Facing parallel inventions: French telecommunication strategies in the digital field from the mid-1950s to the mid-1990s

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This panel on parallel inventions is an opportunity to rethink 15-years of research on data networks and digitization from the perspective of simultaneity.

The subject of parallel inventions in the field of data networks immediately brings to mind the outset of packet switching, a key concept of Arpanet and Internet (Bay, 2019) that was developed in the 1960s by several players, namely Paul Baran at the RAND Corporation, Leonard Kleinrock at UCLA and Donald Davies at the NPL (National Physical Laboratory) in Great Britain. Yet this *Zeitgeist* surrounding packet switching is not the only example of parallel ideas and projects within the history of data networks, nor is it limited to the US context.

My presentation therefore aims to shift the focus to deepen our understanding of simultaneous inventions, turning away from the cumbersome examination of the "great figures" towards collective innovation and adoption. To do so, we will look at the telecommunications sector. Since the 1950s, this sector in the United States, France, Great Britain and other European countries has been confronted with computer needs and the challenge of building data networks based on their infrastructure – communication lines were mainly monopolized by telecommunication companies in Europe until the end of the 1980s. Several parallel paths were experimented during the period from the transition to electronic switching in phone equipment to the development of standards such as X25, which competed with Internet protocols in the 1980s and 1990s, demonstrating that innovation is not a linear process.

Rather than discuss AT&T's hostility towards packet switching as implemented in Arpanet, which has already been well documented (Abbate, 1999), this study will look at the French telecommunications administration and show how those responsible for the communication lines needed for French networks were positioning themselves to face the changes that had begun in the 1950s, whilst assessing parallel inventions that were either internal or external to the administration.

Our paper will therefore focus less on invention *per se* than on the response to simultaneous inventions, and will review several simultaneous paths in the history of digital networks that French telecommunications had to face, and the associated process of collective decision-making. We will start by presenting the parallel development of spatial and temporal switching in the second half of the 1950s, then look at the simultaneous experiment of Caducée and Hermès networks (early 1970s). Complementary case studies will cover the debate about virtual circuits and datagrams from the 1970s to the 1990s, standardization within the field of telematics and the first Web offers in the transition period from the Minitel to the Web in the 1990s.

Our analysis aims to establish a typology of the administration's choices and attitudes, which differ according to whether the alternative is an internal solution or from an external source, but also according to the periods, from the telecommunications monopoly to the 1990s deregulation. In this way, we aim to reveal how inventions were not only connected to the technical context and knowledge, but were also shaped by those who were interested in the resulting technology.

1- From spatial and temporal switching to Web adoption: different approaches to decision making and innovation

1.1. Spatial and temporal switching; circuit and packet switching: simultaneity as a field of exploration (from the 1950s to the beginning of the 1970s)

In 1955, when the CNET (the French National Research Center for Telecommunications) launched a prospective study on electronic switching, the idea was not entirely new. It was first described in research by T. H. Flowers in 1935 and the Deloraine patent in 1945 and would later be discussed at the international symposium held in 1957 in Murray Hill. The electronic switch offered an alternative to the electromechanical system: the functions were performed by specialized calculation units. The value of electronic switching lies in its operating speed, in the miniaturization of material through the use of integrated components, the creation of new services for the subscriber thanks to programs stored in memories, and the possibility of automatic maintenance.

While in 1957 AT&T had announced switching technology, Pierre Marzin, head of CNET from 1954 to 1967 (Griset, 2005), refused to believe that the United States would necessarily retain their lead: he entrusted the research to a new department called "Research on Electronic Machines" (RME). The team led by Louis-Joseph Libois took on the ambitious project, despite insufficient computer memories and a clear lack of adapted components.

Louis-Joseph Libois refused to choose between the "spatial" solution, which seemed simpler at first sight, and the riskier "temporal" solution (Libois, 1989; Griset, 2005). He conducted studies on both options, working on a fully electronic option (temporal switching) while simultaneously developing a spatial switching project that remained based on a voice signal.

