[TsT] Transportes, Servicios y Telecomunicaciones

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The corporate concentration in mass communication technology: the Spanish radiotelegraphy in the transistor and computer era*

La concentración empresarial en las tecnologías de la comunicación de masas: la radiotelegrafía española en la era de los transistores y del ordenador

ÁNGEL CALVO
Universitat de Barcelona, Departamento de Historia Económica, Instituciones, Política y Economía Mundial
Av. Diagonal, 688
angel.calvo@ub.edu
ORCID: 0000-0002-1370-9970

Recibido / Recebido: 20.9.2023. Aceptado / Aceite: 1.6.24.
Cómo citar / Como citar: Calvo, Ángel (2024). "The corporate concentration in mass communication technology: the Spanish radiotelegraphy in the transistor and computer era", *TST. Transportes, Servicios y Telecomunicaciones*, 53, pp. 15-52. DOI: 10.24197/tst.53.2024.15-52.

Abstract: This article addresses the concentration process that took place in Spanish radiotelegraphy during the second half of the 20th century. Specifically, it investigates how the structure of the upstream market affected the implementation of a new technology in Spain. The article also discusses the deployment of a new telecommunication technology at the stage of advanced maturity, using a historiographical approach. In terms of global relevance, this article highlights the appearance of a new mass media technology through a case study that promotes a better comprehension of telecommunications. In methodological terms, this research adopts a multidisciplinary approach with an emphasis on economic and business history and is based on primary sources of a corporate and governmental nature, reports from institutions and newspaper archives. The article follows four main headings: the emergence of a new means of communication – radiotelegraphy; a new company to provide radio-telegraphic services in Spain; the performance of Empresa Nacional de Telecomunicaciones; and its evolution in the computer era.

* Author wishes to acknowledge the Observatori Centre d'Estudis Jordi Nadal d'Història Econòmica del Departament d'Història Econòmica, Institucions, Política i Economia Mundial, Facultat d'Economia i Empresa (Universitat de Barcelona, Spain), José Francisco Arribas Álvarez (Oficial Superior, Registro Mercantil de Madrid), the editors of this journal, and the anonymous reviewers.

Keywords: Empresa Nacional de Telecomunicaciones (ENTEL), Spanish radiotelegraphy, corporate concentration, mass communication technology

Resumen: Este artículo aborda el proceso de concentración que tuvo lugar en la radiotelegrafía española durante la segunda mitad del siglo XX. En concreto, se investiga cómo la estructura del mercado upstream afectó a la implantación de una nueva tecnología en España. El artículo también analiza el despliegue de una nueva tecnología de telecomunicaciones en una etapa de madurez avanzada, utilizando un enfoque historiográfico. En términos de relevancia global, este artículo destaca la aparición de una nueva tecnología de medios de comunicación a través de un estudio de caso que promueve una mejor comprensión de las telecomunicaciones. En términos metodológicos, esta investigación adopta un enfoque multidisciplinario con énfasis en la historia económica y empresarial y se basa en fuentes primarias de carácter corporativo y gubernamental, informes de instituciones y hemerotecas. El artículo gira en torno a cuatro títulos principales: la aparición de un nuevo medio de comunicación: la radiotelegrafía; una nueva empresa para prestar servicios radiotelegráficos en España; el desempeño de la Empresa Nacional de Telecomunicaciones; y su evolución en la era de la informática.

Palabras clave: Empresa Nacional de Telecomunicaciones (ENTEL), radiotelegrafía española, concentración empresarial, tecnología de comunicación de masas.

INTRODUCTION

The international bibliography on radiotelegraphy primarily consists of narratives about the inventors and their contributions, as well as studies on regulatory aspects, monographs on implementation in certain countries, and general histories. This article examines the concentration that took place in Spanish radiotelegraphy during the second half of the 20th century which led to the creation of Empresa Nacional de Telecomunicaciones (ENTEL) in 1961.

This process developed in the transistor era, and, in Spain, during the replacement of the Francoist dictatorial autarkic policy, with its principles of economic nationalism, protectionism and state intervention, by two fundamental milestones in Spain's economic history: the 1959 Stabilization Plan, which promoted a market economy and openness to foreign investment and international trade; and the Four-Year Development Plan of 1963, inspired in the indicative programs implemented in France. The plan targeted the public sector and encouraged the private sector as well (Lieberman, 2005, p. 72). It helped boost the so-called golden age of Spanish economy, by reintegrating it into the international economy (Tafunell and Carreras, 2018, p. 331). It constitutes the most immediate backdrop to

the concentration in radiotelegraphy, a process that preceded the restructuring of public Information and Communication Technology companies in the 1980s[1].

This research aims to investigate the impact of the previous market structure and the relationship between technology, institutions, and business restructuring on the evolution of new media. The extent to which this evolution depends on regulatory development – that had a large impact on the management model for radiotelegraphic services in Spain – or technological change will be examined. This article adds to previous research and international historiography on technology in general (Fickers, 2016), national cases (Aitkin, 1985; Altshuler, 1997; Briggs, 1961; Cavina, 2013; Lichty and Topping, 1975; Figueira, 1994; Pires, 2015) or the impact on business (Drale, 2010).

