Interview of Louis Pouzin

Interviewed by:
James L. Pelkey

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James Pelkey: How did you get involved in this industry? I know in the early '60s you were involved in this somehow.

Louis Pouzin: After I developed the prototype network –

Pelkey: Before that, before CYCLADES, before INRIA.

Pouzin: Well, I started my career in industry, actually. I had been working three and a half years with the telephone company, but I was in the manufacturing area, in the manufacturing department, so what I learned was mostly how to handle people and all the problems associated with missing parts and so on. Then I moved to Bull, the French computer company.

Pelkey: When was that?

Pouzin: That was in -- when was that? 1957. I stayed with Bull -- actually, I had two periods with Bull. The first one was between '57 and the end of '62, and then I went to MIT for two and a half years, where I was part of the team that developed the first timesharing systems, ETSS, and the I moved back to Bull, which in the meantime had become Bull/General Electric. I stayed with them until mid '65 when they were having another crisis, and at that time I moved to a software company, which lent me full time to the French weather bureau to develop a real-time system, in which I introduced some of the ideas which were not yet commonly understood, and after that period, I moved to Simca, a car manufacturer, which became Chrysler France. Now it is Peugeot. After two years with Simca -- actually, I stayed two and a half year with the French weather bureau, the time developing that system, so I stayed two years with Simca. As I said it became Chrysler France, and then, just by luck, the French government, which had, at that time, a specialized agency called Délégation Informatique (Le Délégation générale à l'informatique), they had played with the idea of putting out computer networks for maybe two or three years and suddenly this idea started to materialize, and they looked for someone who would be able to run the project. So I left Simca, Chrysler France, to head that project, employed by the Ministry of -- not the Ministry, the agency that was in charge of the Informatique.

Pelkey: When was that?

Pouzin: That was in the end of '71, and I developed CYCLADES. I was later employed by IRIA. It was a change in payroll. It was basically the same organization I worked for. I developed CYCLADES between -- let's say '72 and '76 or '77. The end of the project is not that clear, and then one of the key people in IRIA was killed in a car accident, so I inherited the management of all pilot projects in IRIA -- let's say between '78 and '81. Then, the Minster of Industry, who was controlling IRIA activities, decided to discontinue IRIA, to just disband it. This didn't work too well because for purely bureaucratic reasons, so they had to reinvent the Institute under the name of INRIA. That's where it got the 'N.' I was, myself, assigned by government decree -- by purely administrative decisions -- to a new agency they had created to develop Informatique in France, but I sort of thought that this agency was not the proper place to do real technical work, so I quit and I went to CNET in '81. That's where I am now. CNET is the technical body of the French PTT, just like Bell Labs for the American carriers. So that's my own story. So I developed CYCLADES, as I said, between '72 and '76, and then, even though we had finished the project, we were involved in (unintelligible) politics, the network sociology.

Pelkey: We're going to talk about network sociology. Did you go to the 'scenarios' in 1972, when the Arpanet demonstrated itself in Washington, DC?

Pouzin: Yeah, that was the first ICCC conference. I was there, yes.

Pelkey: Was that the first time, other than your MIT experience, where you had come in contact with these networking ideas?

Pouzin: No, it wasn't the first time because I was already on the CYCLADES project at the time.

Pelkey: Oh, ok, so CYCLADES started earlier than October of '72?

Pouzin: I was hired in November, '71, but I started discussing with the Agency for Informatique in the spring of '71. It took six months for sorting out all the administrative matters to hire me. So actually, I was involved, let's say mid '71, in technical matters, and then as soon as I was hired on that project, I took a round trip of the United States to see how Arpanet was being developed. I already knew a number of people there because I had been at MIT for two and a half years, so I know a lot of those people were MIT people.

Pelkey: For instance, who were those people?

Pouzin: Corbató, for example. I knew Peter Neumann who at that time, I think -- I'm not sure where he was. He may have been still at Bell Labs, perhaps. Even though they were not the major Arpanet developers, they introduced me to the Arpanet people. So I quickly had a –

Pelkey: Did you meet Larry Roberts during that trip?

Pouzin: Yes. I met Larry Roberts, I met Vint Cerf, I met Barry Wessler. Who else did I meet? I met the people at BBN: Frank Heart, Bob Kahn.

Pelkey: Will Crowther?

Pouzin: Maybe not Will Crowther. I'm not sure who. Maybe Alex McKenzie. I'm not sure. I also met people at SRI. Who was there?

Pelkey: E. B. Shapiro?

Pouzin: Not Shapiro.

Pelkey: Did you go to UCLA and meet Leonard Kleinrock?

Pouzin: Yeah, I met Kleinrock, of course. I knew Kleinrock before anyway. I also met people at Berkeley, which I knew from the timesharing era, but I just can't remember names.

Pelkey: So you had some ideas prior about doing a network, and then when it got approved in '71, you took this tour of the United States. So now you had an idea of what the technology of the Arpanet was going to be.

Pouzin: Yes, and I read papers before, but it looked to me a little bit abstract. I couldn't really grasp the realities, so I was interested by the principle, but I couldn't decide, really, what they were after. So I only understood all the realities, all the goals, after my trip in the States, and then I understood how they started, how they were organized, what they major tasks were in developing the system –

Pelkey: Such as the subnet –

Pouzin: -- the building blocks, and where the deficiencies lay also, because nothing is perfect in this world, so they explained to me the compromises, or the unfinished things, which they had encountered, and we started discussing how to improve that.

Pelkey: So they knew that you were going to go do it -- another network.

Pouzin: Yes, they knew that, but obviously in the beginning they really didn't believe it, because they had this feeling that the Arpanet could only be -- this kind of complicated system could only be implemented in a country like the States, because of the money, expertise and so on. It looked like they didn't believe Europe would be able to bring up something like that.

Pelkey: Did you also visit Donald Davies during this period of time at NPL?

