An Interview with

JOHN DAY

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Conducted by Thomas J. Misa

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John Day Interview

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Abstract

John Day describes his computer science education at the University of Illinois at
Urbana-Champaign, including vignettes of student life in the late 1960s and early 1970s
and campus protests over work on the ILLIAC IV computer. A second portion of the
interview gives highlights of his work on network standards-setting, including Open
Systems Interconnection (OSI) model and American National Standards Institute (ANSI).

Misa: I'm Tom Misa. I'm talking with John Day. We are in my office at the Charles Babbage Institute. It is the 22nd of October 2010. John, let's start out with your background and how you came to Illinois and some of the experiences that you had there – those were fundamental for understanding your perspective and background for the later part of your career in network building and standardization.

Day: O.K. Well then to start, I should probably say that I grew up in southern Illinois. I'm from a very small town called Kinmundy, population 900. The largest town in our county is 14,000. My high school graduating class (1965) was the largest they'd ever seen at 42. Needless to say, I was not exactly prepared for the University of Illinois. It was a rural farming area, better ground than farther south, but not nearly as good as the prairie ground of central Illinois. The high school was "regional" with a neighboring town of 350. Today graduating classes are around 60 and it now encompasses 4 towns of which Kinmundy is the largest. I was a "town kid," i.e. I did not actually live on a farm, not that that is a big distinction.

Misa: The University of Illinois is a place somewhat larger than 42.

Day: Just a tad larger than 42. (laughs) Student population at Illinois is 40,000, entering freshman classes are about 5,000. Most [are] from Chicago and its suburbs.

Misa: How did you end up going there?

Day: I applied and I happened to get in on a tuition scholarship at the last minute. I survived [well] I think for a small-town boy; talk about a green freshman. I'd traveled a little bit with my family, we'd been to Colorado and stuff, but I had basically grown up in a rural farm town. So what I ended up doing was I started the university the summer after I'd graduated from high school. I took two courses, [also] took a light load in the fall and by that time I was acclimated and could pretty well get by.

At some point probably that next freshman summer, I came across a group of really brilliant undergrad mathematicians – there was an NSF math program [during] the summers. I ended up linking up with them; that was a group that I had around me for the entire undergraduate and graduate school at Illinois. I was hungry. I had become a reader early and you know when the nearest bookstore is 100 miles away, I was hungry to be at place like Illinois. It was just the greatest thing since sliced bread for me [for] intellectual stimulation. I got exposed to classical music. Actually, my freshman year one of the stories I always tell is [about] the guy living in the room next to mine (I was in independent housing. I never went to the dorm, dorms would probably have killed me, I couldn't have dealt with the level of confusion.) The guy (David Rosenboom of Quincy) living in the room next to me was a composition major. So my exposure to music started with the 20th century, moved forward from there. I remember hearing a Bartok string quartet in the fall and thinking [it] was the worst noise I've ever heard, and along about February I heard this really neat stuff coming through the wall, and I go to see what it

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was, and it was the same Bartok string quartet. I had learned how to listen to it. I had all that kind of exposure. There was a lot of new music going on. Illinois had a festival of contemporary music every two years back then, and because of our proximity to this guy we got involved. John Cage was around.

My junior year was the 100th anniversary of the university so they had a number of special lectures. One of the events I went to was a lecture by Heinz von Foerster. Heinz was the most charismatic, neat professor I had ever come across. This guy was just incredible. He had a place at Illinois called the Biological Computer Lab, and so I said I'm attaching myself to Heinz, take anything he does. I'm going to try to stay as close to him as I can. Because of my contact to Heinz, I ended up falling in with another group which turned out to be the ILLIAC IV operating system group.

At this time I had gone into EE [electrical engineering] but I had distinctly taken a computer science bent, taking computer courses as much as I could. The computer science department at Illinois wasn't formed until 1967 so I was already in the EE department.[1] I toyed with the idea of switching to CS but I decided why bother? I ended up taking my bachelors degree in EE even though most of what I did was essentially computer science stuff.

Misa: And the year of your bachelors?

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[1] *JD adds:* Actually, the CS dept at Illinois was formed in 1964 before I got there, the graduate program began in 1967, which is probably what I remember hearing about.

Day: 1969.[2] Then I fell in with the ILLIAC IV software group and became a member of the group. We didn't know it at the time but we were probably the finest software group in the country. The things we pulled off and the things we did, nobody else came close.

Misa: How was it that you got attached to that group?

Day: Through Heinz. They were all the same people and I was interacting with them and they said why don't you come and we can give you a little hourly job. You work your way up. The leaders of that group were two guys, Gary Grossman and Dave Grothe. Actually, they weren't officially, but they were who we all looked to. They were the senior guys in the group, brilliant guys, I mean two of the finest guys I've ever worked with. They were really a pair. They had desks next to each other. You always said Grothe and Grossman in the same breath. There were people on the project who weren't close to the OS group who weren't quite sure which one was which. (laughs) There was Carlton Mills and a whole raft of young guys. I was sort of the second tier age wise on the project, and Gary turned over the ILLIAC IV simulator to me. We were trying to put together the ILLIAC operating system, which was to run on a Burroughs 6700. We had a Burroughs 5500 that we were doing all sorts of stuff with ILLIAC IV language and algorithm development, hardware test programs, etc., and this is just as Burroughs is bringing out the 6700.

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[2] *JD adds:* Officially, Fall 1970 [since] I needed one more course to finish.

And as I think I told you before the 5500 was a real eye-opener to us. It really had a major effect on how we viewed the world.

Misa: Can you explain first, how it was distinctive and then second how it influenced your world?

Day: The Burroughs machine for that early [was] ahead of its time. It was a zero address stack machine with virtual memory. The lowest level language on the machine was ALGOL. The compiler was written in itself; the operating system was written in a high-level language. We always said that this was a system that obeyed the principle of least surprise: If A worked and B worked, you could guess how C would work and you'd be right 90% of time. It wasn't like the IBM systems where if you knew how A worked and B worked, you'd have no clue how C worked.

Now, to step back a minute, this was the period 1967 to the early 70s. The hippie movement hit Illinois in the spring of 1967. I remember they were building the Psychology building at the time and there was a construction wall up with a plywood fence. It was the protest for the war and everything, and there were these sort of pseudo-mathematical statements written on the wall, like, "McNamara is everywhere differential and nowhere continuous." One panel had the mathematical definition of continuity written on it completely in [mathematical] notation. No words. They all had intellectual bent to them. It was a very different kind of thing. People were dropping acid. I had a guy

working for me one winter probably in 1970 or 1971 who was dropping acid once a week. It was a wild and woolly time. Now, that said, the whole software group on ILLIAC IV were a bunch of liberal types, okay, everybody had long hair, and the dress code was blue jeans and work shirts and Dingo boots. That was what you wore.

Now what happened with the protests against ILLIAC IV? There had been a Vietnamese Studies Center put in to Southern Illinois University Carbondale. Apparently, they just slipped it in under the radar with the Board of Trustees and got it established. There were huge demonstrations. The thing is SIU is in southern Illinois—"they don't have good dirt in southern Illinois." The Ozarks continue over there; a lot of it looks like Appalachia. It's coal country, and so it's much more of a redneck area than the more prosperous central Illinois. So the disconnect between what was going on at the university, and the rest of the community was huge. The reaction was much, much stronger. You had cops shooting tear gas in the dormitories, head bashing, and all sort horrible things going on in Carbondale.

Misa: Just to make sure we pin this down, the Vietnamese Studies Center could be something that was funded either by the U.S. military or –

Day: It might have been funded by the CIA or more likely U.S. AID or something like that. You'd have to look. That had been going on and the radical side on the Illinois campus got it in their heads that the same thing had been done with ILLIAC IV. That

ILLIAC IV had been secretly approved and that ILLIAC IV was going to be doing secret research on the campus. First of all there was no plan for that; the building ILLIAC was supposed to be housed in was not a secure facility so there was no way that would've happened. For that the building would have had to have been lined with copper mesh and the whole nine yards. That wasn't going to happen; that was never in the plans. The *Daily Illini*, the student newspaper, was part of the leaders of this whole movement and they were trying to be a big leader in advocate journalism. They would say, 'See, we look at the reports of the Board of Trustees meetings and there's nothing about – in our newspaper – there is nothing about ILLIAC IV.' Our guys were the ones who went out and would actually debate them because we were, to some extent, sympathetic. We did the legwork of digging into the archives of the *Champaign News-Gazette* and the *Urbana Courier* and showed that well actually it was covered in the papers. It is just that the *Daily Illini* in those days chose to cover the frat news and not ILLIAC IV. Those newspapers had covered that ILLIAC was approved and it was all out there. That sort of, 'Oh.' That argument didn't hold. So then it came down to there shouldn't be secret research being done on college campuses. And we said, 'Yes, we agree with you.'

Now, in the meantime ILLIAC IV was being built to push LSI [large-scale integration] technology. It was a classic 1970s DOD funding screw-up along the way. Several things happened.

Misa: Okay to back up, to push LSI by creating a computer that required it because of its complexity?

Day: Right, and size. ILLIAC IV was to be a big single control unit with 64 processors to a quadrant.[3] Eventually there were supposed be four quadrants for 256 processors. There was only one built. Burroughs may have actually built some more but there was only one built on the ARPA contract. TI [Texas Instruments] had the contract to build the LSI circuits. The story I heard was that they could build them, [but] they couldn't build them for the price. There was some deal about how that worked. They put their legal eagles to work and got out of the contract. So things that were supposed to be the size of a quarter or a half dollar became the size of probably 5 x 8 circuit cards and so the machine instead of being the size of a mainframe at the time was 10 feet high, 8 feet deep, and 50 feet long.

Misa: Ten by eight by fifty, so the size was equivalent almost to the huge vacuum tube computers.

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[3] For a technical description, see W.J. Bouknight, S.A. Denenberg, D.E. McIntyre, J.M. Randall, A.H. Sameh, D.L. Slotnick, "The Illiac IV System," *Proceedings of the IEEE* 60 no. 4 (April 1972): 369-388. **DOI:** 10.1109/PROC.1972.8647.

Illiac IV (c.1970)
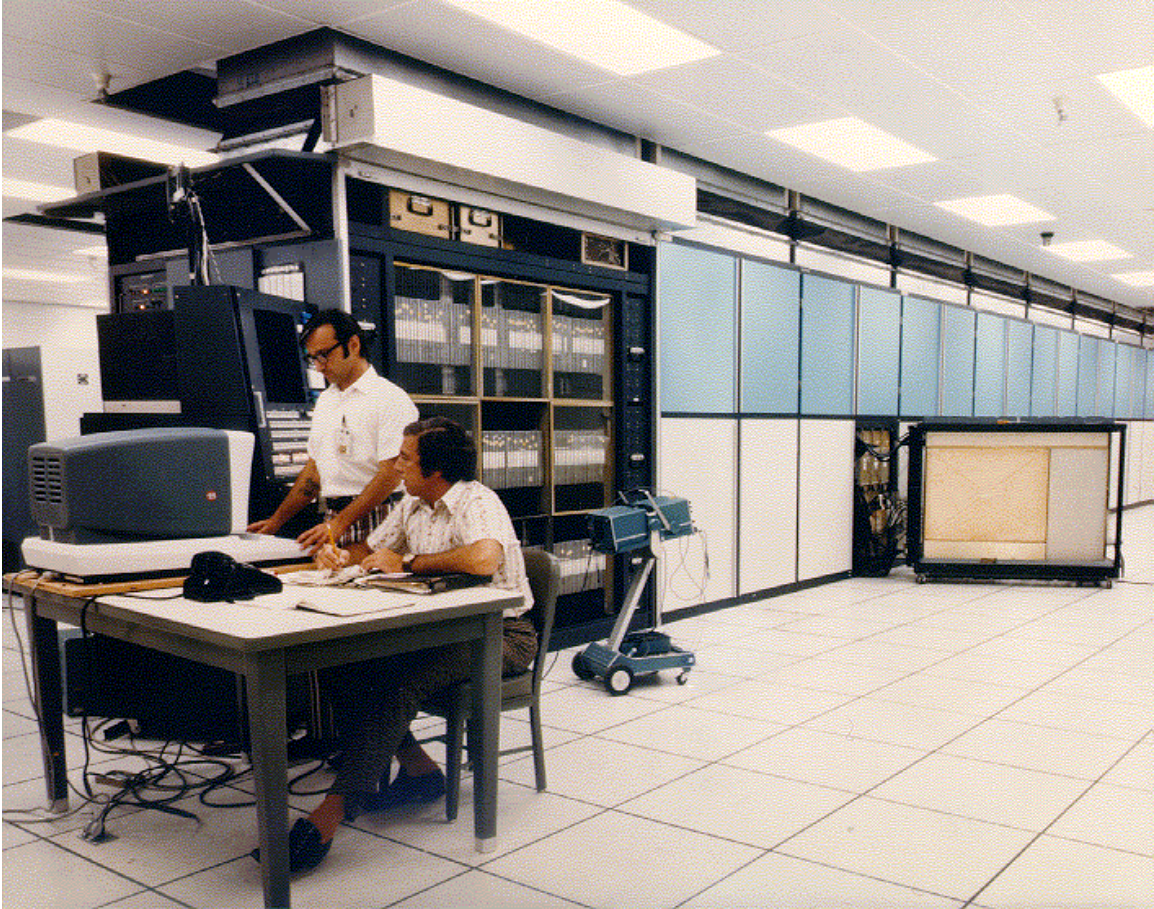
Source: Charles Babbage Institute

Day: Right. It was huge. And the building it was to go in had no heat. So because of this there were huge cost overruns. ILLIAC was costing far more than ARPA had planned. And so there is more and more pressure on [principal investigator Daniel] Slotnick. Burroughs Defense Space and Special Systems had the contract to build the machine. When they went to hook the processing elements up to the control unit they found out that the – and I'll get this backwards, but it's one or the other – the guys who designed the processing elements had used positive logic (a 1 is a high voltage) and the guys who

design the control unit used negative logic (a 1 is a low voltage). So in one a 0 meant 1 and a 1 meant 0, right. (laughs) And they didn't find this out until they went to put them together. Fairly late in the project, right? Ouch. So they were like, 'oh crud.' They ended up putting like a half-million dollars worth of inverters in. A similar thing happened with the I/O subsystem, when we went to attach it. Burroughs in those days numbered bits from left to right. Some idiot thought that high order bits in the word meant those with the biggest numbers, which high order of course means the ones to the left not the ones to the right and so all that had to be rewired. It was a mess. There were other shortcuts taken in the interests of making speed goals, such as checking for a divide by zero by checking only the top bit of the mantissa thus making the unnormalized arithmetic operations useless.

