards, as to what was possible, and we were quite convinced that it didn't come unglued and that it really was a very viable solution. So, at this December meeting, this was known and kind of forecast by those that were on the inside, to be a real shoot-out, because this was the time that they were going to sink CSMA/CD and it was going to be buried, and some rather large companies were determined to make that happen. I was sort of elected, or promoted, or whatever -- nominated -- by the likes of Metcalfe and John Shoch, to be the

cheerleader and the spokesperson for CSMA/CD. So everybody went, and we had a work session for six to eight hours straight, non-stop -- maybe even longer than that -- from noon-time until about 10:00 or 11:00 at night, and then everybody was to come back in and present their findings.

Pelkey: Later that evening or the following day?

Loughry: No, that evening. We worked 'til midnight or 1:00 or 2:00 am. I don't remember when; it was late. At that time, I unveiled some of the data that we at HP had collected, which, of course, the interested parties within CSMA/CD knew all about, and a vote was taken. It was clear that CSMA/CD had a place in the sun, so we then began to really get ourselves organized, and I ultimately, then, became -- well, let's see, I've got to get history straight. That was just sort of an ad hoc group out of DLMAC. We were still organized that way. So then --

Pelkey: I was told that at this meeting, there was a two-thirds vote requirement.

Loughry: I can't recall -- well, there were two-thirds vote requirements, but I think that that's a year or two later. This was 'did CSMA/CD exist at all?'

Pelkey: How many people were at this session?

Loughry: 100, 150, it was pretty good sized.

Pelkey: And it was in Phoenix?

Loughry: It was in Phoenix, yeah. Pretty exciting times.

Pelkey: It must have been a very exciting time. What happened after this vote that night?

Loughry: Then we settled down to still being pretty feisty.

Pelkey: Did the meeting adjourn at that point?

Loughry: No, we continued for another day or so. This was -- I don't know what night it was -- Wednesday night, maybe, out of a week-long meeting. We always had week-long meetings. This has been our tradition ever since the beginning.

Pelkey: But the following day, after this recognition that, because of the data presented, that CSMA/CD had its role, did anything change about the tenor of these meetings?

Loughry: Well, the meetings, as long as they were led by certain individuals, sub-groups led by certain individuals, they were very undemocratic. They were not healthy. They were hard discussions. There was deep politics. It just was not productive, and we spent endless hours arguing; very frustrating, however we gradually made progress. Those of us held other people accountable to little loftier goals and progress, but still it was difficult.

Pelkey: At this point in time, it was kind of the troika plus HP aligned with -- IBM was being forced to come more and more into the open, as I understand it, and the token bus people were trying to find --

Loughry: The token bus figured that -- I can't remember now. I'd have to go back and really think. It was token versus CSMA/CD, but there were both token ring and token bus type participants, so they were arguing among themselves, as well as against CSMA/CD, so we clearly had three schools of thought. Concord, among others, was very loud and outspoken about token bus being the solution, and they had all kinds of -- Gould and Modicon -- whatever else.

Pelkey: That's right, Honeywell.

Loughry: They had all kinds of experience, and they were very knowledgeable people. Mike Crisco was a very, very technically knowledgeable person.

Pelkey: There is a person who was at Honeywell down at Phoenix, who actually lived in Phoenix. I forget the gentleman's name. He eventually went to Concord to work on their MAP/token bus product.

Loughry: Well, there's lots of people. Tom Phinney is probably one of them.

Pelkey: Tom Phinney.

Loughry: He's very technically -- technically super sharp, razor sharp -- and really a super person, although he had his problems. Don't we all? At any rate, I think I'd rather progress in an overview of --

Pelkey: Let me go over two things. You said you wanted to be OSI compatible, even in '79, '80.

Loughry: No, '80. '80 is the first time 802 met, so '80.

Pelkey: You wanted to be OSI. Why did you know that, and how did the ideas about OSI coming in to influence the thinking of 802?

Loughry: Well, many of us in the different companies had participated, in one way or another, in those discussions that were going on. We, HP, had representatives participating in the X3T5 committee, or what was to become the X3T5 committee. It, at the time, was a spark study group. HP, DEC, IBM, Wang, Data General, etc., were in one way or another, involved in some of these OSI discussions, so there was a fair knowledge base about what that was, what that meant, even though the reference model wasn't finally firmly in place for another couple of years. All that started in '75, '76, as far as OSI was concerned, within the X3 community, so that had been going on for five years.

Pelkey: At this point in time, this concept of layered architectures was a fait accompli. That was the way -- they didn't know how many layers, but it was a layered approach, right?

Loughry: Yeah, it was a basic architecture, and that was something that people came to understand and accept as being very meaningful and very significant.

Pelkey: Why do you think that --

Loughry: Because you have a very, very complex subject matter, and somehow you have to begin to simplify it. You somehow have to structure it -- not necessarily in layers -- but you have to structure it in order to deal with it, and in an understandable way, because there are so many

issues that you have to begin to partition it. Then, the next logical things is to build some kind of a house, some kind of a structure, and so it then becomes and architecture. Now, it turns out that the way they thought about it was layered because they recognized that you come from a user, and you go through something, and ultimately you go over some transmission medium, which is not even part of the OSI architecture -- the physical medium is not part of the architecture -- but you go over some physical medium, and they knew they didn't agree on that because the telephone companies all had their own things, so that was out of bounds. Then you went at the other end and you did the reverse, maybe through the same company's product or some other company's product, which was the concept of open systems, then back up to some other user. So the concept of going from user over to user, and doing it in some organized fashion -- the peer-to-peer concept and all those kinds of concepts came in to being. I think it was a tremendous effort to really go through that process of organized thinking, and if we look at history, I think we will see that the OSI reference model is the first time that a standards committee, or set of committees, actually put together a model first, and then developed the protocol, and all that goes with it, after. That is not looked upon today as the paradigm that one might follow in order to do things in an orderly fashion -- top down, as distinct from bottom up. So now we have reference models in graphics, we have reference models in databases, we have reference models in even physical media, which take a totally different form than the seven layer networking model, but never the less they are meaningful models, and in media interchange they've got four layers, as much as they can think or know about today. It's also a much less sophisticated set of subjects.

Pelkey: My belief is that the Arpanet is where you first had this layering --

Loughry: That's quite possible. TCP/IP and ARPA and that whole community clearly demonstrated some of these fundamental concepts.

Pelkey: And the validity of this --

Loughry: And the validity of this concepts.

Pelkey: -- and the way to subdivide the problem and manage the problem, and that the roots of this layered nature.

Loughry: Probably the roots of it came from the TCP/IP world, except that at that time, it was not called an architecture and not layered, and not really called that. They didn't recognize it as that. They didn't do it in a top down fashion, they did it from a bottom up fashion, but they resulted in the utilization of those concepts, which ultimately got recognized as those kinds of concepts. So, no doubt about it. That had a big influence. In fact, I would say what has resulted in TCP/IP and the ARPA community, they're real driving forces, in terms of what now is emerging as modern-day networking on a grand scale, more than just a couple of point-to-point links.

Pelkey: This issue of connection versus connectionless, was that a big point of contention during these periods of time?

Loughry: In 802? No, relatively speaking. It was talked about.

Pelkey: Because token ring really is a connection-oriented scheme. I mean, CSMA/CD is the one that's connectionless, right?

Loughry: Well, you can have connection or connectionless kinds of service at those layers, but no, we did not really discuss that to any significant extent.