Pouzin: I had contact with Donald Davies after I started CYCLADES. It was perhaps mid '72. I remember I called a meeting at that time, because I had felt, during my visit in the US, that there was a need to make -- to bring together the people that had ideas in Europe and those in the States, if only because Europe had this sort of very rigid politic -- PTT organizations, so I thought that these two different environments could not develop exactly the same way. So I called a meeting -- I think it was probably in the spring or the beginning of the summer of '72. I had a few people from Arpanet, I had Donald Davies, I'm not sure we had Peter Kirstein but he might have been there, and that's actually where the first idea of a specialized Working Group started. That's where we invented the phrase International Network Working Group, which at that time didn't belong to anything; it was just a dream, some sort of idealistic approach to try to get people together.

Pelkey: Who was there from Arpanet, do you recall?

Pouzin: It may have been Alex McKenzie, but I'm not really sure about that.

Pelkey: So there was this conversation about this concept of an International Network Working Group, which got materialized at ICCC?

Pouzin: No, then it started to get off the ground -- I think we had a sort of workshop or organizing in the UK in the fall of '72. It was organized by the University of Kent, I guess, and then we were -- again, the Arpanet group, which was there in force, Larry Roberts, Kleinrock, Barry Wessler, everybody was there -- and I think that's the first international presentation I made about CYCLADES, and I noticed that there were a number of people who were attracted by the idea of having a European approach with a different way of separating things out, due to what we know about the European environment. We had a number of technical discussions. That's, I guess, where we first started about having gateways between the US and Europe, and I remember Larry Roberts discussed at length with Donald Davies as to how to convey those ideas to CCITT.

Pelkey: Who had that conversation with Donald?

Pouzin: Larry Roberts and Donald Davies. At that time, the British were ahead of us. They already had published a number of papers, and Donald Davies might have had a prototype working. I'm not sure he had, but he was very close to that, so the American and the British appeared to run the show at this point. I know we were a little bit of the bystanders, trying to grab some piece of the action. I think they discussed about how to give muscle to this International Network Working Group, and since I was, at that time, the French delegate to IFIP TC-6, I started injecting the idea that it could be a Working Group within IFIP, because –

Pelkey: Oh, that's where that came from.

Pouzin: -- sort of a stand alone group that nobody knows had less capability to influence the world, so I was myself in IFIP already and none of them were, so I suggested perhaps they should be part of IFIP.

Pelkey: And it was IFIP 6.0 at that point?

Pouzin: It was IFIP -- the French representative to TC-6. TC-6 was created in the beginning of '72.

Pelkey: And that was on computers and communications.

Pouzin: The title is Data Communication, but we immediately interpreted that as computer communication, not just modems and so on.

Pelkey: So that's how that happened. Thank you.

Pouzin: And I think after that, Vint Cerf knew Alec Curran, who at that time was the chairman of IFIP TC-6, and somehow the idea of creating 6.1, WG 6.1, was invented.

Pelkey: Even before that, at the first ICCC meeting, if I understand correctly, what became the International Network Working Group really became –

Pouzin: Well, it didn't exist at that time. That was the spring of '72.

Pelkey: Right, but in the spring of '72, INWG started?

Pouzin: No, it started later in the year, when we had a meeting in Paris.

Pelkey: So you mentioned this meeting in the summer of '72 with Davies and the Arpanet and Peter Kirstein at the University of Kent.

Pouzin: We had three things in '72. We had the ICCC in Washington, maybe in February or March –

Pelkey: May.

Pouzin: And then we had a purely local, French conference, maybe in June, at the end of June or so. That's where we started the idea of the International Network Working Group. There were very few people there. It was just the people who attended these French events.

Pelkey: And Donald Davies was there –

Pouzin: Donald Davies was there.

Pelkey: Maybe Alex McKenzie and Peter Kirstein –

Pouzin: I can't remember names exactly. Then in the fall of that year we had another meeting –

Pelkey: At University of Kent.

Pouzin: At University of Kent.

Pelkey: Now, when did Vint Cerf become the chairman of this group?

Pouzin: Probably in the beginning of '73 when, once we had introduced this idea of Working Group 6.1, it probably took six months to materialize. So I suppose it must have been the beginning of '73, the first half of '73.

Pelkey: My understanding is that the International Network Working Group existed, and Cerf was chairman, and then it became part of IFIP.

Pouzin: I think it went parallel. We had this informal group, which began without knowing which could be a parent organization.

Pelkey: In 1973, the International Network Working Group decided it needed to become associated with an existing international body if the ideas it was debating were to mature at an international level.

Pouzin: Yeah, but that was parallel. The Working Group people were not really interested in the administrative or the politics of that, and I remember I talked to Alec Curran about, who was the chairman of SC 6, and he went through the general assembly to get Working Group 6.1 approved. So the people in the Working Group, they were not really conscious of that because they didn't know anything about IFIP, or at least very little.

Pelkey: Now, Steve Crocker remembers asking Vint Cerf –

Pouzin: I think Steve Crocker was at that meeting in Paris also. Maybe that was not Alex McKenzie, maybe that was Steve Crocker.

Pelkey: And Steve Crocker asked Vint to be chairman.

Pouzin: Could be. I don't know who asked Vint. I don't remember that.

Pelkey: That's helpful. So, then IFIP 6.1 was in place, and is meeting every six months or –

Pouzin: Every time we had a major conference somewhere -- typically twice a year, sometimes more.

Pelkey: Now, in parallel to that, you're beginning to work on CYCLADES?

Pouzin: Yes.

Pelkey: And CYCLADES takes on a very different character, if I understand, than Arpanet, in terms of its design.

Pouzin: Well, you had both a lot of similarities and substantial differences.

Pelkey: Yours was datagram oriented.

Pouzin: Yes, the packet network was purely a datagram network. That's the major difference.

Pelkey: Whereas the Arpanet was really a virtual circuit network underneath. It looked like a packet net. It put packets on top of it, but it really created these virtual circuits between the IMPs –

Pouzin: Between hosts, yeah, that's right.