All of this led to huge cost overruns. Slotnick was under a lot of pressure to get the machine working and ARPA was reticent to spend more money. At some point, with all the demonstrations going on, Slotnick sees an out. He says I can't guarantee the safety of the machine if it comes to Illinois.

Misa: The suggestion is that he was looking for a way out, more or less not to complete this mis-designed machine?

Day: The machine wasn't mis-designed. The design was fine, at least for the time. The cost overruns by not having the LSI chips immensely increased the cost. I believe there

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were cost overruns on the huge disks developed for it. The coordination in the execution was a problem. Choosing positive logic or negative logic, or knowing which bits are high-order are not design decisions.

Well, and also to get out from under the fact that more money was needed to finish the machine than ARPA was willing to give to him. So there's this whole big deal that goes on and it's decided that they are going to move the machine to Moffett Field in Mountain View. NASA Ames Research Center. Of course the guy who's to take the machine at Ames says 'I won't take the machine unless you give me the money to make it operational.' Basically this is a ploy. They wouldn't have given the money to Slotnick because they had already thrown a lot of money at Slotnick and to their view he had blown it. But they'd give it to the new guy because he said, 'hey, I'm not going to take this machine unless I have the money to make it really useful.' So the whole student demonstration thing simply played into Slotnick's hands. And not only that but by being at Ames Research Center, which was a secure facility, it could now be used to do secure research.

Misa: So instead of having the machine on campus doing open research, it went back into the government sector world.

Day: Right. (laughs) Unintended consequences. But the thing was the radicals were really shooting from the hip, [they had a] superficial understanding of what was going on. We

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had a much deeper understanding of the politics and of the issues surrounding computing

and politics in secret research and all this other stuff. So as I said the group around –

Grossman, Grothe, that whole group – were also doing stuff with Heinz. Grossman's

degree is in music composition so he was working with Herbert Brün in the Music

Department on the side sometimes. We did concerts at the Center for Advanced

Computation. There were electronic music related – it was an incredible milieu that was

going on. As all this is going on, one of the things we were supposed to do with ILLIAC

IV was put it on the net. So that's how we become node twelve on the ARPANET. Once

ILLIAC was going to Moffett Field then our job shifted to providing access for the

people doing research remotely on ILLIAC IV. Again instead of getting some big

machine to do it, we were able to get a PDP 11/20, one of the first PDP 11s. In fact, it

was before they put the slash twenty on the name. We had been writing everything for the

Burroughs machine – oh I should back up. At some point in there we start porting our

code from the B 5500 to the B 6700. The 6500 is just coming out and so we're getting

Beta release 0.5 of the operating system. Eventually, they shipped serial number 2 of the

hardware to Illinois.[4] We had serial number 2 of the hardware. There was a famous – we

were a pretty activist bunch of programmers and the thing was software was new, we

understood it, no one else did and pretty much we could write our own ticket. And we

knew it. We were an arrogant bunch! (laughs) There was always the usual management

screw ups going on and guys who didn't really know what they were doing. The typical

Dilbert kinds of management things were happening. At this point they were going to

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[4] *JD adds:* Not sure this is right. We did have a very early serial number but 2 may have been the
machine at Paoli we were testing with out there.

ship a 6700 to Illinois and install it. It was to be installed in the basement of CSL, Coordinated Science Lab. Actually the building is called something else now, there is still a Coordinated Science Lab at Illinois but it's not the building that this was. The machine was to go in the basement. Of course you had to have a raised floor for air-conditioning and cables. The Burroughs machines had fans in the bottom of the cabinets to pull air conditioning up through the machine. The guy who was in charge of installing the machine thought it was too much trouble to run duct work all the way down to the floor in the basement so he had ducts coming out in the ceiling blowing cold air out. And his main cold air duct came out right over the CPU so you had hot air being pulled up and this cold air coming out. (laughs) It was a disaster.

Misa: Because cold air wasn't going down.

Day: No, it wasn't getting down and the machine was running hot. There was hot air blowing up into cold air coming down. You were getting fog forming. It was a disaster. There were also some games going on with the programmers and so one of our guys Mike Knowles wrote this thing, which I still have some place, called The Choosers ARPA-retta with characters like Grow-T as in Grothe, Randy Goat which was Mike Randall who was our boss. I forget what Grossman's name was. I was In Nomines Dei and so on. It was a whole litany of screw ups and how you could end up with a bad thing [inaudible] – it was a great little play. Sort of an existential comedy thing, patterned on Waiting for Godot. It was like three pages. Hilarious stuff, criticizing making fun of the management.

Misa: Was it ever done as a play or was it just a typed script?

Day: No, it was never done as a play, it was just a typed script. Great fun. Then on the back of it has a drawing of a block T with 'in' marked on the bottom and 'out' marked on one leg of the top and it was titled, 'B 6700 Supervisors Intelligence Test' to get through the maze and you were challenged to beat the time of our current B 6700 supervisor of a minute and thirty-eight seconds. (laughs)

Misa: Which is a fairly insubordinate way of putting things. (laughter)

Day: Well, that's how we worked. (laughs) That got Knowles fired for a while but not for long!

Misa: Could you tell me about Heinz's background, and some of the things that you picked up from working with him?

Day: Heinz von Foerster, as I said in the dedication of my book, taught me how to think.[5] He probably taught all of us how to think. Heinz ran these heuristic classes and as I said he was a charismatic guy. Heinz had done radar research for the Nazis. There are other people who have written things on Heinz, you can find them. He was brought to the U.S. right after the war [in] 1949 by Warren McCulloch to participate in the Macy

Conferences because of some papers that Heinz had written. Heinz grew up in Vienna. Apparently, [he] was thrown out of every school in Vienna. (laughs) Heinz was brought over by Warren McCulloch, and worked with Wiener and von Neumann and all these guys establishing cybernetics. What I surmise is Warren was able to get him a position in the EE department of Illinois, in the plasma lab, the gaseous electronics lab and then once Heinz was able to start getting his own funding, he was able to move on and establish the Biological Computer Lab. Like I said Heinz was charismatic. I've watched him tell the story of "What the Frog's Eye Tells the Frog's Brain"[6] to non-technical people and they just eat it up. We'd be trying to explain something and Heinz would stop us and say, 'Make it a story!' One of the things he always beat on us about was looking at things from the point of view of the organism, not the observer. There were all sorts of funny exercises he would do in his heuristics classes and I've got a write up someplace of his view of the heuristics classes and everything.

Misa: When he was thinking about heuristics he wasn't thinking just about machine or computer heuristics, he was really talking about this in a much broader sense.

Day: Much broader sense.

Misa: Can you say just a bit more about some of his ideas?

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[5] John Day, *Patterns in Network Architecture: A Return to Fundamentals* (Prentice Hall, 2008).
[6] JD adds: [Lettvin, J.Y., Maturana, H.R., McCullough, W. S. and Pitts, W.H. Proceedings of the

Day: One of the stories he would tell is the guy who put on glasses that turned everything upside down. He wore them for a long time and of course his vision shifted and he was able to see everything right side up and he just continued to work. He did that in the winter and then some time in the summer he took them off and after a week or so things flipped back around. Until the first time it snowed and the snow was going up. Because he hadn't seen snow yet. (laughs) It was just all these things he would use and also he would really make us think through stuff. We'd make some bald face statement in class and he'd come down on us with both feet and just tear what we were saying to shreds which made us really think through what we were trying to say. Heinz somehow taught us, I think, to see those subtle inflection points in a problem that end up making all the difference. The ones that are the first order of effectors but may not appear that way on the surface. That's the kind of thing that he taught us. The discussions would get pretty intense. Heinz demanded precision in our thinking and we weren't necessarily all that precise. We got a lot better. All of us in the OS group in ILLIAC IV, we took his heuristics classes every semester; we'd go sit in on them if we weren't signed up for them.

Misa: Was that done in a smaller seminar?

Day: It was a seminar class. The EE department hated it because it was just an easy A as far as they were concerned. What they didn't know was how we saw it. Some of the classes went on and produced – one of them got Heinz in a lot of trouble. We produced

IRE, Nov 1959 (the seminal paper in modern neurophysiology).

something called the Whole University Catalog. I remember one of the early classes we were ordering, through Heinz, copies of the Whole Earth Catalog. It was the first issues that came out, so I have a first issue of the Whole Earth Catalog.

Misa: That's Stewart Brand?

Day: Yes, Stewart Brand. Heinz knew everybody. Heinz had published with Margaret Mead. A friend of mine tells the story of being in Heinz's house in Pescadero [California] after he retired one time and these three people just show up and they are walking up the hill to the house and they are 'oowing' and 'ahhing' over what a great place it is. It turns out to be Timothy Leary, John Paul Getty III and his wife. (laughs)

Misa: Just an afternoon's visitors.

Day: Yes, right! I mean Heinz was invited to [psychologist Jean] Piaget's seventieth birthday party. He knew everybody, and I don't mean just name drop. He would say, 'You gotta talk to so and so, (very famous person).' You'd call them up and you'd say, 'Heinz said' – 'Oh how is Heinz?' (laughs)

Misa: So this was not a typical EE professor. This was somebody with unusual background.

Day: Oh yes. Like I said, he really was teaching us how to think. I told you the story of the dancer, right?

Misa: Why don't we record that.

Day: Okay. One of my favorite stories of Heinz is that Heinz had this guy he wanted to bring in as a visiting professor for a year because the guy had developed a notation for motion that Heinz thought could be made into a nice programming language for robots. So Heinz fills out the paperwork and goes over to the head of the EE department, [Edward C.] Jordan who wrote the big thick book on electricity and magnetism that we all use and was the bible. He was an EE's EE. Heinz puts the paperwork in front of him and asks him to sign it. As far as Heinz is concerned this is pro forma. Jordan looks at it and says, 'Heinz, I can't sign this.' He says, 'Look, I didn't say anything when you brought in a psychologist to the EE department.' That was Ross Ashby who had written *Design for a Brain* [1952], wrote a book on *[Introduction to] Cybernetics* [1956] and a lot of analysis of finite state machines. 'Heinz, I didn't say anything when you brought a physiologist into the department.' That was Humberto Maturana who had done the research for "What the Frog's Eye Tells the Frog's Brain," and was writing some really brilliant stuff on the biology of cognition and stuff. 'And Heinz, I didn't say anything when you brought in an expert on East-Asian philosophy into the EE department.' That was Gotthard Günther who was doing multi-valued logic systems. 'But Heinz, a dancer? I can't get a dancer in the EE department.' So Heinz goes over and gets a cross

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appointment with Women's Physical Education, which was where dance was in those days rather than fine arts, and wanted his name on a door over there. (laughs)

Misa: This is a way of getting somebody with a way of notating motion on campus.

Day: Right, on the campus so that you can work with them. It was great. But in one of the heuristics classes we did the Whole University Catalog sort of a takeoff on the Stewart Brand Whole Earth Catalog. Also for one of our heuristics classes early on, we all got copies of the *Tractatus Logico-Philosophicus* to go through. Which to me the first time I picked it up was like, I've never seen a book like this before. Actually there is a story here too that's worth telling. It turns out Heinz is Wittgenstein's nephew. And we get the *Tractatus* rammed down our throat six ways out of Sunday and we got through it and we're really understanding what it means when you say, '1 The world is all that is the case, 1.1 The world is a totality of facts not things.' I remember one time late, after Heinz retired, I said – and of course it ends with 7 That of which you cannot speak you must pass over in silence. – and I said, 'Heinz, I really like 6.54 better.' That's the one where he says, 'if much you've read and understood these propositions you'll realize that they are all useless, that they're like climbing a ladder and then throwing it away.' And Heinz went, 'Yes, that's a good one isn't it.'

But to really back up, it's one of those funny things in life, I remember my senior year in high school that my best friend[7] and I went down to a show that the local high school in

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[7] *JD adds:* must have been a girl friend, because my friend says it wasn't him.

the big town – Salem, population 6,000 at the time – was putting on and it was a variety

sort of show. One of the skits in the show, and I remember this very well because I

thought it was really funny, was a guy taking his final for his PhD in philosophy and the

one professor says, 'I want to see what you know about my favorite philosopher Ludwig

Wittgenstein.' Well, what a great name for a philosopher! Sounds very impressive! That

was all I knew at the time. He says, 'What was the name of Wittgenstein's blue book?'