Pelkey: That was just -- my view is that the token ring technology, relative to IBM's perspective, was compatible with; one, they had done some ring in token ring, but it was more synchronous. It was more compatible with their whole view of the world or predictability, of deterministic --

Loughry: They had SDLC, and they had loops, and they wanted to protect their interest in the loop technology that they had a lot invested in and their customers had a lot invested in. So the token ring was a logical extension of their loop technology and SDLC, clearly.

Pelkey: And all that goes back, at some level, to the way they originally designed terminals, which was to have the error correcting at the local level, as opposed to these dumb terminals, which was the asynchronous, which was: "We'll see if it echoes back ok," which led to, at some level, this whole concept of how they started to think about protocols.

Loughry: I would say, in general, yes, but I guess I haven't been a student of that, so I'm not too sure of my facts. I haven't researched that history that well, and it has not been of interest to me, so I haven't done that much with it.

Pelkey: So then, there's this December '80 meeting in Arizona that you were referring to --

Loughry: I think what happened was, then, that the CSMA/CD activity got really launched solidly then. It was still very embryonic. Then we started looking at what documents do we have to start drafting a standard, and various people with good expertise began to contribute things, and that's when HP really began to play a heavy role. We were sort of a fourth party. We said: "Ok, we've got this Ethernet document. Now, let's see if we can build something from that spec," and it was impossible. Not many people would admit that, but the fact of the matter is that there were lots of things missing. It was not solid. On the other hand, it was a tremendous step forward. I take nothing away from the people that slaved and sweated over that, but they were forced to finish at midnight on the 30th of September -- that's what their management had decreed. They were not done. There were certain things they couldn't agree on, and they left it out. They didn't put the threshold of what the collision detection was. There was nothing in there that said what the threshold of a collision detection was. It's a rather necessary thing, like the first thing you run into. So there was lots missing, and there was lots that was ill-defined, and there were lots of things that were built on rather ancient parts, with the assumption that they were going to select -- they were going to sort through parts purchased. Now, the message I'm trying to convey is that that was a tremendous starting point, but it was not robust. It did not really lend itself to a public standard under the scrutiny of a lot of companies with a lot of resources such that the end user could put stuff together easily. It was only good for those that really had the background, from those three companies, of writing the spec. They knew, but others didn't, so one of the things that HP contributed to this was sort of another view, looking at this, saying: "Well, let's make this a good spec. Let's make it robust. Let's make it fit all kinds of reasonable operating conditions, and let's get some of these funny little things out of there and get it back into -- not back into but into -- a solid, viable standard," and I think that's one of the things I contributed . . .

Tape Side Ends

Loughry: So then we began to really perfect the standard. Now, at this time, we still had all the media access activities going on within DLMAC, and we had a physical media group that

was doing the different physical media for CSMA/CD and clearly token bus. We had tried to architect this thing such that we abided by OSI, but we discovered that various people, various solutions, were unwilling to be pure about all of this, and so we were not being pure in our specifications. We had token bus dependent things being written into the media access layer of the token, and up into the link layer even, so we were, pardon the expressions, bastardizing what the OSI reference model was all about, and we couldn't agree. It was imperative to one camp that their widget, their functionality, be up in the link layer, and it was imperative that something else be in the link layer, but up in the link layer these two approaches didn't really fit, so we began to run into trouble. This is leading up to what you're referring to, in terms of dissention in the ranks. There was bad press at that time, that IEEE 802 was going nowhere, that nobody could agree, etc. Well, this was because we were not abiding by our own rules, and I will not name names, and I'll not name circumstances, because it was due to mismanagement in my view, that we were just really not doing things in a healthy technical way, or a healthy political way. We were not a democratic group at one time in our history. A lot of us began to get pretty frustrated about this.

Pelkey: This was in 1981?

Loughry: This may be even in '82. I'm not sure of the exact dates, but early on, fairly early on, and it was at that time that we began to realize that we needed to really reorganize. We needed to shift some assignments of some people -- that's a polite way of putting it. We also needed to be realistic about how far down, or up, depending upon the way you want to look at it, could we really be media independent. What we basically said was -- the basic decision was -- that the upper half of the datalink layer, or what we call the LLC -- logical link controller -- that that would be independent of each of the MACs, and of any of the media, but then each of the MACs could have their own -- we then had three MACs -- and that they could be, if they had to be, they could be somewhat dependent upon the messages and functionality of the physical media below, but that was up to each of the three groups. It wasn't up to one group now, so we now tri-furcated it, however you want to say it. So we made a split. We made four groups that were the critical ones. There was the fifth group, but we basically at that time then said 802.2, .3, .4, and .5 --

Pelkey: And .2 was --

Loughry: Two was the link, LLC, and then .3 was CSMA/CD, .4 was Bus, and .5 was Ring.

Pelkey: Do you remember when that happened?

Loughry: Well, that was at the meeting in Boulder, and I'd have to really look that up, date-wise, but it was late '81 or early '82, I guess. Maybe spring of '82. I'm not too sure. At that time, then, we basically said: "Ok, we're going to keep some of our operating principals, like we're not going to let CSMA become a standard before token bus, etc. We were going to stay on parity on that subject, but we then restructured ourselves, reorganized ourselves, in concert with the technology we were trying to standardize on, but in support of some common rules that everybody was going to abide by, one of which was datalink layer. LSE was sacrosanct. You didn't diddle with that. That satisfied all of them, and we had a real pro chairing that committee, and so he --

Pelkey: Who was it?

Loughry: Dave Carlson from AT&T. He's a long-time standards person. He's in the X3 community, and he's a real stickler for details and a real professional; technically knowledgeable and politically astute, and all the rest; calm, cool, collected, unlike some others I won't name. So from that time one, then, we began to really move in a rather healthy, constructive way.

Pelkey: Can you help me relative to -- was there a small group that got together and orchestrated this, was there a master group? Was there, finally, at some meeting, out of frustration, did it get reorganized?

Loughry: I have forgotten. I don't think we had an active executive committee before that time, but that was the time that we really -- well, no, we did have an executive committee before then. We must have, but it was basically members of the executive committee that began to feel that we were getting nowhere, and so then we began to really address this issue. Maris and I and Carlson --

Pelkey: Was Maris the chairman of the executive committee at this point?

Loughry: He's always been chair of 802. So the chair of 802 is the chair of the executive committee. So probably half a dozen of us basically said: "Hey, we need to do something." Then, Maris would propose, and then we began to reorganize ourselves, so we took that seriously, and that became a good thing. Then the members that had --

Pelkey: Was there much pressure from the fact that the press was making these comments? Was that a felt pressure?

Loughry: I'm sure that that was -- it was internal and external. You feel it. You go to meetings and you don't get anywhere, so it's frustrating. A lot of resources were being committed to this. You think about 200 plus people, a week long, from all over the globe, not just the US; 25 percent from Europe. There's tremendous resources being applied to this, plus the people back home working on proposals that never even went to a standards meeting. It's megabucks being expended, not getting very far very fast, but the press really picked up on LANs coming into being, and office productivity, and 802 is going to solve all the world's problems, or at least some statements were made in that direction, so there was tremendous pressure. The other thing that is a fundamental philosophy, as far as I'm concerned with standards and how it is you marry together all this stuff, that is you have to have manageable objectives. So often the technical folks come with solution not knowing what the problems is, and 802 was rampant with that. There were lots of solutions on the table. There was lots of technology, but it really wasn't thought about in terms of what was the optimum application environment for that technology, or did it satisfy umpteen different companies. I would say there was one other -- well, let me stick with that. Really zeroing in on a manageable set of objectives is, in my view, absolutely critical, and then standardizing what should be standardized, and not standardizing on other things, is absolutely vital. The degree of success is how well can you go top down, how well can you agree on the objectives, all of the objectives? Not the ones that you're unwilling to say, but all of them, so that everybody knows them all. You can still have some private ones, but you better not push to hard for those, because you're going to jeopardize what the consensus of the groups is. Then the other key factor is that you want to make this standards effort basically system and product independent. What's the purpose of a standard? The purpose of a standard is to have different vendors put things together separately, and have the ultimate customer glue it all together, so certain things don't belong in a standard. Well, you better not put them in the standard, because you're going to have a very, very hard time agreeing to them. That's a hard lesson for people to learn, and really make hard hitting, objective decisions. "No,