Pelkey: And then sent packets down the link, where in your design, it was pure datagrams at the transport level.

Pouzin: We had a few major differences. That's one. A second one was that we didn't want to have a special hardware interface on the hosts. We decided right from -- that we should use existing hardware and local procedure interface. That means the network should have a number of different procedure adaptations, so that we would use existing hosts without changes in this very critical part of the operating system. The third aspect is an implication of the datagram network; we had an end-to-end protocol that could accept packets out of order, which the ARPA protocol did not. It's related to the datagram network.

Pelkey: What was your inspiration for doing it with datagrams, versus the way the Arpanet was designed.

Pouzin: I think it was -- it has, really, two sources. One was Donald Davies' studies. He had done some simulation studies on datagram networks. He had not built any, but he had done simulation studies, and it looked like it was technically viable. The second thing was, perhaps, my own inspiration. I like things simple. I didn't see any real technical motivation to overlay two levels of end-to-end protocols. I thought one was enough. It had an interesting implication, in that you could have two physical connections between a host and the network, on two different nodes. You could improve reliability by having separate links, two different nodes, without worrying about the order of delivery of the packet.

Pelkey: And the IMP required this interface, this special interface.

Pouzin: Yes it did, and to me it was absolutely non-motivated. It was an additional burden for the host, and I couldn't think of any technical justification for that.

Pelkey: So CYCLADES had no IMPs.

Pouzin: It did have IMPs, but IMPs were using CCITT standards for the lower level of transmission -- V-24, RS-232 -- and they were using the standard host communication procedures. Actually, we had two; we had IBM and we had the Bull machines. So we only had two different local transmission procedures.

Pelkey: Do me a favor and draw what the network would look like.

Pouzin: You had the host, you had the node which you could have an IMP, here you had the modem, the modem. We assumed, initially, that there was no need to 'co-locate' the IMP and the host, because in most cases, you would have several hosts for one IMP, so we had here a leased line. This was any speed between 9.6 and 48, but most lines were actually 19.2, because that's baseband modems. Then we had a transmission procedure, which were the two, and these transmission procedures were the ones existing in the host. So we actually had an IBM BSC kind of procedure and a Bull BSC kind of procedure, which were primitive, but the advantage is you didn't have to make any surgery in the operating system.

Pelkey: So an application just thought it was sending it off to an RS-232 or –

Pouzin: Just like any terminal you could connect to the host, and everything else was implemented at the application level. The transport protocol and everything else was developed as applications, so it made the adaptation of the host much easier.

Pelkey: That's fascinating. This IMP was connected to another IMP over just –

Pouzin: Yeah, we had the usual packet net, with nothing really innovative. We only had the datagram principle, but that's all. We borrowed the very same techniques as Arpanet for adaptive routing. We also had -- in a way, we had --

Pelkey: But you had to modify all of that in order to be able to handle datagrams, because you had to be able to handle out-of- sequence.

Pouzin: Yeah, but the network itself didn't care about the sequence. The network would deliver a datagram, and this transport protocol here would look at the packets and put them –

Pelkey: Assemble them in the right order.

Pouzin: -- whatever, they had -- each packet was numbered, and it put them into a buffer according to their numbers. It's just straight forward.

Pelkey: How much of this did you borrow from BBN's work, in terms of the subnet.

Pouzin: What we borrowed from BBN is the idea of (unintelligible) procedures which you were using an alternate bit -- they use a multiplexing of channels on the physical line. They actually picked this idea from NPL. We applied the very same thing. It was not exactly the very same thing technically, but it was essentially the same concept. We also use the same principle for –

Pelkey: When you say multiplexed the line, that is, whatever the bandwidth of that line was -- in this case 50K -- that you had very narrow channels within it.

Pouzin: You had eight virtual channels on the same physical link, so that you can send packets and handle acknowledgment independently on each of the eight channels. It gives some improvement in bandwidth, so we used the same technique. We used the same technique for routing. We used a similar technique for the network control. They had special bits in the header, which we didn't find very clean, so what we did was to have all the control functions in the network had different addresses, reserved addresses. It was much more general as a principle than having a few bits in the header. I think they would have done that if they had more time to think about the design itself, an obvious improvement that

came after their own design. Except for those things, it was very similar, except of the datagram. They had this end-to-end protocol, and we didn't have that, which made the implementation easier. We also added some tricks for synchronizing the nodes. They had no synchronize clocks in the network. We had one. We had one by having time packets that would keep changing the time between nodes, and the whole network was keeping -- running -- catching the fastest node time, so we could have a network time which was actually at better than two milliseconds, which was a good trick, a good tool when you want to trace obscure events, and things happen in some -- a certain chronological order. Then you can trace information in each of the nodes and have a time associated with it. You can have a time relation when you take dumps off (unintelligible). That's engineering matters. Not major improvement, but some additional things.

Pelkey: Now, CYCLADES, you started it in '72. When had you reached the point where you felt comfortable and confident that this was an implementable system, that the ideas were going to work, this datagram orientation?

Pouzin: I think we had a pretty good conviction about spring of '72.

Pelkey: That early?

Pouzin: That early, yes. We immediately started to work on the principles, and I remember, by the summer of '72, I had the whole specification of the packet network, which I wrote myself, that was ready in spring '72.

Pelkey: When did Hubert Zimmermann join you? When did you recruit him?

Pouzin: I think he must have joined the team in very early '72, I guess, probably January of '72. I started by myself. When I was hired, I think it was November or October of '71, and I already had met Zimmermann, but it took some time for him to leave his military job, and I think he joined January or February of '72.

Pelkey: So pretty early on, then?

Pouzin: Yes, and I had Jean-Louis Grangé, who also joined about the same time. Jean-Louis Grangé was also one of my old people. He had worked with me at the French weather bureau. I hired him at Simca, and I hired him again. He followed me.

