An Interview with

RÉMI DESPRÉS

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Abstract

In this interview, Rémi Després, who was the main architect of the Transpac network, describes the context in which the first packet-switching networks began in France in the 70's. He also describes his role in European data networking history and the birth of the X.25 recommendation at CCITT in 1976.

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Schafer: Dear Mr. Rémi Després, you are the main architect of the packet-switching network, RCP, and then of the public packet-switching network, Transpac, that opened in 1978 in France. How and when did you start to get interested in networks and packet switching?

Després: Well, I started being interested in networking in 1971, but I think it's interesting to understand where I come from. I have been in computers since the beginning. In 1963, I had my first computer – a CAB500 French computer – on which I worked on a Fortran compiler. Then I worked on Antinéa, a computer developed by CNET. CNET is *Centre national d'études des télécommunications*, the research center of the French PTT, which had interest in switching equipments and electronics in general, and had made a computer. So I wrote an assembler for this computer. Next, I worked on another computer of CNET called Ramses II, on which I developed a multi-programming operating system. After that, I went to Berkeley University, where I had a Master degree and a PhD in computer science, in the Department of Electrical Engineering and Computer Science. And coming back to CNET, then a team had started developing a time-sharing system for the Ramses II computer system, and I worked on this, designing a new scheduling algorithm which, I think now, still today, has some virtues that we don't find in UNIX. But in 1971, the CNET was told to stop developing computers: that was the *Plan Calcul* in France, where a new company would be founded to do these kinds of things. So I stopped on this subject, and it was the exact time when CNET was starting the Hermes Project. Hermes was the name of the future data communication network, and this was done in the context of international standardization, in CCITT. In CCITT, the main tendency was to do circuit switching but the British Post Office had identified a new question: Should we also work on a packet mode of operation, which would be different than circuit switching? And in France, at CNET, we had thought about this subject, and Alain Profit, who was in charge of the complete project, asked whether somebody would be interested in studying packet switching. And knowing what it was, I immediately volunteered, believing that it was a very promising technology. The reason why I was interested and I believed it would be interesting is because I had read documents published by the ARPANET team, in particular Larry Roberts and Barry

Wessler at the SJCC 70, and that explained all what were their projects for ARPANET. And I found many interesting ideas in that, and I thought we could do better. So, being in charge of looking at this packet-switching technology, I soon proposed to run an experimental network, which we called RCP, *Réseau à commutation par paquets*, or packet-switching network, and Alain Profit readily authorized the budget for this project. It has to be understood that there was an internal competition in carriers, in operators, between the school of thought where fast circuit switching would be good enough. The theory was that the data traffic is a water drop in an ocean of *telephony*, and that, therefore, the *telephony* technology should be used. But that was wrong. So, that's how I started.

Schafer: You said you had heard of packet-switching network because you read a paper from Larry Roberts, and also at CCITT, there were some ideas on packet-switching networks. Did you also know that at the National Physical Laboratory Donald Davies was working on packet-switching networks, or at this time you didn't know that?

