Telefónica
since 1924

100 years of Telefónica's network history

Julio Linares López

1. Airlines 3
2. Call shops 3
3. Automation 4
4. Data service 4
5. Mobile services 5
6. TV services 5
7. Electronification 6
8. Digitisation 6
9. Industrial consolidation 7
10. ISDN 7
11. Service factory 7
12. IBER Trio 8
13. Internet 8
14. Infovia 9
15. ADSL 9
16. Optical fibre 9
17. IP network 10
18. Liberalisation 10
19. Internationalisation 10
20. Conclusions 11

1. Airlines

Perhaps one of the oldest images of the most widely used technology in Telefónica may be that of a pole supporting overhead copper lines. This solution has been used for the last 100 years and is now coming to an end, coinciding precisely with the centenary of the company itself.

It is probably the only technology that has lasted 100 years, as they typically reach obsolescence more quickly.

This type of outside plant was used to connect customers to telephone centres or telephone centres to each other, and was manned by orderlies, who were always men, in good physical shape, so that they could climb the poles with the hooks attached to their boots, fastening themselves to the poles with wide leather belts, as they did not use ladders or cranes at the time.

Later, the signal transmission lines would also be built underground in ducts, giving rise to two types of outside plant, aerial and underground.

2. Call shops

As indicated above, the outside plant connected telephone subscribers to the call shops that served them, where telephone operators manually operated the switchboards for establishing all types of local, long-distance and international calls.

Call shops were of different sizes depending on whether they served towns or villages. In towns, they could be located in homes and run by families, which was part of their livelihood.

To join Telefónica as a telephonist, at some point, it seems that, in addition to passing an exam, it was required, although today it may seem shocking, to be single, between 18 and 27 years old, not to wear glasses, to be able to spread your arms 1.55 metres apart and to show a certificate of good conduct.

Telephone operators played a key role both in customer relations and in the operation of the service. Perhaps this combination was unique in our history. They had an incredible spirit of service, which has been the best legacy they have left us. At that time Telefónica was female.

The manual service came to present significant limitations, which manifested themselves in delays, in order to meet growing demand. This approach could no longer be continued; it had to be radically changed by automation, which was a major transformation with enormous personal and family consequences.

3. Automation

The automation of the manual telephone service was carried out with electromechanical switching systems, which were actually robots, automatically performing the manual activities that had hitherto been carried out by telephone operators.

The first switching exchanges were rotary exchanges (lasting more than 6 decades) and the following crossbar exchanges (lasting 5 decades). In all cases, they had to be configured according to the expected traffic forecast for the hour loaded. For this purpose, a measurement parameter was established, the Erlang, which is a dimensionless unit that measures the load offered or transported. The economic and quality significance of good dimensioning prompted the emergence of a new discipline of traffic theory.

These plants had to be manned 24 hours a day, every day of the year, by technical operation and maintenance operators, who were admirable people who enjoyed their work immensely; they made a great challenge out of a simple breakdown and were proud of their solution. The plants were always clean, shiny, without a speck of dust, which was the enemy to beat.

The priority and focus of the operators was fundamentally the quality of service, which is the main legacy they have left us. Telefónica was masculinised, why didn't the female telephone operators become technical operators?

Evidently, as the telephone service was automated, the call shops were gradually closed. The full automation of the manual service was completed in 1988, with the closure of the last callshop in Polopos (Granada). In order to provide employment for the telephone operators, new services were invented, such as the alarm clock (098) or information services (003).

Automation required large investments and minority shareholders were attracted through the Matildes campaign. These investments were used to break the supply monopoly, which had been in place since 1945, and served to develop an ambitious industrial plan, in which Telefónica came to own or participate in 30 companies with more than 30,000 employees. The new factories constantly required new products, so innovation was boosted at the Centre for Research and Studies (CIE), which was later transformed into a separate legal entity (Telefónica I+D).

4. Data service

It was precisely the CIE (and later T R&D) that would come to play a leading role in responding to a new demand for data transmission and switching, for which the telephone networks were not ready.

Telefónica was a pioneer in creating a public data service, at a time when it was most common to create private networks, developing the RSAN network, with its own

protocols and equipment, which would later evolve into the IBERPAC network, with standard X.25 protocol and TESYS equipment, which was the largest in-house development undertaken by Telefónica and which made it a leader in Packet Switching, which years later would be the technique used on the Internet.