And of course the students goes, 'Oh my god, I've never heard of Wittgenstein. What am

I supposed to do? I have no idea.' Then aloud, 'Well, I don't know . . . the Blue Book?'

'Yes, you're right!' 'And what was the name of Wittgenstein's brown book?' 'Oh, it

can't be both work in a second time. But what else am I going to do?' 'The Brown Book.'

'You're right!' 'Now what was the name of Wittgenstein's red book?' By this time the

guy's got confidence and he goes, 'The Red Book.' 'Wrong! The *Tractatus Logico-*

Philosophicus. You're flunked. Everyone should know that.' (laughter) The title rolls off

the tongue so well and sounds so impressive. To me that was just a funny story, but four

years later I own Wittgenstein's Red Book and know it practically by heart! (laughs)

Misa: Do you have any idea about how the other faculty or other students thought about

Heinz's work? This is immensely stimulating if you read forward from cybernetics . . . .

Day: Well, obviously a lot of the normal EE people just thought Heinz was weird and out

there. But there were a lot of people on the Illinois campus who thought Heinz was just

fabulous. He collaborated a lot with Herbert Brün in the music department. He had a real

following. So we did this Whole University Catalog. We got Heinz in a lot of trouble because one of the things that we published in the Whole University Catalog was the location of all the pot fields around Champaign-Urbana. (laughs) You can imagine what that did. Heinz actually had to go over to Springfield and testify before the [Illinois state] Legislature. (laughs)

Misa: Because the fields weren't supposed to be there?

Day: No, not at all– of course, the reason the fields were there because farmers had raised hemp there during World War II when the supplies were cut off. And it's a weed, especially in that kind of ground once you get it growing there is no way you're going to get rid of it. Of course, it was also because the ground around Champaign-Urbana is so good. The marijuana was terrible, it wasn't very good at all. (laughs) But it was the time. We talk about the split in the society today but it was much, much worse then between the counterculture and…yes.[8] It was huge. Seeing the movie "Easy Rider" [1969] made me paranoid for two weeks. It was that bad. Luckily around Champaign-Urbana, it wasn't as bad as it was at SIU. It was a bit more affluent. Champaign-Urbana was a bigger university town, more dominant that way. One of the interesting things was the difference between the Urbana police force and the Champaign police force. Urbana cops were required to have a college degree; Champaign cops weren't. Champaign cops were "pigs." The Urbana cops sort of understood that it was better to treat the riots that were

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[8] *JD adds:* A lot more needs to be said in here about the climate in the US and in Illinois and at Illinois during the late 60s and early 70s. It is hard for people today to understand the deep

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going on as the spring water fights rather than a political thing. We moved into a house on High Street just about two blocks off the campus, very close to the campus in Urbana. And right after we moved in – my wife and I were the first floor and Mike Knowles was in the second floor and there was a basement apartment – the guy in the basement had this runaway living with him or had shown up or something, and the cops came by looking for her. So we got to know this Urbana cop. He was a really nice guy. We would run into him every so often. One time there was a big riot going on the quad, and Knowles and I walked down to see what was going on. And we're walking up Matthew Street and there is a line of cops in riot gear (helmets, face masks, nightsticks, etc.) standing where the quad comes toward Morrill and Burrill Hall. As we were walking up this cop wheels off the end with his nightstick and starts tapping it going, 'Where the hell do you think you guys are going?' And we were like, 'Whoa! Huh?' It was this guy we knew. He was just giving us a bad time and we stood and shot the bull with him for thirty minutes or so and then wandered off. But the Urbana cops were much [more] levelheaded. On the Illinois campus, things seldom got really as bad out of hand as they did on other campuses. And some of that was because the university cops and the Urbana cops understood how to do crowd control. You don't want to back them into a corner. One of the things that happened that I always said, 'I'm glad I wasn't there that night,' was – campus town is one block long basically in Champaign, right at Wright Street. There was a theatre there at the time and the [Costa-Gavras] movie "Z" [1969] was showing. Do you remember the movie "Z" all about the overthrow of the Greek government?

divisions in the country, the violence that was going on, both political and otherwise, etc.

Misa: Oh that's right, yes.

Day: Very powerful movie. Well, one night the movie lets out and the patrons come out of the movie to find a line of National Guard at the east end of the block, a line of Champaign cops at the other end of the block and a riot going on in the middle. Can you imagine coming out of "Z" and seeing that? (laughs)

Misa: That's a little too close for comfort.

Day: I'm not sure I'd be here if I'd been there. (laughs) So all of this comes to a head. There were big debates in the lounges of the Illini Union over ILLIAC IV where Grothe and Grossman would get up and some of our other guys would get up and talk with the radicals (these were recorded) and sort of like, 'Well, okay.' Again these guys are really, really smart and they had really understood the issues, and we took it at a level far beyond where these guys could go. It was a really, really top-notch crew. The negotiations were going; the radicals had –

Misa: These were the negotiations [on] DARPA and the ILLIAC IV contract?

Day: No, this was trying to defuse the demonstrations. This big demonstration had been

planned. Now the date on here is kind of funny because it's not exactly as I remember it.

But let me tell you what I remember and we can try and figure out how to resolve it.

Misa: The date says, 'May 5th, 1970.' [literally 5/5/70] This is 'Smash ILLIAC IV,'

Saturday May 9th on the quad.

"Smash ILLIAC IV" (May 1970)

SMASH

U of I
(PROP. U.S.A.F.)

WAR-SYSTEMS
DEVELOPMENT

KILL-DIE
FACTOR

FEED $$$$$$ HERE!

ILLIAC 4

PEOPLE

DESTROY

DEMOLISH

ILLIAC IV

SATURDAY

MAY 9

ON THE QUAD

WORKSHOPS AND TEACH INS (10 a.m.)

SPEAKERS (2 p.m.)

-- member of the BLACK PANTHER PARTY

-- LINDA QUINT of the CHICAGO 15

-- RENNIE DAVIS of the CONSPIRACY

-- JOHN FROINES of the CONSPIRACY

FREE MUSIC ALL DAY

Source: John Day. See also <images.library.uiuc.edu/projects/gcm/ccm/byte.html>.

Day: What I remember is two events happened prior to this; the first one is Kent State.

And of course, all hell breaks loose on campuses across the country after Kent State

[shootings May 4, 1970]. The second one was, some time after that a young black kid

runs from the police, the Champaign cops, into the north end, the black ghetto in

Champaign such as it is. The kid jumps out of his car and starts running across an open field and the official story was the Champaign cop got out of his car slipped and fell, his gun goes off accidentally and kills the kid at 50 yards.

Misa: Which is possible but it doesn't sound likely.

Day: Highly unlikely. No one believed the story. The North end goes up for grabs, there is burning and looting. All hell's breaking loose. That gets quieted down and the ILLIAC IV demonstration is supposed to happen on Saturday.

Misa: That preceding week was very tense.

Day: Yes. Those two events, you know things are getting way out of hand here. There's this big demonstration planned, they made all sorts of plans to bring in National Guard and state cops and all this stuff. That morning [Peter A.] Alsberg walks out on the back porch of the Illini Union and announces that ILLIAC IV is going to California; it will not be on the campus, thus defusing the need for demonstration. There is a minor demonstration where they go up to the site where they're building the Center for Advanced Computation and have a little bid-farewell-to-ILLIAC demonstration and things. The state cops are so pissed because they are not getting to crack heads in the demonstration that was supposed to be on the quad that they encircle the quad that afternoon and cart everybody off and arrest everybody who's on the quad. Some people

had to be awakened. I mean laying on the quad in the summer afternoon was normal, typical college stuff. Some people had to bring their kites in; they were flying kites. All arrested. (laughs) 'We're not going to come over here and all this trouble if we don't get to do something.' So that was it.

Misa: Now with ILLIAC IV leaving campus, there are two pieces that we can maybe fill in; one, you said that you were doing the networking to put ILLIAC IV on the net, but also second, once it left you had a remote support function. Can you talk about first the networking and then second the support function?

Day: Well, it wasn't so much a support function as there were people who were going to use ILLIAC from Illinois. And there was a lot of experimentation and algorithm development and all this stuff. They had created this Center for Advanced Computation and they had built this building on University Ave to house it where ILLIAC IV was supposed to be. So we had this big open second floor area with a little bitty machine room with a PDP 11 in it. It all had raised floors and everything and we had partitions up for offices and things. Before we moved in there we were still over in ERL –

Misa: ERL being?

Day: Engineering Research Lab. (It also has a different name today.) It's one of those acronyms [that] means more than what it stands for. Which is the same building where

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PLATO was; we were over in that building. In fact that's the building where ILLIAC I was originally and when I was an undergraduate, [it was] where the IBM 7094 and the 1401s were. But we had offices over there. We had a room where we had the PDP 11. I remember sitting over there with the first version of the operating system that we wrote. The operating system was written in a high-level language called PEESPOL [PDP-11 ESPOL], ESPOL being the Burroughs 5500/6500 operating system language. That was written by Grothe. The OS called ANTS [ARPA NET Terminal System] was primarily written by Grossman, although some of us were adding stuff to it and fixing things. I remember sitting over there using a model 35 Teletype trying to use Multics over the net. Once we moved into CAC [Center for Advanced Computation], we then started work on our second big operating system — to do it by the book. The great thing about this was we were arguing out what the right structure for an OS was. We were having to figure it out on our own and it really made us great programmers. Grossman came up with his design for the second one, which was a process per function operating system that was based entirely on semaphores. We again wrote it in the high-level language that Grothe had come up with. Grothe had started adding this really powerful macro pre-processor which allowed us to write macros that didn't look like function calls but had arbitrary syntax. So we were able to write macros that looked like extensions to the programming language. So we started creating language constructs for the objects in the operating system, we were writing so that we could write the operating system in terms of itself. This is all 1971, around in there. We are trying to do object-oriented programming in 1971. (laughs) The thing was that the machines weren't up to it. The more complicated

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and involved it got the more compile time it took and it was just really a mess. Today you wouldn't think anything about it.

Misa: Were you aware of the discussion, from about 1968 onward, of there being a "software crisis"?

Day: Sure. Well, that's what we were trying to avoid because we were essentially – we had a whole bunch of utilities, we'd build up on that, we only had that. For example, you remember there was the global variable considered harmful thing? One of the things we actually put into PEESPOL was an un-declare so we could undeclare variables in the code. We were very big about certain levels of the code shouldn't reference other parts of the code. But in a block structured language you are going to have to make some things global just because of the way the scoping works. So we actually put an "un" command in at some points which said, 'Okay, beyond this point you can't *see* any of this stuff anymore. All you can do is call the procedures to let you get at it.' So we were really big on enforcing structure in the programming.

Misa: So the un-command is not an 'un-do' but it's a kind of block, is that right?

Day: Right. It removed variables from the symbol table, so you couldn't reference them. There were procedures you called to do things for you. And to keep you from being tempted to go down and fiddle [with] data structures on your own, we put the un-

command so you couldn't see that stuff. We would build macros – for example, our systems, we were doing a lot of device handling, they were all device drivers so they were passing instructions around between things and data around between things so they were basically state machines. We had a macro for declaring an instruction and declaring the fields that would go in that instruction. It would declare the fields that go in the instruction. And then you could use that and it would assign an op code to it. The compiler was doing all that bookkeeping for us. Then you could declare one in your code and it would allocate one. And it would create template that you could lay on a piece of memory and make it look like that instruction. All that was automatic. I actually had one of the guys working for me because we had this state machine thing, it was a fairly general structure, I had him write essentially a macro for the entire state machine. So all you had to do was plug in the pieces that were unique to your problem, to the device driver you were writing. We'd just compile them up. So we were doing all this stuff. That system ran like a dog. Not because of the compiler stuff, because of all the context switching and data copies involved in doing things that way.

Misa: So it slows the processing down dramatically.

Day: Right. This was really funny there was a group that came along afterwards that went, 'Oh that high-level language stuff, that's for wimps. We're going to do a system in assembler and it'll be a lot faster.' Well, they used the same process for function architecture we had and got almost exactly the same performance we did.

Misa: They were using assembly language?

Day: Right. Then not too long after that we were at a conference in Toronto and a group from Waterloo gave a paper on a communications operating system they had written that had the same design, and they had the same performance that the other team did. At which point I'm going, 'It's the architecture, not the code.' And about this time we were putting Unix on the ARPANET and I run into Vint Cerf at one of the meetings. He says, 'I hear you guys are going to put Unix on the Net. This is going to be great.' I said, 'Yes, but it's going to run like a dog.' He goes, 'What do you mean?' I said, 'Well, it's got the same architecture as ANTS (our system) and Dave Retz' system (the assembler version) and this system at Waterloo, why wouldn't you expect it to have the same problems?' Which was another good story, back about 1973 or so. As I said this whole system was based on semaphores. Grossman had coded up semaphores and it was really, really elegant.

Misa: Can you explain semaphores so we can understand the context?

Day: Semaphores are the Dijkstra construct for doing concurrent control. You have two operations P and V. When you enter a critical section you P a semaphore, if the count goes negative the process blocks, otherwise it continues into the critical section. When the process exits it Vs the semaphore, if the count goes positive, if there is any waiting on

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the queue it is put in the ready queue. When you do this there is a context switch, which in the code comes down to a single assignment statement. The only thing you can point at in the code that is context switching is one assignment statement. Because P and V are perfectly symmetrical. You enter in P; you fall out in V. All the state saving that you associate with context switching is occurring as you enter the procedure. Procedure entry is doing it for you. It is really elegant. I remember reading the code for the first time and going, 'Oh cool!' (laughs) So we had this code review, Alex McKenzie, Roland Bryan, Vint Cerf, Steve Crocker, Jerry Birchfield, Ray Tomlinson, you know, all the usual guys.

