Interview of James White

Interviewed by:
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James Pelkey: I know that you were at UCSB when they were trying to get their node up on the Arpanet. How do you come to be at UCSB and how did you get involved in this process?

James White: I went to graduate school at UC Santa Barbara, and in my last year, near the end of the year, I got took a job with the so-called Computer Research Lab at UCSB, that was headed up by a guy named Glen Culler who was quite well known, especially at that point in the history of computing. So I got involved in computing at Santa Barbara as a result of having gone to school there, and worked on what, at the time, was called the Color-Fried Online System -- ran on an old RW-400 initially, which filled a room full of vacuum tubes I suppose, at the time. It later ran on an IBM 360 Model 50 and later a Model 75 that was run by the computer center at the university that did all the job shop work for the professors and ran the accounting for the university.

Pelkey: What years were these?

White: I graduated from Santa Barbara in '69, so this got started in '69, or perhaps in late '68.

Pelkey: And what was the Culler-Fried System?

White: It was called a mathematically oriented timesharing system that talked to users via terminals which were, literally, Tektronix CRTs and they had a keyboard associated with them, a very funny looking keyboard with round buttons. This was all pretty new stuff in those days, and the idea was that all of the capabilities of the system were mathematical, and that you could plot -- you could do fairly complex calculations and see the plots on the screen, on the oscilloscope. It was quite heavily used in the academic end of things. Students in engineering classes played around with that in connection with their assignments.

Pelkey: That was one of the first computers that had CRTs on it?

White: Yes, I think it was. It was quite a new concept.

Pelkey: Everything else in the world was teletypes.

White: Everything at that particular school at that time was completely batch oriented, with the exception of this system, so computing in general was throwing your deck of cards in the tray and come back in a couple of hours and hope that you don't have three inches of dump listing instead of your results. So I got started in computing by that means, and became a contributing programmer to the evolution of OLS as it was called, On-Line System. Actually, it was called -- no it was OLS. I graduated from Santa Barbara, and the military draft was in effect. This was a year when they had a lottery where they shuffled all the birth dates around and you were either in good shape or bad based on what your birth date was. It turned out I was sort of number two on the list of birth dates, so I was immediately drafted into, as it turned out, the Marine Corp, and the Marine Corp and I didn't see eye to eye, so I had a very, very short stay in the Marine Corp, and I got out unexpectedly, so I went back to Santa Barbara with my bald head.

Pelkey: When was this?

White: This would have been in either '69 or '70. Probably '69. So I went back to Santa Barbara and said: "I'd like to work here again," and they said "Fine." It was at that point that the Arpanet work was starting to get fired up, and as you pointed out earlier, UCSB was one of the first four nodes of the Arpanet, and the work was to be done by this Computer Research Lab that I had been associated with previously and that had done the Culler-Fried System, and they needed someone to essentially do the networking software for their node of the network, so they said: "How would you like to do that?" I said: "Fine," and started then going to these so-called Network Working Group meetings, which were --

Pelkey: Steve Crocker?

White: Steve Crocker who was at ARPA at the time and was sort of the technical ring-leader of this whole national effort, so I got involved in that, started going to these meetings, started reading about the IMP and how it worked and what it meant to attach a host computer to it. So I was, being a programmer, I was to cover the software side of it and a guy whom you've already talked to, probably, Roland Bryan, was the hardware guy, so he's the one who built the box. Today you think of it as being a board only about this big, but then it was a box that was about five feet high and about two feet wide and three or four feet deep, and it was the IBM 360 hardware interface to the Arpanet IMP. So he had done that, or was in the process of building that device. It had a specification of what it looked like from the standpoint of a piece of assembly language code sitting inside the mainframe computer, so I started writing software for that. Of course, the world didn't know, at that point, that there were supposed to be seven layers in every network architecture, but there was clearly a need for something that was called the Network Control Program, which I'm sure you've heard of, which would now be considered the transport layer and on down. So the first job in putting the UCSB machine onto the network was to build a network control program, and that's what I spent most of my time doing for the next little while. I wrote several drawers worth of IBM 360 Assembly Language code, that claimed, in the end, to be a Network Control Program that implemented the host to host protocol defined for the Arpanet, which was still, as I recall, in a state of specification. It had been largely specified by that time, so it was pretty much a stable target, so I did a lot of software.

Pelkey: Now, let me help you be more specific. Your node was installed in December of '69 or January of '70?

White: I don't remember.

Pelkey: UCLA was September and SRI was October.

White: My earliest recollections are that there were four nodes in the network, period.

Pelkey: I think yours was November of '69. Do you remember, when the IMP arrived, were you ready for it?

White: No, I certainly wasn't ready for the IMP when it arrived.

Pelkey: Was Roland's hardware working?

White: It existed as a box. It had its usual set of glitches that were only discovered and fixed as a result of my running software against it. You never had any software that could run in the 360 prior to that that would exercise his box. In fact, I remember taking an awful lot of flack from the computer center because I had occasionally run my Network Control Program against his IMP interface, and this whole, huge IBM 360 model 75 would just stop absolutely cold in its tracks. It was initially assumed that my software had gone off the deep end. It turned out that I had issued a channel command to Roland's box, and it had simply failed to obey the appropriate hardware protocols and didn't return the CPU to the operating system, so there were glitches of that sort that only were recognized once there was a real live working piece of software to exercise the box.

Pelkey: Let me ask you to go back again. When was the first Network Working Group that you went to? Where was it held?

White: I have no idea. Many of the meetings were at BBN in Cambridge.

Pelkey: Did you fly around much to these meetings?

White: I went to each meeting that was held. It wasn't a whole lot of globe-hopping kind of stuff.

Pelkey: Who else was at those meetings?

White: Bob Metcalfe, who was with MIT, was involved; a number of other people from MIT; a guy named Mike Padlipsky who since wrote a curious little book on the history of network architectures that sort of bemoans OSI and wonders why the world didn't simply latch onto the Arpanet protocols, but he was one of the people that I remember because he was quite a character in his physical appearance and manner and so on; Jon Postel, he must have been at UCLA at the time; I'm having trouble remembering additional faces, it's been so many years.

Pelkey: Were there very many people that attended?

White: Oh, there must have been on the order of 20 or 30 people at one of these meetings.

Pelkey: And what were these meetings like?

White: Well, this was all pretty highfalutin stuff, because I was just fresh out of school, and was relatively new to programming because I just sort of discovered what a neat thing computers were.

Pelkey: You had just gotten your bachelor's degree?

White: Just gotten my bachelor's degree, and new kid on the block, and here I was at these meetings at MIT where there were all these "computer scientists" doing all this research, and I

was coming in, as I recall, kind of in mid-stream in terms of the history of the development of the activities of the Network Working Group and their creation of the protocol set for the Arpanet, so I was --

Pelkey: Was the 1822 spec out by the time you got involved?

White: Yeah, sure. It was all a done deal.

Pelkey: So UCSB kind of got started late when they handed this over to you?

White: Yeah, I believe they did, so I did go off to these meetings --

Pelkey: Were they friendly meetings, from your perspective? Was there camaraderie? Was there an in-group and an out-group?

White: Not that I recall. Nothing like, if you want to talk later about the X.400 experience. Nothing like the camaraderie that happened to develop there, but it was a perfectly friendly set of people. They were all academic types, including myself.

Pelkey: Do you remember anybody from ARPA coming and talking to the group about the need to get this show on the road?

White: I think there was an occasional visit by Larry Roberts, but more or less it was Steve Crocker who was running the Network Working Group, of course, and there was, I think, some sense of urgency that was imparted to us by Crocker, but I don't remember anything particularly dramatic or foreboding.

Pelkey: And you were the only one doing anything with IBM. Everybody else was doing it with their Sigmas and PDPs, so you were out there, kind of --

White: That's right, we were the lone -- with the one exception of RAND, which was also one of the early nodes. In fact, the folks at Rand, who were a guy named Eric Harslem, who sometime considerably later went to Xerox, which is where I was at that point in time as well, and a guy named John Heafner who, more recently, was at the National Bureau of Standards, and ran a lot of their OSI work, and then recently has gone to DEC.

Pelkey: He's at IBM.

White: John Heafner is?

Pelkey: I'm meeting with him tomorrow.

White: Last time I heard he had taken a job at DEC, and DEC was looking to open a networking research installation in northern (unintelligible).

Pelkey: He's now down in Raleigh at IBM.

White: Son of a gun. Ok, well, they had an IBM machine, as I recall.

Pelkey: Did you and John interact?

White: Eric and I interacted. Eric was my counterpart at RAND. He wrote the software for his machine. I don't remember what flavor of machine it was. He was developing software down there, and I got to a point where I had my NCP "done." I thought it was done and it worked. I could send traffic to myself through the IMP and back at a very high throughput, and it all worked, and I, in fact, I even had some applications either under development or developed by then. The first thing I did was -- I was supposed to do, essentially, any software that Santa Barbara did for the Arpanet, and in those days, the whole idea was that once you were on the network, you could share resources, so I thought: "Well, what resources do I have to share," and I decided the resource that I had to share was file storage on this huge machine with rows of huge disks and so on, so I designed and implemented something which I called SMFS, the Simple Minded File System, so it was an application layer, as we call it today, protocol that I documented and made available through the RFC mechanism of document distribution that the Network Working Group used. So here I not only had an NCP but I had a Simple Minded File System with documentation and implementation; I could store files and so on. So I can't remember the exact -- I'm sure you know the whole story of electronic mail, which really --

Pelkey: I've heard multiple stories, so I'd like to hear yours.

White: I'll give you another one then. This is of course the field that I've now ended up in, the electronic mail field. That, in a way, is one of the major outgrowths of the Arpanet experience, the notion of electronic mail by means of a network, and it all started at BBN, where a guy named -- it'll come back to me; I can't remember his name, very famous. One of the TENEX guys. Do you remember his name? [Ray Tomlinson]

Pelkey: I can't remember off the top of my head.