The data networks, which supported data communications services and telematic services such as teletex, videotex and dataphone (own invention), shared the transmission infrastructure with the telephone network, with the addition of data switching centres, which used the Packet Switching technique.

5. Mobile services

In parallel with the telephone and data network, a third network would emerge to support mobile services.

Mobile services started in the early 1970s with analogue solutions (Automatic Vehicle Telephony) evolving into portable mobiles, which would be further developed with digital solutions of different successive generations (2G, 3G, 4G and 5G), supporting the pocket phone and the touch screen and encompassing voice, data and video services.

Prepaid solutions, using self-developed management systems, also contributed to the launch of this market.

Mobile networks, which supported mobile services, also shared transmission infrastructures with the telephone network, adding their own switching centres, base stations and antennas, which proliferated in the landscape, for the transmission and reception of radio signals. They were organised in a cellular structure in order to reuse the available radio spectrum.

The different generations of mobile phones followed one another over several decades, each one providing more capacity, more bandwidth or less latency than the previous one. Each one also had a specific contribution, with the pocket phone in the case of 2G, Internet access in 3G, the massification of mobile data in 4G and the varied applications for businesses in 5G.

Mobile services were sometimes complementary to fixed services and sometimes substitutes, their development exceeded all expectations and reached the universal rollouts and absolutely massive penetrations that we enjoy today.

6. T V services

Television is a very bandwidth-hungry service and has required specific network solutions in addition to those discussed above, which have traditionally been of two types: cable TV (CATV) and satellite TV.

CATV required the deployment of a new coaxial network and has been used in Telefónica on a limited and very local basis, although the first attempts were made in Spain in the late 1960s.

Satellite TV has been more widely used, until other more integrated solutions have emerged.

In order to fill these networks with multimedia content, companies were acquired and investments were made in others capable of generating information of this nature.

7. Electronification

As can be seen, each type of service required a specific network solution capable of supporting its characteristics and requirements, until semiconductor technology was sufficiently developed to allow other types of solutions.

The transistor innovation had a major impact on telecommunications. Vacuum valves and electromechanical technology were superseded by microelectronics, which would be incorporated first into transmission systems and then into switching systems. The convergence of communications and computing, which until then had turned their backs on each other, was being driven forward.

In telephone exchanges, computers began to be used as control elements, giving rise to Semi-Electronic Switching Systems. Telefónica tested this new generation of switching systems for several years, carried out some occasional installations, and even debated with great ambition and daring the opportunity to carry out its own development, although prudence prevailed and it limited itself to the design and production of the UPCE-101 switchboard and the modernisation of the crossbar switching systems (MORE).

Finally, it was decided not to use Semi-Electronic Switching Systems, differentiating itself from other operators, to go directly to the next generation, which would be totally electronic and digital, anticipating that it was the best solution to cover future demands and take advantage of technological trends, betting on the total digitalisation of all network elements, which would allow all types of services to be supported.

8. Digitisation

Today, with so much talk about digitisation, we should recognise that digitisation began in the early 1980s, when the first steps were taken to make telecommunications infrastructures fully digital, constituting the main pillar of this great revolution that has reached the present day.

Thus, digitisation, which had begun earlier in transmission systems, using the Pulse Code Modulation (PCM) technique, was extended to switchboards, following the same technique and with Stored Programme Control (SPC), representing a major transformation with significant repercussions.

On the one hand, it favoured the centralisation of all operation and maintenance activities in a single point, reducing the need for technical personnel and, therefore, having a great impact on the people who had been working at the plants until then, helping them to withstand the efficiency demands that liberalisation would entail.

On the other hand, it made it possible to offer detailed billing to customers, abandoning the opacity that had existed until then, as the information provided was limited to the number of steps on the subscriber's meter. This was an absolutely necessary modernisation in response to market demand.

In addition, as mentioned above, digitisation drove mobile development enormously and far beyond what was imagined.

9. Industrial consolidation

Digitalisation had a far-reaching direct effect on the manufacturing industry itself and by indirect impact on its customers, the operators.

The shift from electromechanical to electronic technology meant that production centres could significantly increase their capacity and, as a result, factories went from being local to global, concentrating in far fewer locations.

Moreover, the R&D investments required by digitisation could not be taken on by companies that did not have sufficient scale, forcing the disappearance of some and the consolidation of others, resulting in a supplier market structure as we know it today.

It was a very radical transformation, which lasted several years and had a very significant impact on the value of this industrial sector and its employees. It also greatly affected the operators, who had to adapt their supply chain.