Misa: That's quite a list of names.

Day: Right, all the usual guys. We're going through how the ANTS II design, how ANTS II works, and we come to the semaphore thing and Grossman goes through the code. And there's complete and utter, 'What? Where was the context switch?' 'Well, it was right there.' 'No, no, no, there's got to be more.' We spent three hours going over that one piece of code. We drew out the stacks to show them how it works and everything.

Misa: People didn't believe it, it was so elegant.

Day: Right, well, actually, I don't think they ever got it. I think it was one of those where they couldn't figure out what was wrong – because there wasn't anything wrong with it – but they never really got it. I never saw the 'Ah-ha!' The thing is, working on a

Burroughs machine with the ALGOL compiler which was a recursive descent compiler, we ate and breathed recursion. We thought in recursion. (laughs) We thought everybody else did too.

I remember one other thing, we were doing character time echoing for Telnet and things were slow enough that if we got more characters from the terminal before we could send, we would buffer them up and send them as multiple characters in a single packet. And I remember a conversation at one point with the guys from BBN and they were like, 'You do that?' 'Yes.' 'Huh, we tried to figure out how to do that and we couldn't figure out how to do it.' 'Really? It's hard?' (laughs) We did know this.

Misa: Multiple characters per packet, why would that –

Day: Well, telnet to a TENEX was [one] character at a time. You sent every character and it was echoed by –

Misa: Oh it's the echoing that goes character by character?

Day: Right. But if you happen to type and you get more, you just buffer up what you had and send it. I remember them going, 'You do that? Huh, we tried to do that and we couldn't figure out how to do it.' We all sort of look at each other like, 'it was hard?' We didn't notice. (laughs)

Misa: So it would echo just as a whole packet?

Day: You'd echo whatever you had. Everyone thought that character time echoing over the ARPANET in those days was a dumb thing to do because it was so slow. It was the operating systems that were slow. I remember using TENEX at home over the net and being able to type a line and a half ahead before I got an echo and actually I think most of the time that I stopped because I wasn't quite sure where I was. I'd lost track of where I was typing.

Misa: Now when you're doing networking, you said that ILLIAC was number twelve but it wasn't actually at Illinois?

Day: No, the IMP [ARPANET's Interface Message Processor] that came in Illinois was number twelve.

Misa: But was ILLIAC IV the machine?

Day: No, no, no. The whole idea of getting us an IMP and all that was because of ILLIAC. The fact that ILLIAC never showed up… I think if you look at the early maps there was an IMP at Burroughs, early on, for a while. But I won't swear to it. I'd have to go back and look at the maps [see April and August 1971 maps].

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ARPANET map (April 1971)

ARPA NET, APRIL 1971
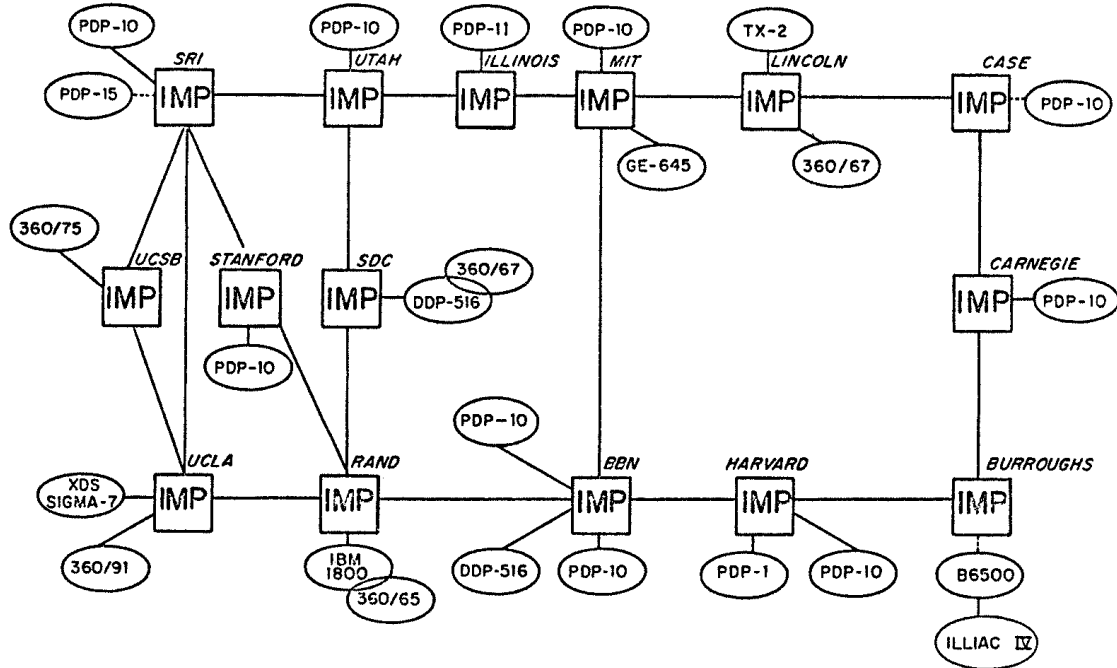
Source: <mercury.lcs.mit.edu/~jnc/tech/jpg/L71Apr.jpg> (July 2013).

Misa: Did you end up having significant work then on this remote support? Support may not be the right word, but the users of ILLIAC that were still on campus at Illinois.

Day: We had a large group of people using the net, in fact we were the largest user of some of the systems on the net. We actually went out and got people and really encouraged it. We had a big algorithms group of our own that were developing things. We had people doing energy research. I know there was a lot of work on economic types things where they were calculating on large matrices. The Physics Department, we were

the largest of the Rutherford High Energy Lab 360 in England. We were doing "illegal" transfers between CERN, Rutherford, and Illinois for Argonne over the net early on. (laughs) Well at least between Illinois, very early on. We were doing ERTS satellite data. Our energy group produced the – do you remember the W. H Freeman who published *Scientific American* produced an input output/matrix poster of the U.S. economy back then?

Misa: Yes.

Day: We produced the energy version of that. Actually I think we ended up killing nuclear reactors. Everyone thinks that the tree huggers killed nuclear reactors; that's not true. Our energy group did a study on the costs of nuclear power and came to the conclusion that the ROI was a negative 200%. The cost was 200% more than you made if you looked at the entire lifecycle cost. They went in and testified before a government committee… I think the AEC had been replaced by then but it was what ever its successor was.

Misa: NRC, the Nuclear Regulatory Commission.

Day: Yes, one of those. Probably it was EPRI [Electric Power Research Institute] the power companies went off and did their own study and came back and said, 'No, you're wrong. It's more like a 250%.' (laughs)

Misa: Negative.

Day: Negative. At which point suddenly you didn't hear people talking about nuclear power anymore. And I always thought that they sort of let people think it was the tree huggers that killed it, when actually they figured out that they were going to end up with a millstone around their necks and they weren't going to go there. That it wasn't cost effective. They certainly didn't want to admit to stockholders that they hadn't done the numbers.

Misa: In terms of nuclear power, the question is whether you also factor in not merely the front side but the waste side.

Day: It was the decommissioning that was the killer.

Misa: And that was something that both of your studies – your study as well as EPRI – did basically the whole life [cycle].

Day: I don't know that it was EPRI, but it is most likely. I just know that somebody told me a bunch of power companies; the power people went off and did it. Now I know that they would have been probably the ones who did it. So now when I hear people talking

about nuclear power, I'm going, 'Guys, two and a half times is a big number to overcome. I can't imagine it's gotten any cheaper, so what are you signing me up for?'

I'm forgetting half of this, there was just so much going on. As I said we put UNIX on the net in the summer of 1975. I went for my first network working group (NWG) meeting in March of 1973 in Boston at BBN [Bolt Beranek and Newman]. I went there in awe of all these big guys who were smart guys and sat there for the first morning and thought, 'Wait a minute, these guys aren't any better than we are. We're this good.' (laughs) So then I jumped in.

Misa: How did you get invited to that meeting?

Day: I don't remember. But it was an FTP [File Transfer Protocol] meeting. I don't think it was a question of invited; every site could send somebody. We needed to send somebody. By that time Grossman and I had pretty much divided up that he'd do the lower layers and I'd do the upper layers. So I went.

Misa: At one time you were a junior person under Grossman and then there is a relationship more like peer-to-peer here.

Day: There may have been a little bit of peer-to-peer but Grossman was always the smartest guy on the block. You heard me tell a story in the addressing talk of Grossman

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coming and saying Tinker [Air Force Base in Oklahoma City] was going to join the net. I figure Grossman had already figured out, what the problem was. He was just seeing if I was going to catch on. But no, Grossman was always the leader. Actually, when would it have been…getting timeline of this is really hard. Somewhere in there we did, we started building…we were building…they were trying to make ANTS something we could farm out and use in lots of different places and other people would use it. We actually did install ANTS in some other facilities, version one. I don't know if version two ever really got off the ground. We had lousy management. Nobody knew how to manage software in those days. We really didn't want to; we wanted to write code. As I said, Grossman was our leader. We had some really bad managers. Actually at one point, probably about 1970, the Burroughs 5500 we had blew the power transformer and the Burroughs FEs [Field Engineers] told us if we could get it out of the building, we could have it when they replaced it. So for a long time sitting around our offices we had this transformer which is about yeh square, stood about this high and weighed like 300 pounds.

Misa: You're saying eight inches square, two feet high.

Day: Yes, two, two and a half feet high. But it was *solid* iron. It was heavier than hell. And at some point that became the Dead Weight Award. (laughs)

Misa: Who would get the Dead Weight Award? It doesn't sound good.

Day: The assistant director of the center got the Dead Weight Award. He came into work one morning and found this thing sitting on his desk. Not in front of it, on it. (laughs) We actually ran a contest in the newsletter of the group for nominees for the Dead Weight Award. Of course we all knew who was going to get it by the time we started. And one morning he comes in and finds this thing sitting on his desk. (laughs) Which of course is not easy to move.

Misa: In the early to mid-1970s – 1973, 1974, 1975 – what were your formal responsibilities?

Day: Writing code.

Misa: Not doing software management.

Day: No, no. I mean not really. Once in a while I had one guy working with me or something; but not really as a manager. When I went to the FTP meeting I came back and did that first file access protocol design that Ken [Pogran] actually implemented on Multics. There is an RFC on that, some place an early RFC.[9]

Misa: We can look that up. They are available.

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[9] See RFC 520: John Day, "A Proposed File Access Protocol Specification" (25 June 1973) at <tools.ietf.org/html/rfc520>.

Day: But at one point the management got so bad – Oh and they also were looking around for money and they wanted to do stuff that was classified and we refused to do classified work. So we had what became known as the Great Proletarian Programmers Revolution.

Misa: 'GPPR'. I am writing it down.

Day: Actually, at one point I had posted in the machine room the picture of Chairman Mao standing by the sea. I know there was an incident when the Dean of the Graduate School came through on a tour. And he looked at that poster in the machine room and he goes, 'Nah, I'm not even going to ask.' So we had told them we wouldn't do secret research. I can't remember exactly how all of this played out.

Misa: There was no campus wide ban?

Day: No, there was no ban. We just thought it was a bad idea and we didn't want to have things we couldn't talk about. We had a big meeting. We decided that we couldn't work with the current situation.

Misa: 'We' being the programmers?

Day: The programmers.

Misa: And about how many of them?

Day: Ten or fifteen. Maybe less, maybe only about ten. But anyway we were the programmers. Grossman walked into Hugh Folk's office, who was the director of the center, and said, 'You either do this or we quit.' That was to fire our boss. We designated who we wanted as our boss – well actually we took the guy who was our boss and said he can do this but he can't be our boss. We spelled it out, who we wanted to be managed by, etc. He ended up quitting.

Misa: Grossman wasn't the person designated?

Day: No, Grossman was not the designee. He didn't want the job. Although Grossman was de facto the manager in any case because he was the one we all took instruction from. That went on for some months and then when Gary was on vacation, they pulled a fast one and said, 'We are going to do secret research or classified work and it's going to be da-de-da.' Since Grossman was on vacation we decided we'd sit tight until he got back. So they thought the whole thing had blown over. Grossman comes back on a Friday or something. We had a meeting at Gary's house on Saturday. Eight o'clock Monday morning Gary walks into the head cheese's office and tenders the resignations of the entire group — with a DOD group showing up to discuss the contract that they are going to do at 9. (laughs)

Misa: Well, that's a moment of decision isn't it?

Day: We played hardball.

Misa: You never expected the resignation to stick?

Day: No, actually it did for some. That's when Grothe left the group and went off and formed his own company called Gcom which he runs to this day in Champaign. I don't remember exactly how that sorted out but we all continued to work there but none of us ever did secret research. I've never had a security clearance in my life. At some point along in there, as I said, December of 1975 we put Unix up on the net. We then stripped down Unix and put it on LSI-11 [a one-board version of the PDP-11] with a plasma screen and a touch panel, so it was sort of an intelligent terminal. We were using it to go through our PDP-11/45 and access the net and do databases on either coast. This was a really cool system. We did a land-use planning system for the six counties around Chicago where basically you didn't need a keyboard. You'd just touch the screen. We'd draw maps. You could shade maps and display data, combinations of population data and all sorts of stuff by just manipulating the screen. I wrote the map drawing software for this.[10]

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[10] *JD adds:* We were still working on ILLIAC IV at the same time. Grothe had gotten in "trouble" for leaving files on the machine in Paoli that had a file name that was, shall we say, not exactly clean. So in protest, I called my mapping software, Universal Mapping Utilizing The Heuristic Approach (UMUTHA).