White: Well, this un-named fellow wrote an e-mail program for TENEX. I think it was called SendMessage [SNDMSG], and all it did was prompt you for a few fields, including the text of the message, and then deposit the file in some directory somewhere and then at a later date the guy you'd sent it too would come back and retrieve that file out of there, and the revelation, I suppose, in practice, was that, because this timesharing system was on a network, and you had a virtual terminal protocol, Telnet, you could be geographically distributed and communicate electronically in the e-mail paradigm with one another.

Pelkey: How did it get out -- my understanding was that they built it for their own little machine. How did it get out into the network?

White: Well, there wasn't a network version of it initially, per se, it was just -- it wasn't a network program, it was just an application running under TENEX. It was TENEX that was accessible to anyone on the network by way of this Telnet protocol. So even though I was in Santa Barbara and didn't have a TENEX system, I could go out through the network from my

mainframe and interactively use the TENEX operating system and run SendMessage and send messages to people. Then, at a later time, there was a -- of course there were a lot of TENEX systems.

Pelkey: Did all the mail stay on the BBN node?

White: Yeah, on the BBN node.

Pelkey: So you could send a message, but someone had to go there to retrieve the message?

White: Right, had to got there electronically. You didn't have to go there physically.

Pelkey: And had to login to see if there were any messages for them?

White: Right. Then at a later time, the guys at BBN, since there were quite a large number of TENEX systems on the network, they decided that messaging was -- electronic mail was also an application for the network, so they augmented their SendMessage program with a background task that talked to its corresponding programs on other TENEX's over the Arpanet, so they devised, they extended the addressing format to include a host name, so I think you could say: "White@UCSB," in this new version of the SendMessage program, and whenever SendMessage saw the "@" it knew this was a network proposition, and it would take -- make a copy of the message and deposit it in the directory and then that deposited file would be picked up at a later moment by the background process, who would say: "Oh, '@UCSB.' I need to establish a connection to some well known socket," as they called it in those days, this advertised address, and talk to my counterpart, my background process on the other machine, and hand it off to him. So that was, to my knowledge, almost certainly was the first network related electronic mail program. So then you had every TENEX system on the network playing this game.

Pelkey: How did UCSB get tied into that? Did you ever get an e-mail package that ran on your IBM?

White: No, I had left by then, so I don't have detailed knowledge of what the guys at Santa Barbara did after I left in the way of networking, but I was at SRI at the time, which was the Network Information Center for the Arpanet, and I was responsible for the network software for SRI, but in a completely different sense. In general, I certainly wasn't a one-man operation any longer, and in general, I wasn't writing a lot of network software, although I was writing some of it, but that was when electronic mail started to become pretty neat and exciting and a phenomenon in the Arpanet, in those days, post-'72, '73, somewhere around there. There was developed, over time, a small family of electronic mail protocols that were an evolution of the private protocol that the TENEX guys did for their TENEX only implementation. So electronic mail was starting to -- it was clear that people were onto something, and I don't think it had ever been anticipated. This was not the kind of resource -- this wasn't really resource sharing, this was interpersonal communication, and it just wasn't something people had envisioned or predicted. I remember, Larry Roberts -- I was working, at the time at SRI for a guy named Dick Watson, and Larry Roberts called SRI, called the Network Information Center essentially, and said: "Hey, we need to develop a standard format for these messages, because this messaging

stuff is getting pretty serious, so let's write down some rules now that shows we're more than just TENEX systems creating messages, let's write down some rules for what the messages look like." So I put together a spec for that, in cooperation with several other people. One of them was a guy at UCLA, which was one of the other original nodes, his name was Bob Braden, and then I think someone else at BBN -- Ray Tomlinson was the BBN guy who did SendMessage, so he sort of created network electronic mail, I guess, so the three or four of us put together what became RFC something or other, 492 or something like that, which was the very first Arpanet agreement about what electronic messages should look like; what the fields were, how they were formatted, so on. Also developed around that time was the first Arpanet protocol for actually transferring the messages, and I can't really remember which of the two preceded the other, the format agreements or the protocol development, but I could dig out some material that would probably clear that up. I don't remember having anything to do with the protocol, although I might have, but somebody somewhere in the Arpanet community, some set of people -- it probably came out of the Network Working Group -- devised this -- Jon Postel, I think, was very involved in this. They devised what became the MTP, Message Transfer Protocol. I don't remember whether it was called the Simple Message Transfer Protocol in those days, but it might have been.

Pelkey: Do you remember when Larry did his TECO hack?

White: The TECO hack, that was -- that rings a bell, but I can't remember what that was.

Pelkey: That was when he did the directory scanner so he could find out if a message was important, as opposed to just that messages came off the way they had been entered into the system, that you could go access the fifth one or --

White: No, I don't remember that, I just remember the phrase, but I have no recollection of what it did. So it helped you managed your incoming mail by scanning it and filtering it and so on. No, I had forgotten all about that.

Pelkey: Let me go back. Do you recall who at SRI did the hardware and software?

White: Yeah, the principal guy was a guy named John Melvin, who was a systems programmer. He maintained the -- I guess SRI had started -- by the way, I was in the lab of a guy named Doug Engelbart, whose name you may have heard of --

Pelkey: He's the reason SRI got on the network, just like Culler was the reason that UCSB was on the network.

White: So Melvin was the systems programmer, essentially, for Engelbart's lab, which was the Augmentation Research Center, ARC, which is what I was part of, so our host was called SRI ARC. And he's the guy who called me up one day while I was at Santa Barbara and said: "Are you interested in moving up here?" I wasn't at the time, but later I was, and so I called him back. So he's the guy who was my contact, that got me a job at SRI.

Pelkey: Had you met him through the networking group?

White: That's right.

Pelkey: So John Melvin was at those meetings.

White: Yeah, I guess he did, now that you mention it.

Pelkey: And did he do the hardware? Who did the hardware?

White: I think no one, because at that time, SRI ARC, the host, was a TENEX, so the host software would have been done by BBN, which would have been cloned throughout the network.

Pelkey: Utah was a TENEX too?

White: I think so.

Pelkey: So you had a Sigma 7 at UCLA, your 370, and two TENEX's?

White: And the Rand 360, whatever it was, I think it was a 67.

Pelkey: What did the Network Information Center do in those days?

White: In many ways it was just a visible focal point, but it was a distribution point, for example, for RFCs. The line of working documentation, they kept all of that stuff, so you could call them up and get RFC such-and-such.

Pelkey: But didn't Steve Crocker, and then later Jon Postel be the one that said: "Ok, it's number -- "

White: Yeah, Jon Postel was the source of the numbers. You had to call Jon up if you wanted to say anything in public in the Network Working Group because he had to give you a serial number.

Pelkey: So how did that work with the NIC at SRI.

White: The NIC was just the distribution point for the physical, completed documents.

Pelkey: So they would send it to NIC and NIC would log them on-line?

White: No, there was nothing on-line about this. This was just all physical documents. It was all very simple minded initially.

Pelkey: It later became on-line?

White: Yeah, but it was initially all very simple minded.

Pelkey: I've seen them.

White: They produced --

Pelkey: Jon Postel took me through them in detail.

White: They produced -- I think the basic premise was that they were essentially a library for network information, a literal understanding of the name of the enterprise, it was the Network Information Center. It was where all the information about the network was supposed to go so that in one place, all of these players at the different participating universities could get the information that they needed.

Pelkey: Was it used much?

White: I think it was, yes, even at that stage, it was recognized as the place that you could go to --

Pelkey: Who ran the NIC?

White: I can't swear this person was the absolute first person to do it, but I think she might have been; it's someone named Jake Feinler, who still runs the NIC to this very day. J A K E, and it's a woman, despite the name. F E I N L E R. There were several other staff members, just people out of the Augmentation Research Center who got involved in the NIC, in being the Network Information Center, and you've probably seen publications that the NIC did in the early days.

Pelkey: No, I haven't.

White: Ok, well there was a light green covered book, about an inch thick, that was -- I also remember that one of the first things that was done, and this was really Doug Engelbart who was putting these ideas together -- an idea was that when a person in each of the nodes was to be designated as the NIC representative, I think they were called the Network Liaison, or something like that, and there might even have been two, one technical and one non- technical, but I think the idea was there was one person who, at each site, was appointed, and then therefore sort of bought into the notion that there was a Network Information Center, there was information that needed to be gathered and collected and disseminated, and that was the idea. So this book eventually came into being, this light green covered book that was a desk reference for the Arpanet community, and it had the topological maps of the network and it had -- it was a directory of individuals; I'm sure, as a minimum, it had the names and addresses and phone numbers of all these Network Liaison people, and I think it also probably had lists of RFCs and almost a hodge-podge of information that you might consider of a reference nature for this little fledgling community of people who were all electronically tied together. Doug's goal was that over time, the services of the NIC, which were initially just paper oriented, would become electronically delivered, and I suppose that was accomplished to some degree. I don't know whether you are familiar with the computing systems that they had at SRI that Engelbart's group developed, but of particular relevance is something called the Journal, which was a -- well it was an electronic mail system. It was initially, at that point in time, it was confined to their particular

host system, but it was a very extremely sophisticated electronic mail system whose key characteristic was that every single message sent through it was archived forever. It was assigned a catalog number and was archived. It was written onto mag tape. For some period of time, it was actually on the rigid disks of the computer and could be retrieved, but forever it was put onto tape and it was printed out, so he used this Journal system, which was extremely advanced for its time, as one of the key things that he thought he had to contribute to the electronic delivery of these network Arpanet support services. So he began to offer the Journal for use by people outside of his group, over the network, so you could get an account on -- the system was called NLS. In his particular field, it was the seminal achievement. It's what led to -- it was a hyper-text, if your familiar with that phrase -- one of the earliest examples of hyper-text, where you could have citations in the text of a document, and it was all screen oriented and had a mouse, which his lab invented, to select and point at something, the citation, and click the mouse and you'd go there, and then you could go back, so he wanted to weave all this -- he wanted to put more and more information on-line, and then provide computer based access to it, which is what happened. By this time there were --

Pelkey: This time being?