10. ISDN

But perhaps the greatest ambition and focus in digitalisation was on the development and deployment of a network capable of supporting the convergence of all types of fixed services (voice, data, text, images, video, ...) in an integrated manner: Integrated Services Digital Network (ISDN).

All operators and all their suppliers, without exception, opted for circuit switching as the best solution to support ISDN, through the development of international standards that would guarantee its interoperability.

The vision at that time was reflected in the document, which was published in 1985, entitled "Telefónica 15 years to the year 2000". This document illustrates that strategic planning was done for the very long term and that the year 2000 was considered a very emblematic year.

The concept was very powerful and ambitious and intended to support narrowband services such as voice and data (B-ISDN-BE) and broadband services including video and TV (B-ISDN-BA). The first part was deployed and rolled out in different geographies, while the claims of the second part would be covered by other solutions in the future.

The technology used in the public ISDN network was also used in switchboards for private networks, which Telefónica took advantage of to make a great leap forward, automating telephone access to companies by eliminating the need to use operators, through a new service that was a great success in the business market, IBERCOM. To achieve this, it was necessary to develop its own protocol to link the switchboards to the public network.

11. Service factory

The use of computers in the exchanges and, therefore, their control by software allowed the development of a wide variety of Supplementary Telephone Services such as caller

identification, abbreviated dialling, call waiting, redialling, three-way conferencing or network answering. It also led to the conception of the so-called Intelligent Network (IN), to support the services of the nine hundred series, while allowing the development of new services in a simple way and without having to resort to the supplier.

It was a time of technological exuberance when ISDN and IR platforms offered endless possibilities.

The technological opportunities were so many and so varied that new services were constantly being developed, which led us to conceptualise this process as a "Service Factory" that materialised in a set of activities with very precise guidelines supported by online tools, configuring a common service development methodology called PROMDES.

The Service Factory had the ambition, perhaps overly exaggerated, to produce one new service per week, with the additional major objective of increasing the usage of our network, which was at very low levels (6 minutes/line per day), with a consequent impact on revenue growth.

12. IBER Trio

As part of the objective of further developing the portfolio of services, both fixed and mobile, it was a priority to serve well the business market, which was the first to be liberalised.

At the time, there was a wide demand for point-to-point circuits, at different speeds, to cover various distances from one building to another. Therefore, a catalogue of managed point-to-point circuit services was structured and supported by the IBERMIC network, in addition to the other existing networks.

The trio of IBERPAC, IBERCOM and IBERMIC responded to a new and very powerful brand strategy for the enterprise market, to cover respectively data, voice and circuit services, with enormous strength and clear leadership, reinforcing our position in this market and preserving our market share in an increasingly competitive environment.

Obviously, mobile services had a complementary role to these fundamental fixed services and their relevance would progressively grow.

13. Internet

We did not pay enough attention then to another standard, which was emerging in parallel, the TCP/IP protocol, which would be the seed of the Internet.

So excited and focused were we on our own projects and ambitions that we were unable to anticipate that this was the beginning of a technological revolution of enormous proportions and significance, as we later realised.

In this context, even "peer to peer" (P2P) agreements were signed with Internet access providers, without mutual financial compensation, shaping the Internet interconnection model, later so much debated and still in force today.

However, we launched our own Internet Service Provider (ISP), when the maximum access speed was 9,600 bits/second, which was marketed under the brand name TeleLine and which would evolve and transform into Terra.

14. Infovia

Precisely to react to the emergence of the Internet, in the mid-1990s, Telefónica developed a service that packaged a modem, a browser and a local access tariff, which became popular under the name InfoVía.

This service, which used the cheapest tariff available at the time, regardless of distance, favoured the development of the Internet in Spain and encouraged its use, as it had eliminated bill shocks when accessing a server located in another region or country.

It was a quick response to correct our initial positioning on the Internet and to incorporate ourselves, with sufficient prominence, into this new wave that would radically impact everyone and everything.

15. ADSL

There remained one demand to be met, which was the availability of flat rates that would allow the Internet user to be permanently connected 24 hours a day, if he/she so wished.

To meet this demand, a dedicated network solution was needed, which would come with ADSL, which also allowed for much higher bandwidth access.

The first ADSL service launched, which we characterised at the time as Broadband, offered a speed of 256 Kbits/second.

ADSL found a good complement in Wifi, to be able to offer wireless coverage indoors.