Misa: And the plasma screens were from?

Day: From [Don Bitzer's] PLATO. Yes, extra plasma, yes go over and get a couple. (laughs)

Misa: That would not have been easy to get somewhere else.

Day: No, no. The only place you can probably – And you know we found somebody who had a touch panel we could put over the top of the whole. We stripped down Unix so it would run on an LSI-11 and had it all up and running. In fact we even did a version of that for CINCPAC [Commander in Chief, Pacific].

Misa: Did you have any other contacts with Bitzer and the PLATO group?

Day: Some did, some didn't. I didn't. There was a little bit of rivalry between the two groups. I know when they were implementing the next version of PLATO about this time that [Peter] Alsberg had done a back of the envelope calculation that told them when it was going to fail. And he hit it on the head. It was a bit of an embarrassment for Bitzer and company.

Misa: When was this going to fail? Can you explain that?

Day: It wasn't going to scale. He said, 'They'll run into problems when they hit this many terminals.' And Peter nailed it. The fact that they got caught flatfooted didn't put them in a very good light.

Misa: Now everybody thinks about networks, at that time networks were something that was new. People weren't thinking about congestion.

Day: Well, you didn't have to think about congestion. This was not about networks but how many terminals a PLATO machine could support.

Misa: Was it a different kind of calculation?

Day: No, the Arpanet was built with very tight flow control. The way the [IMP] system worked, basically you didn't accept a packet until you had a buffer to put it in. There was very tight congestion control in the Arpanet so it was not a problem. You had the Christmas lock up of course. Which was predicted, according to Phil [Philip H. Enslow] they had predicted that would happen. Basically, a packet or a message on the Arpanet was up to eight packets. The story goes that Christmas Eve [sometime in the] 1970s, one of those early years, they guys at the Network Measurement Center at UCLA were about to go home. Well, it's five o'clock Pacific Time on Christmas eve, nobody else is working for the most part. This is the closest we're going to see to a quiet network, [so

somebody asked:] let's see what the state of all the IMPs are. So they told all the IMPs to send them essentially statistics messages which were multi-packet messages. They start coming in and you end up with the IMP in front of the Network Measurement Center having a number of packets partially reassembled and not enough memory to finish any of them. So it locks. Which of course means the ones that feed it lock, which means of course it propagates right back across the country.

Misa: That's the consequence of this tight congestion control that you can't take anything in unless there is a place for it.

Day: It was a packet not a message; [then] you didn't reserve a whole message. But for the most part that was not a problem. Also the 56 Kb lines were faster than most processors could drive them. Processors were really slow in those days.

Misa: You always see the 56Kb as being unimaginable slow but not for the processors of the time.

Day: In those days you saw 56Kb as being unimaginably fast. It was lightning speed. NPL net and CYCLADES were built with 9.6. Okay? I don't think loading factors in the Arpanet were seldom over 20 percent.

Misa: That's a suggestion ARPANET was somewhat underused.

Day: It was over provisioned. We didn't have the compute power on the net to fully

utilize it.

Misa: Over provisioned but then the question was who would be actually using it?

Day: Well, but you were supposed to be moving all this data. The machines had a hard

time – I mean you might be able to set up a bulk transfer and really go at it but for the

most part it was hard to do. It wasn't done much on a sustained basis. That was not a real

problem.[11]

Misa: Should we take a break and plan our next session?

[Second session]

Misa: John, let's identify some of the major turning points in standards setting. I think

we will be careful to not go into each one of the episodes in detail. Today our time is

somewhat constrained.

Day: I went to my first INWG [International Network Working Group] meeting in, I

think, 1975, held with the NCC or National Computer Conference or whatever in

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[11] *JD adds:* It is also about this time 1976 that I was trying to figure out how to do semaphores in
a network and realized the problem was the same as updating multiple copies of a database. This
lead to Alsberg and I publishing one of two algorithms on how to update multiple copies that is
cited (and misquoted) to this day. We did quite a bit of work on distributed databases during this

Anaheim. I remember sitting there all day and listening to stuff and talking and everything. It's where I get one of the quotes that's in the book.[12] As we were walking out of there they fired off a rocket from Vandenberg [Air Force Base], we saw it going up. Alex McKenzie asked me in the parking lot what my interest in the meeting was and I said, 'Upper layers.' He said, 'Well, we got telnet and FTP what else do you need?' (laughs) I always remembered that.

Misa: Besides telnet and FTP what layers could there be?

Day: What else could you need? I was like flabbergasted. I was like where should I start? At least I thought so then. But really right after that we found out – we already knew about X.25, a lot of those people were a lot more clued in than I was. You have to remember I'm still running between being a college person with a degree and getting exposed to all of this. By this time I'm getting exposed to John Cage and all this stuff is going on and there is still a lot of Kinmundy [Illinois] left in this kid. (laughs) I mean in this period I can go to Chicago for like six or eight hours and the confusion level gets to me. And of course Boston is just like, what the heck? Not only is the confusion level high and all this commotion and sensory overload but nothing sits square with the world. (laughs) This is a new experience to me.

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period as well.

[12] Day, *Patterns in Network Architecture*, page 97.

Misa: Right, because University of Illinois was diverse and intellectual and on and on, but not metropolitan and not urban.

Day: Right, exactly! (laughs) And a great way station for where I was coming from. Had I gone to the University of Chicago or Cambridge from Kinmundy, I would have probably collapsed in the first two weeks. But anyway, we start finding out about X.25 and the senior guys, like Louis Pouzin and everybody are going to ITU meetings and lobbying and I'm seeing all the papers and reading them. I know in 1975, when the first version of X.25 came out we had developed an outline form for specifying protocols informally. We treated them like a state machine, for every message type we'd say, 'When is it sent? Action upon receipt.' We developed what we called robot prose; you say the same thing just change it as little as you had to to make it work. It was completely unambiguous. We were really big about that. Also at the same time the book *The CIA and the Cult of Intelligence* [1974] came out and remember that the CIA took it to court and made them delete a lot of sections. Rather than reedit the book they just left blanks where the sections they had had to take out where.[13]

Misa: Well, that's the best thing to do, either blank it out or black it out so that you are honest.

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[13] *JD adds:* I have left out that in the summer of '76, I moved to Houston so my wife could post-doc at Baylor and I continued to work at Illinois and commute over the Net.

Day: And you know that – right. And also stuff that was contested but they were allowed

to keep in was highlighted in some way. So I did the same thing with the X.25 spec. I

took our outline form and I took the X.25 document and I cut and pasted it into that spec

to illustrate what wasn't there. That was one of the exercises we did. But at this point we

are going to meetings, INWG [is] holding meetings in Toronto and elsewhere. We're

meeting on transport and virtual terminal and all this stuff. In 1977 I made my first trip to

Europe to attend an INWG working group on virtual terminal that we held at INRIA

[Institut National de Recherche en Informatique et Automatique]. We worked for three or

four days, for a week on producing the virtual terminal spec. Again Grossman's doing the

lower layers and I'm doing the upper layers, so Grossman's working the transport

protocol and he's attending those meetings and I was doing this one. Actually, it's a

pretty elegant virtual terminal protocol we came up with. It was a base protocol to which

there were extensions and procedures for adding extensions. You could build up the

complexity. All of that fed into – and then of course the transport meeting is held in

London in late 1977. André Danthine publishes that in his protocol conference in

February of 1978. Grossman and I went to the fourth Datacom symposium, now called

SIGCOMM, which must have been 1974, somewhere in there. That was a really neat

meeting. It was held in Quebec City. Everybody was there and there were dynamite

papers. Alex McKenzie gave this paper on managing the ARPANET. Louis [Pouzin] was

there, Hubert [Zimmerman] was there and Danthine was there. All these people are there

and every night we are all going out to dinner. Louis and Andre are finding restaurants

for us. The food is fabulous. I remember we were coming back for a birds-of-a-feather

session one evening after dinner we had to get back. Andre had arranged this one. We were all at the restaurant called l'Ancetre – the ancestor – in the old part of Quebec. We finish dinner, we pay the bill, and at exactly that moment there are three cabs sitting outside waiting for us. We all troupe out, jump in the cabs, and head back to the hotel which is the new Concorde just outside the wall. Grossman and I were in the cab with Danthine and we had this bizarre cab driver. We are coming out the street that runs through the wall, the main street there along the "Plains of Abraham" to the hotel. We're coming up to this red light and the cabbie is going full tilt and is going to have to turn left. All the sudden the cabbie pulls into the left lane heads right at the oncoming traffic. (!) At the last possible second the light turns green, he turns left. He had it timed to the second. Grossman and I are in the back seat just howling in laughter. I remember being in those sessions and the AT&T guys are worried about how many central offices we are going through and all this stuff, for errors and things. I happened to have just read one of the papers before I came to the meeting and I pointed out that the noisiest lines — and actually to answer your question I didn't know it at the time, I didn't know the phone system that well at the time — the noisiest line in the net wasn't Illinois to Utah. In fact that was one of the least noisy.

Misa: You are talking about electrical noise?

Day: About bit errors, detected bit errors. The noisiest line in the net was Rome, New York, to Boston.

Misa: For any special reason?

Day: It probably went through some of the oldest equipment in the country and it probably did go through more central offices than any other line. The line to Utah probably went through a central office in Champaign, a hub in the 'burbs of Chicago and then a straight hop to Utah. If I had to guess. (laughs) But that was a great meeting. That may have been the first time I met Louis. I thought he was great and Hubert and Michel Gien and all those guys. They were our kind of guys and we fell in with them very quickly. So we were doing stuff with them all the time. So we had a lot of stuff going on with those guys. As I said the other day, once INWG makes a decision on transport at the end of 1977, unbeknownst to me this whole thing is going on in SPARC and ANSI and the ANSI community. INWG is purely the research community, as I remember it. It was [NPL]; it was [EUnet] and people from ETH, and Gregor Bochmann from University of Quebec; it was primarily the research world.

Misa: So none of the big computer companies?

Day: No. We'd have to look at the list but I don't remember the players as being anybody but ARPANET people, CYCLADES people, NPL [National Physical Laboratory] people, UCL [University College London]. When I say NPL I mean the Brits, but that was mainly UCL – you know Peter Higginson and I'm drawing a blank, the guy who was a

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senior there, his name is on a lot of the early papers – and NPL, [Donald] Davies and all these other people. That's another story. I think it was the IFIP Congress in Toronto in 1976. One of the events was an evening at the Ontario Science Center and one of the things they had was an interactive display where you pull levers to set logic gates to make a ball fall through. I don't know if I took a picture of this or not, but I came around the corner and found a little nine-year-old boy standing there trying to figure out what levers to pull and standing behind him are Alex McKenzie, Vint Cerf, and Donald Davies telling him what to do. (laughs) And I'm standing there thinking, 'Kid, if you only knew!' I don't know if I took a picture or not but it was one of those moments where you wanted a picture!

Misa: Can you say something about the social environment of the networking community?

Day: It was very collegial at that point. At least it seemed so to me. It was very collegial. Everyone is trying stuff. Everyone is interested in the problem. Now I may have been naïve but I didn't sense a lot of ego during that period. I didn't really sense that anybody was trying to outdo anybody else. There was a lot of 'what's the right answer?' I remember that first FTP meeting, where we started the FTP we have now, of us going, 'Okay, now I think we're starting to get this right.' We never got to but I think people were trying to find the right answers to things. We were pushing this not because it was

ours but because we thought it was the right answer. The connection-oriented thing was just too rigid, it wasn't going to scale.

Misa: X.25?

Day: The X.25 approach. It was in my estimation, and there could have been a lot of undercurrents that I wasn't aware of, but it seemed to me to be very collegial. People would come up with things. and other people would incorporate them very quickly just because we were all trying to figure out what was the right way to do this.

Misa: And this was through the mid-70s at least?

Day: Well, it's up through 1978. Now all of that said, there is this undercurrent going on that is not part of INWG which is the connection-oriented world. The phone companies are against this and they are writing things against this. Of course this is when Louis is running around – I remember there was a famous talk, it may have been at this IFIP Congress. There were two meetings in Toronto on successive years. I remember one of them Louis is getting up doing his anti-X.25 talk and Louis had these wonderful hand drawn slides that he always did and this one had one of a castle labeled 'PTT' and hanging out of one of the parapets of the castle is a hangman's gallows and a user is hanging from the noose. (laughs) Louis is railing against why X.25 is a bad idea and we don't want to do it. It was a huge hall, ballroom sort of thing at the York hotel in Toronto

that's near the train station downtown. The place is packed; there must have been three hundred people in there. It was a panel and Louis was the last speaker. The session is running late, so Louis is running over time. There are people coming in the door for the next session, they're lining along the walls. The moderator stops Louis and says, 'Louis you are running over.' Louis says, 'Well, what do want me to do?' And the crowd spontaneously says, 'Go on! Go on!' (laughs) In the front row there are these PTT people taking notes furiously. It was these kind of speeches that gets CYCLADES shut down. About this time is when the Nora-Minc Report [1978-80] is written which outlines several pilot projects that should be done by France. His top guys all end up in charge of –

Misa: You said the Nora-Minc report; you've got a complete copy in one of your boxes.[14]

Day: Yes, a complete copy with all the supporting stuff. And basically Louis gets sidelined. (pause) He, to a large extent, becomes persona non grata.