White: I was at SRI for a total of five years, from '72 to '77. I'd just be guessing at the moment, it's probably '74, '73, something like that. By that time, one of the other major Arpanet application protocols had been designed. It was the file transfer protocol, so you could move information, bulk information, from point A to point B, host to host, on the network, store it in that guy's file system -- sort of a standardized version of what the Simple Minded File System from Santa Barbara was trying to be, which was completely ad hoc in its design; this was a protocol that had been agreed by the Network Working Group and officially published, and that was the second major application of the Arpanet, the first being Telnet, the interactive host access capability. So beginning to come into place were the mechanisms needed to move electronic versions of documents around the Arpanet. So increasingly, those documents became available in that forum, and found their way into the database of the NIC electronically, as well as in hard copy.

Pelkey: So the NIC became kind of the big disc center for the network.

White: Not in the resource sharing sense at all, only in the information sharing sense.

Pelkey: So the information on where things were, the master index, at some level?

White: Yeah, the master index.

Pelkey: Where everything was and who had it was at the NIC? You could get the information where it was, but the NIC would help you find where it was.

White: Right, and the network liaison people at each of the various sites were responsible for providing various identified pieces of information, so there were questionnaires that were sent out to these people -- who are the main -- who should one contact for information about the use of your system? Who is the person that should be contacted if you're using that system and

trouble is experienced? Who are administrative people of one sort or another? Very importantly, then, there were identified what resources you had available, so you, of course, identified what hardware you had and what software was available, and then you could essentially advertise the existence and availability of resources that were perhaps unique to your particular host, and this, of course, is the essence of what the Arpanet was originally conceived to do -- to be a resource sharing vehicle -- so the NIC, and I think this might have been actually the -- this information might have been also in that green book, but there may have been yet another book, I'm not sure. I've got copies of these books at home. I should have done a little homework in advance of your visit, by the way. So all this information about resources was gathered, and some of these resources were available by virtue of the implementation, at that site, of specific Arpanet protocols. So, for example, if you had Telnet access, you could indicate that and you could indicate any specific information that one needed to use you. This is information similar to what was in the scenario book for the ICQ, but it was more of a formal job of it.   So some of the resources were available by means of specialized protocols that you'd implement -- file transfer or Telnet -- but others were just the programs that were available on your computer. If you had software that did -- I think actually there was a program called Maxima at MIT on one of their systems that somehow manipulated formulas, did formula reductions that you can now do in any Hewlett Packard calculator. You type in an algebraic formula and it would reduce it or take the derivative of it, or things like that, all symbolically. That's just one example of a resource that was, for free now, accessible to the community by virtue of their being Telnet access to your host. Any program that any local users could run could be run by a remote user as well, so in these questionnaires, you'd list all these resources that you have at your site, and you'd send in your questionnaire, and the NIC would compile all of the results of the survey, and they would publish the results. So you had, in this book, which was called the Network Resource something or other, you had an almost complete catalog of who was on the network, in terms of machines, people and software or possibly hardware resources. I guess the essence of the NIC idea was that you can't share resources you don't know about.

Pelkey: Do you remember, as a user, of going off and poking around in other systems and look at their software and say: "God, that's a pretty neat idea. We ought to implement this here." Some people said that one of the things they did and how ideas in software started to migrate was people would go and try somebody else's software and there started to become a community of people who started to realize what other people were doing that hadn't been shared up to that point in time.

White: To be honest, I can't remember doing that myself. I do remember, very well, poking around in other people's systems, because it was a whole new world that was now available, and you'd sit down with this resource book or with your own specific knowledge of a particular system -- how to get into it -- and you would play. You would try things that you had never been able to try before. It was quite exciting.

Pelkey: Looking back on it, RFCs strike me as being a very important process.

White: Very important indeed. That approach has been reused numerous times in various other settings since then. It's typical of all the standards activities now internationally, but yeah, the idea that you have a collection, an open ended collection of documents, each one uniquely

numbered so you know whether you have them all, for example, and there's a well known channel where you can get a number and send a copy of the document and thereby publish it, so to speak, it was a very important concept in terms of unifying the community and allowing you to get a handle on what was actually going on, make sure that there weren't exchanges of information that were part of a particular activity that you weren't aware of, because by definition, you knew what all the exchanges were because they were carefully numbered and cataloged.

Pelkey: When it started off, it was really meant to be -- because it wasn't electronic, it was paper and there was a small collection of people, tens of people or maybe a hundred, it was really meant to be a way to try a crazy idea out, because no one knew what was going to happen. I think, when it became electronic, the audience started to become hundreds and maybe thousands of people, that the motivation to put a hair-brained idea out got lessened because people could remember that you had posited this stupid idea, and so it started to become more conservative.

White: Well, I remember being very intimidated for long periods of time, initially, with the whole system, and I remember the very first RFC that I ever sent -- it was a one paragraph commentary on some previous RFC that Steve Crocker had put out, where I pointed out a bug in his contribution, and then he put out a very polite follow-up contribution that showed how it wasn't a bug at all, so I had finally gotten enough gumption to enter the process by submitting an RFC which turned out to be a piece of trash.

Pelkey: But it was ok.

White: It was ok, except it was slightly embarrassing, and that's why I still remember it, but after that --

Pelkey: But now I can go back and look at that.

White: You absolutely can. Doug Engelbart's probably got it somewhere on some shelf someplace, as well as its being at the NIC or wherever else it might -- Jon Postel, it's probably in his den at home or something.

Pelkey: But that character of experimentation, I think that's one of the things about e-mail -- at first it was totally unstructured text. It could be one word or 50 words --

White: That's right, it could be a (unintelligible) or it could be a thought.

Pelkey: So, as a consequence, since there was no structure, it was liberating in a way. Not only was it new, in terms of a medium, but it was also in terms of media. Whatever you wanted to communicate you could communicate.

White: Yes, that's true.

Pelkey: I'm sure we're going to be getting to how e-mails have progressed here, I suspect, in a few minutes, but those early days, it strikes me that the unstructured nature of it -- now, if you

wanted to and RFC for a new project, everyone would know that they're going to be around forever so it wouldn't have the same kind of quality as these first RFCs which people thought were going to be thrown in the can at some point. Does this make any sense to you?

Tape Side Ends

White: . . . put online to make a network resource out of the Culler-Fried Online System, and so I designed the application protocol that would make all of the functionality of OLS available over the network, but it was a complete flop in practice. It worked fine, but because of the unusual nature of the Culler-Fried System, having to do with computation and graphs and things like that, it was virtually never used, because it wasn't just a TTY oriented thing. It was an actual machine to machine protocol where you'd send a formula that you wanted computed and back would come an array of numbers in binary form. You could have written a user interface on your TENEX or your what-have-you, and thereby had all of the capabilities of the Culler-Fried On-Line System available to you, but no one ever did it.

Pelkey: Some of it was probably because they didn't have Tektronix terminals.

White: Could be. They could have had no display medium, that's true. Additionally, it required a software development effort on the using side, and that was probably a big factor. The whole OSI experience is the notion of consensus and the fact that it made it through this process means that it's going to have a certain constituency that's worth contending with, but that wasn't the case in the early days, because people had specialized resources, some of which needed to be delivered through the network in a specialized way, and in order to write -- in order to then take advantage of that resource, you needed the development effort on your end.

Pelkey: You had mentioned, during the period which we weren't recording, that John Heafner and Eric Harslem were at RAND, and you really spent time interfacing to RAND because they were using a 370 vintage machine as well. Eric was your counterpart.

White: Yeah, it was a 360, not a 370, which hadn't been invented then. He was my counterpart. He was writing the system software, the network software for Rand, and we did our early testing. I don't know whether that part was on the tape or not.

Pelkey: Now it's 1977 and you've been in one of the most interesting groups that was going on at this particular point in time, although increasingly people were being raided from SRI and Doug's group to go across the street to Xerox PARC.

White: Yeah, that's what happened. I got raided.

Pelkey: Did you get raided too? So you went to Xerox PARC.

White: Yes. I didn't go to Xerox PARC, I went to, what had just been formed, the Xerox Office Systems Division, and I was recruited there by Bob Metcalfe. Before we go on to that, perhaps I should mention that one very important thing that happened near the end of my stay at SRI was that we developed -- initially myself, and then later I was joined by Jon Postel, who moved to

SRI from UCLA -- there was an ARPA sponsored research and development project called the National Software Works, the NSW, that was -- the objective of that was to bring the Air Force computing system out of the dark ages, out of the job shop environment into online computing capabilities, and they needed to develop a whole family of protocols and protocol environments in support of that National Software Works effort, so I developed a protocol or protocol environment called PCP, the Procedure Call Protocol. The basic idea was you got these two machines at either end of the network, they want to share resources of one sort or another, they want to communicate. What's the right paradigm for that communication in general? The observation was that a very large fraction of communication applications were request/response in nature; "please do the following for me, retrieve this file for me in this format," and then back comes this response that says: "Sure," or "No, there's no such file," or whatever. So the PCP was an attempt to generalize, or abstract from that, the notion that you could think of procedure calls spanning a network, in addition to procedure calls within a computer, so we developed this thing called the Procedure Call Protocol as the basic architecture for the National Software Works, for which responsibility that SRI, Doug Engelbart had from ARPA to develop this networking structure. As it turned out -- by the way, the way we had gotten to this was that we, at that point, were looking at SRI at taking this huge, monolithic NLS system that I was describing, this Journal, e-mail capability --

Pelkey: Was it a national library system or something?