The implementation of wireless telegraphy in Spain did not follow neither the formula of state service, as in the electric telegraph, nor the private monopoly embodied by the Compañía Telefónica Nacional de España (CTNE), as in the telephone network. The state maintained the horizontal disintegration in the telecommunications service, but it granted the operation of radiotelegraphy to private companies (Calvo, 2021, pp. 16-48).

The peculiarity of the Spanish case is the country's geographical composition, with a peninsular and island territory and African colonies[2], as well as territories emancipated from its colonial rule but closely related to the former metropolis.

As for the theoretical/conceptual lens, it is fruitful to consider path dependency, given the importance of past events or how regulatory actors may actively seek to shape future developments through regulation (Nelson, 1993; Van de Ven and Garud, 1989, pp. 195-225). In terms of methodology, this research adopts a multidisciplinary approach with an emphasis on economic and business history as well as on the history of technology, and certain aspects of management.

[1] Research based on primary sources has highlighted the reasons that led to processes of concentration and rationalization of Instituto Nacional de Industria's (henceforth INI) public companies which, on occasions, gave rise to internationally competitive companies, as was the case of Indra (Calvo, 2024, p. 119).

[2] Morocco, for example, was considered by the great powers as a sensitive area for international telecommunications. During World War I, England urged Spain to conquer the entire Moroccan Riff to establish a censorship office to prevent the transmission of encrypted radiotelegraphic messages. Ministerio de Exteriores, H, 3116, Exp. 4, 1914-1917.

It is based on primary sources of governmental information, institutional and business data, reports from public institutions, and newspaper archives. They include firstly, the Archives of the Ministry of Foreign Affairs, and the Historical Archives of the Bank of Spain and the Mercantile Register; secondly, the personal archive of Ricardo Urgoiti at the Students' Residence in Madrid; lastly, documents of the two main companies involved in this historical process: Compañía Nacional de Telegrafía sin Hilos (CNTsH) and Transradio Española, S. A. (TESA) and the Spanish National Telephone Company[3].

This article significantly expands Spanish literature on the topic, which focuses on telegraphy (Bahamonde, 2002), radio in general (Balsebre, 2001; Lorenzo, 1992; Lusa, 2006; Sánchez Miñana, 2004a), regional studies (Pérez, 2020; Pérez and Quintana, 2020), broadcasting (Soria, 1935)[4], radiocommunications (Sánchez Miñana, 2004b), particular subsectors (Cruz and Piniella, 2017) and corporate monographs (CRAME, 1981). Thus, there is not a comprehensive and long-term study on this field.

The article is divided in four sections: the emergence of a new technology (radiotelegraphy); a new company to provide radio-telegraphic services in Spain; the performance of ENTEL; and ENTEL in the computer era.

In short, this article describes two of the three main stages in the development of wireless telegraphy from electricity as the dominant technical system towards electronics: adolescence and long maturity. Additionally, it aims to present the peculiarities of the Spanish context.

1. THE EMERGENCE OF A NEW TECHNOLOGY: RADIOTELEGRAPHY

Radiotelegraphy, also known as wireless telegraphy, is a technology of distance communication that uses a portion of the electromagnetic spectrum, from the longest wavelengths – including microwaves and radio

[3] These sources are available to the public except those of the Spanish National Telephone Company, which were accessed in the context of a research on the company's history. Compañía Nacional de Telegrafía sin Hilos's records are not preserved, and the Transradio Española's annual reports are from the author's collection.

[4] Archivo personal Ricardo Urgoiti, Residencia de Estudiantes, RU/7/33, Ruiz Golluri, Joaquín (1937). *Historia verídica de la radiodifusión en España desde su iniciación hasta hoy*.

waves – to the shortest – excluding gamma rays and X-rays (Crow, Longford and Sawchuk, 2010)[5]. It developed and expanded because of economic growth, increase in human activity, and greater mobility of the factors of production, capital, and labor.

Throughout history, postal service, optical and electric telegraph (in its terrestrial, submarine and radio forms), and the telephone have succeeded each other. Radiotelegraphy presents a great complexity.

Its origins go back to the mid-19th century and. An international group of experts participated in its development, including Faraday, Tesla, Popov, and Marconi. Faraday discovered the formation of waves radiating in space, while Tesla demonstrated radio signaling in 1892-1893, at least two years before Marconi's first attempts. In September 1897, Tesla applied for a patent for a four-circuit system (two circuits in the transmitter and two in the receiver), recommending that all four circuits were tuned in the same frequency. This System of Transmission of Electrical Energy was patented on March 20, 1900, several months before Marconi filed his first application: American patent No. 763,772, November 10, 1900 (Nicklanovich, 1997, pp. 8-18). Russian physicist Alexander Popov used a Branly coherent type antenna and receiver for the detection of the atmospheric discharge signal in 1895, but he did not combine his receiver with a transmitter for message signaling purposes until he became aware of Marconi's work (Susskind, 1962). Marconi added an antenna and introduced new methods for the practical working of wireless telegraphy (Sarkar et al., 2006; Maclaurin, 1949; Scannell and Cardiff, 1991; Sterling and Kittross, 1978; Briggs, 1961).