Misa: Why?

Day: Because well, first of all CYCLADES was an embarrassment to the PTTs because they built a successful network and PTTs hadn't been able to. In fact, Hubert goes to work for the PTT to help them figure out how to build networks correctly. I remember

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[14] Simon Nora and Alain Minc, *L'informatisation de la Société* (Paris: La Documentation française, 1978); John Day papers, Box 10 <purl.umn.edu/52604>.

very soon after that we were probably in the early 80s, Hubert had asked me to review

protocol specs for Minitel, in French. (laughs) But basically Louis had embarrassed them

and he was not touting their party line and they came down hard on him.

Misa: You said that there was a turning point in 1978 or so?

Day: Yes. That's the one that Andy [Russell] wants me to take a look at it some time. If

you go read the stuff, Steve Crocker asked Vint [Cerf] to start INWG, INWG becomes

IFIP working group 6.1, the purpose of that is to promote TCP as an international

transport protocol. In 1978, INWG IFIP 6.1 chooses a synthesis of CYCLADES TS and

TCP as the international transport protocol. (Although it looks very much like TS.) Now

the reason they did this, I was told, was that they needed something that would operate

over X.25 as well as something that would operate over something like IP. TS would,

TCP wouldn't.

Misa: TS *would* interoperate?

Day: It would operate over either one. IP wouldn't and Vint was unwilling to change it so

that it would. So people voted for TS. There was something else in there. They basically

took their ball and went home. Basically after that –

Misa: So, Cerf was more or less saying 'we won't deal with X.25'?

Day: Right.

Misa: That's a pretty strong formulation.

Day: Right. Of course the Europeans, given the situation, had no choice; they had to deal with it.

Misa: Because of the PTT –

Day: PTT dominance, yes. They had to get lines from the PTTs. Also the fact that at the time we believed that the overhead was unacceptable to run TCP over IP over X.25. Now I wrote – there was a discussion on the Internet History list back a number of months ago now where there was some discussion of this. I said: It's real interesting that that was the interpretation in 1978 – that it was too much overhead to do that – but by probably five years later when OSI had analyzed the network layer and had decided that X.25 was subnetwork access protocol at 3A and that IP was subnetwork independent convergence or that there was a protocol of subnetwork independent convergence at 3C, at the top of layer three, that we actually ended up with exactly that configuration of a transport over a datagram protocol over X.25. And then how in a few short [years] what had been unacceptable overhead was now considered the right way to do it.

Misa: An unacceptable overhead, can we pin that down?

Day: Well, three protocols stacked on top of each other instead of two. But then of course I went ahead and described the fact that since IP names the interface, that it was at layer 3A along with X.25. Okay? Not at layer 3C where they think it is. Now I didn't say that but I put it very nicely.[15] And I threw it out to the list and even though Noel Chiappa and Vint had been commenting on this topic, once I put out that note there was a deafening silence. Because I had just written out nice chapter and verse for essentially what I said Wednesday [i.e. two days earlier at a talk at University of Minnesota's Digital Technology Center] that the internet protocol was not an internet protocol, that it was the same level of X.25.

Misa: At the same level . . . ?

Day: Over it. Right. Because it names the interface, X.25 names the interface, well, where else could it be? Right?

Misa: That there had been discussion but once that point came up then –

Day: Once I said that no one commented on it *at all*. (laughs)

Misa: Which is one of those significant silences.

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[15] See the posts of Day, Cerf, and Chiappa at <mailman.postel.org/pipermail/internet-history/2009-November/author.html#996> (March 2011).

Day: Yes, right. So at that point, I don't think we knew it then, but I was talking Andy [Russell] last night and he says, 'If you look at the attendance list of IFIP, the attendance changes significantly after that.' Because with all that stuff done most of those people either go do something else or go work on OSI. As part of that fall out –

Misa: This is 1978?

Day: 1978. Because the INWG transport meeting is in late 1977; stuff is published at Danthine's conference in February of 1978; the first OSI meeting is March 1978 in D.C. where we adopt Charlie Bachman's seven layer model. There are three working groups: architecture, upper layers, lower layers. Hubert is in charge of architecture. I can't remember but I think John Newman was in charge of WG 3 [working group] or maybe it was Hal Folts. I don't remember who was in charge of working group two. I want to say Lloyd Hollis but I could be wrong about that.[16] I know he was in charge of the U.S. group. Hubert [Zimmerman] sometime after that, probably September-ish, calls me up and says, 'Would you take the chair of formal description techniques in architecture, come to the two week meeting in Paris in October?' I said, 'Hey, this sounds like fun!' So I go to that meeting as a Liaison representative from IFIP; that's the meeting – I think I told you that story. So I started organizing that, that becomes the annex E of the first versions of the reference model where the FDT [?] stuff is laid out. In the meantime I am also participating in the discussions on the reference model itself. That meeting culminates in the – the first meeting produced SC16/N46 as a version of the reference

model. The second one produces SC16/N117, that's the one where we had been editing –

I was staying at Michel Gien's house and Michel and I were upstairs at AFNOR

[Association Française de Normalisation] editing documents until about midnight at

which point we gave up because nothing we could do could be copied and incorporated

anyway. So we gave up about midnight. I was using a French editor, you know it was one

of those things where you know all the commands there you just don't know what they're

called. You just fake it. (laughs) So we went home, went to bed. They continued working

collating the documents, getting the documents ready for the next morning until 4 a.m.

There were eight of them and they finish at 4 a.m. and find themselves locked in Tour

Europe at La Defense. Finally Hubert finds a way out by climbing through a window

someplace or something. He gets them out of the building puts everybody in his "deux

chevaux" [a small Citroën 2CV]. Eight people in a "deux chevaux." One of them is

Charlie [Bachman] who is over 6 feet tall, Don [Sheppard] from Canada who is a pretty

burly guy too. And Kenji Naemura from Japan (who had gotten his PhD on ILLIAC IV)

and Tilly Bayard who was our WG 1 secretariat and I forget who all else but there were

like eight people in this deux chevaux. Zim takes them around to their hotels, drops them

off and we're back by eight thirty the next morning. I have pictures, we don't look good.

(laughs) But this was not uncommon. I mean SC16 meetings were long hours. You were

constantly on the run. At some point after that I may have gone to at least one or two

ANSI-SPARC meeting after that. But at some point then, they start to form X3T5 as the

U.S. OSI committee with Jerry Foley as the chair and –. Richard desJardins is the chair

and [John] Aschenbrenner as the international rep. They asked me if I would chair

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[16] *JD adds:* It was Alwyn Langsford.

architecture and Lloyd Hollis was chairing upper layers and Neumann was chairing T56 which was the transport layer. Actually, I caused – and John Neumann never forgave me for this – I caused the U.S. to vote 'no' on transport the first time. The spec was in terrible shape. It was un-implementable as it was written. It took a little theatre to do it. I knew what I was doing. I wrote about a page and a half contribution that laid out that the spec was in lousy shape, that this was our first implementable standard, and it had to be good.

Misa: Because people would start building . . . ?

Day: People would point at it as lousy. The [OSI] reference model could be flaky as heck but there was nothing there to build; that was okay. But this had to be good. There is not even a state diagram or a state table in this protocol spec. How can you even consider it to be? Well, we went to the U.S. X3T5 meeting at CBEMA [Computer and Business Equipment Manufacturers Association] and I purposely withheld the document until the discussion of the vote came out, because I didn't want to give them time to think about it. So when the discussion comes up, I said, 'I have a comment.' I passed it out. Everyone sat there reading it. I remember Lyman Chapin leaning over to whoever was next to him [desJardins] and going, 'Well, he's right.' (laughs) When we started the vote was going to be 17 to 1 to pass it. Five minutes later the vote was 1 to 17 against. Newman was pissed. But it was necessary; we had to have a good document.

Misa: Your sense was this was not an implementable version?

Day: Right. It was something people could point to. But again, had I handed it out at the beginning of the meeting, the day before, or whenever the meeting started, things would have edged around and it wouldn't have made much impact. The way I did it was guaranteed to maximize the impact.

I started chairing X3T51, as I said the other day, when I took the chair of T51 I was ten years younger than anyone else in the committee. In most cases fifteen years younger than anyone else in the committee. But yet I had probably more experience with using a network than anybody else in the committee. Because everything else had been terminal, datacom networks up to that point, so I was one of the few people that actually used a packet switched network. So I was chair of the reference model.

Misa: That's the architecture level, right?

Day: Yes. I was chair of that for most of its existence up through the early 90s.

Misa: It's beginning when approximately?

Day: 1979/1980, probably. I don't know you'd have to look. I don't know if it was late 1979. (I attended the first two SC16/WG1 meetings as an IFIP representative, so it had to

be after that.) I know it was after the October meeting. There is not much time after that

so it's probably 1979. It may have been even later. I'm guessing it was before the next

London meeting in June. But it might have still been SPARC at that point.[17] Between the

1978 meeting and the 1979 meeting I reorganized the draft document and submitted that.

It wasn't adopted in total but it's basically the structure that we have now. Somehow

along there (by 1982 or so) I ended up as the rapporteur for the Reference Model and also

that kind of made me – I became sort of even though there was no such position, I was

Zim's [Hubert Zimmermann] assistant chair of the architecture committee. If you

couldn't find Zim, you found me. And when Zim couldn't be at something that the chair

of working group one needed to be at I was the one who went instead. That's how I

ended up with a name plate that says, 'Jean Jour, AFNOR.' (laughs)

Misa: Two sides, two halves, for different roles.

Day: The two-sided one. Right: it was John Day, U.S.A. on one side and Jean Jour,

AFNOR on the other side. Then it was just a question of doing it. 1982 I left Illinois and

came out to Boston and worked for Charlie Bachman for two years.

Misa: You worked for Charlie?

Day: At Cullinane. He had left Honeywell and went to Cullinane for two years before he

formed his own company. When Charlie formed his own company, I decided not to go

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[17] *JD adds:* This is wrong, X3T5 was probably formed before the 1980 meeting in Berlin.

with Charlie and I went to Codex.[18] So we were just doing it. There were a number of

games that got played in through there. I got the T5 1 stuff really organized, as I said the

other day. The way we would process things in working group one [was] we had new

work items that were new things we were starting, and then we had questions that we

were answering about the reference model. And those became either new projects or they

became the commentaries on the reference model, and there was a commentaries

document. When contributions would come in, I'd make a copy. One set I'd file by

number and the other set I'd file by question or topic that they were related to. I kept

those in a binder and when we got ready to go to international meeting I'd just copy the

binder and give copies to all the US delegates who were going to SC21/WG1. We'd go

through it at the meeting before and determine what our U.S. position would be on each

of those questions.

Misa: The document itself though is specifying the position, not the individual person.

Day: Right. Well, it was an agreement amongst the committee as to what our position

would be and of course you had to be somewhat flexible but by the same token you were

expected to support the U.S. position. ANSI or X3 had a rule which I've always thought

was a good idea which was to go to an international meeting you had to be at the last two

out of three U.S. meetings.

[18] "Codex in Brief";
<www.historyofcomputercommunications.info/Organizations/Startups/Codex/CodexHome.html>
(July 2013). See also James Pelkey's interview with John Day (11 July 1988, Canton, MA) at
<www.historyofcomputercommunications.info/Individuals/DayJohn/InterviewJohnDay.html>.

Misa: So that you picked up not only the formal stuff but the informal stuff.

Day: You knew what was going on, yes. In fact to be a member of the committee, you had to be at two out of three meetings. I always thought that was a good idea. When people would ask me 'how do you join?' I'd say, 'Show up.' (laughs) That's the way you join.

Misa: Conversely if you don't –

Day: You're not! It was an incredible amount of travel. As I said the other day in the talk [see above], when [OSI] was going there was a national meeting or an international subgroup working group meeting of some kind every month, if not multiple meetings per month, every month of the year. Every nine months was an SC16/SC21 meeting that lasted for two and a half weeks. During those meetings you were on fourteen hours a day or more. Meetings would last ten hours a day, you'd go get dinner, you might have a nice dinner but then you'd come back and you either were beating stuff out with people or you had documents you had to write overnight for stuff the next day. It was very intense.

Misa: How did this interact with your job responsibilities? It was a huge commitment of time.

Day: Actually, because I was fairly well organized about it, the only time I had that kind of commitment was when I was there. When I was home I didn't have to spend too much

time on the standards stuff. Then it wasn't terribly intense. I might write a document or a contribution once in a while but I could do that in the evenings so I was mainly doing product stuff during the day.

Misa: But the extensive traveling would also be against either your company's time or your personal time.

Day: Yes, that was a problem. Well, now wait. Yes, but now when I said that there were all these meetings, I didn't go to all of them. The only things I would go to were my U.S. task group and working group one meetings. I didn't try to go both of them. I know some people like Lyman Chapin who were going to those meetings and going to IETF [Internet Engineering Task Force] meetings. I didn't even try to do that. I knew people that were going to the ISO meetings, the NBS workshop meetings, and the IETF meetings. I didn't even attempt to do that. And there were people going to CCITT [Comité Consultatif International Téléphonique et Télégraphique[19]] meetings at the same time. I don't think I've ever attended a CCITT meeting. I just really held my travel to what I had to do. Even so there were restaurants in Washington, D.C. that thought I lived in the neighborhood because I was there often enough. (laughs). I walked in one time and I remember them saying, 'Oh we haven't seen you for a while.' I said, 'Well, I haven't been in town.' 'What? We thought you lived around here.' When that happens you know you've been

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[19] CCITT was formed in 1956; renamed in 1993 as International Telegraph Union's Telecommunication Standardization Sector.

traveling too much. As I said the other day, the politics were intense. People were

playing all sorts of ugly games.