White: No, it stood for On Line System, but OLS was taken by someone else, it was the only coincidence that we had taken it at UCSB, so he named it NLS because he couldn't call it OLS, so it stood for On Line System. The 'N' in 'On Line.' Doug wanted to look, at that point, at the proposition of taking NLS and breaking it in two; the back end where all the computation and storage and analysis were going on, and the front end which was the user interface. So the way we did that was we thought: "Well, we've got this huge program and what we now have to do is identify this cut, this slice, through the monolith, and if you actually make that cut, what you're going to find is you've got procedure calls where you need to make it across the cut, and there's no way to do that, so we should design a way to do it." So that's what led us to do it. We proposed that and developed it and evolved it for ARPA, for the NSW, and then we got beaten up about it in the Network Working Group at the hands, principally, of BBN, who thought: "That's a terribly bad paradigm for a network, because the performance characteristics are completely different." Obviously, a procedure call in a computer takes so many microseconds, where in a network it takes perhaps seconds. To cut a long story short, we got beaten up very badly about this. We lost the confidence of ARPA in what we were doing, based on the criticism we received from BBN, and we literally lost the business, so to speak. We lost responsibility for that work. We were still involved in the NSW, but we weren't involved with -- no longer responsible for that architecture. So anyway, the reason that came to mind is that Bob Metcalfe was at Xerox at that point. He had been at PARC, he had invented Ethernet with Dave Boggs and a few other people, and then he had made a switch to the fledgling Office Systems Division, which was to go on to invent the Star Workstation, I don't know if you've ever heard of that or not, and all of the Ethernet based office equipment line that they currently have. So he recruited me from SRI based on our acquaintance, first of all, in the Network Working Group when he was at MIT, and more recently he was aware of the PCP work that we had been doing, and he thought that was what was needed on an Ethernet in an office environment as a way of talking

between, say, a workstation and a file server over a ten megabit Ethernet medium, so anyway, he hired me to Xerox.

Pelkey: Were you aware of what Vint Cerf was doing over at Stanford during your days at SRI?

White: Do you mean the TCP/IP stuff? I wasn't aware of it in any detailed technical sense. I wasn't following it per se. Another guy who was recruited to Xerox by Metcalfe and who ended up working in the group that I ran, a guy named Yogen Dalal who had worked with Vint Cerf at Stanford -- Yogen got his PhD at Stanford -- so Yogen was one of the --

Pelkey: How do you spell his name?

White: Y O G E N, D A L A L. It's an Indian name. He later was one of the founders of Metaphor, and now is, I guess, VP of Engineering at Claris. So Yogen and I became friends, and so that was the extent to which I was really following the TCP/IP activities, was the extent that I knew Yogen and talked to him, basically.

Pelkey: Were you aware of any of the activities going on at Xerox PARC?

White: No, not really.

Pelkey: Doug's group must have been very exciting during this period of time.

White: Oh, it was. It was amazing. They had stuff that nobody else would have for many years.

Pelkey: Many of the ideas that were there got over into Xerox PARC; the mouse, bit mapped display --

White: Absolutely, that's where an awful lot of it --

Pelkey: How did those ideas get from Doug's group to Xerox PARC do you think?

White: People flow, by and large.

Pelkey: Do you recall Doug ever expressing frustration about this people flow?

White: No, I don't. Doug was, of course, if you know him at all or know who he was, he was an absolute visionary.

Pelkey: I want to go see his hyper-text product.

White: Doug's hypertext product? Does he have a new product in that area?

Pelkey: No, the one's that's existed for some time, which I've been told is still the best.

White: That's NLS. The online.

Pelkey: He's where now?

White: Last time I looked he was at TymShare, because the TymShare eventually bought, literally bought the Augmentation Research Center at SRI in an effort to commercialize the technology that had been developed, so Doug, and virtually everybody else in the lab -- I had left by then; this was happening almost, I think, literally as I was leaving -- they went to TymShare and he went there as well, and then sort of fell into a backwater of the company -- he's kind of a tragic figure, actually, because he made unparalleled contributions initially, and hasn't been able to do it subsequently, but he is constantly frustrated at how slow the technology is finding its way into real life, so I would have guessed that anything he saw that was to be considered a technology transfer that would further society in this respect, in terms of getting this technology to them, he would have loved it. Being at SRI it wasn't a profit-making concern, so he didn't have any -- wouldn't have had any qualms of that nature.

Pelkey: How long were you at Xerox?

White: From '77 to '84, I think -- no. Let's see, yeah.

Pelkey: And where did you go in '84?

White: Went to 3Com -- Metcalfe's company again. Metcalfe and I go way back, and I was there just for 18 months. Let's see if these numbers add up.

Pelkey: So that would be to mid '86, second half of '86. Then you went?

White: Then I came here.

Pelkey: Now, at Xerox, in terms of the ideas that you were working on, this protocol to protocol --

White: We were the attempt of Xerox to commercialize the PARC office technology; the high-powered workstation idea, the Ethernet idea, the work group idea, the very visual user interface idea with menus and icons.

Pelkey: Was Dave Liddle in this group?

White: Yes.

Pelkey: Don Macero?

White: Don Macero was a factor quite a bit later on. He was in Dallas, and he was president of the Office Products Division. This was a new division called the Office Systems Division that was distinct. Eventually, the two were coalesced, and that's the point at which Don Macero became involved in the work of this group.

Pelkey: Now, in '79, the end of '78, Metcalfe leaves?

White: Yeah, to found 3Com.

Pelkey: And somewhere along the line you got involved in e-mail?

White: Yeah. I was recruited by Metcalfe to do communications software inter-architecture at Xerox for their Office Product line, so my first job was Manager of what was called the Communications Software Group, and it had -- Yogen Dalal was in it and another brilliant guy named Will Crowther from BBN was in it, and several other people --

Pelkey: Did you recruit Will?

White: No. I think Metcalfe recruited almost all of us, if not all of us.

Pelkey: And did Will come directly from BBN?

White: I believe so, yes. And also, another guy named Doug Brotz, who then went off to become a principal, at a much later date, in Adobe, and wrote all of the graphical components of PostScript. He was in the group, and basically we did the network architecture for --

Pelkey: Just the four of you?

White: No, there were several other people. Another guy named Robert Kir who some years ago had a heart attack and died.

Pelkey: Where's Crowther these days?

White: Last time I looked he had moved over to PARC. Odds are he's not there anymore, but I don't have any specific information. He might have gone to DEC or someplace like that. There were several other people. Another important guy was a guy named Larry Garlick, who is the one person I recruited to Xerox, again from Engelbart's group, just to add insult to injury. Larry Garlick has since become the VP of Distributed Systems at Sun Microsystems, so he's doing alright, I'm sure. Another young guy who works for Larry now there as well named Bob Lyon. Those were perhaps --

Pelkey: And when he left, he recruited Bob Lyon.

White: Probably. It works like that, of course.

Pelkey: All you engineers like to work with people you already know.

White: Well, the well-known theory that there are only ten computer scientists in the world, they just keep moving around very rapidly -- It's really true. Anyway, we had responsibility for communication architecture and network architecture and communications software and

products within that organization, so we designed some communication protocols; one called SPP, the Sequenced Packet Protocol, which, if you now ever hear in the trade rags about the XNS architecture, that's us, the Xerox Network Systems architecture, which is a somewhat unsuccessful rival in the marketplace to TCP/IP. It also was done by Yogen Dalal after he moved to Xerox.

Pelkey: You inherited PUP?

White: That's right, we did the commercialization of PUP.

Pelkey: And you started working on XNS in '77, right?

White: Yeah, that's right. That was our job.

Pelkey: And when did you complete XNS? It must have been by 1979?

White: It was whenever the Star Workstation was introduced was sort of the only time you could consider it done, but it, of course, evolved over time. I'm trying to remember when that was. I can't remember, off hand, when the Star was introduced.

Pelkey: 1980, I think.

White: Was it?

Pelkey: Actually, it might have been later, it must have been '81.

White: It must have been '81.

Pelkey: I don't know, I can find out. So, your group did XNS?

White: Yeah, that's right, we did XNS, and it was --

Pelkey: Did Bob work with you closely in that period of time?

White: He sure did.

Pelkey: That was his love.

White: So, the XNS architecture had Ethernet at the bottom, and that was later to be deliberately made a de facto standard by going into the business with DEC and Intel, the so-called DIX -- DEC, Intel, Xerox -- joint Ethernet spec, which has since become IEEE 802.3.

Pelkey: When was the Blue Book? 1980?

White: I tell you, I'm terrible with the dates, and you sound authoritative, though you may be stringing me along. I'll be happy to take my shelves (unintelligible) on the library and rip off

some dates for you and try to quantify this a little bit better, because I know I'm terrible at it. You should be fortunate I can even remember what was going on in these days.

Pelkey: I am. I'm just thankful you remember who you are at this point.

White: So anyway, starting to move into the e-mail area; we did all the lower layer protocols and the communications software. At this point, there was some work going on in PARC, with whom we worked very closely -- the whole idea was that Office Systems was technology transfer transaction from PARC to a development organization and then to the marketplace -- the group doing this, or the group constituted to do it was deliberately put physically right next door to PARC, to facilitate this sharing of ideas and technology. So one of the things that was going on in PARC was work on electronic mail, which was considered quite an interesting research topic at that time, and they did a distributed, Ethernet based electronic mail system called the Grapevine, which I always thought was a very cute name, and they wanted to do --

Pelkey: Is this after Metcalfe had left?

White: No, no, Metcalfe was there.

Pelkey: So this was '78-ish.

White: Ok.

Pelkey: I know Metcalfe left and was at MIT in the first five months of '79, and I'm certain that the Blue Book came out in the spring of 1980.

White: He was at MIT, what, on a consulting basis at that point?

Pelkey: Right, for the first five months of 1979. That I guarantee.

White: Well, this was definitely during Bob's days at Xerox. The idea then, was, to provide a workstation user interface for this e-mail, for the Grapevine, and it was decided that it should be a collaboration between PARC and the commercialization group, the Office Systems people, us, with an eye toward eventual productization of this, and this might turn out to be a prototype, or it might turn out to be something you could actually steal code from in an effort to get a product at a later date, but this was all brand new stuff, so my group collaborated with PARC to do this workstation product, which I think ran on the Alto, which was the original PARC workstation machine.

Pelkey: Who was your counterpart over at PARC working on Grapevine?

White: There were several people: one was a guy named Andrew Birrell. He's written many papers in the field on that subject and related subjects. There's another guy from the university -- something like the University of Newcastle in the UK, Roger Needham. It might not have been Newcastle, but I think it was, and he was another principal in that activity on the PARC side.

Pelkey: Now, are you aware of TCP at this point?

White: Oh, yeah, because we have already done SPP, which was the next generation of TCP/IP. It's sort of what Yogen Dalal learned working with Vint Cerf at Stanford, he tried to do a next generation of that at Xerox.