Pelkey: That's a common tale. Now, one activity you're on -- let me pose something, and then you can take me off. One area that I'm very interested in talking about is X-25 and what happened to X- 25 from your perspective, because of Larry Roberts coming over and the things that happened there. The second one is, in 6.1, the meetings there with Cerf who, at the end of '73, when they came out with this TCP document, the kinds of debates that started taking place within that which led to the events that happened within 6.1 to go into TC97, Subcommittee 6 and then to Subcommittee 16. Thirdly, the involvement subsequent to that, the debates that happened as a consequence of CYCLADES, this kind of new orientation that you brought.

Pouzin: It happened, in a way, earlier than CYCLADES, because I think that we invented, in CYCLADES, this window scheme, which actually was just a generalization of techniques that already existed. Some people may think they have invented it, but it was actually derived from HDLC, except you make -- you make credit decoupled from acknowledgment. That was perhaps a little engineering change, but it made the whole thing much more flexible. Apparently, the Arpanet people hadn't thought of that, and they were, in a way, triggered into trying to overdo it, something. Since we had, simultaneously, this idea of datagram, which I promoted mainly in Europe, and again they hadn't thought of the generalized datagram scheme in the Arpanet, perhaps the window scheme, so I think they wanted to create some integration of those two ideas, and come up with a still better scheme, and they, in a way, rushed TCP, the TCP design, to integrate those two aspects; datagram, datagram fragmentation, connectionless delivery -- delivering packets out of order if it happens to be out of order -- and have an end-to-end

protocol with a window scheme. So they integrated all those concepts in one thing, which they tried to sell us, and we didn't buy it.

Pelkey: When you say 'window scheme,' could you just explain that a little bit more.

Pouzin: A window scheme is -- when you send information through any communication system, you always have some kind of numbering scheme for the blocks, packets, whatever you send. You use those numbers for the receiver to tell the sender that he has received. You also use the same numbering scheme for the receiver to give the sender some credit. That means so many -- the indication of how much more he can send, how many more packets he can send –

Pelkey: Will send, is about to send?

Pouzin: The receiver doesn't want to become flooded. He may not have the capacity of handling –

Pelkey: So the receiver tells the sender, saying "I received packet one, and -- "

Pouzin: " -- and you can send me up to five." I can receive up to five, and a little bit later it will say, "I'm ready to receive up to ten," for example. So, in the old schemes, like HDLC, the credit was a fixed value associated with the acknowledgment. So whenever you would acknowledge some particular block, you would imply that you also give credit for so many more, but by decoupling the two, you could have a variable credit, which could be constantly adjusted to the capacity of the receiver. It was an engineering improvement, not a radically new concept, but something that made things much more flexible to handle. So that was a CYCLADES contribution. So Vint and Bob Kahn and probably a few others, like Yogen Dalal, picked up the idea and tried to use this window scheme to be able to handle not only individual packets, but any of the (unintelligible) that they could generate in being fragmented along the way. They assume that perhaps networks would use different packet lengths and that a single packet could be fragmented in a number of packets along the way, all of them would arrive out of order, and still they would use the very same window scheme to control the flow. They turned the window scheme into an octet counting scheme. Instead of giving credit for a number of packets, you give credit for a number of octets. It was technically tricky -- I mean smart, but we didn't buy the idea because we thought it was first too complex in implementation and much too hard to sell to industry. The second thing is it mingled -- it actually handled in the very same protocol, matters that belong to the transport level, and matter that belong to the end-to-end protocol. That kind of coupling was politically unacceptable, because these two levels of system were handled by two different worlds.

Pelkey: The transport being the PTTs –

Pouzin: And the other world, the computer people. So obviously it was not acceptable in terms of technical sociology. You cannot sell something that involves the consensus of these two different worlds. That is a very small detail. So we thought that was not a good way of organizing things, even though it was technically sound. It was not organizationally sound from our viewpoint.

Pelkey: That consumed a great deal of time in these IFIP 6.1 meetings -- this inability of the US faction, led by Cerf, and the Arpanet people, to come to grips with -- they didn't understand the political realities that you accepted, about the European scene, with the PTTs and the concept of the authority of the boundary of the network, that it was the PTTs and you had to define this well, as opposed to the engineering elegance, which Cerf might have been representing as a better engineering solution, and it might have been, but it wasn't implementable. That led to these debates that went on with them.

Pouzin: Well, we didn't spend that much time, actually. We first had discussions about lower details. What we wanted was to have, in the packet format, at least the information we thought was necessary, so both parties tried to put bits here and there. We had discussions on that. It took maybe half a year. After that, they sort of froze their design, but then we started to become disinterested because we didn't think it could really work. So then we started to skirt the issue and considered that as something we couldn't avoid because they had the whole ARPA backing behind them, so we thought we couldn't stop that. On

the other hand, we had quite a good feeling that they would not invade Europe very much, so we started to organize our thing in Europe differently.

Pelkey: Now, is that about the point in time that you went to -- you started thinking that IFIP was not the right place -- that you needed to go to ISO?

Pouzin: Well, we had an intermediate path, actually. In IFIP, there was this INWG 96 proposal, which was written by Alex McKenzie. I'm not sure what the time was. I guess it was around '78, probably. It was '77 or '78, I'm not sure about the year, but Alex McKenzie's intention was not to try to solve the differences, but to propose some kind of protocol that actually was a sort of a common divider between the European viewpoint and the Arpanet viewpoint, and for maybe two more years –

Pelkey: That was January '76, wasn't it?

Pouzin: Yes.

Pelkey: Proposal for International End-to-End Protocol?

Pouzin: That became sort of a –

Pelkey: McKenzie, Scantlebury, Zimmermann and Cerf.

Pouzin: It may have been signed by different people, but it was mainly written by McKenzie.

Pelkey: I have it as being Cerf, McKenzie, Scantlebury and Zimmermann published an article in Computer Communication Review.

Pouzin: At the time, there was no official I/O standard, so it became sort of an interim de facto standard, which a lot of people around the world took as a model, but there is one thing that perhaps you haven't really analyzed in your report. Maybe you did, but we never talked about it, this COST Eleven

Pelkey: This what?