Misa: Can you say something about the tactics?

Day: Well, you try and stack meetings. People would try and slip things in overnight.

There was one time an entirely new 50 page section appeared overnight before the

Plenary where it was to be approved. IBM was always trying to stonewall, slow stuff

down. There has been a lot of talk over the years about people wanting to speed up the

standards process, and I just laughed at them because I really began to realize there is no

way to do it. The larger the group the more time it takes to get agreement. It is a

socialization process. I was guilty of some of the stuff too. I think I told you the "Boston

seven" story. We had a lot of discussions early on in the [OSI] reference model about

naming address and we weren't getting anywhere. We had called a halt to it. We were not

going to bring this subject up anymore for a while. Later it started to come up again and I

began to get the impression that some people actually had some pretty good ideas. I

thought we could make some progress but there were some people that were pontificating

and getting in the way and stuff. So the day after New Year's, 1983, I called a meeting in

Boston and I invited seven people who I knew would disagree but get something done.

We met for two days, knocked out a document, wrote it up, brought it in to [X3T5] and

we all said, yes. And IBM was pissed as hell because they hadn't been invited to the

meeting and we out voted them. But it got it off the ground. I remember the first time we

had a naming addressing meeting then after that which we got the new work item

approved it was in D.C. By this time I'd begun to understand the flow of these meetings.

Everyone had contributions into the meeting to start with and we spent the first day and a

half just going around the table and letting people talk and comment on the contributions.

I remember people coming up to me and going, 'Are we going to get anything out of this

meeting? I mean this isn't going anywhere.' 'Just bare with me,' [I said].

Misa: Because it appears that it's just chewing up the time.

Day: Right, but you need to get everybody sensitized to what everybody else is thinking.

End of the second day, I went up to the white board and I said, 'Guys from what I've

been hearing these are the topics I'm seeing. This is what we need to cover. I want to

break you up into groups and each of you produce a piece of this based on what we've

heard.' Now they've all been sensitized to what everybody else is thinking, they know

what they can get away with. By Friday, we walked out of that meeting with 90

handwritten pages as a first draft. I've watched that process happen time and time again.

You have to let everyone talk, rummage around, get an idea and then you can sit

somebody down and start coalescing. You get a draft; it's not perfect. The next meeting

you start to refine it. People are bringing in more contributions and stuff. But you have to

give them time to get used to each other.

Misa: Standard setting is some kind of consensus building or consensus finding or whatever; you can't just do that in an efficient top-down process.

Day: No, it's not efficient; it can't be. Also because you need people to go off and write stuff. And everyone needs to hear what everyone else's concerns are so that when you go to formulate what you're going to put into it you know what you have to take into account.

Misa: Are there mechanisms that help facilitate people listening, not only having a chance to talk –

Day: Yes, I mean if you just let people – generally if it doesn't get too raucous. So we would do things like that. I had done this in 1977, I'd been asked to be on the National Commission for Libraries and Information Science (NCLIS) task group. Since books are a weakness with me, I said, 'Yes, I'd like to do this for you guys.' What we came up with was the precursor to Z39. I watched that process there where we had OCLC and Ballots and New York Public. Was it Ballots? [Yes] There was a library cataloging thing at Stanford.[20] Anyway there were three or four big heavies that didn't trust each other. And I watched the Stockholm syndrome take place.

Misa: Where you identify with –

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[20] The Stanford University library automation project was called BALLOTS (Bibliographic Automation of Large Library Operations using a Time-sharing System).

Day: No, no, they all come into it being suspicious of each other but after beating on each other and doing stuff together for a while, by the time they finished that first draft (which didn't really standardize much) they were willing to put more into it and have more commonality. They were willing to work together more. I watched that process develop with those guys. I knew I was going to going to go off and do other things, I was not going to go do library protocols for the rest of my life. So I saw myself purely as a facilitator and as the network expert that said, 'No don't do that do this,' to help them along. Then there was the museum one later. (laughs)

Misa: The museum one?

Day: Yes, did I tell you that story?

Misa: I don't think so.

Day: I got involved with museums later on in the late 1980s when I was doing research on the Matteo Ricci map. I was spending a lot of time at our local museum. I happened to see something go by in one of the magazines about museum software. So I was sort of curious about it and one of companies was in Chicago and I was working for Motorola, I was in Chicago all the time. So I called up the woman who was in charge of the company and said, 'I saw your thing, I'd like to come by and talk to you about it; just sort of

curious.' Finally we hooked up and she said, 'Come by my house in Wilmette.' So I went by and we are sort of chitchatting before we start and she says, 'I got all these books on cognition. I'm really into cognition things. This was a big thing I was into at Illinois, when I went to school in Illinois and I studied with Heinz von Foerster.' I said, 'Yes, so did I.' She says, 'Well, we did something called the Whole University Catalogue.' I said, 'Yes, so did I.' (laughs) We'd been in the same classes together. We completely didn't recognize each other.

Misa: Didn't recognize the name or anything.

Day: Right. (laughs) Well she was married, she changed her name. So we got to be good friends. Later, she knew I did standards but she did not know which ones. So they start this museums standards process. She invites me to come to a meeting at the Smithsonian. There is this guy in the group who is a technical guy lording it over all the museum people who are very computer averse. She doesn't know that I'm doing OSI standards; she just knows that I do standards. I know that they are going to be talking about OSI standards. I also know he is going to try and do the, 'Yes, yes, you are a technical guy but you don't really understand *our* problem, the museum/library problem.' So I show up late on a Sunday morning to this meeting, sit in the back of the room. The guy's assistant gets up and starts explaining the whole OSI stuff. Well, the whole OSI thing and the relation to ANSI and everything is so complicated unless you're in it you don't really understand it. You don't get it right. And he's getting confused and so finally I raise my hand and

said, 'Let me try and clarify this.' And I went through the whole rigmarole of ISO and the relation to CCITT and how the relation to ANSI works and which committees are doing what and all this stuff. And I stop. My friend was co-chairing the meeting with this guy and she says, 'John you should probably introduce yourself.' I say, 'My name is John Day. I work for Motorola. I'm rapporteur of the OSI reference model. I'm in charge of strategic planning for OSI. And many years ago I was on the NCLIS Task Force that came up with the pre-cursor to Z39.' She says, 'Aren't you affiliated with a museum?' I said, 'Yes, I'm advisory curator for East Asian studies for the Kendall Whaling Museum.' This guy's got no place to go. I have impeccable credentials on everything he wants to say I don't understand. (laughs) And not only that I was there before he was. People said later they had never seen this guy speechless before. And he is pissed as hell at my friend for bringing in the ringer and will not believe that she didn't know she was bringing in the ringer.

Misa: Right because you had parallel –

Day: Right. She's sitting there just, 'I don't believe this.' And of course I knew walking into it that I was the ringer. (laughs) You don't get to do that very often but it is fun when you do.

Misa: When you have that chance, yes. John, there is your thirty-page editing document. We need to make sure that we don't miss its significance.

Day: That document was compiled because of the hanky-panky that tended to go on at editing meetings. Now in ISO when something goes to DP and DIS there was a procedure. You vote and you submit comments in the document. One of the things most people don't understand is if you vote 'yes with comments' that means I approve the document and accepting my comments is optional. So no one votes 'yes with comments.' You always vote 'no with comment' and my 'no' will be changed to a 'yes' if the following major comments are accepted or dealt with in a manner that is approved to us. But lots of things can go on in an editing meeting to resolve those comments that changes the document in ways that you didn't expect. And lots of ways were tried and so it became necessary because everything was so contentious, to really start to write down the rules that constituted a fair playing field, to ensure due process. In particular, you might have things like the comments are submitted, you show up, and delegates would show up to the editing meeting with new material that nobody's ever seen and they want to include it. It was just all sorts of stuff. Almost every line, every rule in that document can probably be tied back to some incident in some editing meeting someplace, so that's why we wrote those.

Misa: And the thirty pages [of directions] were needed to set up a structure that would promote an orderly process.

Day: Right. To ensure fair play, that nobody got railroaded, that people played by the rules, there was a level playing field, etc.

Misa: Does the larger [ISO] structure not have some overall guidelines?

Day: No. It's funny but ISO has very few hard and fast rules about how working groups operate and how editing meetings are to operate. ISO had never had a committee that worked on the scale that we did. Most all of their SCs were maybe twenty-five, thirty people with maybe six or eight in a working group, if that. We had five hundred people and hundreds in a working group and many sub-groups under that. The ISO structure had not been set up to deal with anything of this scale or anything as contentious as this. So we were pretty much on our own to come up with the procedures.

Misa: The results but also the procedures to deal with this. That's almost an order of magnitude larger.

Day: Yes. There were SCs that didn't produce a hundred documents in five years and we were producing a hundred documents in a couple months. One of the "innovations" I instituted with the Secretariat was, they had document registers and they'd just do a document register whenever they felt like it. I said, 'Would you please do a document register every hundred documents or every five hundred documents? I don't care when but I want –

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Misa: A register means?

Day: A list of what the documents are that are numbered.

Misa: Kind of an index?

Day: Yes, an index. It's a document of just the titles SC 16 N1, N2, N3 and so on. I said, 'If you do them every one hundred or five hundred whatever you want to pick, then if I need to find a register to find out where a document is to find out what number it is I know where to look for it.' As it is I had no idea where the document registers were. They were like, 'Oh yes, that could be useful, couldn't it?' Just real simple things. But it had never been a big deal, it had never been that important because there had never been that many documents.

Misa: So the scale of standard setting here was unusually large and that really strained the capacity of the tradition –

Day: Yes, the traditions. ISO had just never had to set those kinds of rules. There were no real rules for how a working group ran. We were getting into problems because at the TC level, at the SC level you voted by country, but at the working group level you voted by individual. But that was getting to be a little difficult because then you could have

countries that were stacking the deck. And we had a lot of complaints from the Europeans

because we were sending these large delegations. We had a lot of people going to the

meeting. And they were, like, 'wait a minute you guys have five people going to the

meeting and we can only afford to send one or two'.

Misa: So that's five US votes and –

Day: Well, yes, there are five people arguing for it and two people not. It tends to make it

look like one or the other.

Misa: Without trying to go into detail, were there other important turning points that

happened during this rather long period?

Day: Yes, there were lots of things going on. Passing transport was a big deal. Around

1985 there was the Br'er Rabbit incident. I couldn't believe the Europeans were this

stupid. But ECMA [European Computer Manufacturers Association] sued IBM to make

the source available for IBM SNA LU6.2 specifications. They won the suit in Europe and

then ECMA turned around and introduced LU 6.2 as a contribution to OSI to replace the

upper layers. I remember Zim [Hubert Zimmerman] telling me this the first night at a

meeting and he and I were having dinner and I started to laugh. And he got really testy

with me, like, what are you laughing about. And I went, 'Oh, Massa don't throw me into

dat dere briar patch!' (laughs) He said, 'What?' Of course he doesn't know the Br'er

Rabbit stories. So I had to explain that this was Br'er Rabbit, that this is exactly what

IBM wanted you to do was throw them in the briar patch. Sure enough, the meeting

where that was being discussed was happening in Raleigh, and everyone is trying to

maneuver to get this thing thrown out and the IBM guys (who were heads of delegation

for several countries) are going into the copy room and locking the door and strategizing

on how to try and get it through. They finally defeated it, but yeah. Long about 1982, I

was still at Cullinane, I remember an IBM ad comes out in *Scientific American*[21] showing

[IBM's] SNA [Systems Network Architecture] having seven layers. I remember taking it

into Charlie [Bachman] and saying, 'Well, we made it.' Because SNA had five layers

before that, and they were advertising seven and they were buying into the [OSI]

reference model.

Misa: Into the seven layer model?

Day: Right. When the *Scientific American* ad came out was when they started the game

of OSI does data transfer but it doesn't do management. Now we didn't have a

management proposal going in. The research community hadn't really looked at network

management. And IBM was stonewalling network management fairly well. It was a fairly

easy thing to stonewall. It was easy to throw up issues and things about how to do it

rather than getting anything actually done. Now as part of my regular work, sometime in

the spring of 1984 we started working on network management at Codex (unrelated to

standards). And so I went off and tried to figure out what the architecture of network

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[21] *JD adds:* Andy Russell found the ad recently.

management should be and I came up with some stuff. That fall General Motors comes by and says, 'We've been trying to figure out what network management is all about.' So I did a presentation and said, 'This is what we're thinking.' And they were like, 'My gosh, you guys have much more understanding of it than anybody else we've talked to. Would you help us write the document, write specs and everything?' we said, 'Sure.' So I started sending some of my people to 802 to help GM put together a management protocol.

Misa: 802?

Day: Yes, IEEE 802. I did this on purpose because I knew if I went it would attract attention. So there are these young whippersnappers from Codex who are going to the 802 and what they are taking to 802 is stuff that I'm writing and we are doing at Codex. I come up with the whole four-level architecture for it, and it was patterned on the structure of the brain and the whole nine yards. In fact there was a diagram that was on my whiteboard for a long time in 1984 that showed sensor, agent, manager, super manager, and then peripheral, hypothalamus, cerebellum, cerebrum.

Misa: Oh, matching the layers?