Radiotelegraphy underwent three main stages in its development, which mark a shift from electricity as the dominant technical system to electronics. The early years of the 20th century, the technology's infancy, were decisive for the progress of the new technology, closely linked to the development of the commercial application of Marconi's patents. By 1899, the British Admiralty recommended the acquisition of sets of Marconi's apparatus for experiments. Two years later, the Admiralty signed an agreement with Marconi's Wireless Telegraph Company to supply equipment

[5] Radio spectrum, a limited natural resource, consists of all radio waves (in frequency bands between 9 KHz and 3000 GHz) that propagate through space without the need for artificial guidance. Wireless telegraphy mediatized the air (Rikitianskaia, Balbi and Lobinger, 2018, pp. 758–779).

for naval use at fixed prices, as well as information about any improvements or signaling methods. Additionally, the Admiralty's messages should be given priority over all other messages. In a second agreement, the Admiralty acquired the right to use Marconi's existing and future patents, as well as the exclusive use of a long-distance station for twenty minutes each day for eleven years. In exchange, the Admiralty paid the company £26,600 in fees and an annual amount for the duration of the agreement[6].

Another important milestone occurred in 1901, when British Lloyds acquired the exclusive right from Marconi International Maritime Communications to use its branded equipment on all its stations. In return, Lloyds agreed not to communicate with ships equipped with any other system and to reject the use of any other system on its stations or in its connected stations, except those established in the United States of America (USA). The practical application of this principle resulted in Lloyds stations declining to answer calls from ships equipped with other systems. This action may have created barriers to the usefulness of radiographic telegraphy. However, it did not benefit the technical development of wireless telegraphy, which was still at a very early stage. Only free competition could be expected to bring about the necessary improvements and progress in this modern branch of technical science (*Reports*, 1907)[7].

During adolescence, spanning the first two decades of the 20th century, the advent of electronics presented novel possibilities for radio. The use of oscillating arcs generating continuous waves enabled radio to transmit speech. The most important breakthrough was the thermionic valve – the first diode valve – patented by Marconi Wireless. The discovery of the triode in 1907 brought about a radical change in the development of the radio system. This was due to its ability to amplify the antenna signal by a factor of 10, at least, resulting in improved radio receiving equipment. Since 1912 Lee de Forest and Alexander Meissner began using triodes to generate continuous electromagnetic waves which could be used for radiotelephony. Decisive technical advances in long-distance telecommunications were introduced from 1923 onwards with the advent of shortwave directional radio telegraphy (Huurdeman, 2003, p. 275).

[6] House of Commons, *Debates*, June 28, 1906, vol. 159, cc. 1122-1123.

[7] At the International Radiotelegraph Conference (Madrid, 1932), the term radiocommunication replaced radiotelegraphy. Lloyds had some 1,300 agents and subagents who were especially responsible for transmitting maritime intelligence from their respective districts.

During the maturity stage, shorter wavelengths, allocated for the first time to amateurs, achieved transatlantic transmission in 1921 with very affordable short-wave transmitters. As a result, Marconi was compelled to choose this method – the *beam system* – which was subsequently adopted by the major companies in 1926. The innovation of radiotelegraphy had decisive consequences, including increased speed, improved energy efficiency, uninterrupted messaging, day and night, and secure transmission (Huurdeman 2003, p. 279; Griset 1995, pp. 37-63; Berg 2007)[8]. From the mid-1920s, with over 16,000 stations worldwide, radiotelegraphy reached a profound technological diversification, due to the addition of the civil aviation and radiogoniometry services. In the early 1930s, a globally integrated network emerged, which was controlled by companies and groups that linked cable and radio (Pires, 2015, pp. 230, 281).

In the years prior to World War II (WWII), several countries, notably Germany, developed a wide range of navigation systems, such as Lorenz, Erika – a long distance navigation system – or Electra, which gave rise to others such as the Knickebein system – a long-rang blind bombing system based on Lorenz and pioneered by Telefunken, which was quickly improved and renamed to X-Great (Guntharp, 2019).

After major advances in the military field during WWII – for instance, radar and long-range navigation system (LORAN), developed in the USA – radio communication continued to make progress in the civilian sphere, particularly towards miniaturization. In 1954, Regency commercialized the first pocket transistor radio – Regency TR-1 – and in 1960 Sony introduced its first transistorized radio, with significant gains in size and battery lifetime. Over the two following decades, transistors displaced valves with few exceptions (Schiffer, 2022, pp. 176 and 208). Early 1960s Very high frequency Omni-directional range (VOR) systems, short/medium-range navigation system, became widespread instead of commercial AM radio stations for navigation (Wyatt and Tooley, 2013, p. 127)[9].