Després: Well, when I started being in charge of packet switching, I don't remember whether I had read some papers from National Physical Laboratory or not. But I know for sure that as soon as I was in the subject, I read everything, and I had many contacts. And I visited National Physical Laboratory, Donald Davies, Roger Scantlebury. There were people doing something interesting: they used ordinary mini computers to switch data traffic, which was not the case of ARPANET. They had special devices. And I had contact also with the team in the UK Post Office, the British Post Office I should say, where they had invented what they called the Virtual Call System on Permanent Virtual Circuit System. But they did it, I would say, in a much too complex way. They had specialized hardware. It was not reliable. There were many limits in their design, but many of these ideas were good anyway. So, that influenced what we did a lot. We also had documents about real operational systems: the Tymnet network in the U.S., for the Timeshare Service Bureau, was running with something which is very-very similar to something that we called later on virtual circuits. And there was a SITA network of the airline companies doing some communication between typewriters to exchange something similar to Telex messages. They had also computers used as switching systems. So, we looked at all of that and decided that, yes, there was room for an implementation of a working system to interconnect computers and terminals using ordinary mini computers. And that was the RCP project. So, the problem was to do, I would say, the equivalent of Tymnet – I mean, how terminals would access the very remote service bureau without extremely expensive telephone calls on long distance. That was one of the goals. The other one was to replace what was done at that time to interconnect computers; remote batch terminals were connected to central computers with multi-point links, expensive and not very reliable leased lines interconnected. So, we wanted all of this to be replaced by a common infrastructure with an economic model where customers would prefer to use this network rather than using long-distance telephone calls or multi-point leased lines. Now, packet switching was ideal for that with three characteristics. One is statistical multiplexing. Most of this computer traffic is very bursty. And if you have a long-distance line, which is expensive, reserving a circuit is a waste. So, statistical multiplexing permits to save a lot on long-distance links and also on local links – access links to the network. The second point is that, with packet switching, we make data rate conversion. That is, we can have a terminal, which is connected to the network at a slow speed, and it can communicate with another one which is at a different speed and possibly with a different format. At that time, terminals were typewriters and keyboard displays working in character mode, sending characters one by one, and computers would exchange short messages like packets with a different format. And packet switching had the potential to have direct connection between these two completely different systems. And it also had the possibility to have computers communicating in a mesh environment – many-to-many – with a single-access link to the network with just a single speed, no splitting down into small circuits. And another point of packet switching is that we could use standard hardware. We didn't need specialized circuit-switching hardware to implement switches. This being said, there could be a variant in the way to take advantage of these three characteristics. And the Tymnet or EPSS… Oh, I didn't give the name. The British proposed the virtual calls on what they called the Experimental Packet-Switching System, EPSS. And this approach was clearly very sound because it permitted to control the quality of service which is offered to customers. If you want to replace leased lines, you cannot do that if you cannot guarantee a minimum quality of service, and we needed that. And virtual circuits did permit this quality of service control. Another aspect was, as I said, an economic model. And we understood that what customers would have to pay should depend on several criteria – the volume of data, which should be the key factor, but also, if they reserve something to have some guaranteed quality of service, there should be part of the charge based on that. All of this seemed very simple to do with the virtual circuit model. So we decided to test it, validate it, and first improve a lot from what we learned from EPSS, above all by not needing specialized hardware.

Schafer: In the packet-switching network, there were two possibilities. As you said, virtual circuits, and in France, another team preferred datagrams. You said you choose virtual circuits because of the quality of service, and also the economic model was important, and it was for users. Which users at this time were in prevision?

Després: Well, I kind of answered already that we wanted remote access to timesharing systems and substitute to these lines. Our users were companies using IBM computers or from some other companies, but IBM had at that time more than half the total market. So these were the customers… Or maybe I didn't answer completely your question. Let me say that I missed something we had as an objective, it is to be competitive. That is, not to waste transmission capacity. And that will be a determining factor against the other choice, which was datagrams. So, well, you referred to datagrams, and that was not named that way at that time. It was named a little later on. I may come back to that. The Cyclades project in France was initiated by the Ministry of Industry. And they decided to go with independent packets, the networks not knowing connections between computers. So what is a datagram? That is a small packet of information which has two addresses in it – the source address, the destination address – and which has a maximum length. And you send this across a network, and in the datagram model, it may be lost if the network has queues which kind of overflow, and you have to manage with that. Now, it has two problems, or several problems I would say. One is terrible waste. At that time, most of the packets which were transmitted were of just a few useful characters. If you add to these useful characters two addresses, you waste the available bandwidth and you find a terrible dilemma: "Which length of address should I take? If I take it long, the waste is even worse. If I take it short, I have a limited number of customers." And to take an example, within the ARPANET, there were datagrams that didn't go to the end user, but there were already datagrams. They had two-octet adresses: Cigale, Cyclades – Cigale is the name of the telecom part of Cyclades – had three octet adresses, but one of the octets was to identify the network. Well, they added something interesting, which is there is not a single ARPANET. They have some several networks intended to be interconnected. So one of that for the network number and then, within the network, two octets – 64,000 customers maximum. If we would have taken this number, we would not have been able to support the number of customers we had a few years later. Ten years after opening Transpac, we have 100,000 new customers – more than what Cyclades would have ever supported. So, we have avoided this dilemma in virtual circuits, we give the address of the other end once and for all. And after that, packets have just two octets and just the number of the connection. And we didn't have this dilemma of how long should be these addresses, and we didn't waste bandwidth. So that was the first criteria. The second criteria was quality of service control. With the datagrams, as we said, every source can put datagrams in the network. If there are some queue overflows, you just throw them out. With virtual circuits, each connection is identified, and the network can indicate at which rate of them it accepts packets. And if at the other end packets don't go away, then sources are slowed down. We can give the guarantee of never losing anything except when there is hardware failure or link failure. And this was key for acceptability of the service we offered because we intended to have it tariffed. And RCP has been the tool to prove that we could really never lose any data, except sometimes on the link and there is an immediate transmission. But the customer pays for data presented at one end and that went out on the other end, not for data that were sent and never reached the destination. Okay, so it can be considered, as some people say it, that datagrams are the basis of how the Internet works today. But the Internet today doesn't have the same cost of lines, doesn't have the same lengths of data packets. Data packets are much, much longer. You send pictures, you send big bunches of data, so that the two addresses are not that bad. And Internet has essentially been developed as an oversized network. It is so large that the queues don't overflow too often on… and it's okay. It's acceptable. It's called a best efforts network, which is not a model we could have sold to our customers because they would have preferred to make their own networks. So essentially that's the reasons why we selected virtual circuits. And we discussed with computer manufacturers because one of the objectives of RCP was not only to show that internally it would work, but also to show that real computers could be connected to this kind of network. And IBM in its research laboratory in La Gaude in France, where for the worldwide company was a telecommunication research center, they implemented an adaptation to RCP and told us, "A public network with datagrams, we will not accept, but one with this kind of technology, yes, we can." And also it was confirmed that the choice was the right one. Later on, when Telenet started… Maybe I will come back to that. No, let me make the point now. Telenet has been the first public network based on packet switching open in the U.S. It was a company run by Larry Roberts, the father of ARPANET. And he had with him Barry Wessler, who was already his main assistant in the ARPANET project. And independently of what we did, he had decided for a virtual circuit model because that was their solution adapted to the market of that time. There was absolutely no doubt.