Day: Right. That was sort of my guide, again pulling on what I had learned from Heinz [von Foerster]. It all comes back. So we put that all together. We had this whole thing

around the GM MAP/TOP effort going on in 802. We built up that, did a protocol based on that, started building a system. Doing some good stuff. Once that was set, then we brought it into the ISO committee fully formed as a liaison contribution from IEEE. IBM never saw it coming. We came in with protocols already written, ready to go to DP. They'd been stonewalling network management. Basically, I did an end run on them.

Misa: But here was a fully fledged plan that they couldn't stonewall.

Day: Right, right. And I had the whole GM MAP/TOP effort behind me. That's how you had to play the game.

Misa: Well, standards are a lot more interesting than we typically think.

Day: Oh, yes. All sorts – you got to play the game very well. I would do things in the meeting if I thought like IBM was stonewalling, I would say out loud in the meeting, 'You are stonewalling.' Because as soon as I said it they couldn't do anything that appeared to be stonewalling.

Misa: Because they would be raising the questions as though they were neutral, straight forward.

Day: Right. So they couldn't be saying anything that would've indicated slowing things down. You had to play the game that way. I accidentally got one guy moved off the project at one point because he was saying stuff that was contradicting what other IBM guys were saying. I pulled it out in front of the T5 plenary at one point and said, 'Now, come on guys, get your story straight here; who am I supposed to believe?' Since he was contradicting the senior guys from IBM, they didn't like to be embarrassed like that. So he was re-assigned to Paris. So you had to play that game even internally.

Misa: I wonder if it would be a good time to think about other people or other topics to put down on a list.

Day: Okay, on the ILLIAC side, I really think you should talk to Gary Grossman, Dave Grothe,…if you could find Mike Randall, I have no idea where he is. He was an Australian. [Slotnick]'s dead. [Peter Alsberg. Steve Bunch], he and I are actually working together now. If I went through the names, I could pull up some more. Hugh Folk was the head of the Center for Advanced Computation and recorded the ILLIAC debates; I think he may be dead. For very early ILLIAC IV you want to talk to Dave Kuck and Duncan Lawrie who are both still at Illinois. You might talk to Bruce Hanna, not because of technical stuff but for the non-computing stuff that CAC was doing. We can probably point you at other people to who were – we were doing database stuff, Geneva Belford, Enrique Grapa, we were doing lots of things. As far as the OSI stuff – and I don't know who is alive and who is dead – John Ashenbrener, deceased of course, Jerry Foley

probably deceased, Dick desJardins. Go through [Pelkey]'s list of interviews because [Jim Pelkey] interviewed a lot of these people in the 1980s.[22] Charlie [Bachman] of course since you haven't talked to him about OSI. You need to talk to Hubert [Zimmermann deceased], although he is not big on worrying about the past. But he would know the European side. There's [Peter Higginson, Scantleberry, Derek Barber] from the U.K., [Brian Wood, deceased] from the U.K., [Keith Knightson] was a wire stringer, bellhead. There is another guy, Peter Linington was a professor at the University of Kent I think if he is still there. Hoyt Kesterson form the U.S., he's in Phoenix. Kala Marietta who is in Colorado. Of course you should talk to Louis Pouzin and André Danthine and Michel Gien and Najah Nafah and Jean Louis Grangé. Oh, Marc Levillon, now there is a real gentleman. He was the head of IBM delegation in France. I had lunch with Marc this summer and I just – Marc is such an elegant gentleman. I love this man; he's great. I like Marc a lot. One time we were up in AFNOR trying to come up with a translation of 'Commitment Concurrency and Recovery' that would maintain the acronym in French and we couldn't find one. I turned to Marc and I said, 'This is all your fault.' He looks a bit stunned and says, 'What?' 'If you guys had done a good job of colonizing England in 1066 we wouldn't be having this problem now.' He says, 'Yes, you're right.' (laughs) But no, Marc is a real gentleman, just a fabulous guy. He's got a good art collection too. I should go through some of the lists. Did I say Peter Higginson?

Misa: Yes.

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[22] See James Pelkey *Entrepreneurial Capitalism & Innovation: A History of Computer Communications, 1968–1988* at <www.historyofcomputercommunications.info/> (July 2013).

Day: I can't remember the guy's name who is the senior guy at UCL. I know you know him. If I go through the list I can probably think. There are also some AT&T guys: Bud Emmons and… no, he was IBM. If you can find Andrew Chandler in the UK, but he's disappeared. Steve Oxala (sp?) and Jon Becker. [Peter Gibbon], from the U.K. Paul Bartoli of course and Herb Bertine. Fred Brook. Chuck Young, deceased. They all worked for AT&T.

Misa: John this is a splendid list of names and approach to what is an important story to document.

Day: I think that the story to pin down is the story I was telling in the talk I gave: that this thing is a lot messier and that there are forces at work here. We haven't even gotten into and I didn't participate in the whole Corporation for Open Systems debates, the NBS workshops where there are basically continuing fights over the same issues as to what is going to be the OSI stack. Basically OSI is killed because there is no real consensus where they were going. Everybody believes this is going to be the arc of commercial networking; therefore everybody is trying to make sure they get their piece of the pie. Oh, you should put Lyman Chapin down. There is a whole bunch of Americans that I probably missed. Lyman for sure. These people were debating all this stuff time and time again. Everyone is always trying to ensure that there is tight control on everything so that nobody gets ahead. This is the problem. As I said the other day in that talk: it was not

only the computer companies versus the phone companies, but it was Europe versus U.S. versus Japan.

Misa: I think that messiness is helpful to understand–

Day: I was talking to one of the [University of Minnesota] grad students over lunch; well he's a grad student but he was working for Honeywell and he's on one of the 802 committees. And he said, 'Oh yes, everything you are saying I've seen. My gosh I thought it was just me.' (laughs) Oh yes, it's even better. I think that – and of course then there is the situation that I went through on Wednesday [two days earlier], that we tried to bring the two communities back together in 1992 and it completely blew up with adopting CLNP [Connectionless-mode Network Protocol] as the protocol. There was a whole attempt that at that point that would be the way to start an OSI stack on top of everything and essentially move everything onto the Internet as OSI but it was completely rejected. Part of it was because we changed what we – it was rejected because it was OSI, period. I mean there was a discussion on the end-to-end list several months ago where Noel Chiappa said the protocol wars were TP4 versus TCP and I came back and said, 'No, it was connection/connectionless.' He comes back with this long rambling reply with no, no, no, here's all the reasons why it's not – Read Abbate [*Inventing the Internet* (MIT 1999)]. I said, 'Why would I read Abbate? She's a third party source. I'm a first party source. I was there.' And then I gave chapter and verse starting at '74 going up through INWG [International Network Working Group] and when I got to the INWG

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story I says, 'here's where the decision between TCP and TP4 was made. [INWG 96 became the basis for the ISO TP4.] This was before you even knew there was a problem; and the battle has always been connection/connectionless.' John Crowcroft and Craig Partridge both came back and said, 'No, John is right that's the way I remember it.' Noel was at MIT after INWG and all he saw was what he saw at MIT. But I think it's significant that what the Internet people were seeing was this was a battle of TP4 versus TCP, when the INWG decision had been made before OSI started.

Misa: So that decision was already in place.

Day: Yes. A few years ago Scott Bradner was writing articles in his Network World column he went, 'Oh yes, DoD took TCP to OSI and they turned them down.' Well, yes, there was a point around 1983 or 1984 where the DoD guys brought in TCP and the Europeans all looked at them and said, 'Guys, we decided this issue back in 1979. We adopted Cerf's recommendation. Where were you?' There was a whole process that lead up to this. Where were you? So this is all part of the myth of not being in the game that was going on. I was going through my lectures with one of our education people who is fairly network savvy the other day. And she's going, 'We've been teaching them all wrong.' I says, 'Yes, I know.' 'But what you are saying is what we've been telling them is wrong.' I said, 'Yes, I know. It is wrong. This is what happened. This is the right way to look at things.'

Misa: So the networking classes, just to make it explicit, are picking up only half of the story?

Day: Well, if you read [Andrew S.] Tanenbaum OSI failed because the code was too complicated. No, it failed because we failed to resolve the fundamental contentions within the group. It's like I said in that presentation. As far as I'm concerned the lesson you take from OSI is never invite the legacy in. The mistake OSI made was doing it with the PTTs.

Misa: The 'legacy' meaning?

Day: The old guard. Whatever the old guard is, you don't invite them in. You are trying to do something new, you may sound like you're being reasonable, you are being nice—don't be. Because they will essentially dilute you to death, because they've got too much invested in the status quo. Take them down; it's the only way to do it.

Misa: So they would have been happy with the full connection model, is that right?

Day: Yes, they wanted the full connection model and we should have just headed for something like just CLNP, TP4 nothing else.

Misa: But because they were the legacy, so to say, part of the process –

Day: 1979 there is no deregulation in Europe. There is all this stuff, nothing has happened yet. It looks like it's the only choice you have. You can't have competing models, not when they control the wires. So from the European perspective, they had no choice and maybe they didn't in 1979. As I said, if you look at the conclusions I came to is I think one of the conclusions is that networking was forced into the commercial world way too soon.

Misa: Too soon in the sense that there are many unsolved problems that we basically now have built in and normalized and regularized into infrastructure that runs the economy?

Day: Yes. Well, there was that, and there is also the fact that because of the fight, even by the late 1970s, you are starting to see the signs of a bunker mentality between the connection and the connectionless people. Nobody is going to give up anything. And to some extent we can't see a way to give up anything. We can't see a middle ground between connection and connectionless. And what we think is the middle ground doesn't really go anywhere. We thought it was shared state that it's a continuum of shared state and the connection/connectionless are two extremes, but there were no other points on the line or not enough to make it worthwhile.

Misa: You are polarized at each end and there was no way of constructing a middle ground?

Day: Not only that but there was no way to have a discussion that didn't lead you to maybe losing the whole thing. Everyone was afraid they'd lose the whole ball of wax. So you've got this polarization. By the 1980s, there are two camps. I mean it's 'us' and 'them'. The US votes 'no' on the OSI reference model because there is no connectionless in it. One of the outputs you get at the US to vote 'yes' is to create a work item on a connectionless addendum. In October 1983 when we had a meeting in Ottawa, the document is supposed to go to DP and Hubert [Zimmermann] comes to me and says, 'I don't think we've got the votes.' I says, 'Look, we need to find the votes or the U.S. is not coming back, because it's the only reason we're here.' You say there is not going to be any connectionless in the OSI model, there is no reason for the U.S. to be here. We found the votes and passed it but it was always oil and water. They kept putting in constraints like, there will be no conversion between connection and connectionless at layer three; that kind of thing, to try and make it as useless as possible. Of course they were basically just cutting off their nose to spite their face at that point. Meanwhile connectionless is becoming a religion in the Internet world. In the 1980s everything has to be connectionless: file transfer, SNMP [Simple Network Management Protocol], everything has to be connectionless which is stupid. They are not solving the open problems. By this time you've got a new crop of people in there who are going, 'It works. It runs. Isn't this fun? We can play with this. This is all great and groovy.' Why should we make it – no one is trying to push to make it productizable.

Misa: Which is enough to make most people crazy.

Day: No kidding.

Misa: So this is a place where a contentious history really has left a consequential result.

Day: Oh yes. We are up the creek without a paddle right now because we didn't do this in 1992.

Misa: The 'this' is the unsolved problems?

Day: Router table size.

Misa: Router table size?

Day: It was never addressed: that and multihoming (pause). That was always secondary. And of course the result from the architecture work I've been doing indicates that if you fully do the addressing architecture you don't need a large address space anyway.

Misa: Which has implications for IPv6.

Day: Yes, IPv6 has been a complete and utter waste of time. Twice.

Misa: Twice?

Day: Yes. A, you don't need a global address space and B, we had the right answer in 1992 and we didn't do it. If we had done CLNP in 1992 what I'm talking about now would have much less reason to be done. We'd actually be able to fix a lot of these problems and move on. We wouldn't have to make the kind of radical changes I'm talking about.

Misa: You'd mentioned that Cisco already had this operating.

Day: They have LISP up and running, yes. But there are scaling problems with it. I know people at Cisco who think there is going to be a melt down within five years. (pause) LISP is a patch, it doesn't fix the problem. As I said in my lecture on Wednesday, it's been clear to me from the day Noel Chiappa said, 'Loc/Id split' that that was not the answer. It's obvious.

Misa: And just to put a footnote, in your talk you talked about the hypothesis of the Loc/Id split being scalable, [but] it is not.

Day: No. Well in fact Dave Meyer ran into problems with it and they haven't really fixed it. The thing that worries me is the failover time. If you try and do anything really time

critical on the net at this point and you have a failure at the wrong time – it takes seconds to failover – you could lose the east coast. (pause) Or the other scenario I like to do which is, 'You were climbing in the Tetons and you had a fall, you had a bad head injury. You are in the hospital at Jackson Hole. They are doing remote surgery on you from Mass General to repair the problem and the usual afternoon thunderstorms are moving across the area.' (laughs) 'When the transformer outside the hospital takes a hit and one router goes down and while it's failing over the knife makes the wrong cut and you die on the table.' But it's only a few seconds. (laughs)

Misa: That's one of the successes but also one of the hidden problems.

Day: Well, generally the attitude in the IETF is, 'Well, it works good for Google what else do we need?' I mean I can download my Facebook page or I can run my YouTubes but, sorry, there is a lot more at stake here.

Misa: Anything that is real time as opposed to something that can be buffered.

Day: Yes. So the addressing problem is really critical.

Misa: John, I think we should be mindful of our time here. This may be a good time to wrap up.

Day: Yes, what time is it? 1:20. Oh I need to get to the airport and grab something to eat.