this doesn't belong in the standard. It doesn't have anything to do with interchangeability or compatibility or interoperability or any of those other kinds of things. I think the other thing that also was occurring at this time: that is that OSI had not gained that much visibility and momentum, and customers had not really come to understand the true multi-vendor environment. They were still dealing with one vendor as their preferred vendor, so we didn't see the benefit, the economic leverage, the product performance requirements to tie together what different vendors could put in their products independent of the interface, and that wasn't as visible at that time in history, but that kept coming up. So, as that became more and more visible, then people began to understand: "Hey, we really do have to got this multi-vendor route," which, of course, is what OSI is all about to begin with, but it wasn't that visible, it wasn't that close to the consciousness of the people working on the standards.

Pelkey: Because you still had the Datapoints, or the Ungermann-Basses. You had these vendors out there selling proprietary -- Nestar, Corvus -- selling proprietary solutions, trying to become big companies.

Loughry: Oh, yeah, tremendous economic incentives, because people could see the potential market, and as it began to get elevated in the press, then the small companies said: "Oh, wow, look at that market developing. We got to get in on the action." So, you had the standards bandwagon effect, and for a while there, you may recall, there was a tremendous series of articles, a whole year long, where broadband -- baseband/broadband issue -- well, that was kind of a smoke screen, but if you weren't knowledgeable, and you listened to the people that were pitching their things, then "broadband was great and baseband was terrible. Baseband will never go anywhere." The fact that broadband is much more complex, and we didn't really have the technology, and it wasn't really invented, and it wasn't economically viable, had nothing to do with it. It was the solution, and it was what was sold, and the same companies were singing the tune: "CSMA/CD will never go anywhere. It's not deterministic and you have to have deterministic, and blah, blah, blah."

Pelkey: And star versus bus versus all these topologies being argued. There was some great significance to it all.

Loughry: Right, and I chose not to get into the personalities and the companies and the positions, but all those things were going on, and it slowed down the standards process, and then 802 is rightfully criticized for not making a lot of progress. 802 also realized it wasn't, but it's difficult to change certain personalities. It's difficult to make management reassignments. It doesn't happen easily, in a company or --

Pelkey: Especially in a body that's kind of (unintelligible) like that, as opposed to hierarchical.

Loughry: And then this is viewed as -- well, let me not say too much, but you're in the public eye, so to be cheerleader, or chair, of some big standards committee, is a plus, so you don't want to give that up too easily, and I won't say more.

Pelkey: I agree. At the Boulder meeting, this came to a head, and you reorganized --

Loughry: And we reorganized, right. We had done some work ahead of time, and people were aware of what was going on, but that's when we finalized it, and then we said things like: "The plenary is no longer a decision making body." We used to have plenary votes, in which the plenary of 200 people would try to vote on issues, and it was -- you just don't have knowledgeable voting in a large body that only comes together for a few hours at the beginning

and the end. So the plenary, then, was just dissemination of information status reporting, and each of the individual committees really did the voting, and the executive committee would either affirm or deny what the working groups brought forward. So there was accountability to a higher group, but anybody in 802 could object to the executive committee, either to the working group chairs or to the executive committee, so there was a right of anybody in the committee to say: "Hey, things aren't going right." We built in what you'd expect of normal, reasonable democratic process. So, from henceforth, we've been organized according to that, and we've actually added working groups. At that time, we only had .5. Now we have .6, .7, .8 and .9 since then. Let's see, you raised some other questions.

Pelkey: When, then, did this (unintelligible) get formalized.

Loughry: We began really voting them out in '83, so it was about a three year gestation period for things to start the balloting process, and then they were approved at various times in '83 and '84, and the first set of standards was actually published in January of '85. Understand, you have to go through three levels of balloting: the committee itself, then a committee totally outside of 802 -- the Technical Committee on Computer Communications, which is an IEEE Computer Society technical committee, so that votes, and that's some 150 strong around the globe; Arabia, China -- and then the Standards Board itself, so you have to have three tiers.

Pelkey: Who makes up the Standards Board?

Loughry: These are people who are basically elected by the IEEE. It's the highest level of authority within the IEEE, reporting to the offices in New York, which is where the IEEE headquarters are.

Pelkey: And you had international participation in all of these?

Loughry: We had international participation all along.

Pelkey: In the beginning of this process, as you were saying, you had 80 companies that had some form of technology. Some participated and some didn't participate. As this process proceeded through this cycle, did some of the people who had non-standard -- what became non-standard -- technologies, did they begin dropping out, or did they just lose interest or --

Loughry: That depends on the committee, on the working group, and on how that working group functions, and what it was up to. Everything you mentioned happened. Some people dropped out. Other people began to realize what it takes to write a standard, and that's compromise. The definition of a standard is compromise, and the sooner you learn that, the better. It's absolutely imperative, because no single company has all the answers, no matter how big they are, no matter how much the resources or how many people they have at the meetings. They may have lots of good answers, but they don't have them all, and other people have just as good a chance -- I won't say chance, but -- they have access to healthy technology, and they contribute. Now, different committees and different chairs operate in different ways, and it's very interesting, because you get going along with one approach to standards, and then you begin to see that maybe you didn't do things right, and maybe there's other opportunities. Now, different committees operated in different ways. The 802.4 wanted to embed all kinds of functionality into their original standard, and they had half a dozen or so different flavors or the token bus; carrier, and broadband, FSK and PFSK, and I can't remember them all, but whatever they are. In the .3 world, I perceived a different situation. We had the opportunity of losing the Ethernet game, because there were people who were holding out for different things,

and we just needed a consolidation. We needed one standard that everybody agreed to, so that we didn't have an Ethernet Rev. 1 and 2 and 3 and 4, versus 802, versus company X and Y and Z. It was imperative that we consolidate on one, so there were some critical times, but ultimately it was recognized that 802.3 was really a viable thing. Lots of things happened to make that come into being, and large companies then said: "Well, we don't want two standards. We don't want our own approach and 802.3, therefore, we're going to throw our weight to 802.3," so we reached a turning point. We reached critical mass of the major players that really were influencing things and driving things and had the technical expertise and the resources to do it.

Pelkey: Which were largely the four companies.

Loughry: Yeah.

Pelkey: I mean others did, but the four of you had the weight.

Loughry: The three first, and then I believe HP -- without being egotistical about it -- I think we played a very significant role.

Pelkey: Other companies see it that way. Without HP, it wouldn't -- now, some people hold the view that what originally became the spec was very, very similar to the Blue Book.

Loughry: Oh, certainly.

Pelkey: There were some changes, but some people hold the view that, in light of all that's there, there were very modest changes to it. Do you share that view?