Schafer: So as we see there were two different solutions in France, virtual circuits, you developed it, and datagrams, Louis Pouzin and his team were for datagram solutions. You started this work in 1971, and at the same time, Louis Pouzin at IRIA started his work. There was a project of collaboration – of cooperation – between the two projects at the beginning in 1972. Could you please explain the situation with the Cyclades team? Was this a case of two solutions that showed different cultures, probably a common carrier culture with virtual circuits and a computing culture with IRIA? Do you agree with this vision? Is it right?

Després: No, I certainly don't agree with the idea which has been pushed in France that our design of the Transpac network was based on *telephony* culture. All of my background, as I said at the beginning, is that of a computer engineer, a software engineer, and all of what I did was based on this culture, not on telecommunication culture. Now, what was the relationship with this team? Well, the Cyclades project was essentially a French ARPANET. ARPANET had also a telecommunication project because that was needed to interconnect research centers. But the main objective was cooperation between research centers. The network was a tool. So it was discussed between the Ministry of Industry and the PTT Ministry whether they would need a telecommunication network of their own or whether we could build one for them. And the principle was, I think, or I was told, agreed that the PTT would build the network. But the IRIA team, Louis Pouzin, had a view that he knew how to do the network that we wanted to design better than we did. And he convinced the Ministry of Industry and Maurice Allègre, who was in charge of the *Délégation informatique* – a very powerful bureau in the Ministry of Industry – that we didn't understand what were the requirements of the market. Instead of letting us develop our network and using it, he tried to replace our design by his own design. At some time, it was agreed that one person of his team would work with us – Jean-Louis Grangé. He came here at CNET for some time, but he was not really interested in participating in the RCP project and he stopped some time after that. What is important to notice is that I was the designer of this future Transpac network. I was completely free to take the design which I thought was adapted, and I was never interviewed by anyone of the Ministry of Industry about why we did things like we did then. Only once I was invited by Louis Pouzin to go to IRIA where, instead of listening to what I was designing and why, he told me all the details of how our network should be done, with lots of mistakes as far as I am concerned. It couldn't fit with our requirements. So this kind of disappeared as a will to cooperate. And Cigale went its own way, and we went our own way. And RCP has been a great success with, as I said, some computer manufacturers connecting to RCP. That was IBM and also Honeywell-Bull and CII who did these connections. CII, the French computer manufacturer, asked for some government money to do it but still did it. And that was very successful, where the Cigale network disappeared after that.

Schafer: Yes, and Cyclades died in 1979. Could we think that not RCP but then Transpac that opened in 1978 killed Cyclades? That the French common carriers are responsible for the end of the Cyclades network? We could say that this battle was a little David versus Goliath because in France at this time, the common carriers had the monopoly on the lines. They were very powerful, and the Cyclades team was very small. Was it an equal fight, or was it sure that the common carriers would develop their network?

Deprés: Well, there is this idea, which I heard, that the French PTT killed Cyclades. No. Well, first, Cyclades was a project where they could have used our network instead of building one. So we didn't kill the project in general. But they tend to have been more interested in doing some telecom work than cooperative work between computers. But at a time when we had already obtained an international standard for public data networks, the X.25 recommendation in CCITT, Cyclades was still asking for eight million francs provision of links for their network from the PTT to be given. Why would the PTT have done that? I mean, not making a gift may have ended up as killing the project, but the project was not sustainable because it was a waste of energy. Bandwidth was wasted. In fact, the PTT was in a position where they were subsidizing this project with Louis Pouzin, a great showman in international conferences explaining that we were doing everything wrong. So it didn't make sense. I mean, he killed the project himself. And I even have doubts that he was really interested in fixing all the problems that this network would have had if it had continued. So lack of money because he wanted some money to do things against the PTT and probably lack of interest in continuing.