The work on temporal and spatial switching can be reported in three periods. The first period until 1970 was exploratory and focused on spatial switching, whilst the second period, from 1970 to 1972, was that of two experimental installations: the Plato project in temporal switching and the Pericles project in spatial switching. The third period began in 1972, and was marked by the beginning of industrialization and the multiplication of temporal switching experiments.

In this first case, the CNET's desire to catch up with the USA led to the parallel exploration of a cautious vision and a riskier path, thus allowing them to rely on a safe option whilst testing the alternative.

The same approach was then used in data networks, resulting in the development of two network projects at the end of the 1960s: Caducée and Hermès.

In 1969, in response to the technical limitations encountered for the switched phone network and telex and in response to the multiplication of specialized and dedicated links, the CNET decided to set up a network specifically dedicated to data transmission: Caducée. However, this network based on existing analog lines was only a standby solution until the completion of Hermès, which would boast the most promising and recent techniques. Caducée was also designed to "obtain as much information as possible on the structure of teleinformatic traffic in order to guide studies on future networks" (Guillet, De Mesnil, 1976: 41) and to enable the Administration of Telecommunications to deal with main issues, in particular pricing. However, the Hermès network remained the central project. Launched at the same time as the Caducée project, Hermès was expected to be at the forefront of research and was based on temporal switching. Here again, a safe solution was implemented alongside a more challenging option, and although Hermès was not considered a success, it was one of the first examples of the Integrated Services Digital Network (ISDN) and enabled a CNET team to develop further research on packet switching.

In the field of packet-switching networks again, the CNET had to face two technical proposals, but in this case one originated from a different environment: it was exogenous to the telecommunications milieu and came from the computing field.

1.2. Datagrams vs. virtual circuits, and standards in telematics: simultaneity as a field of struggle (1970s-1980s)

In the late 1960s and at the beginning of the 1970s, Europe was far from lagging behind in the packet-switching network domain. In all except the funding, research conducted in Great Britain and France in particular could hold its own against US counterparts, as noted by Donald Davies, who at the time worked at the National Physical Laboratory.

> MCK : Well, in March 1966 you gave a seminar on packet-switching to an invited audience at NPL, and the original time-sharing seminars had taken place in November 1965; so somewhere between those dates you'd invented the packet-switching concept. […]
> DWD : Yes, I think that's virtually true. The basic ideas were produced really just in a few evenings of thought, during or immediately after the seminar. Then I began to work them out in a little bit more detail, thinking about the interfaces involved, about how the processes would be organized and drawing a few diagrams and so on. […] And then the main event, as you said, was the lecture in March 1966. After that lecture, I was still concerned whether the ideas had any merit: were they very obvious, and did everybody know about them anyway?[1]

This technique, which consists of dividing the messages to be transmitted into packets of data to enable easier circulation within the network, was the brainchild of three researchers: Paul Baran and Leonard Kleinrock (United States) and Donald Davies (UK). These three pioneers, while achieving significantly convergent results, did not have the same motivations. As Janet Abbate reminds us:

> If the watchword for Baran was survivability, the priority for Davies was interactive computing » (Abbate, 1999: 2).
> « Packet switching was never adopted on the basis of purely technical criteria, but always because it fit into a broader social-technical understanding of how data networks could and should be used » (idem: 8).

For the French researchers, it was also a "socio-technical" concern that was behind the launching of the Cyclades network project in 1971 by Louis Pouzin's team at the IRIA (Institut de recherche en informatique et automatique), a research institute dedicated to automation and computing (Griset, Beltran, 2007). The IRIA team was rapidly faced with a strong interest for packet switching that had also developed in the telecommunications world. Whereas IRIA's computer scientists implemented a datagram mode, in which packets of data were scattered from node to node throughout the network according to the best path available, the telecom model involved the same path being used for all packets of data concerning the same message (virtual circuit mode). According to the telecom operators, this choice was well suited in terms of pricing and quality of service to provide a commercial offer, particularly to companies (Schafer, 2012).