Pelkey: You took PUP which Metcalfe had done, and you took Yogen's ideas that had come from the TCP/IP community, what Cerf had been working on, and you merged those two things to come up with XNS.

White: That's right, that's basically what happened, for that particular level of XNS, for the actual transport specifications, as opposed to applications that you build on top of that.

Pelkey: It wasn't SMTP or Simple Mail Protocol or something that was being specified also in the TCP community. Did that get incorporated?

White: No.

Pelkey: So Grapevine was a completely different --

White: Grapevine was -- to be sure, the people at PARC knew all about SMTP --

Pelkey: And had been on the Arpanet and knew what was happening --

White: Yeah, absolutely, they knew everything there was to know in the field, I'm sure.

Pelkey: But then went to a blackboard and said: "Ok, here's the way it should be done."

White: This was to be a truly distributed, Ethernet based mail system. So we did the joint development of the user interface, which was a program called Laurel. At PARC, they picked all their product names from the Sunset Garden Book, so everything, with the exception of a few hardware products --

Pelkey: I wonder where Alto got its name?

White: I don't know where that came from. That whole series of names of things that were the names of trees and flowers.

Pelkey: That Altos is probably from Palo Alto.

White: Could be. So anyway, Laurel was done, and that was the first effort at PARC and at office systems -- by the way, the name of the group actually wasn't the Office Systems Division early on, it wasn't a division, it was called SDD, Systems Development Department. I don't remember what it was a department of, but it was SDD -- it was a group of several hundred people, physically distributed between Palo Alto and El Segundo, who were doing all the development for the Star and related products. So that was my -- subsequent to SendMessage on

the Arpanet and the TENEX world, and the Journal at SRI, this was my next involvement in electronic mail. We knew, of course, that electronic mail was important to an office system, and that's what we were about -- by the way, that was the most exciting place I've ever worked; even more exciting than Doug's group, because we thought we were going to create the office of the future, and we literally thought we were going to do that. We didn't succeed. We didn't succeed in the commercial sense because Xerox was fabulously unsuccessful with the whole product line, but we certainly did completely succeed from a purely technological standpoint, which wouldn't make any venture capitalists very happy, but all the ideas that were --

Pelkey: Customers would have to suffer $15,000 or whatever -- there were some small glitches.

White: That's right, it was a little bit pricey in its day.

Pelkey: Elegant, but pricey.

White: Also, it was a closed environment, which is one of the major reasons it was a strategic blunder.

Pelkey: Major.

White: And in fact, that's the reason, in the end, jumping ahead a little bit, that people left Xerox in droves, because, on both the PARC side and the Office Systems side, because it was recognized that the marketing of the product -- not to blame it on the marketing effort; certainly, as you say, price was a factor, and there were, I'm sure, other issues, but it was perceived not to be -- it was not on the verge of success.

Pelkey: This stuff was -- it may have been common place to you and to the technocrats out there it might have been: "Gee, whiz, this is great," but to a lot of people out there, when they looked at this stuff, it must have looked like it came from Mars.

White: Well, the very first ad that Xerox ran, coincident with the announcement of the Star workstation was a hand-drawn picture of a caveman with a wheel, and the tag was: "How do you describe something that has never existed before?" It captures the idea that you just mentioned. People didn't know what to make of it. It had never been seen before, but it's, of course, now the basis for essentially all the personal computing and workstation technology that exists. Anyway, round about 1979, possibly late '78, Dave Liddle sent me, through inter-office mail, an announcement of a meeting in Montreal. It was an announcement of the first meeting of what would become IFIP Working Group 6.5 -- I don't know if you know what IFIP is, but it's the International Federation for Information Processing. It's actually rooted in the United Nations; it's part of UNESCO. Basically, it's a group of academics that meet on a variety of topics internationally in the interest of international harmony and sharing of information. The IFIP folks, through a guy named Ron Uhlig, who was I think at either Bell Northern Research or -- what's their PBX, they're located in Santa Clara --

Pelkey: Oh, right.

White: I forget -- Northern Telecom. Here was this announcement of a meeting in Montreal, an IFIP workshop on electronic messaging, and Liddle had scribbled on it: "Go, or send some senior person." So I went, and this meeting was certainly the first of its kind, and it was the first international forum at which electronic mail was discussed, as far as I know, with an eye toward what are the problems of electronic mail? What are the issues? What are the opportunities? How would you do it? What is it? That kind of stuff.

Pelkey: Was this the first meeting of this?

White: Yes, this was a workshop. This is the very first time that IFIP touched this subject. It created the group 6.5.

Pelkey: What date was this again?

White: I think it was early '79 or late '78.

Pelkey: And the meeting was held in Montreal?

White: Montreal, and it was a bunch of people from various and sundry places who just showed up in response to that same announcement, and this group, as a result of it, it was concluded -- and this workshop had proceedings and a document that was -- I think it had papers submitted to it and had discussions and so on, brainstorming. I don't remember very much about what actually occurred at that meeting, but the result of it was that 6.5 was created as an ongoing group to be a focal point internationally for people to talk about electronic mail, and it was chaired by a guy named Ian Cunningham, who was at Bell Northern Research, and he started this group up, and we met every few months at various places around. Actually, the 6.5 group was structured into sub-groups, both topical and geographically oriented, so there was, for example, there was the so-called Systems Environment sub-group, which was the engineering side of things, if you like, and there was a User Environment sub-group, which was sort of the marketing side -- what are the requirements for electronic mail? And then each of these two groups had a North American group and a European group, and the group that Ian Cunningham chaired was the North American Systems Environment side of it, so North Americans talking about the technical aspects of electronic mail, basically.

Pelkey: Were you on this group?

White: Yes, I was -- since I had been at the kick-off meeting, I went back to Xerox and explained what had happened, and it was decided that this was something we should follow, so I started doing that, going to these meetings.

Pelkey: Was there a formal committee or was it just whoever came to the meetings?

White: It was whoever came.

Pelkey: There was a chairman and whoever came?

White: Right, and it was hosted around in different places, and it was sort of like you were starting with a clean slate. There was no common understanding, no common terminology, no common anything, just the phrase 'electronic mail' is really all there was. So this group started to essentially develop a conceptual model of what electronic mail was all about, especially a model that was suited to a highly physically distributed, geographically distributed system, so it didn't start out talking about one computer with a bunch of software in it, it really talked about the conceptual level of: "Well, if it's distributed, there must be several components of this system that shuffle messages back and forth," so gave names to what we perceived to be the major components; names like Message Transfer Agent, MTA, which is the name it gave to the functional entity, whatever it is, whose job is to relay messages, either from end-users to other end-users or from one MTA to another as part of a long chain of these things that are doing the overall job. So we developed a lot of terminology which didn't exist, and we developed a functional model of how the pieces talked to each other and what their responsibilities were, and then we got into a lot of discussion about exactly what were the services you'd expect to receive from an electronic mail system. For example, should there be different priorities of message relay; urgent, low priority -- just one example of many different aspects that you might envision might be characteristic of an electronic mail system that would be interesting to have. So this work went on for about two years, and then this same guy, Ian Cunningham and his organization, BNR, decided that the time was right for there to be work, continued international work with the stated objective of developing communications standards for electronic mail systems that were distributed in this way on an international basis, so they selected the CCITT, Consultative Committee for International Telegraphy and Telephony, which is the standards making body of the PTTs, as the forum in which to do this work, because it was perceived that you couldn't ever have a global electronic mail system or network without the instrumental participation of the PTTs, because, for example, in some countries, and certainly at that point in time, but still today, it's by law impossible to do it any other way. So it was thought that that would be a good place to do it, so there was a proposition made to the CCITT. There was a so-called study question drafted which said: "Well, here's an interesting problem with these dimensions, and this is what might come out of it." So we proposed that the CCITT decide to do work in this area, and it did.

Pelkey: When was this?

White: This was -- the work would have started in 1981. So Ian Cunningham recruited several of us who had been involved in the IFIP meetings, recruited us, so to speak, to move over and continue these discussions in CCITT, with a whole different objective, a more formal objective that you might actually develop technical standards that would then be a basis for actually building such a system. I remember very vividly standing in a hotel corridor in The Hague, which was the site of the second meeting on this subject, the first one that I was able to attend, and I remember his telling me that this was going to be much bigger, much bigger than X.25, which was, at that point, sort of the only existence proof for international data communications standards of this sort: networking and all of that, the commercialization of the Arpanet, X.25. So that was all very exciting, and that got started. The way that worked was that -- of course, these were international meetings. They were typically hosted by PTTs or other member organizations and they moved all around the world. That was exciting too, because I had always wanted to travel, my whole life, and I had never traveled, so all of a sudden, I had to go to the Hague, like it was next door. So that was all very exciting from a personal standpoint as well.

So the way these meetings worked was the CCITT has a four year clock. Every four years they reissue all of their standards, so work gets done in the first three of those four years, and then the fourth year of the cycle, it gets translated into two other languages and voted on by PTTs, and then the clock ticks and it becomes a standard. So essentially, we had three years allotted initially, and typically you start work in an area, and the clock would tick, and you weren't done, so you'd let it tick another four years' worth, and then you'd have something. That's sort of the way -- I don't remember whether X.25 went in one tick or two --

Pelkey: One.

White: -- but in sort of the grand scheme of CCITT things, it was quite unusual to do it in one tick, in one study period. But anyway, we had these meetings, they were international, there were maybe three of them a year, and basically what happened was that the technology was transferred out of IFIP into CCITT.

Pelkey: Did IFIP 6.5 cease to exist?

White: No, it continued. In fact, when Ian Cunningham resigned the chair of 6.5 to chair the CCITT group, I took up the chair of 6.5, and we, just parenthetically, we then continued to meet, but we said: "Ok, e-mail has now been -- it would be senseless for us to continue to talk about e-mail because that's already being -- it's been advanced, now, to a better place," so we decided that we would -- I must be missing a step in the chronology here, because I can't believe that I actually did that at the moment that he took over. There probably was a period of overlap when he continued -- I don't remember, I'll have to look it up. Anyway, at some point along that point in time, I took over the chairmanship of that group, and we started looking at the problems of directories --

Pelkey: What was to become X.500?