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[8] Marconi successful experiments may be read in *Nature*, 114, 1924, pp. 359–361. *The New York Times* was quick (July 24, 1924) to report the construction plans of stations to communicate England with its Dominions. Shortwave transmission and reception of information uses electromagnetic waves about 10 to 80 m in length having frequencies of approximately 29.7 to 3.5 Mhz.

[9] The transistor, a name which unifies the words transfer resistor, is, according to the *Encyclopedia Britannica*, a semiconductor device for amplifying, controlling, and generating electrical signals. Transistors are the active components of integrated circuits, or microchips, which often contain billions of these minuscule devices.

To conclude this review of the evolution of radiotelegraphy, in the 1970s, LORAN became the premier radio navigation system and soon, the United States Navy experimented with satellite navigation (Walker, 2011, pp. 29-30).

The advances in radiotelegraphy were accompanied by institutional interventions. The first international regulations were drafted in 1903 by delegates from nine different countries attending the *Preliminary Conference on Wireless Telegraphy* in Berlin. This meeting was held mainly to prevent the creation of a monopoly of a single system, and secondly to avoid disruption of the different systems. Seven of nine countries represented in the conference – Austria, France, Germany, Hungary, Russia, Spain, and the USA – agreed to propose a set of general regulatory principles to their respective governments[10]. Those countries observed the new technology with different stances. France considered it unnecessary to regulate the public communication service between coastal stations in different countries. Spain, Hungary, Russia, and Great Britain supported the French delegation. However, the British observed that preventing interference was an uncertain technical question that had still not been certified by science. Austria tried to limit the question to regulating communication between shore stations and ships, between ships, or between stations (*Preliminary Conference*, 1903, pp. 12-13).

In 1906, the *International Radiotelegraph Convention of Berlin* approved mandatory intercommunication between ships regardless of the system used. The International Bureau of Telegraph Administrations was tasked with several administrative duties arising from the agreements relating charges for radio telegrams, operation of radiotelegraph stations, priority of the SOS distress signals, and government license requirement to establish and operate ship stations. Twenty-six countries signed the final protocol, which had to be submitted for approval to the respective governments[11]. Again, differences between countries emerged. By then, Marconi technology stations predominated in the United Kingdom, Italy, and Canada, whereas other systems operated by other companies prevailed in the rest of the world (*Reports*, 1907, p. 91).

[10] All seven countries signed the final Protocol. Great Britain and Italy did not sign, supporting Marconi's thesis and claiming that breaking the monopoly would only benefit other wireless telegraphy operating companies.

[11] Argentina, Austria, Hungary, Belgium, Brazil, Bulgaria, Chile, Denmark, France, Germany, Greece, Italy, Japan, Mexico, Monaco, Netherlands, Norway, Persia, Portugal, Romania, Russia, Spain, Sweden, Turkey, United States and Uruguay (*Documents*, 1906, pp. 345-347).

The 1906 conference had the lasting institutional effect of giving birth to the Radiotelegraph Union (Rikitianskaia, 2020, s. p.). The new agency further pursued its regulatory work at the London, 1912, and Washington, 1927, meetings, as well as through the General Radiocommunication Regulations defined in Cairo, 1938, and Atlantic City, 1947 (*International Radiotelegraph Convention*, 1928; Stewart, 1959, pp. 28-49)[12].

Six years separated the Berlin and London conferences. The countries participating in the latter committed to exchanging radio telegrams between shore and ship stations as well as between stations on different ships, regardless of the radiotelegraphic system adopted. However, to avoid hindering scientific progress, they agreed not to prevent the contingent use of a radiotelegraph system which was not capable of communicating with other systems[13].

Although the 1903 *Preliminary Conference* constituted a severe setback for Marconi, it did not put an end to the rivalry between Marconi and Telefunken. The 1906 treaty ostensibly granted equal rights to both parties. However, the regulations were restricted to ship-to-shore communication, so the *private war* between Marconi and Telefunken continued until 1912, when the joint venture Deutsche Betriebsgesellschaft für drahtlose Telegraphie mbH (DEBEG) was established. By 1913, these two companies operated approximately 60% of the 4,500 coastal and on-board stations while two dozen or so different suppliers shared the remaining market (Friedewald, 2012, pp. 7 and 11). Telefunken enjoyed wide acceptance among military customers.

2. A NEW COMPANY OF RADIO-TELEGRAPHIC SERVICES IN SPAIN: ENTEL

Radiotelegraphy developed vigorously throughout the 20th century and became a very powerful means of mass communication from an elite level, run by the wealthier (Balsebre, 2001, pp. 125-126). At the time, the

[12] International Radiotelegraph Union, *ITU Archives*.

[13] The Conference defined a coast station as any radiotelegraph station established on land or on board any permanently anchored ship and used for the exchange of correspondence with ships at sea. By ship station it meant any radiotelegraph station established on board a ship which was not permanently anchored (*International Radiotelegraph Convention*, 1913). The Paris revision (1925) stated that the charge for a radio telegram included the following charges: coast station, ship station, telegraph transmission, transits for intermediate coast or ship stations, and those for special services requested by the sender (*International Service Regulations*, 1926, p. 62).