In addition, ADSL was also initially used to support TV services (IPTV) with a solution developed in-house, given that there was no equipment available on the market, known commercially at the time as Imagenio. Once again, Telefónica relied on technological innovation to anticipate and lead the evolution.

ADSL, in short, had a major business-transforming effect by encouraging a shift from primarily voice to broadband services, extending the life of copper lines.

16. Optical fibre

ADSL had its physical speed limitations and although it could evolve towards more capable solutions (VDSL), it was decided to make the leap to a new solution more adaptable to future needs, a new generation for access which would be Fibre Optics.

Its predecessor was the FOTON plan, which in the mid-1990s was intended to reach every city block in cities with more than 50,000 inhabitants with fibre optics to serve the business market. However, the roll-out was discontinued, perhaps because supply was ahead of demand, probably due to over-anticipation.

With the final deployment of fibre optics, broadband took on a new dimension by allowing Gigabit/second magnitudes to be offered in the access part of the network, supporting

the transmission of signals for the most demanding services, such as ultra high definition television.

The strategic decision to use fibre optics in the access network, in addition to the major transmission routes, anticipated that the demand for bandwidth in access would continue to grow, lead the market, and have great transformative power in the network as a whole.

17. IP network

As broadband and its deployment increased, the development of Internet applications was encouraged, which in turn generated more demand for bandwidth, in a very positive virtuous circle.

The Internet became so widespread that the network had to be adapted definitively to this type of traffic, so routers were incorporated, which became its basic equipment, and so it became an IP network using the TCP/IP protocol for the exchange of information packets.

This IP network is capable of supporting, in an integrated manner, all types of services, from the least demanding to the most demanding in terms of capacity and performance. The IP network is the solution that has been desired for years, built with the best available resources.

In this environment, software-defined networks (SD-WANs) are emerging in order to provide a good response to large enterprises with regard to their variety of quality and security needs, allowing different functionalities to be flexibly configured for different demands.

18. Liberalisation

The evolution of the technological innovation mentioned above materialised exclusively in the Spanish market until 1989, when the first steps were taken in the internalisation of the company, anticipating liberalisation and preparing to face its challenges and take advantage of its opportunities.

The full liberalisation of the domestic market finally took place in 1998. The change from operating under a monopoly to having to operate in a highly competitive open market was the biggest and most impactful transformation ever undertaken in Telefónica's history.

For its proper execution, it was necessary to take advantage of the results of many of these technological changes, such as the total centralisation of operation and maintenance, to have a competitive cost structure, or the availability of a broad portfolio of products and services and a remarkable innovative capacity, to be able to compete commercially and lead the market.

19. Internationalisation

The internationalisation process took place over several years and since its inception, the technological strategy has been a common one, with specific or temporary adaptations specific to each country. The main technological changes and

transformations have materialised in all of them, although the moment of their beginning and the pace of their development may vary.

Probably the biggest exceptions have been in TV services, as CATV was only used in Peru and temporarily in Spain. Satellite TV has been more widespread, with a progressive evolution towards IPTV.

Voice, data and mobile services have had similar approaches in all countries, as have integrated solutions, first ISDN and then IP.

20. Conclusions

It has been 100 years of anticipation and transformation with constant changes that have demanded a permanent effort to adapt, demonstrating, once again, that the single greatest constant in history is that everything changes.

There have been successes and mistakes. Mistakes are inevitable when the vision is ambitious and daring and we should not regret them, as they are a great source of learning. The important thing is to catch them early and correct them quickly and swiftly.

We have only commented on the changes that have occurred as a result of the main technological innovations that have taken place over the last 100 years. These changes have been intense and are occurring at an ever-increasing pace, and we can expect even more profound transformations in the years to come.

Without the technological changes that have taken place, today we would not be able to be permanently connected, telecommute, telecom shop, make payments electronically, have telemedicine, access all kinds of information, share social networks, enjoy online entertainment, have an agenda, contacts, photographs and content in our pocket, ...; in short, be able to lead a fully digital life.

However, we must admit that technologies, however powerful they may be, are nothing without the people who transform them into useful, quality services for society. For this reason, we must express our utmost admiration and respect for the security guards, telephone operators, technical operators and graduates who, throughout the 100 years of Telefónica's history, have made this possible, thanking them for their dedication, commitment and effort, because as the French poet said "each wave owes the beauty of its profile only to the withdrawal of the one that precedes it".

Let us hope that this look back will help us to look further ahead, fully aware that it is not the strongest who survive but those who are best adapted to their environment.

www.telefonica.com