Loughry: Well, if you want to put percentages on it, way in excess of 75% of what the Ethernet book was originally is now the standard, so if you want to say 75% is significant, and it certainly is, the MAC definition itself is like 95% the same. The differences come in in the frame structure and the physical layer, which was not robust at all. Some objectives were not very good, like sending short frames was not possible in the original Ethernet, so the length field was added over the objections of the Ethernet folks, but it was perceived to have enough significance in the world -- HP and others thought that it was important, so the length field was added. It was not in the original Ethernet. Similarly, the service access points were added, and they were not in the original Ethernet. That was added at the link layer, but that was to be consistent with OSI, because we had SIAPs in OSI. Now, we had type fields in Ethernet, which was sort of doing the same kind of thing, but not in an organized way, and nowhere ever in any Ethernet spec is a type field defined. It just is not there. That's a fundamental problem, because it was an agreement, but there was no standard, there was no stated policy, there was no criteria, there was no use for it. Did it just address the next layer or two layers up? So it was flaky, in the sense that what it was and how you used it was not defined, yet there were behind the scenes agreements, which were ok, but it was an incomplete story. Let's see, where was I… Difference. Then, there's a lot of differences in the physical layer. It was DC coupling in the beginning, and we made it AC coupled, because of the failure modes and robustness, noise immunity. There was the heartbeat that was added that wasn't there to begin with. We branched out in a couple of other areas, in terms of other physical layer signaling that wasn't there to begin with. We also did some things that aren't in use today, so there were useless things, but we attempted to make it general purpose.

Pelkey: The process of --

Loughry: Let me get back to one point I'd like to reach later -- the pitch was the process of how you go about the standards. The token bus put in everything, but didn't test a lot of things, so now they're having to rewrite the standard. CSMA/CD said: "We're going to do one thing first, one thing right, reach consolidation, get it out, get a solid standard out, and then we'll think about adding other physical media," like twisted pair and like fiber and broadband. So we went about it in a different process, and I still stick to what we did, because I think it's fundamentally right. You better be sure of what you do, leave the door open -- hooks in for some of these other things -- but don't try to do everything without verifying it. We tried very hard to verify everything we did before we put it into a standard. Ok, your question.

Pelkey: At some level, the effort of the three, in order for them to get together and work together, they had to put it in the public domain that they were working towards a standard. While at some level they were, one could argue that other than for Intel -- Intel would have the biggest stake in making it a standard, whereas for Xerox and DEC, it was more for internal consumption and hooking their things together. They wanted cheaper technology, but they might not have been as motivated towards having this an open standard as Intel was because of the chip issues, and maybe because of HP -- that HP was the real issue, in terms of driving it towards becoming a standard, and that while DEC and Xerox participated in the process, they didn't want the thing to go too far from where they were, but until they saw that it was really going to happen, they weren't as motivated to make it a standard. Is that a fair reading of the situation?

Loughry: Well, they wanted a standard, but they wanted the standard their way, because they had already made investments of various kinds. So what's new? I understand that, and I can't say that that's bad.

Pelkey: I'm not saying it's bad or good either, I'm just trying to - -

Loughry: So I think that those companies clearly thought that they had a good and adequate solution, and they had a running start, and they wanted to keep it that way, because it was work for them to change. Any time you make any kind of a change in the standard, you're subject to retro-fitting and customer dissatisfaction, so it was natural for them to not want to make any changes. You're right, it took some time to convince them that what they had was not even good enough for them, and that's the basis on which you have to motivate those companies. "Hey look, you based this spec on selected parts. If this really goes, you're not going to be able to get the parts even that you want, because everybody's going to be wanting them, and the yield is not that low," because what they had taken is a stock part, but then they had taken -- it was way less than 10% of that part, as produced commercially, was suitable for this particular application, plus the fact that it wasn't even a good number to begin with. There were all kinds of things wrong with it. So the yields were low on that part, the availability of that part was in jeopardy, it was dependent on one supplier. Anything you wanted to say about it was not fundamentally sound for a good, long-term industry standard. It took a while for those companies to realize that, and they realized it, but still wanted their values allowed, so the way I succeeded in getting their support, at the same time acknowledging that they had an installed base, was to literally put in the spec for the collision thresholds, such and such a value recommended and another value allowed. That allowed them to exist, but it clearly said, for the future, this was recommended, and now where we are, those companies are supporting taking out the allowed. This is now five years later from those times, because that was way back in '83.

Pelkey: Was the transceiver an issue at this point in time?

Loughry: These subjects are in the transceiver.

Pelkey: Because the transceiver was a big problem, if I understand.

Loughry: Yeah, a lot of the problems were in the physical layer, because that's where you had many variations on the theme. The robustness was not as well understood, known, and different people had different notions of where this thing was to be physically installed, and what the environment was. That's where most of the discussions took place. The ones that mentioned in the higher layers are the length field, and the SIAP, and the type field; those you all tweak with a little bit of software, and you can change the software rev any time you want relatively easily, compared to physically going out and changing all the transceivers. (unintelligible).

Pelkey: Now, was TCP/IP, around '83, '84 -- Berkeley had released its UNIX version with TCP/IP. It hadn't really taken off, but that whole area was starting to pick up. Did that have any influence in what was happening?

Loughry: I don't think so. Relatively little. I'm sure it had some influence, because it's in the networking arena, but my perception there is that, although 802, when it started, was a very inexperienced standards body, gradually it's gained, and it's now, I think, a pretty professional group. TCP/IP, on the other hand, to this day, remains unprofessional. I don't mean that -- let me correct that, I don't mean that they're unprofessional, but their process is drastically different, and they don't have a formal way of voting. They don't have some consistent membership that approves this stuff. It's whoever, Postel and others, are, at that moment in history, that small cluster of people that say 'yes,' then that's it for that day, and then another RFC comes out. We now have 1,000 of them, and they're still coming out, and so it's a dialogue. It's much more the academic, researchy type solution, as it was intended --

Pelkey: Originally to be.

Loughry: -- to be. It was intended to be that, and it still is, and it was not until that group had the Monterey meeting two years ago -- probably three years ago this August, two or three years ago, I'm not sure -- the workshop, the TCP/IP workshop in Monterey, where they began to realize that they didn't have as viable a way to reach agreement, and some of their solutions were not widely accepted. They had all these implementors, and they had different solutions, because the TCP/IP specs were also not that clear, and they were being interpreted differently. People were going beyond the specs in the implementation arena and coming up with incompatibilities -- that they too had the same problem. So then -- and because they also wanted to use Ethernet, they wanted to use 802.3 for the SNAP protocol and tying in with address ARPs and address resolution and other kinds of things in the TCP/IP community, that they then began to look to the 802 world, particularly Ethernet, as utilizing that technology, and also beginning to draw on a little bit of the process. They haven't really adopted it very formally, but they recognize that: "Hey, we really need to look at things." So, they're trying, but they still don't have a governing board, or they don't have a standards board, or they don't have a stable membership. Almost anybody can come in off the street and express their view and vote -- or not vote -- but express their view, and then this elite group -- I don't mean to be super critical, but -- then they basically make the decision, and then it gets revised and updated as time goes on, so it's just a different process.

Pelkey: It's a process that was appropriate for this academic research --

Loughry: Very appropriate. Need to be fleet-footed, need to have the greatest minds contributing their cerebral popcorn to nice solutions, and trying it out and getting it going, but if you're trying to get common implementations on a very broad basis, then you need more than that. You need more than a series of publications of RFCs telling you the greatest way to do it this week. I'm overstating it.

Pelkey: I understand. I need to back you up a little bit, because I want to talk in a little more general nature about things, because you've thought about this a lot. IBM, many people say, had their cake and ate it too. They got the illusion of having a standard, yet in token ring, there really isn't a standard. There's the TI chipset and you have the IBM chipset, which is slightly different, and their software is slightly different, and everyone thinks token ring is a standard, where in fact, it really isn't. They got their cake and ate it too. Is that a fair statement?