USA led with 110,561 legal radiocommunication stations, followed at a distance by the greater powers – United Kingdom and France – middle powers, like Italy, and minor powers, like Sweden[14]. France's position behind Italy and Sweden's ahead of Germany is surprising. Spain, also a middle power, was far behind Italy in the rankings, but was particularly strong in radiotelephones (Table 1).

To obtain comparable indicators, it is necessary to analyze the degree of penetration of the technology in terms of population. Netherlands leads the list with 14.21 conversations per thousand inhabitants. The closest followers are a major power, like the United Kingdom, with 2.63, a highly dynamic country, such as Sweden, with 1.31, and an export economy, like Argentina, with 2.7. The poor performance of the major powers is striking. In Europe, France and Germany occupy modest positions (0.98 and 1.86 conversations per 1,000 inhabitants, respectively), as does the USA, with 0.26. Economically underdeveloped countries such as Greece and Portugal lag with 0.03 and 0.01. Data for Spain is unavailable.

Countries	Public coast stations			Ship stations			Conversations/population (000)	
	Radiotelegraph	Radiotelephone	Mixed	Radiotelegraph	Radiotelephone	Mixed	Amateurs	Radiotelegraphy
Argentina	3	1	219	160	579	219	8,9	2,70
Netherlands	0	8	458	130	1,683	458	1,3	14,21
Portugal	0	0	169	34	871	169	190	0,01
Germany	0	2	796	226	1,599	796	8,326	1,86
United Kingdom	1	2	1,526	2,75	5,456	1,526	10,736	2,63
Australia (Commonwealth)	0	0	172	38	2351	172	4,077	0,24
Sweden	2	4	2,354	1,135	472	2,354	35,059	1,31
Switzerland	1	0	15	11	3	15	600	n/a
Italy	3	28	256	4,188	2,044	256	1,566	0,92
Spain	10	26	147	353	3,362	147	942	
USA	24	544	892	480	108,6	892	237,159	0,26
France	0	20	591	93	2788	591	4294	0,98
Greece	1	7	280	339	226	280	50	0,03

Table 1. Radiocommunications statistics, ca. 1961
Source: Author's elaboration from *International Telecommunications Union* (1963), pp. 2-4

[14] Of course, clandestine stations affected the statistics.

Spain's strength in radiotelephones can be justified by several reasons. On the one hand, the horizontal diversification of TESA involved the service of international radiotelephone communications. There were radiotelephone communications with the fishing fleet and ENTEL served some specialized agencies, including NASA, by radiotelegraph and radiotelephone. Likely, radiotelephones complemented the conventional network. On the other hand, it is known that the Spanish market had advanced technology. Marconi Española had developed synthesized radiotelephones in its different versions of mobile base stations and repeaters with up to 20 channels and 10 W. Another important aspect can be found in connectivity. Some of these versions, particularly those intended for the armed forces, included radio integration equipment to link subscribers of a telephone network with radiotelephones (Calvo, 2019b, p. 125). The latest reason relates to a large and emerging market that, within a few years, included public administrations – police and armed forces – and the private sector – taxi cooperatives, hydroelectric and oil companies (*Electrical Communication*, 58, 2, 1983, p. 219).

From a business perspective, cut-throat competition with Japanese manufacturers of transistor-based electronic equipment dented Telefunken's financial status in the 1960s. Telefunken, which had been a subsidiary of AEG since 1941, merged with its parent company in 1967 to form AEG-Telefunken. In 1970, the German government encouraged corporate concentration by promoting the merger of AEG-Telefunken-Siemens, which ultimately failed (*Computerworld*, 33, 1974, p. 31; Malanowski, 2011, p. 127; Fuchs, 2015, p. 129; Flamm, 2010, p. 163). The giant AEG-Telefunken ran out of capital, which led to the largest corporate collapse in Germany since WWII (*The New York Times*, 10 August 1982).

Germany offers an important case study that contrasts with what happened in Spain. In Spain, the first institutional regulations appeared during the initial adolescence of radiotelegraphy. In line with the mainstream international regulation, the Spanish aimed to prevent the creation of a monopoly for the benefit of a single system. The character of modern telecommunications in Spain – horizontal disintegration or segregation – and the assumption that they were addressed and resolved along different lines have been mentioned. The first peculiarity is that in radiotelegraphy the private initiative anticipated state action, which resulted in the assignment to the Telegraph Corps and its establishment in 1908 as an attribute of the sovereignty of the state. Operation was the responsibility of the central administration. A second feature is that the monopoly was maintained in co-

existence with that granted to CTNE in voice telephony, market niches, military radiotelegraphy, isolated facilities for experimental purposes, and coastal stations.