Schafer: As we see, the discussions were not only at the national level but at the international level. You said there were the ARPANET project, the British people, the CCITT, the European level… There were a lot of actors in this story. What were your contacts with the international community and with ARPANET?

Deprés: Okay, with ARPANET, we didn't have much. As I said, all the documents were very clear, available to anyone, and we knew what ARPANET was doing well enough for our purpose. But at ICCC 72 was created the so-called International Network Working Group, where I met for the first time Vint Cerf, Frank Heart of BBN, and Barry Wessler, and they presented their ideas. We exchanged views. And this group later on became parts of IFIP – International Federation for Information Processing – which was a largely academic group, and which had basically no interest in operators' objectives and was even an anti-PTT front. And Louis Pouzin was very active in that, and that was the place where coming from the PTT you would not be welcome anyway. So we did not participate much in that. We had more work to do somewhere else. But we had, on the other hand, many contacts with our peers, the other operators. I mentioned the British Post Office and some others in CEPT – *Commission européenne des postes et des télécommunications* – which was a kind of lobbying organization to propose in CCITT things which were adapted to the European context. And many other contacts in CCITT and bilateral contacts. So maybe I can tell the story of major steps which led to X.25. I was just entering this telecommunication business when I was invited to the first international meeting I ever attended at CEPT. And the question of packet mode of operation was raised, and I had to explain a little bit that there were two ways of doing it – independent packets (later on called datagrams) or virtual circuits. And a man from the PTT, Bernard Rouxeville, proposed that I would be the *rapporteur* on packet switching for the CEPT, and I was nominated for that. I didn't know anything about CEPT. And then we started some work with other participants. And at the same time, CCITT had its own *rapporteur*. Halvor Bothner-By was from Norway. So we had alternative meetings – CEPT meetings, which I chaired with Halvor Bothner-By being one of the participants and CCITT meetings where Halvor Bothner-By was the Chair, and I was participating. And after a few meetings, we decided that the choice between the two technologies was unfeasible with the state of knowledge on the subject and decided to study both in parallel. And after that, we had a great turning point when the Canadian of TransCanada Telephone Systems and Bell Canada went around the world to propose their specification of what the public network should be. They were highly motivated to compete with IBM. IBM had the SNA [System Network Architecture]. And they wanted public network operators to have their own standard. The specification they proposed, called SNAP – Standard Network Access Protocol – was largely based on the datagram model completed with TCP-like protocol and had one more layer of protocol than Cyclades – a link-layer protocol where corrections, where packet losses would be compensated immediately on each link. So they had a meeting with the French PTT exposing what their plan was. And their main technician was Anton Rybczynski. And I remember continuing after the meeting with Tony, and we walked in the street in Paris, and we discussed how they were doing things, how we were doing things. And later that night in a café along the Seine, we kind of drew what could be an agreement between their views and our views, and that would take the virtual circuit layer of our RCP-Transpac and their lower layer. Their lower layer was based on HDLC, an ISO design, rather complex. We had a simpler one, but theirs had the advantage to be more sellable to ISO. So we decided to do that. That might be a carbon-common objective for our two companies. And after that, I went with Paul Guinaudeau, one of my colleagues in CCETT – *Centre Commun d'Etudes de Télévision et Télécommunications* – where I had moved in the meantime in Rennes. And we went to Canada and explained again in particular that if we took this design, it would be very easy to interconnect our two networks. The same protocol which became X.25 that we use for computer to be connected to the network can be used essentially unchanged between the two networks. And that was key to make a realistic plan that there would be a worldwide service as opposed to just a national non-interconnected service. And I think that was a key point to convince them that we could go that way. So the decision was made between Bell Canada and the French PTT that our public network and their public network would have the common spec we would write down in details. Then Tony Rybczyncksi went to Rennes for a few days – I don't remember the exact duration – and worked with Paul Guinaudeau and myself, and we wrote our common specification and design for the public network. I think I didn't mention yet that what's very important to resist the pressure of Ministry of Industry to abandon what we were doing. We had Philippe Picard at the head of this complete project. In 1973, the *Directeur général des télécommunications,* the head of telecommunication branch in the French PTT, announced that France would develop public packet switching network in '73. The expectation was then that it could be opened as early as '76, but it opened in '78. And after that a project head was nominated – Philippe Picard – and he has been very efficient in dealing with all aspects of the project. The technical part was mine, but anticipating what tariffs would be, anticipating communications with potential customers was his responsibility. So, he agreed. He was the one to decide with Bell Canada that we would go with the same specification. And we did that in Rennes. And soon after we got contact with Telenet. And I went to Washington and spent some time with Barry Wessler, and we discovered that they had a very close concept to what we had chosen, again the confirmation that the market needed that. That was a virtual circuit close to ours. With some minor modifications, they joined the group of three carriers – data communication carriers – intending to have the same specification for their networks and with the understood possibility to interconnect them. And in the meantime, we had in France prepared the Transpac deployment by a call for tender and manufacturers selected to develop it. The specification was virtual-circuit based. Oh, something I missed in the history of relationship between our team and the Cyclades team… When we were preparing the specification of this public network, I was required to include a datagram version. And so, okay, we will add something for datagrams, but we will add virtual circuits to have it working at least. And I was asked someday by Alain Profit, who was head of Hermes project, "What would you do if you were asked to just have datagrams?" And I said, "Certainly not continue to be responsible for that. I cannot do that." I never heard again about this question, but the pressure was very strong. So back to where we were.