Tape Side Ends

Loughry: IBM has always played an active role in the 802 development. I have a great deal of respect for most of the people from IBM. They are technically very knowledgeable and in general they conduct themselves at a pretty high level, but the fact of the matter is that they drove the 802.5 standard up to a point, and then more players got involved, and IBM basically then slacked off from driving it. They basically said: "Ok, we'll go with what we've got," and in summary, the 802.5 standard today is necessary but not sufficient. If you look at their chip set or TI's, you'll find many more different token types than are in the .5 standard, and if you look at the current standards development, you will see that today's standards development is adding in some of those token types. This is now 1988, and it was '84 or '85 time frame that they basically quit the first time around.

Pelkey: The process that you are referring to that happened when everybody realized that it was in their best interest to have a standard, that never happened over on the token ring side.

Loughry: What now?

Pelkey: You were talking about this process of convincing Xerox and DEC that it was in their best interest to go along and have one standard that everybody worked with. What happened, IBM --

Loughry: That didn't happen with --

Pelkey: -- didn't open itself up and say: "Let's take the best of what everybody else has, and let's have one which we will comply with." They said: "We've got ours. If you want to think of something different, that's fine, but we're going to -- "

Loughry: No, you're right, that did not happen, so there was not an HP or somebody else --

Pelkey: -- so what happened, the process of creating a standard that happened in 802.3, in the pure sense, didn't happen in 802.5.

Loughry: Precisely. There were attempts to do it, but again, it has to do with the people, their expertise, their expectations, and do they really bring -- do they have enough common interest to do the hard bargaining and reach agreement? When you get some players in the meeting

that, through no intent on their part to disrupt or to tear apart, but just their human nature, they turn out not to be overly constructive, because they want to express their views and their ideas, and it's more important to express their ideas than it is to reach consensus, and it's really selfish reasons, almost -- not even for their company, but just selfish reasons as individuals. They like to be heard, they like to wax eloquent and give a technological speech, or something or other. If you have too many of those players, then you don't have the group that's really a group, and some time or other you have to bite the bullet and say: "Hey, do we really want to be a group with one common solution?" How do you do that? It depends on who is cheerleading the group and who the players are. It's a combination of both.

Pelkey: Hubert Zimmerman was telling me that he made the rule, on the OSI reference model work, that people could only make positive, constructive comments. You were never allowed to make a negative comment about something, and he said that was one of the things that he thought was instrumental in causing that progress to happen. People realized that, when they said something, it had to be positive, and you didn't want to get too far away from what was real.

Loughry: I've never had that rule, but I have no problem affirming that. That's a meaningful idea.

Pelkey: And maybe some of what they were doing was in reaction to having seen this divisiveness, this digression that was happening. It was a different solution to try to address the same problem. There's many solutions.

Loughry: So I think in .3, .4 and .5, we see examples of different scenarios of how the standard was reached, or breached, I guess, as the case may be.

Pelkey: Before continuing historically, let me ask you an abstract question. As we get more networks working in corporations, and anybody can talk to anybody else -- at HP you have sophisticated electronic mail and I'm not sure of the state of computer conferencing -- but you can create work groups independent of organizational structures and titles and authority and pay and all this -- communities of interest, if you will -- I believe that that's going to create significant problems for traditional management of companies, in how to deal with this democratization that's happening, or this new way of how organizations are going to work with each other. I want to draw an analogy. Do you subscribe to this idea that it's going to be different?

Loughry: It will be different, yes. The information age has made some changes and will bring about much more significant changes.

Pelkey: Right, and I think it's this issue of interconnection, of ideas and people, which is much more the concepts inherent to the information age than it is having more data in central databases. Does that make sense?

Loughry: I have no problem with that.

Pelkey: Comparing TCP/IP process as having been one way of a community of interest getting together to come to a decision and causing something to happen and then complies with it, one could argue that the standards making process is another role model of how organizations are going to have to work together internally as a way of resolving issues that organizations are going to come up with. There isn't going to be a right answer, because there never is. Reality isn't reality, it's only how we construct it to be, what competition is or what the market needs,

and this process of connecting everybody else is going to give this process a much richer fulfillment. At the same time, it's going to be much more divisive, and everybody is going to have their say, as opposed to having some product-line manager and some technician deciding what the product is going to look like. The way we work within organizations, given this new information infrastructure, the standards making process, versus the TCP/IP process, are two role models of the new ways of running organizations. How do you run organizations in this new world?

Loughry: Well, I think the question you're asking is: "Will the way information flows in future organizations be much freer, more open, more accessible, and will that then impact how decisions are made, who makes the decisions?" My answer to that is yes, it's going to change things drastically. The big managers are still going to make big decisions, but they will be provided with a lot more meaningful information, assembled by people of lesser organizational height, such that the big decisions, where you're going to spend $1 million, or $n million to build a plant in Timbuktu, yes or no, or is it in some other place, the big manager is still going to be making those decisions, no doubt. That's not going to be left to the member of the technical staff or to a committee, because ultimately somebody is responsible and accountable. On the other hand, the resources available to be able to forecast and set up strategic positions and recommendations, the tools that technology and standards, among other things, will bring to bear is going to be tremendous, and that's what the information age is all about. Did I recommend to you that book, Information Technology?

Pelkey: Yes, and I have that book.

Loughry: Ok, because if you look at that, on some page in there, there's a diagram where it has technology and experience and time, and it's got the data processing industry, and it starts out in the '50s, and it's got four phases. There's the clerical phase, clerical records; then there's the MIS Department and historical data; and then you begin to emerge in the forecasting arena, but really pretty contemporary stuff; and then there's strategic, or longer-range thinking, which is where we're beginning to get into now. I subscribe to that model. How we go about it is going to be an interesting challenge, to make that change, to make that migration. I can easily get bombarded by the information age and get choked by the need to log on to ten different electronic mail systems, and I can't cope with it, because I'd be doing that all day long, so how I make use of this information, what I discard and what I pay attention to, and who I access, and how I go about that whole process, requires a different mental process from what I was accustom to a few years ago, so there's drastic changes in the wind, and I've often --

Pelkey: One can parallelize between what's happening in Japan, where Americans get frustrated dealing with the Japanese and negotiating with them because before the decision is rendered, they spend lots of time getting consensus with the whole organization. When the decision is rendered, they can implement it relatively quickly. Americans then go off and figure out how they're going to implement it, but they can get to a decision very quickly, and this new way of how organizations are going to work is going to be much more analogous to the way the Japanese work.

Loughry: Let me affirm that with some recent experiences in the 802.3 standards world, because again, it's how do you process information and how do you reach decisions. What we did with this 10BASE-T, which is currently a very hot topic in -- it's twisted pair, 10 megabits -- what we basically did was to really insist that we establish a set of objectives that everybody could agree to. Now, we modified those slightly as we got greater insight as to what our objectives could or should be, but the basic set stayed, and we didn't put in conflicting

objectives as time went on. They were sort of complementary, supportive, elaborative, whatever. In that series of discussions, we put a lot of emphasis on the objectives, we put timelines for proposals to be in, we had an extension of that to be fair to everybody -- and these were some controversial proposals -- but we considered seven proposals from some rather large corporations. We spent a lot of time in the study group. Now, .3 puts itself through a hoop. You've got to go past five criteria, or you don't write a standard. I'll come back to those if you're interested, but basically, we converted that study group to a task force in March of this year, and they have already gone through two drafts of the standard, because in the process of finalizing those objectives and evaluating the proposals, they had reams, literally, of technical, detailed technical documents -- crosstalk measurements, input noise measurements, you name it -- so now when they go about writing the standard, they knew what they were doing. There are no fundamental directions -- fundamental, do we go this way or this way -- decisions to be made. It's only fine tuning, fine tuning, so we have before .3 now, in three months, the second revision of a draft standard, some 40 pages. It's a little too optimistic -- well, we will not try to go for letter ballot next week, but I believe we can go for letter ballot in November. That's feasible -- highly feasible -- not guaranteed by any means, so that's a nine-month period from T0 to letter ballot (unintelligible). When we go to letter ballot in .3, things are pretty stable. They can still get changed, but the direction is set, the numbers are there, there's not big voids. It's a pretty stable thing, and the message I'm trying to say is knowing what the objectives are, going top down, then you have a common yardstick which is not company X versus company Y's proposal, but company A through Z's proposals, compared against this objectives, so it's a different way of thinking. It's nothing new in this world, but it's applying some fundamental discipline to the whole process and making what I think is reasonable progress. That's not been a small committee -- sixty, seventy people in those task force meetings, and large companies represented, with lots of vested interests.