Pouzin: COST Eleven or EIN. You don't know about that, ok. That's another major piece of the strategy. Back in -- well, about the same time as CYCLADES started, the European project -- initially COST Eleven, COST meaning Cooperacion Scientifique et Technique; Technical and Scientific Cooperation. It was just a sort of a set of actions that the European community countries had decided to use as an area for cooperation, so they had listed a number of potential projects, and number 11 was a computer network. That was probably in the beginning of the '70s. And anything that has a European cooperation context takes a long time to set up, so some time in '72, we had the very first meetings of the COST Eleven project, which was then renamed EIN, European Informatics Network. That was headed by Derek Barber from NPL, and the participating countries were Sweden, Germany, Switzerland, the UK, France, Italy and Yugoslavia. That's seven?

Pelkey: Belgium?

Pouzin: Belgium was not part of it. The Netherlands was not part of it. You may have to check that, because I may have -- that's a long time ago. I may have forgotten something. This project started, again, with another idea of linking computer with a packet net and hosts on, and since we had already quite definite ideas as to how to build CYCLADES, we were very influential in the European scene, and most of the concepts that were implemented -- because that was implemented actually -- in the EIN, were derived from CYCLADES. They made a few technical changes because, obviously, it's not acceptable for the European community to take something that already exists without adding anything. So they changed a few things, which sometimes were improvements, sometimes were not, and then the network was built. It was built by -- the packet net was built by the (unintelligible) Consortium -- and the host software was developed by each of the participating organizations. They bought most of the CYCLADES ideas. We

succeeded in convincing most of this European community that out principles were quite right, so that created a strong consensus in Europe at the academic level. Then, when the ISO work started in '77, about half those people went into their national standards organizations to push the very same ideas. Not only that, but the various manufacturers who had been involved in the CYCLADES experiment or the EIN experiment -- and that included Siemans, Olivetti, Bull, also IBM, but IBM didn't really participate. IBM machines were in there, but IBM people were not. So we had ICL, Bull and Olivetti, which were more or less in agreement about the principles, and you may also remember that, during the '70s, even though it was discontinued in '77 or '78, we had this Unidata attempt in Europe. So, all the effort to build Unidata happened also at the same time as EIN and CYCLADES. Since those industries were involved in the experimental software that was developed for these networks, the technical people from those manufacturers more or less accepted those same ideas. So we had, by '77, we had maybe a group of 40 or 50 people in Europe that were involved in the standard making, but also already more or less consensual.

Pelkey: Fascinating. That's incredibly helpful . . .

Pouzin: . . . so we had a sort of lobby which started at the academic level, and then moved into industry and standard making.

Pelkey: Yes, so it moved into industry through the –

Pouzin: EIN and CYCLADES, these developments, and then the industry people, plus the academic people, because standard bodies accept also academic people as delegates, so that was a community that agreed very quickly about the very same principles, which were the OSI model and the transport protocol and so on.

Pelkey: Now, during that period of time, there was also this effort going on in X-25, was there not?

Pouzin: X-25 started in '76.

Pelkey: Oh, ok.

Pouzin: It started a bit late, but it went very fast.

Pelkey: And it went very fast because, in fact, it was compatible with what the PTTs wanted.

Pouzin: Because the PTTs wanted it badly. They were afraid of losing control, because at that time you had private packet nets turning up, and in particular, they had this Euronet problem, because the European communities decided they wanted to build a packet net for their own needs, to provide the Europeans with a tool to access the databases in Europe. So the PTTs were suddenly facing a dilemma: either they would do it or it would be done without them. So they decided they had to find some consensus in Europe as to how to make packet switching as a public service. They also invited a (unintelligible), like IBM pressure, which nobody believed in, but it succeeded in convincing PTT people that IBM was going to take over if they had no standard.

Pelkey: Now, Larry Roberts put quite a lot of energy into that, right? Barry Wessler, because now they're part of Telenet, they very much wanted a standard to be created so that the different manufacturers could all conform to standards so that they wouldn't have to worry about selling this equipment to every manufacturer, and saying: "Here's the network. If you have that, you can get the interface from your computer manufacturer." So when they started that process, there was this receptiveness, if I understand you correctly, on the part of the PTTs, and I guess their understanding is they must have played to that, this IBM fear or –

Pouzin: No, it was probably a help in creating this IBM paranoia. He did that on purpose, of course.

Pelkey: Right.

Pouzin: But the PTT also used that to line up the PTTs that didn't want to move, like the German, for example. There was no real enthusiasm in Europe for packet switching on the PTTs' part. They had to work hard to convince a number of PTTs to agree about a public service.

Pelkey: Now, the fact that these other activities were going on, the EIN and CYCLADES, there was clearly momentum in the computer circles, the academic circles, that couldn't have been lost on the PTTs.

Pouzin: It was mostly lost, actually, because most of them didn't think that packet switching was a technically good idea. They didn't think it was economically viable. Second, it's a matter of culture. They had absolutely no connection with the academic world, not very much with the industrial world either. They were absolutely isolated. It's no longer true, now, they all have a lot of contact, but at that time, it was still a sort of a world in a world. The PTTs had their own problems. They were handling telephony, they were handling telex, modems, and so on, but absolutely no involvement in the computer oriented systems.

Pelkey: Although in Europe, the PTTs were allowed to sell computer services?

Pouzin: No. Well, they're allowed to do anything they want, but they didn't do it.

Pelkey: Whereas in the United States, our PTT, AT&T, was specifically prohibited from doing anything in the computer business. That was not part of the regulated business of AT&T. Even though there was a movement toward deregulation, which was a large part of the backdrop of what was beginning to happen in the United States, deregulation wasn't happening in Europe.

Pouzin: In Europe, the regulation applies to the subscribers, but not to the PTT. The PTT can do anything it likes. That's no longer true, maybe, because there had been a change in the way people -- in the way government understands the PTTs' role, but let 's say ten years ago, the PTTs were practically entirely free to do whatever they liked, except they had absolutely no intention to be involved in computer oriented services.