The first phase of radiotelegraphy in Spain followed a tortuous path, due to the entry and exit of companies, which was an effect of uncertainty (Calvo, 2021, pp. 16-48). As the holder of the monopoly of all electrical communications[15], the state, in 1908, granted to Huber y Compañía en Comandita Sociedad Española Oerlikon the installation and operation of radiotelegraphic service on the peninsula territory, on territories adjacent to the mainland – the Balearic Islands – and those more remote – the Canary Islands – as well as in the African possessions. Huber y Compañía en Comandita, Sociedad Española Oerlikon, based in Madrid, adopted its designation when the general partner Fritz Wegmann left the Sociedad Comanditaria Huber y Wegmann, Comandita, Sociedad Española Oerlikon, and was replaced by the engineer Emilio Bitterli[16]. The company, which circumvented the requirement of being a "national entity", transferred its rights to the Compañía Concesionaria del Servicio Público Español de Telegrafía sin Hilos, created in June 1908 as a subsidiary of the Compagnie Française de Télégraphie sans Fil et d'Applications Électriques (CFdTSFAE), which was looking to consolidate its international expansion.[17]

Two companies dominated operating consecutively: the CNTsH and TESA, which left a deep mark on the sector.

[15] The monopoly was created by the Basis and Regulations for the establishment of radiotelegraphic service, authorized by the law of October 26, 1907 (*Gaceta de Madrid* [GM], 25, 25 January 1908, p. 333). In accordance with international conventions (*Documents de la Conférence Radiotélégraphique Internationale de Berlin*, 1906) all Spanish radiotelegraph stations open to public service were obliged to exchange their correspondence without distinction of radiotelegraphic systems.

[16] *Revista Ilustrada de Banca, Ferrocarriles, Industria y Seguros*, December 10, 1903, p. 16; *Electrón*, 232, December 10, 1903, p. 7; *El Progreso Industrial y Mercantil*, 67, November 10, 1903, p. 5.

[17] Compañía Concesionaria del Servicio Público Español de Telegrafía sin Hilos, *Statutes*; Archivo Histórico del Banco de España, Compañía Nacional de Telegrafía sin Hilos, *Extract from the deed of incorporation of the national company and the deed of ratification thereof*, Madrid, June 1911.

CNTsH, incorporated in 1910, was based in Madrid[18]. It was devoted to the installation, sale, and rental of all types of receiving equipment and stations for warships and merchant ships alike, to which it also provided a press service in the Atlantic Ocean. It was also the exclusive representative in Spain of Marconi's Wireless Telegraph Company, of the Belgian company, Société Anonyme Internationale de Télégraphie Sans Fil (1913), and of the large German radio industry companies Telefunken and Marconi Gesellschaft, already tied up in a market-sharing deal.

As for TESA, it was created by 1928, dominated by foreign capital – Cable and Wireless Ltd. (Diego, 1995, p. 25). In 1929, TESA took over the international service facilities – open to other companies under the Washington agreement – and its coastal stations after a decree-law terminated CNTsH's contract[19]. After the Spanish Civil War, its board of directors promoted a policy of *nationalization* until it gradually imposed a majority of Spanish capital through the company Torres Quevedo S. A., created in 1943. This was a way to concentrate all the shares belonging to INI, Franco's dictatorship's tool of the autarkic period to develop industries neglected by the private sector[20].

TESA evolved in several directions, starting with a horizontal diversification, which included international radiotelephonic communications in its field of activity[21]. Besides setting the terms of operation, various legal provisions placed in its hands the infrastructures belonging to CNTsH, namely the stations of the international service and the radiotelegraphic

[18] Registro Mercantil de Madrid, Compañía Nacional de Telegrafía sin Hilos, fol. 8b, sheet 2.641, provisional, volume 64, 24 December 1910. On the defense of this policy by the government (De la Cierva) to avoid hindrances to the "improvement of the services we long for" and criticism of this policy by the opposition are visible in: *Diario de Sesiones del Congreso*, legislature 1907-1908, 12 October 1907, pp. 1756-1764.

[19] *GM*, 2 May 1929, 122, p. 697.

[20] In 1941, two years after the end of the Civil War, eight of the nine members of the board of directors were Spanish. One year later, the state extended its representation with four additional members (Transradio Española, *Memoria 1941*, p. 4; *1942*, p. 7). In 1947, the number of Cable and Wireless Ltd. board members was increased to two.

[21] In 1928 TESA was authorized to provide international radiotelephonic service, inaugurating communication with New York and Buenos Aires. Marconi Wireless installed the first shortwave transmitter manufactured by Marconi (SWB1). The Bellini Tossi type antennas consisted of curtains of tuned dipoles, one as a reflector and other, parallel, as a radiator (Miralles, 2006, p. 45).

coastlines. TESA took over groups of stations in Madrid-Aranjuez-Alcobendas and Barcelona. The contract for the radiotelegraphic service between the state and CNTSH was terminated[22].