Pelkey: It seems to me that that process, plus the NBS workshops and so on, are very, very illuminating, in terms of how, when in organizations you connect everybody else up and everybody can chatter and everybody can throw stuff out there and how you organize all this information sharing process to effective action.

Loughry: I think we know how to do it in a live meeting with a limited number of people. I don't think we know how to do it very effectively yet electronically, and I have participated in experiments to write standards via conferencing systems. You write a draft, and then everybody can comment on Clause A, B and C. The process of managing that becomes horrendous, because you don't have the first-hand, face-to-face interaction. You have to put it all down. Then, have you explained yourself? It becomes very complex if the committee is very large. If it's two or three people, then they probably know each other well enough and you can do it that way, and they probably are in pretty good agreement to begin with, but the larger the number of players, the more complex it gets. The larger the geographic area that you cover, the more complex it gets, because you have different cultural views, as well as different technological views, different economic view and political views, so you have economic, political, cultural, as well as just the technological, which is, of course, what you're supposed to be talking about, but you talk about all the other stuff too.

Pelkey: I think that these, to me, this process that you've been through and been instrumental in -- and it grows out of a lot of the stuff that happened in communications, and it happened in computers too, but I'm focusing on communications -- is extremely important in terms of giving insight, in terms of the kinds of issues that have to be confronted and we are going to be faced with, and what's proving to be effective today, in terms of new organizational forms. The same problem you're dealing with, which is what's realistic in the marketplace and how do you solve it,

and you have all these different communities of interest, it's the same stuff that goes on inside this building and in every company every day of the year. Having end-points and means and a process, it's there, but it's not hierarchical, authority driven as is the traditional way American businesses run themselves. Coming back to the history, it's now January '83, and you voted for it. You mentioned in '85 they were published. At this point in time, the NBS workshops and OSI are starting to become more of an impact in this country.

Loughry: At the same time that we were finishing our first round of balloting on what is now 802.3, the implementors' workshops were just getting started. I believe that was in March of '83, if I have my dates correct, because we met at Lake Tahoe, and that's when we did our confirmation ballot, and that was at the same time that one NBS workshop had started. I'm sure that's right.

Pelkey: The NBS workshop concept was really something that started - - there was a meeting in Boston, as I understand it, at the end of 1982 where the concept of how to make this happen, and again Rob Rosenthal and --

Loughry: Rosenthal was a key leader in that.

Pelkey: Again, it's bringing companies together in some kind of a framework in which they can share information and work these things out.

Loughry: Well, I think what's recognized is that you have a standard, but that still doesn't make for interoperability, and you need something more than that.

Pelkey: Where do you think that consciousness came from? Was that a relatively new idea? That's not a telecommunications experience, right? It's more related to some of these areas.

Loughry: What happens is that -- it was painfully obvious in the case of 802 that it was only two layers, and you needed a lot more to get it to work, because with layers one and two, you have nothing. You have to have more, and out of some of the 802 experience grew the fact that other people had, on top of 802, all different kinds of concepts. We had Xerox's XNS, we had TCP/IP, we had a possibility of OSI coming into being. There was the Tokyo meeting, and we had SNA, and you name it. There was all of these things, and OSI at that time wasn't all that firm and defined and voted out. It was just coming into being. It was well on its way, but it was still embryonic. So, I think people began to realize that more was needed. Now, I think NBS had done some experiments to use different vendors' equipment, tied into a real live CSMA/CD system on the campus at Gaithersburg. It was a 3 megabit Ethernet type thing, and so they encouraged other people to bring in some of their equipment and tie it in, and they collected error data, and throughput data, and all kinds of things. Then you begin to -- just in the process of tying different peoples' equipment together, you realize that people have different sized buffers -- very fundamental issues. You begin to see the tip of the iceberg. Well, if you're really going to have interoperability, then if you send a dump load of dirt, a truckload of dirt, you better have a place to park it. You can think of a better example, but at any rate, ice cream -- so it was realized then that you needed more than what was appropriate to standardize on in order to have a real practical, implementable scheme. I think the notion of implementors' agreements was born just because all of us were coming to the same realization, that it was sufficient - it was necessary, but not sufficient -- to do the whole thing, so clearly, that came into being. Now, my model of that is -- let me just refer to one thing which I can describe verbally. [Leafing through some papers] What we have is sort of a three-phased chart from paper to product, starting off with a development, and then implementation, and then conformance. Now, the

standards have, in some cases, built-in options, because the standards writers had enough forethought to understand that it was to apply to a wide range of products, like transport class zero through four -- dumb terminals and smart terminals -- so you needed options. That's the option category. Then there's ambiguities and omissions. Well ambiguities, maybe the standards writers weren't smart enough to write it in an unambiguous fashion, so whoever it is that reads it that didn't write it is stuck. They've got to interpret between the lines. Then there are omissions. There are omissions because you couldn't agree on something and you just left it out, or there were omissions because you really weren't smart enough to know that it needed to be there, and it just was plain left out through oversight. So, this first vertical line I call the base standard. That's absolutely necessary. Without that, then you don't have much. Now, for somebody that's going to pick up that standard and implement it and use it -- some vendor in this case, ultimately destined for a user -- the first task is to sort out what's been given to him by the base standards. They've got to pick the options, they've got to fill in the ambiguities and omissions if they're absolutely essential to that application. Now, I make the assumption that this implementation category is for some broad application arena, not for one company or for one buyer, and we can have the MAP and the TOP as examples. The manufacturer's world and the office world are two examples. You might have the banking, you might have transportation, and on the list goes, the securities world. Given that world that you're dealing with, then you're going to, first of all, sort all this stuff out, but then you're going to have to pick the buffer sizes, you're going to have to pick integer sizes, you're going to have to pick all kinds of things that may be very appropriate to whatever industry you're in. If you're in the banking industry, then it's a billion bucks per picosecond, and you better have reliability and redundancy and error checking and authentication and security. Those become very, very important, whereas maybe the length of the packet doesn't really matter so much, but if you're out on the manufacturing line and you're tweaking dozens of controllers and all you're doing is turning a valve two degrees and you're sending back and forth a lot of control and status information with very little measurement data. The whole purpose, the end purpose to which you're putting this standard varies greatly -- or set of standards. This can be viewed as one layer or it can be ultimately viewed as a stack for that application. So then, what you come up with a second vertical line is what I call the implementable standard. This one is not implementable. It is and it isn't. You certainly can implement it, but you really don't have all that ultimate customers are going to want. Then, of course, we have conformance test, and that's proof that you've done something useful, and I won't go into this too much, other than to say that it's absolutely necessary. The standards world is now beginning to think about: how do they build in testable standards; and there's lot of work going on in this area. It's like quality. You do not inspect quality in, you design it in. Well, you design testability in, and we don't have testability in some of the standards. 802.3 is a living example of it. There is no way of getting into the bowels of MAC to test it. One goes in and one goes out, and what happens in between is magic, although you can prove that it works black box-wise, which is good. At least you have something, but it's not, maybe, as helpful as it could be. So I believe that this model is something that's very viable today, and I could make all kinds of comments about it. I think the process here is pretty formalized. The process here is about as loose as TCP/IP. Anybody can come in off the streets and influence things, and that's not right, because they have tremendous potential leverage over the standards writers -- more than they have any right to if they are not knowledgeable, honest, open, objective people, yet they also have a lot of knowledge, in that they are the ones that are trying to put this stuff together, and they know that to implement some of this stuff takes an awful lot of code, and you better be very judicious about what you implement, otherwise you're not going to have a viable product. So, there's lots of hard facts of life that go on in this implementation arena that we cannot ignore. It's absolutely vital. The formal mechanisms for the feedback loops between these areas and this area, and between this

area and these areas, and likewise linked between here and all of these, they're very loose today. They're informal. They need to be formalized, but today they're informal.