Since French officials did not intend these two public research projects— Cyclades and RCP—to compete, it seemed natural to bring them closer together. The two teams tried to cooperate in 1972, but by 1973 Louis Pouzin and Rémi Després, the leader of the RCP project, realized that their approaches were incompatible. Rémi Després recalled in a 2012 interview:

> 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 that we didn't understand the requirements of the market. Instead of letting us develop our network and using it, he

[1] Donald Davies' interview with Martin Campbell-Kelly at the *National Physical Laboratory*, March 17, 1986, Oral Archives of the Charles Babbage Institute. https://conservancy.umn.edu/handle/11299/107241

> 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.
> 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[2].

This incompatibility (Russell, Schafer, 2014) had international and European consequences. At the international level, the datagram approach of the Cyclades team was also preferred for use in the Internet with the definition of TCP in 1974 (McKenzie, 2011), while the virtual circuits solution was recognized by the CCITT (which later became ITU-T) in 1976, allowing the telecommunications world to converge internationally towards this X25 protocol; at the European level, the datagrams vs virtual circuits battle was also echoed within two networks launched by the EEC (Labarrère, 1985): EIN (*European Informatics Networks*) was part of the COST Actions (Scientific and Technical Cooperation) and was based on a datagram mode, whilst Euronet was based on a virtual circuit mode.
Here simultaneity was a factor of convergence for French telecommunications but this time with its own international environment. Indeed, the Administration turned to their "natural partners", namely the other administrations of telecommunications, to help them reject the exogenous solution and adopt a common standard. French telecommunications also had strong political support: the Nora-Minc report on the computerization of society (Nora, Minc, 1978), a true best-seller (Walliser, 1989), gave a key role to telecommunications in this computerization and the telematics project was also supported, adopted and strongly funded by the French State at the same time.
However, *British Telecom* and the BBC made England also a pioneer in this telematics field. The British system Prestel was launched in 1976. The *Deutsche Bundespost* began to take an interest in videotext too, and the *Bildschirmtext* was tested in June 1980 in Düsseldorf. Other European countries also experimented with videotex systems: Finland developed a system that was designed for administrative and professional use with Telset, and Denmark produced a similar system called with Teledata (Gauthronet, 1982).
Despite similarities between the different projects, the French system was the only real success (Schafer, Thierry, 2012; Mailland, Driscoll, 2017). The Prestel system launched in the UK was a failure. The cost of a television set capable of receiving and displaying videotex information was a handicap to the massive introduction of Prestel in Great Britain, while France had decided to invest in a free independent terminal, the Minitel, to stimulate telematic traffic.
Although the French strategy appeared to be a success at the national level, it remained an exception at the European level and was a solution that proved difficult to export due to the inability of European countries to agree on common standards. An agreement was signed in Rennes on 27 January 1978 between the French telecommunications administration, the *British Post Office* and the *Deutsche Bundespost* for the use of interactive videography, then finally revoked by the UK under pressure from its manufacturers, who feared French competition. In this case, European cooperation, previously seen as an asset for French telecommunications, was bypassed by national industrial interests (Schafer, 2012).
These industrial policies aimed at strengthening national interests were challenged in the second part of the 1980s by a European concern to stimulate competition and open markets

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[2] Interview with Rémi Després by Valérie Schafer, 16 May 2012 (quoted in Russell, Schafer, 2014).

through deregulation.