Schafer: You mentioned Halvor Bothner-By at the CCITT. I think he invented the name "datagram." And he was convinced with this solution.

Després: Well, yes, he was. It happened that the Norwegians had an ARPANET node, and he was close to the ARPANET environment. Essentially he was in favor of datagrams. That's why we both in CEPT and in CCITT decided "let's specify both directions," because we understood we couldn't pick just one among the two of us. In fact, I proposed to continue with the two being confident that eventually the virtual circuit will make it, and that's what happened. And the name datagram was invented in a train between Rennes and Paris, coming back from a CEPT meeting of which I was the Chair.

Schafer: And you said that you discovered that Larry Roberts had a solution that was very close with your solution, that you had an agreement with the Canadian people. Could they help to make a standard?

Després: Yes. It's a good question because it was a difficult point. The Canadians were not permitted to vote in CCITT. And they have a competitor, the Railway… I don't remember the name of the company, but having large data networks using lines along railway lines. And so it was key to find a support from the British Post Office. The British Post Office had first been in favor of virtual circuits their way – the EPSS version. Then because there was a European network called EIN – European Informatics Network – which happened to be based on the Cyclades technology, then they were in favor of datagrams. And then another project called EuroNet came, and the decision had to be made to go the EIN way or the Transpac way. And the decision went on the right side, I think. It went the Transpac way. The day after the decision was made, the UK became very favorable to virtual circuits, and that was very useful. Philip Kelly was expert in how to deal with questions in CCITT. He immediately obtained a name – X.25 – and he organized the way to present official contributions in CCITT. So we had this small group where we worked together. He also influenced the Japanese to join the team to have this common specification. So we made a few minor changes during this process. And then a specification was submitted to the CCITT by the French PTT (we were autonomous to do that), and the British Post Office in the name of the others who were not permitted to contribute.

Schafer: Did you start to try to have this standard or *Avis* X.25 very fast because you knew that it was very strategic?

Després: Well, I don't remember exactly the dates, but all of this must have happened in '75, what I have described, or '74. '75. Then there was a plenary meeting of the Study Group 7, the one in charge of data networks, in March '76. CCITT meetings typically lasted a week, encompassing a weekend. So at this meeting, many administrations were very surprised. "Look. They come with a specification. We don't understand what that is." And we had lots of criticisms, doubts, as we say, fear–uncertainty-and-doubts. And it was decided that during the weekend we would try to resolve all the issues that we raised to see whether a specification could be really acceptable. And I was in charge of the meeting. And we took all the issues one by one. Full Saturday, not finished. Full Sunday, not finished… Finished, I mean! All the issues were resolved. And during the night of Sunday to Monday, Paul Guinaudeau and Anton Rybczyncksi didn't sleep. They wrote a perfect and clean version. Both of them had a very nice handwriting. At that time, we did not have a typewriter, so… And in the morning, they could give a clean English version, a clean French version because two languages were required to vote. The photocopy worked for everyone to have the specifications. And then we could vote, and there was a unanimous approval of what we had did technically during the weekend and what they had done by their handwriting during the night.

Schafer: Were all the common carriers self-conscious that it was important to have a common standard to have a worldwide network? I think the German people, for example, they were not very interested in packet switching network. Were they present?