Pelkey: (unintelligible) seven layering -- they got together some number of years hence, my assumption is that just as this has gone from the early days of being relatively loose to big enough to be managed and formalized because the community interests are so large and diverse and you can't get anywhere if you don't formalize it, the same thing is going to happen increasingly here, and eventually here. I think ENE was an important event in that regard. People are starting to realize that this stuff does have to plug-and-play, and we do need to work together, and the customers like it when we do that.

Loughry: So that's a simple model.

Pelkey: Oh, I agree. So the process of MAP and TOP and the NBS workshops and 802, all those things started to come together in '83, '84 --

Loughry: Well, I think in the '83 to '86 or '87 time frame, it really took focus. Then it was since '86 or '87 that when COS -- well, it was '86 that COS started.

Pelkey: Were you involved in that process at all?

Loughry: Yes. HP was one of the founding fathers of COS. We thought it was absolutely necessary.

Pelkey: Do you know how that came about?

Loughry: Yes. It got started by a segment of the computer industry that basically said: "OSI is important, and other, more proprietary solutions are not as important, and we need to stop proprietary solutions." HP felt that OSI was exceedingly important, and our approach to life is that what we want is good multi-vendor solutions, and OSI is the only thing around. We also think it happens to be a very viable thing. It's not just a lousy solution, it's a great solution. It's got some problems, but it's a very useful solution, so we were very, very pro-OSI. We also felt that it was important to spur on these standards activities, and get them, really, a little more attentive to the fact that the world really does want what you're producing. Produce it some more, faster, ok? So it was an attempt to say: "Ok, well, different companies can participate in different ways in the standards committees, but understanding what our needs and benefits are, we can pool our resources and influence, in the public arena -- not behind the scenes at all, but in the public arena -- what's going on in the standards committees." So those two sets of objectives, promoting OSI and making the standards writing process more effective, were some of the original driving forces. So there were 16 or 17 companies -- maybe 18, I don't know, but no more than 18 -- companies that got together to form COS.

Pelkey: Who was the leader in bringing that about?

Loughry: Well, Xerox, HP, DEC --

Pelkey: Was there one person that was the driving force?

Loughry: Well, Jack Bittel was the person that sort of got it started, but he got it started to be anti-proprietary, and it took half a meeting to turn that around. It was not anti- proprietary, it was pro-OSI. COS really, then, got formed.

Pelkey: Bittel?

Loughry: Jack Bittel. He's with some computer association in Washington. I can look it up, I just don't remember. I've known of him for a long time, but have mixed views, which I won't go into, but basically he is the one that sort of said: "Hey, let's get some PR going for pro-OSI and anti-Big Blue," is what it was. So, we basically turned that around and COS got formed . . .

Tape Side Ends

Loughry: . . . and mapped out such that nobody could dominate, so that was very, very intentional. It was going to be an open, democratic process, and there was going to be no dominance and so forth.

Pelkey: You wanted things settled down before IBM could come walking in the door --

Loughry: Yeah, that's not something that you should be putting in a book.

Pelkey: Now, COS and this issue of ENE, there were questions along the way as to whether or not COS was going to pull this off, in the sense of having conformance testing, and it was only the last few months when -- like all these things -- where there was a deadline, whether September 30th or ENE, all of a sudden people had to get serious about it or it would be an embarrassment. There have been some changes in COS which hopefully will be an improvement. I agree with little model, that's an important process. Lots of things came into place at this point in time, as well as the maturity of organizations such as 802 has helped in dealing with the process of standards faster, such as the twisted pair Ethernet – 10BASE-T -- which got through very, very quickly.

Loughry: It isn't just 802, it's the whole OSI world: X3T5 and the SC21, and various groups. Zimmerman was part of SC21, WG -- I'm not sure which ones he specialized in, but it doesn't make any difference.

Pelkey: A couple of generic questions. The issue of standards and the rate of technology change. At some level, standards benefit to bigger companies -- they benefit users, obviously, because of interoperability and multi-vendor solutions and so on -- but one could argue that they can have a tendency to slow technology down, unless standards making gets into de jure, and then there's the question of whether that's the appropriate place for standards bodies to be. Do you hold a view that standards making can slow the rate of change of technology?

Loughry: That was a thesis that was put forth loudly and strongly in the late '60s and early '70s. I had people argue against me: "You can't standardize that. That's technology that is just unstandardizable," by the then vice-president of DEC, Gordon Bell. That happened to be IEEE 488. "That's the wrong thing to standardize. Impossible. Don't do it." I don't believe that that's right, and I think history has proven that it's not right. It depends on what portion of the thing you standardize. If you standardize on things that are product, system, application independent, then what have you done? You basically have given the companies that are inventing products the opportunity to put their resources into what's value-added for their unique product, and you have taken away from them the need to put a lot of resources on inventing that which can really be standard. So who has benefited? The manufacturers, the vendors have, because they are applying resources where they can get a return on their investment, and the ultimate users, customers, are benefiting, because they don't have to learn ten interface systems, they only

have to learn one, and they have, now, more bang for their buck, more value added in the product that they're getting, because that's where the vendor is putting their resources and their expertise. I see this as truly a win/win situation for everybody IF you standardize on the right thing. That's a golden rule. You can standardize on highway interfaces. In general, if you're going to travel on Route 280, you've got to have four wheels, not two or one or something. You need to have turn signals, headlights, safety devices, whatever, but not everybody wants to drive to work in a moving van every day, and not everybody wants to drive to work in a blue VW every day. What you put between those four wheels -- what color it is, how high it is, what's its storage capacity, how fast it travels -- depends on your specific needs. The things that are truly common, truly interact with other, in this case, human beings safety-wise, are the things that you standardize on. The things that are optimized for particular applications, either lowest cost economy transportation or highest volume per gallon of gas to move across country, then you put a different shell on those four tires, and I think the same thing is true with all kinds of these standards. There's a right thing and a wrong thing to standardize on in all kinds of different standards.

Pelkey: And it's important to have a large enough group participating so that you make sure you've standardized at the right level.