The policy of nationalization of foreign communications, promoted by Primo de Rivera's dictatorship, encouraged a group of bankers, landowners, and liberal professionals to incorporate a new company under the name Compañía Internacional de Radio Española S. A. (CIRESA). Based in Madrid, it began operations on 12 March 1928 (Martín Aceña and Comín, 1991, p. 250; Bahamonde, 2002, p. 44)[23]. Faus (2007, p. 1068) attributes the founding of CIRESA to the shareholders of Radio España. Its members were the banker Estanislao de Urquijo y Ussía, Marquis of Urquijo, the landowners José López Niulat, Marquis of Perijáa, José María Jayme y Sánchez, and José Castilla, and the lawyer Gumersindo Rico González. All resided in Madrid[24]. The Marquis of Urquijo, the Marquis of Perijáa, and Gumersindo Rico had personal connections with CTNE.

CIRESA was associated with several unsuccessful attempts to create an international radiotelegraphy service[25] or to operate regional networks in Basilé, in the island of Fernando Poo[26].

Once dependent on INI, CIRESA, in 1953, signed the contract to operate radio communications. Over the years it took over cable communications between Italy and Spain from Italcable[27]. CIRESA ensured communications with the entire world through its foreign correspondents and

[22] *GM*, 137, 17 May 1929, pp. 1, 007-1, 008; 2 May 1929, 122, pp. 699-700. In Italy, although the fascist regime stressed the public character of the radio, foreign and national investors (Marconi-controlled Radiofono Company and Società Italiana Radio Audizioni Circolari) created the first broadcasting company, which was granted a monopolistic concession, the Unione Radiofonica Italiana (URI). URI became Ente Italiano per le Audizioni Radiofoniche (EIAR), which by the end of the 1930s had 1.2 million subscribers nationwide (*Comitato radiotelegrafico*, 1929, p. 916). EIAR then became Radio Audizioni Italia (RAI) in 1944 (Chiti, Gardini and Sandulli, 2017, p. 293; Franceschelli, 2009, p. 43).

[23] *Boletín Oficial del Estado* (*BOE*), 305, 22 December 1959, pp. 16263-16264

[24] Registro Mercantil de Madrid, sheet 5748.

[25] *Diario Oficial de Comunicaciones*, 25 June 1931, pp. 1531-1532.

[26] *Diario Oficial de Comunicaciones*, 28 March 1930, p. 738.

[27] BOE, 11/2/1953, pp. 871-872. Radio Argentina obtained provisional authorisation to establish direct radio communication between Madrid and New York: Centro Documental de la Memoria Histórica, 1933-12-13/1933-12-16, PS-MADRID,627,60; the first 20 kW shortwave transmitter, built by Standard Telephones and Cables, was installed at the transmitting station of this company (Miralles, 2006, p. 45). Under the agreement with Italcable, it took over the entire international cable service in both directions, which had previously been controlled in Spain by that company.

through the submarine cable links of the Italcable's extensive and important network, which included moorings in Spain, Italy, Portugal, and South America[28].

INI had created in 1943 the Torres Quevedo company to operate telecommunications services in general, particularly in the north of the former Spanish Protectorate in Morocco, by means of a broad concession. Subsequently, it extended its field of action within its specialty to *nationalize* various fundamental services that were controlled by foreign capital[29].

Although the government understood that the companies within INI formed an "efficient whole" dedicated to telecommunications services (Decree 23351, 30 November 1961), INI saw the need to "unify operational and management criteria and simplify the development of these activities as much as possible" (*BOE*, 288, 2 December 1961, p. 17072). INI conceived a plan to strengthen its role in radiocommunications. Following detailed studies, it proposed the creation of a company to integrate companies engaged in the provision of telecommunications services with special characteristics. INI aimed to create an alternative to CTNE focused on international communications, following the dual model used in United Kingdom and France, where the telephone was operated by the government and radiotelegraphy and submarine cables were operated by large private companies (Cable & Wireless and France, respectively). The main difference was that in Spain the telephone service was provided by CTNE, a private company, and the other services had to be combined in a single company (Romeo, 2006, p. 294-297).

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[28] Italcable, Servizi Cablografici, Radiotelegrafici e Radioelettrici S. p. A, domiciled in Rome, was the concession holder for the submarine telegraph cables Italy-Malaga-Las Palmas-South America (Decree of 18 July 1922), Italy-Barcelona-Malaga (Decree of 31 March 1926) and Malaga-Lisbon (Decree of 29 November 1927) (*BOE*, 31 March 1971, 77, p. 5246).

[29] A capital increase allowed to take over the communication service in the northern part of Morocco, radio broadcasting services in Tetouan (Radio Dersa), telecommunication services in Guinea, the acquisition of equity in two companies (majority shareholder in Telefónica de Tánger and minority interests in Empresa Nacional Radio Marítima), the nationalization of TESA services, and the creation of various companies (Elcor, Suministros Electromecánicos y Eléctricos, and Elmar) to operate international telecommunication services in Tangiers. The creation of CIRESA would complete the nationalization of Spain's radio and broadcasting services in Ceuta and Melilla (Archive of the Ministry of Foreign Affairs, Madrid, [Memorandum justifying the proposed restructuring of the company Torres Quevedo S.A.]).