Pelkey: Right, because that was alien to them.

Pouzin: It was totally alien. They were not interested in that. They considered the computer people as mainly –

Pelkey: Users.

Pouzin: Users or subscribers, but absolutely -- they also perceived them as totally unable to think of and to design anything that could resemble public services.

Pelkey: Were you involved much in the X-25 debates or meetings?

Pouzin: I was partly involved, yes, in a way fighting the PTTs in CCITT meetings. We had

Pelkey: So you were allied with –

Pouzin: IFIP became a member of CCITT at that time, so we had IFIP representatives, mainly 6.1 people, attending CCITT meetings at the time they were designing X-25. So we were, at the time, we fought to have the datagram service included in the design, but it was not accepted.

Pelkey: What kind of service?

Pouzin: Datagram.

Pelkey: Datagram service? So IFIP started off trying to reach an agreement as to what these protocols were. During this period of time, part of it got pulled off into this X-25 process. First of all, in January of '76, we had this McKenzie article, which I want to come back to. It was kind of bridging this idea of virtual circuits and datagrams. I want to make sure I understand what it bridged, from your perspective. At about this same time, IFIP started to get involved in the CCITT undertakings, in terms of X-25, and at that same time, there was a recognition that in order for IFIP to be successful, seeing this resistance that was there in CCITT, that there was a need to be part of another standards body, which led to ISO being more of the parent to IFIP, which led to TC97 Subcommittee 6. So it was "in order for us to protect our world, in order for us to be able to get what we want in terms of datagram services and so on, we better get with somebody else who had clout and importance, other than just IFIP." Is that –

Pouzin: It was clear that IFIP is not a standard making body. It was just working out pre-standards, or consensus about standards, but the real work is done through the standards bodies. ISO was in charge of higher-level protocols, so our people in IFIP moved to the ISO working committees, which were organized by country. So each one, in his own country, joined the national standards body to lobby for the higher-level protocols, but on the other hand, the lower level protocols are worked out by a completely different organization. That's CCITT, in which only the PTTs were members, and the IFIP people could not become delegates of their own country because the PTTs wouldn't accept them in their delegation. So they had to attend as IFIP members.

Pelkey: Was there any formal process by which this IFIP group became -- how did -- TC97 Subcommittee 6, that was already in progress because it was dealing with HDLC. It was kind of the data communications subcommittee. So did the IFIP people just start going to this group as representatives from their countries or did they go en masse? Was there an attempt, en masse, to have this group absorbed by Subcommittee 6, or did IFIP 6.1 want to become an active member of Subcommittee 6?

Pouzin: If I remember, within the French party, we started to push the ideas of having marginal protocol studies, end-to-end protocols, but there was no technical committee, except the SC 6, that could handle that. SC 6 was HDLC, so we started to push those ideas, and simultaneously, our colleagues within 6.1 started to do the same thing in Germany and in the UK, but it was not clear what was going to come out of that.

Pelkey: That must have been a complex period, a frustrating period of time.

Pouzin: Somehow, what we wanted first was to have a special -- another group -- as part of SC 6. That's what we were aiming at, but somehow British people suggested in a nice general meeting, an organizational meeting in which we did not participate, they suggested having a new subcommittee somehow.

Pelkey: Right.

Pouzin: And it worked. So SC 16 was created, suddenly.

Pelkey: If I understand correctly, there was a meeting in Melbourne or Sydney –

Pouzin: It was in Australia. I'm not sure where, but it was in Australia.

Pelkey: In the spring of '77?

Pouzin: Yes.

Pelkey: In which Subcommittee 6 said that this higher-level stuff, the upper levels, wasn't mature enough to warrant this kind of separate study group. Then, a week later, TC97 decided that it was mature enough to create SC 16.

Pouzin: I think that (unintelligible) -- the original part of those committees, perhaps there was someone who had a good lunch, and he had good friends, and he could –

Pelkey: Do you know who the British gentleman was that led the charge?

Pouzin: No, I don't know.

Pelkey: That was an important point.

Pouzin: It certainly shortened the -- it could have waited two more years.

Pelkey: Did the group of you who had been struggling, trying to get this Subcommittee 6 to want to act and take this stuff seriously -- I can only imagine you must have been very frustrated at this point in time, because you all believed so much in your ideas and in what was happening, you were kind of beating your head against the wall, you had CCITT, you couldn't go there, and Subcommittee 6, they were dealing with HDLC and thought this upper layer stuff was –

Pouzin: We were prepared to work the long way, having a group in SC- 6 and gradually have autonomy, and suddenly it occurred, much early than we expected.

Pelkey: It must have been very liberating. The group of you must have been excited at that moment.

Pouzin: Well, we thought now we have to redefine the strategy, because then we had to immediately start working on how to organize that; who would be the chairman and so on, so there had been a struggle at that time to decide which country would have the chairmanship.

Pelkey: The secretariat. If I understand correctly, it came down to primarily the UK, who really wanted it because they had kind of created it, and the Americans, even though I understand they had really argued against SC 16 being created.

Pouzin: That's right.

Pelkey: ANSI didn't really want it to be created.

Pouzin: I think the contenders were the French, the British, and then the Americans didn't want -- for some reason they argued that they needed more committees, they didn't have the appropriate quota of committees, for some reason they thought it was an important thing even though they had been against it before, but once it was voted, they thought it was better to take control.

Pelkey: Americans!

Pouzin: But it was very good, because we had Charlie Bachman, who is an excellent man, so we absolutely had no regret that it was an American party, because he was an excellent chairman.

Pelkey: It must have been strange to have the Americans, who had been against it, all of a sudden now become the secretariat.

Pouzin: Yeah, but that's quite typical in political haggling. You fight against something, but if it occurs, you want to control it. You just would like to delay it as much as possible.