Loughry: You need to have a diversity of view. The question is: how do you handle the diversity of view? There's no simple answer for that, but I am a firm believer in what I choose to call the corporate wisdom, and that doesn't mean any corporation, that's the assembled throng; who's ever there. You may do some things to recruit organizations or entities that you think need to be represented, but basically, if you have to work too hard to get them there, then they're not going to be that much interested to contribute, so it's really those who show up, with a little bit of encouragement, but making sure that the door is continually open and that you try to use a democratic process to get the issues resolved. As I said before, lots of different small companies have all kinds of wisdom, and sometimes the big companies realize that a small company has lots of wisdom, and they're very thankful for the contribution that that particular company made. Now, our experience at HP has been that we were not afraid to give up our technology, in the case of IEEE 488, because we felt that the model of what we were doing was also the model for industry and industry's problem, and we thought we had a viable solution. We had autonomous divisions that were each putting their own interfaces on products. Some were serial input, some were serial output, and they wouldn't have the reverse, and so forth, but our customers wanted to tie our instruments together in systems, so we had a special division that was doing nothing but customer engineering. It was one-shot systems, and they weren't very profitable. That's part of the driving force for 488, but once we did it, then we found that customers were buying products with that interface on it BECAUSE it was standard. Why were they doing it? Because they had confidence that it wasn't going to change tomorrow. It was going to be there for at least five years. If they made an investment today, it was a sane investment for a few more years. Because they knew they were going to automate, they knew that they wanted in their central stores products that they could haul out, that were stand-along bench instruments one day and the next day they were going to be put into some kind of an automated system. It was there. They knew how to use that instrument. They were just using it the day before on the bench, but now they can put it in their automatic system, so without going into the bucks, it was a fair amount of business for HP because here was a standard solution that not just HP had products for, but other companies had products for. So we clearly gained. We did not lose at all, economically or technically, from that experience, so that is one of the things that led us up to doing the same kind of thing with 802. We very strategically pick what standards committees we put that kind of effort into, and that's our own business and we won't go into that today, but you pick and you choose.

Pelkey: The other issue is de facto versus de jure. Should standards bodies be in the process of defining a standard before technology has competed in the open marketplace and you've established what the need is so that you better understand what you should be standardizing to? V.32 is an example of a standard that's really a de jure standard. Someone said: "We're going to create this."

Loughry: Well, I think there's a case for both. I don't think one way is right and the other way is wrong. Standards can come about in any number of ways. I choose to call it de facto and 'forward looking' standards, on the ones that somehow address the future, and not everything is proven at the time you start out. I think, to the extent that you can see around the corner and predict what the needs of the future are going to be, you're that much better off, because you have the flexibility to get the insight of a lot of different companies and a lot of different views. The disadvantage of the de facto is that, basically, it was put there by one company, usually, or one small set of players, wherever they've come from, and their exposure, their experience, is -- it isn't tunnel vision, but it's narrower than what you might have if you have a set players in an open standards committee. You can look at it all different ways. Maybe when you started out with what turned out to be de facto, there wasn't the visibility on anybody's part that this was a big thing. This was maybe small potatoes, and so that's the way it started, and then it kind of grew gradually over time, and it got bigger and bigger and more entrenched and more market, and it just followed. There's a case for that. On the other hand, I think really, maybe, the big success stories come when you realize the need and you make, at the earliest possible time, a marriage between the technology and the application environment, whatever that turns out to be, because if you see that that application environment is growing, then you have an opportunity to have the application environment influence the standard, instead of have a de facto solution be applied to the environment. Now, one of the problems standards committees continually suffer from is the fact that not many users participate. It's a fundamental problem, and it's unfortunate, but they don't instantly see the rewards; they're unwilling to put in the resources to it; they don't have the expertise, the same kind of expertise at the deep technology level to contribute their users. The standard is not an end in itself, it's a means to an end for them. It may be the end of another step for the vendor, but to the user, they could care less whether they even see the standard. They just want results, so they have a whole different perspective, and knowledge base, and set of criteria, so in general, they don't participate.

Pelkey: Maybe this implementors' -- implementation phase --

Loughry: It helps. If you take the -- the standards development group, that's ninety-some percent vendors. You're lucky if you get ten percent users. In the implementors workshops, you have about fifty-fifty. It's pretty close to being even. Now, it turns out those users are also implementing very different things at various stages, but still it's a much, much higher population of users.

Pelkey: Which is really important, to start to -- as you formalize that more, hopefully, there's a feedback loop that will happen sooner, that will be helpful to the standards process.

Loughry: Now the de facto standards, of course, tend to focus on a fairly narrow set of things. What you need to do, then, is to have them focus on a broader set, broaden it out, don't make it so restrictive. There's all kinds of things you can do to a de facto standard, to move a de facto standard in the direction of what I call 'a good industry standard.' So I guess my bottom line is that either is ok. If you have the insight to do the forward-looking standard. There's much benefit.

Pelkey: With the X3T9 experience, how do you, as a person involved in this 802 process, how do you prevent the same thing -- you doing the same thing to somebody in the future as this one has done to you?

Loughry: That's a good point. What I am doing is I am actively involved in the management of X3. I am the vice-chairman of X3, the parent committee, which represents some 3,000 standards developers in this country, and I'm also the chair of a future focus committee within X3 trying to answer the question: what should we do differently so that we enter the 21st century with all wheels hitting solidly to produce standards that are really needed and necessary? What kinds of standards -- technical subject matters -- do we address? What do we do to change our process? How do we reorganize ourselves? How do we make use of the information age in more effective way? I'm working at that level to try and solve some of these problems. I was very personally actively involved in the conflicts between T9 and 802.6, and tried to solve the turf charters, the charter wars, the turf issues. I tried to solve some of the personality issues, because we had some bad personalities, some bad practices, some bad ethics. You name it, we had it. I guess my bottom line answer is: I'm trying as best I can, and still do all my other jobs, to interact, to really sort out much higher level kinds of issues. I served as an ad hoc in some funding activities relative to ANSI funding of secretariats for all of the information technology in all of the United States. I'm trying to address some of the bigger issues, far removed from the trenches of whether you use 24-gauge or 26-gauge twisted pair in 10BASE-T whole different world, but I believe that it's absolutely essential that we do that. All kinds of issues; what are we doing to train our leaders in the standards committees? A critical issue. What are we doing in the way of mechanization to facilitate this process? A standard goes up and down the line. Once it's in a draft form, an initially, reasonably stable draft form, it goes up and down the line 40 times before it comes out the other end as an international standard, and that's a lot of up and down the line. That's on average of course. What do we do to facilitate that process? We have right here, a few feet from where you're sitting, a desktop publishing system, so when - - several of us are editors or various standards committees, so - - when we get done with our task here as an editor, all cooperating in the community -- this isn't of in the corner writing a standard now, this is full blown, public, democratic process -- when we get done here, that's camera ready copy that goes to ISO, and they just merely photograph it and the standard is printed, as distinct from when I started out with IEC 625 and IEEE 488, we were in the typewriter age. Then it had to be translated into French, and we went through years, literally years, four years, from an approved standard to a published standard. Now, we're cutting that down to --

Pelkey: Weeks?

Loughry: Well, it's more than weeks, because there's still a lot of cycles you have to go through. There's still a lot of protocol, still a lot of checks and balances: was all the voting legitimate? Did you address all the negatives from all 42 countries? All that sort of stuff, but you're getting down to within months, not years, to go from an approved standard to a published standard. So it's a big set of issues, but it's fascinating, absolutely fascinating. I find it neat to understand how human beings represent themselves, how they represent their companies, how they represent their countries, because they really have to do all three. Of course, they're being paid by somebody, but still, how they do that, how they bend without breaking, and how they give in, and how they support, and how they provide their data; it's absolutely fascinating.

Pelkey: You have a sense of what I'm interested in. Are there areas that we haven't touched on that come to mind?

Loughry: Well, if we're looking from post-'83 to now -- not quite so much the 1990's --as you're saying, up to now, I guess we probably covered the major ones.

Pelkey: Maybe when you read the transcription something else will come to mind. This has been very, very helpful to me, and I thank you very much for your time and for your contributions to this process.

Loughry: I like to talk about the subject. I'm thoroughly involved in it.
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END OF INTERVIEW