White: Yeah, which is about to become X.500. So we looked at that problem from a technical standpoint. We talked about: "Gee, how should people be named in a user-friendly way in an international environment; not only people, but distribution lists and computers and services and so on? What's the conceptual model of how the global database is structured?" Things like that.

Pelkey: Did the IFIP European 6.2 systems group agree with you to work on directories?

White: No, as it turned out, in both cases, the R1 quadrants or the four quadrants, the North American Systems Environment sub-group was the only truly active group. The other group just never went anywhere.

Pelkey: Deferred to your greater wisdom.

White: It's just that they didn't -- I don't know, they didn't have the right person there to organize it or they didn't have the interest, or what, but for difficult to explain reasons, there was only one group that really was instrumental. The other groups occasionally had meetings and they occasionally produced minutes and occasionally wrote things down, but it just didn't turn

out to be the place where the work was done. That might have been because a lot of the relevant technical experience was North American. It came out of the Arpanet, basically, and we knew that electronic mail in a network had been born in the Arpanet.

Pelkey: So you had a legacy to uphold.

White: I guess. I didn't mean it in that sense, but I was just sort of substantiating the notion that a lot of the expertise was inherently North American.

Pelkey: Right.

White: So that was the end of the parenthetical comment, but we went on to do directory -- initial spade work for directory stuff.

Pelkey: And when did you become aware of OSI?

White: I personally became aware of it in a significant way as I became involved in the CCITT message handling effort, because that was, almost by definition, sitting on top of the OSI platform when it was done. It was known that it had to work that way, and this was an application that would run on an X.25 network, and it would run using lower level protocols which were simultaneously being finalized, developed, up through the session layer at that point. Transport had already been done. So this was all -- we were now in the OSI arena, in terms of any work that we were to do. So that was what went on in IFIP. The real main line work then went on in CCITT, and over a period of three years, as I said, at about three meetings a year, we developed a whole lot of agreements, starting out first at the level of just prose descriptions of what the different aspects of the service were, the same thing that had been started in IFIP. Got agreement on all of that stuff, and at that point in time, there was another technology that had just been standardized in the previous tick of the clock by CCITT called Teletext, which, if your familiar with that at all, it was envisioned as the next generation of Telex that would make such incredible advances as eliminating the restriction on lower case characters. In any case, this technology, which originated, I think, in --

Pelkey: Bulgaria.

White: Yeah, some hotbed of electronic mail technology -- it was pushed, I guess, by the Germans and the Swedes, but anyway, it had just been standardized, and of course electronic mail, almost already but with absolute certainty in due course, will put a bullet in the Teletext technology, because it just isn't enough of a technological leap, but it was well understood by the people who knew about these things -- I wasn't one of them at the time -- that there was great political risk to this enterprise on e-mail, and CCITT, even though CCITT had agreed formally to do it, because it was quite apparent that it was a competing technology, competing to Teletext, so a lot of effort was taken to --

Pelkey: It probably was perceived to offer very little incremental value.

White: One of the steps that was taken to protect the effort was to make sure that this electronic mail system that was being specified was feature rich. Truly, and there are lots of features in what is now the standard that are not defensible, in terms of their technical and marketplace merit, and some of those are in there because -- it was deliberately overloaded to make it very apparent that this was a substantial advance over Teletext, and even that it was really -- they weren't competing, this was a whole different kind of application of communications technology. There was specific provision made in the recommendations on how Teletext and message handling systems would inter-work, how you get Teletext documents in and out of electronic mail systems and conversely. So that was all going on.

Pelkey: It must have been an interesting experience for you to become aware of these different political things.

White: Yeah, it was.

Pelkey: Political management of technology.

White: Yeah, and this was certainly one of the most rewarding, and wonderful, and fun experiences I've ever had in my professional life, this activity. I was very quiet and shy and non-participative for quite some time, perhaps on the order of nine months, a year, something like that. I'd attend the meetings and --

Pelkey: What, '72, '73?

White: Yeah. I mean '82.

Pelkey: I thought you had gotten over that.

White: I don't need to be deliberately confused about my dates, thanks very much. Anyway, I had, by then, quite a substantial amount of technical experience in this area, and we reached a point in the development of the progress of the work where it was necessary to begin designing the protocols, the actual bits on the wire, that would deliver these services and define this e-mail system. So I thought I knew how to do that, what the basic technical infrastructure should be, and it all came out of that work that I had done first at SRI, the PCP protocol stuff, and also I had -- I didn't mention to you -- a next generation of that . . .

Tape Side Ends

Pelkey: This is the kind of stuff that's really useful to me. You're saying that your ability to be able to define and create the protocol had its legacy in --

White: Yeah, in the work that was done for the National Software Works, which was rejected by ARPA, and then subsequent work called Courier at Xerox, which was the reason that Metcalfe had recruited me in the first place to go to Xerox, that is, to this very day, in the -- in fact is central to the whole architecture of the Xerox Office System line. I thought I had a pretty good understanding of how one should go about designing complex application protocols, which

had never been done before. X.400 was, by far, the most complex protocol that had ever been standardized, perhaps that had ever been designed anywhere. It's probably an order of magnitude more complex technically than X.25, and it makes sense that it is because it's delivering actual end-user functionality with great complexity to it and all of that. So I thought: "I know how to contribute to this," and I thought: "Well, how should I do it?" I called up Ian Cunningham and got some advice and he suggested that the way that works, in this game, is that you involve some other people that you think know what they're doing, and you work this out in advance, and then you come with a contribution, as it's called, which is just a paper that you're submitting to the meeting that has your ideas on it, and then you know that you represent a consensus of at least a few organizations that are there at the meeting, so it's not an uphill battle, necessarily. So that's what I tried to do. I contacted two other people: someone named Debbie Deutsch, who was then, and probably still is, at BBN, and Ted Meyer, who is here at Telenet, and has also been very instrumental in all of X.400 during the same period, the whole time. So I thought if I could get these two people to buy into this idea, then I'm in pretty good shape. Well, they didn't but into it. They didn't believe it, and it was actually competing, to some degree, with work that Debbie was then doing at BBN under contract to NBS, which was also doing standards for e-mail at that time. They were developing a format for the standard of messages, which you could conceive of as a natural outgrowth of the Arpanet work on message format standards. This was a much more involved technical proposition that they were working on, so one of the difficulties I had was that this was in direct competition with the work that Debbie was doing for the NBS. So I didn't -- I tried to play the game the way I understood it was supposed to be played, and I didn't happen to get people that were sympathetic, so I called --

Pelkey: This is towards the end of '82? It must be '83.

White: I think it's later than '82, because this was very, very late in the whole process that these protocols were actually nailed down, it was remarkable --

Pelkey: Were you still at Xerox or were you now at 3Com?

White: No, I was at Xerox.

Pelkey: So it was probably, it must be '83.

White: That sounds about right. So I went back to square one, and I said: "Who should I talk to, specifically? I have this idea for how we should do these protocols. Who should I talk to?" In fact, I remember, when I first called Ian up about this and said: "I have this idea," he said: "Is it technical or is it administrative? Oh, it's technical, go talk to this guy," and, as I've since learned, he was dealing with life on a higher plain at that point, worrying about whether he was going to get shot by some PTT for doing the wrong thing. He wasn't exactly -- he didn't have his head in the technology. So anyway, he said: "You should talk to a guy at BNR here named Doug Steedman," who turns out to be another key player in the whole story. So I did, and I never met this guy. I called him up and said: "I have this idea about how to do these protocols. I would like to show it to you," so I sent him a copy of this paper which I had then all completely worked out. It was a draft contribution to the meeting. So we arranged to meet in Ottawa, which is where he was based, to develop this further and talk about it. So I showed up in Ottawa at the

Holiday Inn at the prearranged time and met this guy who I had never met before. He was a pretty scraggly looking guy with long hair. Anyway, we spent the day in the hotel room with a whiteboard going through this, and he, of course, had read it all by then and studied it. He had some ideas about -- he basically supported the whole premise of it, and he wanted to contribute specific tactical ideas, so we sort of redid it on the fly there, and I went back at a later date and revised it, and we submitted it. So I came to that particular meeting at which it had been pre-advertised at the previous meeting that the protocol approach would be decided at this meeting. This meeting was then hosted here by Telenet down -- I wasn't with them at the time, but Telenet was then located down the street here in Vienna, Tyson's Corner.

Pelkey: When was this meeting?

White: This is the same time frame that I'm talking about, '83 sometime. So I had essentially had pre-approved this idea with the company which the chairman of the whole meeting was associated. The title that the CCITT gives to these people is 'rapporteur', which is French for 'reporter', or something. So, in a sense, this had been pre-arranged that this was the approach that was the right approach. So we had this meeting in Tyson's Corner at which it had been advertised that this decision would be taken, some decision on this subject, and Ian felt that this was the right solution, but the competing solution was the NBS work, and that was pretty serious, because it was on the way to becoming FIPS, the Federal Information Processing Standard. That was the whole objective of the NBS work. They were going to define a standard format for messages for the US.

Pelkey: And who was leading that charge?

White: It was a gal named Shirley Ward Watkins, who was at the NBS, and Debbie Deutsch, with BBN, was contractor to them, so both of them were present, and she was the official representative and Debbie was the technical person in support. So there were two propositions on the table: one was mine and one was NBS's. It was the custom of these meetings to do most of the technical work in subgroups, because a meeting might have 35 people, and you can't do a lot of useful work in a forum of that size. So these so-called ad hoc groups would be constituted for the length of the meeting that would take on particular topics. Ian constituted an ad hoc group for that meeting that was to go off and work on the problem of how the approach to the protocol – and, in fact, there were several protocols that had to be designed, and eventually were: P2, the message format standard, which was literally in direct competition with the NBS work; and then P1, which was the relay protocol; and P3, which was how a workstation would submit and take delivery of messages. So the point was that we knew that we had a lot of protocol design work to do, so the idea of this ad hoc group was that it would go weigh the pros and cons of the various approaches to that set of problems, and Doug Steedman was appointed the chairman of this ad hoc group, and he and I were the ones who had done this, so it was, in a sense, rigged to achieve the right technical outcome. The essence of the solution that Doug and I were putting forward was that you would design -- and we had designed in detail in the contribution -- a high level language for describing protocols, which has since come to be known as ASN.1, and has now captured the world of standardization, but it was a new idea that you should stop drawing pictures of packets, and these three bits do that, and these other two bits are here, and these fields are there, because you're talking about such a volume of complex data

structures that you'll just never make it that way. So the essence of the contribution was a language for describing the protocol at a very abstract level, so you could say: "I've got this field, and it's an integer, and this other field named such-and-such is a string. These fields are grouped together and this whole data structure is part of this other data structure." So it was a language, and then it was a set of rules for how that language -- how from that language, the detailed bits on the wire could be inferred as a mechanical process that could actually automated by the compiler, essentially. So the ad hoc group's result was that that was the method of choice, and that the NBS approach wasn't the method of choice, so those results were reported back.