Pelkey: Now my sense of it is that during this period of time, IBM was a real pain in the ass.

Pouzin: A bit, but not that much.

Pelkey: They weren't very much for standards at this point in time.

Pouzin: They were constantly trying to divert discussions into nowhere, but they did not actually try too hard. That's something we never actually understood. At the time they were still promoting SNA and having trouble promoting SNA. It was not yet mature. It was not efficient and so on, so they obviously had commercial problems with that. On the other hand, the technical people had apparently no strong instructions to block the whole process. They probably had instructions to delay the process, but not to block it.

Pelkey: Do you recall, while you were still part of SC 6, that there was some motivation on the group and your part to get this HDLC thing through and passed and out in order to get on to other things -- to try to get it going faster? It had been in committee, at this point, for years.

Pouzin: Not really. HDLC was actually a good training ground, because we started to invent some particular use of HDLC, which would turn into an end-to-end protocol, a packet transport protocol. It did not really fit, but we tried that, and it was a good exercise to see how to sell ideas, what sort of objections people would have, but it was not really an obstacle in itself. It was something else that -- we wanted to work on a different subject. We didn't want to get rid of HDLC, we just wanted to have a different group which would do some other work. Then it didn't really sell, because most people who were involved in the HDLC had no real network understanding, and they also, apparently, had sort of old-fashioned ideas that this kind of protocol, the HDLC protocol, was only intended for controlling terminals, but not for computer to computer communication. So that didn't get anywhere, even though they were smart people, technically they had no -- they had no intention and no understanding of the computer and the computer communication environment. So fortunately, we had SC 16, which forced new blood to come in.

Pelkey: Did you go to many of the SC 16 meetings?

Pouzin: I never went to any SC 16 meetings. I actually dropped out as soon as it was created, because I was spending too much of my time in SC 6. Since most of my people were involved in SC 16, I thought it was enough.

Pelkey: I hear there was one great meeting in Berlin, where it was finally put to draft recommendation. It will certainly be in the book how the Americans kind of stood up and said something not too flattering, which tended to be the Americans' way at this point in time, but kind of neutral, and then this English gentleman whose name I have but forget, stood up and said this seven layer model and recommendation was nonsense and wasn't worth the paper it was written on. Here all these people from all these other countries who had worked for a couple of years at a very hectic pace and had worked until 3:00 in the morning, all had put this energy into it, and here this guy stands up at the first meeting he ever attended, and makes these comments. Basically, everybody looked around the room and just said: "Fuck you," and just passed it. That's how it got passed.

Pouzin: Yeah, that happens.

Pelkey: I'm trying to catch the humanness of why things happen. Not to be disparaging or negative about it, it's just that to understand it, it's moments of time when leadership, or lack or leadership, cause the momentum to change and something to happen. Going back to this McKenzie document that was written, you said that was kind of a bridging, that there had been this kind of process.

Pouzin: It was something that could be considered as a particular case of TCP/IP, and which was also in line with the European approach.

Pelkey: How could that have been done?

Pouzin: Well, it was a clever compromise. Just by restricting parameters and -- instead of working on the octet level, he agreed to work on a group of certain octets that would be a block, so he was not entirely antagonistic to our principles in Europe. He was just using a few more bits for that, but it could have been considered by the TCP/IP people as a particular case of using it. It didn't prevent them from using the functionality, but at least he proposed something that could be considered as an intermediate

protocol, which would have allowed TCP/IP networks to communicate with European networks, and use a single protocol, which was, in a way, part of their own implementation.

Pelkey: One of the areas that you could help me with -- this whole industry moved beyond circuit switching and moved to packet switching. Then, within packet switching, there was this view of what was X-25 or what was in the subnet, which was setting up these virtual circuits which is kind of connection oriented. Then, you have the connectionless, which was your scheme, the datagram. TCP, when it was first developed, was datagram, but it was packets, it was these octets, and it dealt with everything from the host application level and the network all in one.

Pouzin: Well not application, layer four. If you refer to the OSI model, it included -- in a way, it's a sort of a protocol that merges layer four functions plus layer three functions.

Pelkey: And this is before the split?

Pouzin: Before the split, yes.

Pelkey: So it wasn't virtual circuit, but the way it implemented the datagram caused it to have both level three and level four imbedded in one protocol.

Pouzin: The undesirable coupling, in our view, was that, in order -- when you have a cascade of packet networks which may use different packet sizes, if you have a long packet that has to go through a network that uses shorter packets, and you have to cut the long packet into one or more smaller packets, that means that you must introduce, at this point, some kind of protocol that will allow you to put those pieces back together at the destination. What they did was to integrate, in one single protocol, the reassembly of packets at layer four and the reassembly of packets at layer three. That means the fragmentation of packets at layer three and the possible reassembly should follow the same protocol as used at layer four. That is a coupling that, obviously, was not sellable in the context of these two PTT and computer industries. Maybe it would be sellable now, but that's ten years later.

Pelkey: They eventually did. When they went to TCP/IP, they did split TCP.

Pouzin: Yes.

Pelkey: To conform to the arguments that the Europeans had been making, correct?

Pouzin: Well, they accepted X-25, which means that, when you use X- 25, the TCP/IP fragmentation is useless, because the X-25 networks all accept a single packet length which is 128 octets, and they have no fragmentation scheme in the X-25 world. If you want to go through a series of X-25 packet nets, you had better use one packet length that they all understand. There is no way to fragment in between networks. That means that, in the context of the X-25 service, the fragmentation capability of TCP/IP is useless. But they used it in local networks, I guess. When you have an association of various local nets which use different packet lengths, then they may have private gateways that follow the TCP/IP fragmentation scheme, and which can break packets into smaller packets using the TCP/IP protocol.