1.3. From Minitel to Web: simultaneity as a way for hybridization (1990s)

In this context, the Minitel was increasingly considered to slow the global interconnection and information highways promoted by the USA at an international level.
The first reaction of a significant number of French participants was to propose modernizing the Minitel rather than replacing it. On the contrary, most of those advocating a radical transition to the Web were pioneering users of micro computing. Alongside these clear-cut positions, a movement of transfer and hybridization of technologies had begun: this was the new solution that the French telecommunications industry was exploring.
The telecommunications administration began experimenting gateways in the 1980s, despite its reluctance to deal with the Internet and the Web due to issues including the uncertainty about the quality of service and payment systems (Schafer, 2018). In 1984, a modem card developed by Roland Moreno made Transpac available to Apple machines. Agreements were also made with Atari, and the resulting connection kit enabled users to connect the Minitel to a computer and save screen pages.
In February 1997, France Telecom launched MinitelNet, which provided an email address to send or receive email to or from any Internet subscriber, but at a similar cost to that of telematics services. In September 2000, the France Telecom subsidiary Intelmatique launched I-Minitel, an emulator running on the two main families of microcomputer platforms[3]. The 3615 homepage had also evolved and gave direct access to the directory of a selection of Internet services, including 3615 Club-Internet, World-net, Wanadoo and Caramail.
Thus, as explained by Franck Rebillard (2012: 33): “In the mid-1990s, three socio-technical paths emerged: one is in line with existing national telematic services; the second is based on a transnational and open communication system, mainly for the academic world; the last is made up of hybrid initiatives led by industrial communication actors”.
Yves Parfait (2014), one of the founders of France Telecom’s 1996 Wanadoo ISP , remembers that the company had four different stands presenting different approaches to telematics and digitization at Geneva’s Telecom95 exhibition: “It was a revelation: everyone said to themselves “you have to put it in the same jar”, and that’s how we found ourselves in the same team with extraordinary enthusiasm”.
The time had come for hybridization in a world of deregulation (Schafer, 2018) where telecom operators had no choice but to explore ways to respond to external pressure. This is reminiscent of the parallel exploration of spatial and temporal switching in the 1950s. Although the context had changed, the fear of progressing more slowly than the USA once again played a role in triggering action, but this time actors sought the hybridization and creolization of innovation (Schafer, Thierry, 2016), allowing them to find their own path, that was suited to their individual identity.

2- Do parallel inventions slow or drive innovation?

These different study cases, which would of course deserve to be presented in greater depth, lead us to draw a number of conclusions and proposals for the analysis of simultaneous inventions. Among the most obvious, as underlined in our introduction:

[3] Mac OS and Microsoft Windows.

- This question is an invitation to explore not only the successes, but also the failures, the approaches that were explored and then abandoned, or those that merged. In this way, we avoid a hagiographic, teleological and presentist narrative that focuses on individual founders and often very specifically concerns the United States when discussing network history. Andrew Russell, Campbell-Kelly and Garcia-Swartz (2013) and many other historians have already shown the interest of thinking about the diversity of networks and "missing narratives" to analyse the history of the Internet in a more general context.
- Thinking about the complexity of innovation and alternative paths also encourages us to think about how to write the history of "winners" and "losers", how to document the latter, and how to understand and trace their choices. Without advocating a counterfactual history, it is essential to rediscover and analyse indecision. Approaching this subject from an STS perspective would of course enable us to think in terms of agencies and translations of these processes, which allow certain players to converge around a solution for reasons that cover much more than simply technical issues.
- Obviously this presentation is also a demonstration of the complexity of decision making, which is based not only on technical questions but also organizational, structural or economic issues (e.g. the telecommunications monopoly on phone lines, the mistrust of datagrams by telecommunications operators due to an economic model that seems less manageable).
- Our proposal also explores the telecommunications sector, whose role has not always been fully considered at the heart of this narrative, and invites the reader to take different scales and temporalities into account: our case studies not only show the difficult convergence between the computing field and telecommunications in France, but also demonstrate the rejection of exogenous solutions by the French telecommunications sector. Our study also includes European issues, transatlantic relations and the international scale of standardisation bodies such as the ITU or ISO as vital elements of the discussion. In terms of temporalities, there is also an invitation here to consider how the end of monopolies and deregulation has affected innovation strategies.
- Finally, although we could pursue at length the list of all the elements linked to the analysis of simultaneous inventions, which would be a sizeable collective research program for the coming years, I would like to emphasize the interest of studying how the preference of one path rather than another or the exploration of several parallel paths affects organizations: the importance lies in also understanding the legacy of the decisions made and the paths taken, and how far these choices change the structure of organizations.

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