Pelkey: Was that a heated session?

White: Yeah, that was a very -- well, it wasn't as heated as you might imagine, for some reason, given the stakes that -- essentially the stakes were whether NBS was going to develop standards for electronic mail or not, as it turned out. Actually, the ad hoc group was amazingly objective and quiet, and Debbie, the technical person, was the member of that group, and I don't know where Shirley was, but the NBS person, she was, when the results were reported back is when she realized that the NBS work was going to be rejected, and she was truly distressed in a very visible way, and -- "this was not the outcome that I was assuming this meeting was going to produce." Anyway, that was it, and the thing that -- it was agreed by the whole meeting, and that was what was then later used as the basis for all of the protocol design work. The thing that this did for me was it made me realize that, even in an arena as formal and as large as the CCITT, which is an international group of postal, telegraph and telephone administrations, it seemed to be the case that, in this forum, if you had a good, solid technical idea, and you put it forward, it stood a chance of being accepted, and I remember to this day that realization that that was the case, and that just turned me on, so that changed my whole attitude toward the process, and I no longer was a closet standards person, but I was gung ho, and contributions at all subsequent meetings just started to flow, and we made other advances based on experience gained at Xerox and SRI and places like that. I've since learned that it's not characteristic of standards work in general that that's true. Many standards activities are highly politicized. A good example of that would be the IEEE work on LAN standards, the first example being the Ethernet work, which was essentially all politics and no technical content. At the end of that whole standards activity, essentially word for word, the Blue Book was agreed as an IEEE standard with one or two changes. So that was an example of a highly politicized --

Pelkey: Why do you find that as being political?

White: Because that's what it was. There was no technical work being done at the meeting. There were not technical ideas being put forward, being agreed.

Pelkey: How is that different than that you went and did this document on your own and then had it accepted, your and David's work, and got it accepted?

White: The difference is that that was just one piece of the puzzle, and the IEEE Ethernet Blue Book case, the whole solution existed before the standards activity ever started. The WHOLE solution was in a book, a very carefully written book, written by a guy named Dave Redell, who was also another person in that original group that I had at Xerox who since went on to -- he was

involved in the Grapevine work. He more recently went on to the then new DEC research lab in Palo Alto. Dave Redell, R E D E L L. He's the guy who essentially wrote the Blue Book. Anyway, the Ethernet standard is --

Pelkey: I bet that was an exciting period for you. All of a sudden, you have quite a legacy.

White: Well, I happened to be in a lot of really exciting places.

Pelkey: Right, and had been a wallflower throughout this whole period, and all of a sudden now to realize that you can influence things.

White: Well, the revelation for me was that I had spent years doing what I still considered to be, and is generally acknowledged to be, very, very good technical work as part of a large group of very, very bright, energetic people that had no impact on the industry. That's an overstatement, but nothing like the impact that it should have and could have had, and what I realized at some point was that this was -- I realized what it meant, what the significance of the standards process was and that, at least in some of the standards arenas, you could do, essentially, engineering work in real time. That is, if the standards activity had a stated duration of three days, you could do engineering just like you were doing it inside your company, and it could not only be of a reasonably high quality, but at the end of it all, you had a consensus. You had the whole world who, almost by definition, at the end of that process, says: "Yes, we buy into this." That was the tremendous revelation for me, that that was the case, the you needed to have -- the world is going to place great importance on standards, and you can do all of the brilliant technical work you wanted to, and if it never developed the consensus, then it was just all a waste of time. So I realized, suddenly, that -- or maybe over a period of time -- that this work was going to be not only reasonably good technical quality, and it's very good quality for something developed in a standards setting process that was employed, but it's going to be accepted and have impact. So anyway, it was that one contribution that was accepted that spurred me to really make something of this, in terms of my own personal contribution to it. So I did contribution after contribution on different subjects, and I found that, as a rule, that the darned things, if they had merit, they would get accepted, and futhermore, that other people in the group from other companies and countries actually did have additional insights that improved the quality of your initial proposal sometime. Sometimes they didn't, but in a large number of cases they did, because people were aware, for example, of requirements that you weren't aware of.

Pelkey: I take it from your comments then that you are a big believer in du jure versus de facto standards.

White: I don't know that you could say either way, as a general rule --

Pelkey: The case of Ethernet versus X.400 was certainly a case of - -

White: Ethernet was a case where the whole solution had been worked out in industry, and then was essentially rubber stamped as a result of a very painful and drawn out process.

Pelkey: As was X.25?

White: X.25 as well, yeah. X.400 was completely different, because nobody walked in –

Pelkey: Most of the modem standards up through V-32 were all pre-existing, and the marketplace had --

White: Yes and no, and I think this is one of the important observations about the standards process and the point in history that we're at with regard to standards, because I believe that X.400 was a turning point in this regard in that it was not the blessing of some previously developed commercial technology. There was no commercially developed technology in this particular area that was a suitable candidate, and I don't think that's and overstatement. The only conceivable -- just to pursue this a little bit -- perhaps there were two remotely conceivable possibilities: one was to take something out of the Arpanet, which to this day Jon Postel will say should have been done; or perhaps you take SNA and you just lift a bunch of stuff out of there. Neither of those two approaches was even proposed, for I don't know what reason, but the whole process of X.400 was an exercise in what a friend of mine at the French PTT called international design; it was a piece of design work that was collaborative in nature and three years in length. Nobody walked in with the solution at the outset. Each contribution, major contributions, came from a variety of sources.

Pelkey: Where does EDI come into all of this?

White: EDI -- one of the important, now seemingly obvious, decisions that was taken in IFIP in the initial design work, was that you need to distinguish between the electronic envelope and the content of that envelope. The electronic envelope being what has the address on the face of it that causes the message to be routed properly through the MTS, through the messaging system, and then at the end it's opened up to find out what's in it. So a very crisp distinction was made in the X.400 between those two aspects. The distinction, which you don't find, typically, in any existing messaging product, for example for PC LANs or things like that, they usually don't carefully distinguish between those two, but, basically the job of X.400 is to move a bag of bits from point A to point B in a store and forward, non-real time fashion, and it does that, so EDI is now, I think, perceived by some, but not everyone, to be a simple application of store and forward messaging. It's a different kind of thing that you're sending in store and forward fashion, but the essence is that you need to interconnect large numbers of diverse players in a non- real time application that really is well modeled as electronic mail; moving invoices, and it just seems like a natural application and yet -- I think that's the way it will come down, but --

Pelkey: So EDI is the formatting of what's in the envelope, in contrast to X.400 is the envelope.

White: Right. Envelope -- X.400 is primarily the envelope.

Pelkey: Mail, for example, would be something -- X.400 is thought of as electronic mail including contents, and that's not technically correct.

White: It is technically correct in that one of the three protocols that X.400 standardized in the one called P2 is the format of the message for a particular application, which is given the name

interpersonal messaging, it's essentially electronic memos and it's what most existing electronic mail systems are all about, is those "To, From, cc:, subject -- "

Pelkey: So EDI would be a class up another P?

White: That's right.

Pelkey: Which now X12 is trying to identify all these classes --

White: And X12 had as its life's work primarily the specification of an endless list of business transactions.

Pelkey: And is X12 a CCITT?

White: No, X12 is just presently an ANSI standard, but there's quite a lot of work that's been going on to get the people working in EDI to see that X.400 is a very, very interesting transport vehicle for their transactions. The same gentleman, Ted Meyer, that I mentioned, spent a number of years over the last four years working in X12 in ANSI to get them to take this view, and he's had mixed results. CCITT Study Group 7 met for the last time before the next tick of the clock -- the next tick of the clock is the plenary meeting in November in Melbourne -- the Study Group 7 had its last meeting before that final meeting in March in Geneva. That's where CCITT approved the '88 version of X.400, which is what I've been doing with my life's work for the last three years. I'm the current rapporteur for X.400 at CCITT, so I sort of took over that from Ian Cunningham when he --

Pelkey: Where did Ian go?

White: He's still --

Pelkey: To CCITT?

White: That would probably be a fate worse than death, but --

Pelkey: One that he's not aspiring to.

White: No, he's in BNR, and I don't know what he is doing, and I only talk to him occasionally because we're just in different activities, but at that final meeting, one of whose objectives was to talk about what happens after the next tick of the clock, or for the next little while in this fourth year which is more or less dead because this is translation (unintelligible), so we suggested, and it was agreed by Study Group 7, that CCITT should have an activity which is all about what's involved in carrying EDI transactions through X.400 messaging systems, so Ted Meyer - - we appointed the so-called interim rapporteur on this -- so he's the guy who now has an international mandate from CCITT to begin looking at this area, and what is expected to come out of it is that, essentially, little or no additional technical specifications will even be required, because I believe that X.400 is essentially adequate to do this, but what will happen is that there will be an international focal point for this discussion. This will come to a head and CCITT, after due

process and discussions worldwide, will say some things about how to do this, and that will be a tremendous impetus to the industry to adopt that as a -- perhaps even as the prime vehicle for moving EDI transactions. I think it should be --

Pelkey: I want to come back a bit -- so now it's the end of '83 and your perspective on these matters has changed. You decide to go to 3Com.