Després: No, they didn't participate actively on this packet-switching debate. Actually, they had been depending on Euronet as their packet-switching network coming. As you know, the focus in Germany was in improving the speed of the Telex network. And they had a project, circuit switching, a not-so-fast circuit-switching project actually. They were not active.

Schafer: Would you say in Europe the British and the French people were the leaders?

Després: Yes. Actually, Spain was active, too. They had a project with a banking network, and they supported the X.25 approach.

Schafer: And AT&T, you didn't mention it?

Després: So in the U.S., the project was different. Well, AT&T was not really involved in that. And that was a problem for Telenet, who had no voting right in CCITT. And after the Study Group 7 plenary universal approval, we had the CCITT plenary where things had to be endorsed, and that was in June '76. And there was unanimous approval as typical in CCITT, but with two requests – one coming from the U.S. and one coming from IBM. The U.S. asked that, for the next period of study, four-year study period, we would work on adding a datagram version. And IBM said "OK, you have X.25 which can mix many connections on a link, but you have small terminals needing only one connection. We would like to see a specific design for that. And we did something in these four years so that the next version of X.25 – the second version of X.25 four years after – had a datagram variant, which no one ever implemented. And four years later, it was abandoned. It was complex, not corresponding to any market for those who had networks to run.

Schafer: And you said, there was a request from the U.S. for datagrams. Where did it come from? And why? Was it a political reason, a technical reason? Why?

Després: I don't know the real origin of the datagram. But AT&T was not as advanced as Telenet on this question of packet switching and asking for something considered to be in line with the philosophy of ARPANET and possibly also the beginning of Internet was felt to make sense, I suppose. Well, I don't know, that seemed more tactical than corresponding to any project to deploy a network with what we were defining.

Schafer: And IBM?

Després: Yes. IBM asked for a simplified protocol for small terminals that need a single connection. But they abandoned that, knowing there was very little to be gained by changing the general X.25, which was rather simple actually. The fact that it was simple is clear because we made a demo of an X.25 switch at an international conference. And I remember Larry Roberts being very surprised that we had done that so quickly and said, "Oh, if you can do that, you can do everything." But it was not complex. A single engineer did program the switch.

Schafer: X.25 is adopted in 1976. If we come back to France, what was the situation?

Després: Okay, so, we had ordered switches for the Transpac network with a virtual circuit specification and a datagram specification, which was abandoned later on. And the X.25 specification was so close to what we had written in the call for tender that the manufacturers decided to switch to the real X.25 without any delay or extra charge for the change of specification. So we had as the main provider of the X.25 switch the SESA Company, who had already been in charge at the EIN nodes. They knew datagrams better. Now, they were on a virtual circuit project working with TRT, a large modem company well known in telecommunications and with a significant financial power, and a small company, TIT, who designed the very innovative switch, which had some difficulties but eventually was very successful. So, well, if you ask…

Schafer: So they implemented X.25 in what was called Transpac?

Després: Yeah, the name Transpac was already chosen. It was in 1973 or 4, I don't know: that was "project Transpac." Then, it was developed.

Schafer: And it was a real cooperative work between common carriers and industrial people?

Després: Yes, well, if I look at what made the success of Transpac in my own vision, first, there was the strong commitment of the *Directeur général des télécommunications*, Louis-Joseph Libois in '73, announcing a project. Then Jacques Dondoux who organized the team to do the job, and that when we designed what became X.25. And before the network was really ordered, Gérard Théry, a new *Directeur général des télécoms,* came, and was quickly convinced by Philippe Picard that this was a good project, and he accepted to go on. And another reason for success, and I think I should not have false modesty, is because we had a very good specification, well designed and well adapted to the market. And that was a factor of success. The cooperative spirit of the DGT or our team with the industrials was very good – SESA, TRT, TIT. There were some bad news as things were progressing, but we always managed to agree on how to best avoid to have delays slipping, and we ended up with a small delay and a very good initial design. There were bugs at the beginning, which we quickly fixed. And another cause for success was the innovative and realistic tariff. For the first time, a network had a charge where it did not depend at all on distance. As far as I know, Gérard Théry was the initiator of this aggressive way of presenting things. Later on, Internet had a charge, which was a fixed charge, but not depending on distance at all, but not depending on quantity either. Here what was very innovative is the lack of independence and distance. And also we prepared the opening of the network with different tools. Paul Guinaudeau, whom I mentioned about specification with Tony Rybczyncksi, with a very small team, implemented a validation node called REX25. That was on a mini computer, which permitted to manufacturers before opening Transpac to validate that their design would work according to the specification on this REX25 developed by Paul Guinaudeau. And also we had the X.25 specification, but we wrote very detailed what we called STUR – *Spécifications techniques d'utilisation du réseau* – all the technical details of how the network works and what the equipment should do. Another decision which had to be taken at that time was to have or not certification of the equipments to be connected. The tradition in the telecommunication industry was that you would never connect data equipment to a network without having certified that it won't hurt the network. So I made the point that, with X.25, whatever the user equipment would do, it would never damage the network. There was self-protection of the network. It was not necessary to have this. If we had needed this certification, this would have delayed the availability of equipments connected to the network. Because of all that, at day one, when the network was open, there [was] actual traffic going through with real equipments from computers.