Pelkey: I have this sense with TCP/IP that there were a number of events that came together: the early developers of local area networks were really pushing for this datagram orientation, as opposed to this TCP monolithic orientation; then there was the problem of different gateways with different packet lengths; and finally, you had these radio networks, which couldn't acknowledge back. With TCP, the way they designed it originally, putting a local area network in between different gateways would bog the network down, and in fact, TCP would become inoperative. So there really came this need to break it into TCP and IP in order to be able to have the gateway-to-gateway functions with the level four stuff on top. So local area networking was a driving force towards datagram schemes, and breaking it down between level three and level four. That's a view I hold.

Pouzin: In practice, there are some ideas that perhaps we all had back in the middle of the '70s that didn't work too well. We thought we could send packets without worrying too much about it, and somehow reassemble them at the destination, but in practice, when you use a conjunction of several nets of different characteristics, then things don't work well. So you need flow control in the middle, and that kind of flow control is not part of the local network design, so you have to add an additional level of control, which may be the one you are using at the transport level, but very often, those gateways are developed independently of the end-to-end protocol because you can have as many end-to-end protocols as you want. Therefore, the people who develop gateways try to make them independent of end-to-end protocols by having their own local flow control, which did not work in conjunction with the end-to-end control. So the things became quite difficult to handle. That's where practice, actually, was not as beautiful as the ideas we had originally. I guess TCP/IP is also a little bit a part of the dream. It assumed that things could run beautifully by having a whole set of compatible and well coordinated protocols, but that's not the way it occurred in practice.

Pelkey: To me, that was a very interesting point in time, because you and Donald Davies and the groups that were associated with you were unique on the European scene, but this group of people who made up the Arpanet, this American group, where a significant amount of energy and accomplishment had taken place, one of the natural outcomes of that was this TCP effort. Then the Americans, because they refused to understand the politics and the realities of the European market, they got dogmatic about their view of the world, which they later would change and be more –

Pouzin: Well, I think they didn't understand the standards making process.

Pelkey: They didn't understand the standards making process. When this McKenzie document was created, it was almost the last hurrah of the American Arpanet community, and at that point in time, they went back and did their TCP/IP and a new group of Americans, the Bachmans and Days and other people, got involved in the ISO process. It wasn't the Arpanet people, and the Arpanet people kind of stopped being part of this whole scene of how things developed.

Pouzin: I think they believed in money power. They thought that by flooding manufacturers with money, they would have a lot of implementation and would be, by brute force, it would be acceptable. Perhaps it would have worked if the only market in the world would have been America, but the Europeans didn't care about that process, because they didn't receive a cent of the ARPA money, for one thing, so they had no money pressure. The second thing, they had a strong organization for making standards -- ECMA, CCITT, ISO -- and everything is a little bit bureaucratic. Well the people who work in those structures are, I'll say, much less influenced by immediate market pressure. They are influenced by their own employers' policies, which may be long-term policies. Those manufacturers had no pressure to implement local network protocols. They had absolutely no pressure from TCP/IP, for example, so they were not feeling threatened by that.

Pelkey: At the same time, the Europeans realized that, in order for them to compete with the US companies, that they really did need these standards.

Pouzin: I think it was not really an antagonistic approach. It was -- just because we had a different consensus. This process we worked out through CYCLADES and ECMA and so on, it was already agreed, so there was no major reason to change that approach, and furthermore, the TCP/IP didn't look like the right ideas. So they just went their own -- according to their own conviction, and since there was no immediate pressure to deviate from that, it just kept going.

Pelkey: So X-25 gets approved as a standard in –

Pouzin: '76, and then it took four years to make it work. The first version was voted in '76.

Pelkey: Which was very, very fast for standards making. It was incredible.

Pouzin: Of course, the first version didn't work. It was only in '78 that they had a workable version.

Pelkey: Did you stay involved in that? Did you continue to go to those meetings from IFIP?

Pouzin: IFIP, yes, but not CCITT. We thought we had lost and that there was no point in attending the meetings anymore.

Pelkey: You thought you had lost when –

Pouzin: Lost the datagram, so we were not really interested –

Pelkey: So you went to these meetings in the beginning to argue the case for datagrams –

Pouzin: That's right.

Pelkey: -- but when it became virtual circuit –

Pouzin: We just decided we had lost the case and the PTTs would do their own thing, so 'so be it.'

Pelkey: Then equally, when SC 16 was created, you had people like Hubert and so on who attended those and you didn't feel a need to attend those?

Pouzin: I didn't go personally because I had many other things to do, but most of my people went: Hubert, Michel Gien, a number of people. It was, as a whole, maybe more than half a dozen people who attended meetings in different committees.

Pelkey: And from that period of time until now, what has happened in the European scene that is an outgrowth of these ideas? Certainly, part of it is just the ISO process coming to completion. Is there anything else?

Pouzin: Anything else that would be specifically European? Not much. I don't see anything else that you might dub as European. There might be other things in other areas which I don't know too well. There might be things in telecommunications, for example.

Pelkey: I'm not interested in that, only data communications.

Pouzin: I would say the messaging thing is also an interesting –

Pelkey: IFIP 6.5.

Pouzin: -- but it's much more balanced. The American side and the European side have both very strong play in the X-400 happening, but you can't say that it's European or American. I think it's really a good mixture of ideas coming from both sides.

Pelkey: Japan, during this period of time, went to these meetings and did some networks, but for the most part, they weren't very influential.

Pouzin: No, they have never been influential in this part of standard making.

Pelkey: Canadians were kind of active.

Pouzin: Canadians were quite active in the politics of X-25 initially, and they also have been active in X-400.

Pelkey: Right, Northern Telecom.

Pouzin: They were not very active in all the other layers of the OSI model.

Pelkey: I don't have any more questions. You've been incredibly helpful to me in terms of understanding some things I didn't understand, and I'll do some rewriting to compensate for that.

Pouzin: Europe's is complex, because it's not just one set of actions, it's a number of different actions which actually support each other. It's the same game played in different places at the same time. That's the way things occur in Europe, because otherwise you don't have the critical mass, so you have to infiltrate a number of different groups.

Pelkey: Thank you very much for your time.

END OF THE INTERVIEW