White: I should say that during that whole three years that's just now ended in our scenario, I was the editor of all these recommendations -- it turned out to be eight recommendations in X.400 -- so I was the person who, after every meeting, went home to his word processor, Xerox Star workstation, and wrote like crazy to type all this stuff in. The point is, I was now very, very involved in CCITT, and it had almost become my career path, if you like, and while I was at Xerox, at that point, I had turned down a promotion to go one step further up the management chain and manage 50 people because I thought: "No, I'm doing this X.400 stuff, and that's really what I want to do right now," so I had made a big commitment. Now, the whole thing was ending, that we had a standard, or were about to have one, and it was completed, and so I had to decide what to do. One thing I was very interested in doing -- by the way, it had been identified, during the course of events, that a major deficiency of the electronic mail environment that was now standardized was that there was no directory in support of it, so while, in principal, the machinery could be in place to move messages between arbitrary correspondents, you had no idea of finding out who those correspondents were and what their electronic addresses were. That was a known deficiency. It was known to be a very big subject in its own right, so it was set aside and it was expected that in the subsequent study period, in the next four years, there would be standards developed in that area, and I decided that was something I might like to do. I might like to be the person who was responsible for that. There was another guy --

Pelkey: Excuse me, if I understand correctly, you became the chair of IFIP 6.5 when?

White: I'd have to go back and look, which I will.

Pelkey: If I understand your previous comments, that was, in fact, this directory issue.

White: That's right, and that's one of the reason that I was inclined, now, to go do it in CCITT; sort of repeating the history of Ian Cunningham on a different plain.

Pelkey: And when you decided to step up to the CCITT to push through the directory, were you still at Xerox?

White: No, I was at 3Com. I decided that I might like to do this directory rapporteuring, and that I was well qualified to do that, but Doug Steedman, who had collaborated with me on that initial contribution and on many other important areas subsequent to that, he also wanted to do that, so I thought: "Well, don't think I'm going to get to do this, because Doug is in BNR and Ian Cunningham is in BNR, and so on," so I decided that I would roll over and not pursue that, but I knew that I wanted to be involved in some way in the X.400 arena, probably doing product development in that area. I decided that it was time for me to leave Xerox, not primarily because of this -- this was the point at which things were falling apart at Xerox. It was quite clear by then

that we were not going to be commercially successful. We were not creating the office of the future in a commercial sense, and the thing that did it for me was that Xerox went back on its decision to make XNS be open. They published Ethernet, the Blue Book, they published the XNS equivalent of TCP/IP, which was SPP as I described earlier, and then they decided that was a mistake, they shouldn't have done that, because it was the fruits of many expensive years of research at PARC and then subsequently development in SDD; a bad idea to hand that technology out on the street corner. So they published up through the transport protocols, and then they went back on their decision; they never published, at that time, any applications, so there was nothing you could do with XNS.

Pelkey: Do you recall when they published SPP?

White: No, I don't. They started a whole series of publications, and then they never -- there were only about three instances of that serious --

Pelkey: Most people perceive XNS for coaxial cable to be far superior to TCP.

White: I think that if you had an objective assessment, and I'm guessing here because I don't remember enough about either, especially TCP/IP, to have a personal opinion at the moment, I suspect it would be judged superior technically, because it was done by one of the same people who did TCP/IP after he did TCP/IP, and by a very clever guy indeed.

Pelkey: So what did you do at --

White: So I decided to go to 3Com and --

Pelkey: Did you contact Bob and say --

White: I did eventually. I looked high and low for a place to work. I knew that there I was, living in Silicon Valley, so there are endless places to work in that field, but I was interested in e-mail, and I was interested in X.400 standardized e-mail, and I came to the conclusion that all of the interesting activity was on the east coast, because that's where all the value added carriers. Telenet is here, for example, Dialcom, our major competitor, is here, and so on. Yet, I didn't particularly want to go to the east coast. I had lived all my life in California. I was born in California. My wife would have killed not to leave the area, and I looked high and low, looking for a place to work. I actually interviewed here at that point in time, and we couldn't come to terms, and I didn't get an acceptable offer, and I didn't come here. Metcalfe was my last resort. All of a sudden I thought: "Well, 3Com, it's not likely -- they're just Ethernet, and it's not likely that they have any interest in e-mail," but it turned out they did. They had a product, which I didn't even know about, EtherMail. So I called them up, said I was thinking about moving jobs, he said: "Don't think about it. Come here," so I eventually did very shortly thereafter, with the objective of developing for 3Com an X.400 product. I actually had a big detour. For the first six months I was there, I had to write software, which I hadn't done, personally, in many years, but Metcalfe had just gotten an OEM contract with Xerox to develop a PC front end for the Xerox/Ethernet based mail system, so here I was, I had just gone to 3Com, I was one of the designers of the protocol that had to be implemented, so I was absolutely the right person to do

it, so I was imposed upon to do it. So I spent six months writing software like there was no tomorrow, day and night, to do that, and then, after that was done, I got to launch into the X.400 product area. I did some initial planning and think-pieces and proposals within the company, and it was perceived to be a very exciting thing. It was sort of like a new idea, based on international standards, great stuff, but that was the point in time at which . . .

Tape Side Ends

White: . . . The LAN world was about to be turned upside down from the network operating system standpoint by IBM's and Microsoft's introduction of what was called the Net BIOS, which is essentially a de facto -- a move to make a de facto standard for the way networks are put together in LANs, so the resources of 3Com were redirected to cope with that situation; develop, essentially, a new version of the Ethernet 3Com Network Operating System, which has since been named 3 Plus. So anyway, I did my six months on that OEM deal, and I did some initial work, and then I realized that my group was sort of being raided, and it became apparent that I wasn't going to be able to do X.400 for some considerable time, so I was facing a crisis, a professional crisis, so I ended up, again, calling Telenet, saying: "I'm calling you again." This was a year and a half after I called them previously. This time I came out again, interviewed, and they were in a position where I was just the right person at the right time, so I came out here. Before I came out here, I was asked if I would -- I had already, at this point, decided not to go for the X.500 chairmanship, I'd let Doug Steedman do that, because I didn't think -- I wasn't being altruistic -- I didn't think that I could mount an effort to cause myself to be able to be permitted to do that. So then I went to 3Com, and I had just written off the chairmanship, although I very much intended to participate, and it was agreed as a condition of my moving to 3Com that I would be allowed to do that, and I was. Then I was approached by, again, this friend of mine, Ted Meyer, whom I have mentioned several times, and he asked me, on behalf of several other companies, whether I would consider to be the new X.400 rapporteur. So I had previously decided I didn't want to do that, because it just seemed like it would be pretty dull and boring in comparison. It was just the following work, but then when I was specifically asked, I gave it some thought, and I decided that I would, I would like to do that. So I agreed to do it, and I was appointed to that roll.

Pelkey: While you were still at 3Com?

White: While I was still at 3Com, that's right, and that was considered by 3Com to be pretty exciting stuff because it was PR and 3Com was quite small. There I was, employee number 214 or something like that, so that was all great, but the fact that it turned out not to be the right moment for 3Com to move into this area, combined with the amount of time it was clear I was going to have to spend in my roll as chair of this group, that the writing was on the wall that this was not going to work out, so I was faced with what I had to then consider the one career mistake that I had made in my life --

Pelkey: Moved on.

White: Moved on. As much as I liked Bob Metcalfe and 3Com, which was a fabulously exciting place to work, and certainly whet my appetite for small companies, I decided that this is

where I needed to go. So after a very, very intense personal decision making process involving my wife and so on, we decided we would move out here, so we did.

Pelkey: Have you completed your X.400 product for Telenet? I presume you came here in order to do X.400.

White: Yes, and I haven't done that either, and probably -- I can only tell you limited amounts of this because it would be considered proprietary information of some sensitivity, but in summary I haven't succeeded in that objective either here at Telenet. The one major thing that I have done is that I have completed the development of X.400 version 88 and gotten to raise its right hand agree that that's all acceptable. So here we are.

Pelkey: Very impressive.

White: But it was really -- I guess just to abstract from all that a little bit -- one of the great lessons that I've learned is it's not sufficient to have the good technical ideas, you have to have a lot more than that, and in the positioning of technology in the manufacturing and marketplace, consensus is everything. As you know, there's a great, sort of world force at work that says: "I may not know exactly what in the hell ISO is doing and what CCITT are doing, but their OSI and so they are the right thing," and there's a lot of technical trash that's been developed, and it's part of OSI, especially down at the lower layers, but it is the consensus of the world, and it is now, therefore, the purchase price for buying into the game of OSI and international multi-vendor communication. X.400, as a technical proposition, is much superior to some of the trash, at least, that's there, and that's very gratifying, but A, the fact that you need a consensus -- you can do all the brilliant work you want at Xerox and have it all trashed in the end -- consensus making requirements, and also the fact that it is possible in the standards arena to do real substantive technical engineering work and have it be accepted. I'm quite frankly now in a place, after having done this, having been in CCITT for now seven years, about to be eight years, that I could do this for the rest of my life, which I don't have the least bit of interest in doing and I'm now retiring from that work, but I could chair these groups ad nauseam, and I know how to do it very well. I know the process. I know how it works. I could put forward a lot of technical propositions and they'd be agreed, based on where they're coming from, and the fact that you can establish a situation like that, even in an area that's, kind of, as prosaic as the world of international standards, is really exciting. Plus, just the whole international dimension of it had been a great thrill. I know people all over the world, and it's quite clear that we have created a technology that will create -- that is the infrastructure for a whole new world wide communication medium that I'm quite confident will, in due course, rival the telephone network and the international postal system in its pervasiveness. The fact that you can do that takes a long time, but the fact that you can do it at all and that you can get a pretty high-quality technical basis for it is a revelation to me.

Pelkey: You have been incredibly kind with you time, and I will impose on your time a little bit more in the sense of trying to help me with some dates after you get this transcript back.

White: Yeah, I can do that in advance, because I've got notes and documents that I can just produce you a little chronology --

Pelkey: That would certainly be helpful, because what you have done is critical to my storytelling, so I wouldn't impose upon you if I didn't think it was important.

White: No, I'm happy to do it.

Pelkey: I have no other questions, so thank you.

END OF THE INTERVIEW