Schafer: You explain the reason of the success. But I will say, which success? What was the success of Transpac? It opened in 1978. It died in June 2012. So it's a very long story.

Després: Yes, well, actually, Transpac became the name of the company, and the company still runs X.25 network. What you mentioned is the end of X.25, per se. The X.25 service is still working. You say it will close in June? We are not in June yet. Last year they said it would close in the autumn, and they pushed the delay a little bit. But it's an extremely simple design which computers supported, and the banks run many applications on Transpac, one of which is the point-of-sale terminals which check that you have on your bank account the proper amount for what you are buying, and these go through Transpac. What I mentioned was the success for the initial phase of Transpac. The next phase has been the international connections to other networks in ’79. ’79, there was the first connection between Datapac and Telenet and the first connection between our network and the three international carriers in the U.S. – RCA, ITT, Western Union International, who then connected to Tymnet and Telenet. And all of this happened in ’79. One year later, there were 18 foreign networks communicating in X.25 offering the worldwide service. Now, what is important to know is that at that time, the transatlantic links we had with each of these carriers were a pair of 9.6 kilobits per second links. At the time where a single computer could be connected to Transpac at 48 kilobits per second, this shows that a single user could completely overburden an international link. And it shows that flow control was an essential feature of the protocols we had to run. And after that, many applications of the bank industry, of the banks, I mean, of the industry, too, grew, but a great acceleration of the growth of Transpac has been the Teletel service, the Minitel. The very daring decision of the DGT has been to offer to all telephone customers a small keyboard and display system called the Minitel. And in 1985, we already had one million of these communicating through Transpac to ask for telephone numbers of people or to access some services, like airline reservations, railway reservations first. And it was also very successful for some adult entertainment actually, which was cause of the growth of that service, too.

Schafer: And this killer application that was the *annuaire électronique* …?

Després: Yes, it was the reason why it was given for free. One of the rationales was that, at the time, when the telephone network of France was going very quickly – we were late a few years before – the diary, the telephone book was never up to date and costing a lot. And having an electronic terminal would be competitive, and that was very successful. And yeah, I guess that’s what was the real growth. And Transpac was the largest network of this category worldwide, and Euronet served many countries in Europe.

Schafer: And then when the Internet grew in Europe and the general public discovered the Web in the 90s, some people said that the Minitel and the common carrier politic were responsible of the very late turn from Minitel, in France, to the Internet. People had the Minitel, so they didn't welcome the Internet. Do you think that, with this virtual circuit turn, with Transpac and then with the development of the Minitel, France missed a chance to play a very important role in the Internet and that we missed a chance in the technical history?

Després: Okay, there are two aspects of the question. Did we miss an opportunity at *that* time? No, I don't believe we did miss any opportunity. As I said, Transpac was very successful nationally, customers very happy, and the French manufacturers did export our technology. France was the leader of the packet-switching technology. We had exports in, let's see, in Brazil, in Australia, in New Zealand, Netherlands, China, but the question is why didn't we go on. And I think that's when we missed another opportunity because, in France, there was no political support of our data network technology. Just the opposite in the U.S. where you had the vice president Al Gore supporting that Internet research network at the beginning would be a source of worldwide business. The growth of Internet started with applications. The first application was messaging. I believe that Vint Cerf, the father of TCP/IP, who had moved from ARPA to MCI, where he worked on a messaging system, when he went back to ARPA, he succeeded to convince that this commercial application could be supported on this network of researchers at that time. And then first explosive growth of Internet. The second one has been the Web. When the Web technology came, the traffic increase has been very, very fast. But all of this could have worked on the virtual circuits just as well. I had a confirmation of this talking with Vint Cerf years later. He was technical advisor of one of the companies I ran later on. And we did agree on this analysis. It's not a matter of being datagrams or virtual circuits. It's a matter of a network which supports these applications. Now, coming back to France, as I said, the Ministry of Industry was still considering that we were doing things wrong. And they obtained that the Transpac network would not be run by the PTT alone but that it would be run by an independent company in which the PTT would have most of the shares but where there would be private shareholders representing the customers.

And in a traditional administration like we had at that time, that was not welcome at all. So the mother company, DGT, was not pushing Transpac to expand its business as much as it could. And a decision came later on. I was the first CTO – Chief Technical Officer of Transpac. And after Transpac had successfully been open, the question was, “Could we in the company do some research to have an evolution of our service?” And the answer has been, “No, no, you don’t. The mother company will do all the research.” The second question has been, for me, “Can I go back then to do the research?” And the answer has been, “No, no, you left the administrations, and now you are on your own.” At that time, there was another idea which came in from, this time, real telecommunication guys, as opposed to computer specialists like I was, and they tried to invent ATM. Well, they worked on ATM as something that would replace the old X.25. So X.25 was not welcome in that environment. ATM was asynchronous transfer mode, which was virtual circuit-oriented with the ambition to have both the computer traffic and the telephone traffic, which is an interesting idea. We could have evolved X.25 to do that, too, but they were kind of ignoring this, which was part of a Transpac network on the side. So we didn’t defend the technology. I was told by some professor, but unfortunately I don’t remember his name. I’m not even sure, he was from Ireland. I think that was the case. He told me that for the research network in Europe there was a proposal made to the PTTs to make some adaptation of the addressing of EuroNet, of X.25 technology, and the answer has been negative, so they were pushed to use ARPANET, I mean Internet technology instead. That’s really unfortunate.

Schafer: So the decisions at this time, they were not really technical? It was very political, and…

Després: What was political was the absence of desire to go on with this advance we had in technology, which was worldwide deployed. So we left the occasion for the Internet technology to become the worldwide network. At the beginning when Internet had to go to remote countries, this was done across the X.25 worldwide network. One could say that we missed a name for that network. It didn’t have a name. That was the "X.25", the "PTT-packet-switching" network. There was no name. "Internet" was single thing.

Schafer: So you have no regrets with the choice – virtual circuit? It was a good solution at this time for commercial development and for a general public network, if I understand what you explained. And then the development of the Internet, the fact that you worked on IPv6 and that you really know the IP solution and how it works, did it change your opinion on datagrams and on TCP/IP?

Després: Well, not really. Absolutely not on the fact that at this time virtual circuits was the only solution, as Telenet has shown. Now, one reason why, today, datagram-based networks can work is that the waste of bandwidth that we would have had at that time is not the same. At that time there were only a few useful characters per packet. And now there are large, large packets with video being transmitted and… so that adding two addresses is not such a waste. Besides, the price of long-distance links has decreased extremely fast with fiber optics. We have to remember that at sometime Bob Metcalfe, the inventor of Ethernet, said, "I predict that by some time, Internet will collapse. If it doesn't, I will eat my article." And Internet didn't collapse, and he had to eat his article. I think the reason is because, thanks to fiber optics and fast switches, Internet has always been oversized. So there is plenty of capacity, and it works. But there is no good control of quality of service. And this is a subject, which is well now on the table, and we talk about network neutrality because the capacity is a little limited in some places. We should maybe advantage this or that … and all of this quality control we had in the X.25 generation, my guess is that it will come back some way or some other in the Internet. Now, the fact that Internet is a datagram network is what it is. It started with IPv4 with addresses containing four characters, four octets. But as soon as in the early 80s, it was understood that these addresses would become too small for the number of customers. And that's when IPv6 was invented with addresses of 16 octets – four times as long as the previous ones. And when I started retirement in 2003, for some reasons related to a company which had problems, I wanted to continue to work. And I decided to go to the IETF where Internet is being standardized. And I understood that how to go from IPv4 to IPv6 wasn't studied well enough. There were missing pieces there, and I worked on that. And the difficulty there is to go from v4 to v6 is one more illustration of the terrible problems we would have created if we would have gone the datagram way at a time when even four-octet addresses would be too large. So we would have had a small number of customers and the need to change to a second generation very close after we had opened the service. This would not have worked. And TCP, which is part of this design, first was successful in Internet because there was a single source. ARPA had financed the TCP stack, freely given for all UNIX computers, which were becoming predominant. And contrary to the story where our Internet was a very decentralized design, it was a very centralized design. When we had the RCP and X.25 connections from IBM, Bull, etc., that was independent designs. It was not the same package downloaded in various computers. So, now I do interesting things on IPv6 – basically on transition from v4 to v6 – but it doesn't change the idea that, at that time, we needed virtual circuits and that maybe they will come back some way or some other.

Schafer: Thank you very much, Rémi Després, for this interview.