INI's plan resulted in the incorporation of ENTEL in 1961 (Decree 2335, 30 September 1961), merging two telecommunications companies (TESA and CIRESA) with the public telecommunication services of the Spanish territories in the Gulf of Guinea and others held by the Torres Quevedo company (Calvo, 2016, pp. 273-276)[30]. This represented a notable shift from the previous policy of privatization. Based on territorial criteria, ENTEL was divided into provincial delegations, centers, and stations, with headquarters in three of the most important cities in the Peninsula (Barcelona, Valencia, and Bilbao) and one in the Canary Islands (Las Palmas).

ENTEL did not have large networks, neither cable nor overhead lines, as most of them were devoted to linking the traffic center with the broadcasting and reception centers. The installations were in four points in the province of Madrid, three in the province of Barcelona, one in Las Palmas, and another on the premises of the coastal station of Cádiz. Leased circuits were used for terrestrial links between distant populations, enabling messages and official correspondence to official entities, and restricted private messages, including the service of radiotelephony coastlines to subscribers.

Five years after its incorporation, ENTEL employed over 500 employees, most of them unskilled. The staff consisted of six managers, ten graduates, 26 civil servants in the general technical corps of telecommunications, 220 technicians, three medical staff), forty unqualified technicians with similar functions to graduates, 294 administrative positions, and 131 traffic and operational employees. In 1966, production increased by 5% and the rate of absenteeism was 4% per employee, or 6.7 hours per man-unit (*Comisión de Telecomunicaciones y Correos*, 1967, p. 76)[31]. The

[30] *BOE*, 288, 2 December 1961, p. 17072; INI Archives, Sociedad Estatal de Participaciones Industriales (SEPI), box 37; SEPI, E.13.771, 30 November 1961; E.13.642, 26 November 1962, Sale to INI of all the assets of Telecommunications Services in the Spanish territories in the Gulf of Guinea and debit to INI's account of the amount – 35 million pesetas – as a contribution to the new company; SEPI, E.13.644, 26 November 1962, Deed of incorporation of ENTEL with a capital of 40 million pesetas. Research based on primary sources has highlighted the reasons that led to processes of concentration and rationalization of INI's public companies, which, on occasions, fueled international competitive companies, for instance, Indra.

[31] In 1947, Francisco Setuain presided over TESA, and one of its board members, the Count of Marsal, held the same position in the company Torres Quevedo.

company provided additional and advanced training, including a traineeship for qualified personnel prior to the beginning of service (*Comisión de Telecomunicaciones y Correos*, 1967, p. 74)[32].

3. THE PERFORMANCE OF ENTEL

Providing service meant in part growth. ENTEL's entry in the market resulted in a substantial boost of investment in Spanish radiotelegraphy. In 1966, the investment by ENTEL quadrupled that of CIRESA and more than quintupled that of TESA in 1962 (Chart 1).

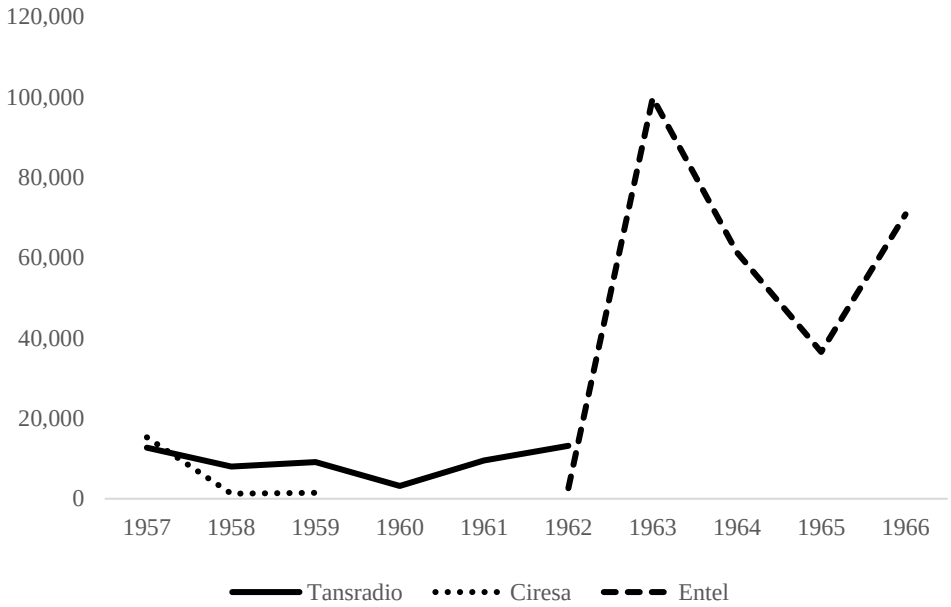


Chart 1. Investments in radiocommunication, Spain, 1957-1966 (000 ptas.)
Source: Author's elaboration from *Comisión de Telecomunicaciones y Correos*, 1967, p. 88

[32] The details of ENTEL's technical staff are not well documented. We know that some came from TESA, and before that from the Telegraph Corps. It was the case of telecommunications engineers, future technical director of ENTEL, Luis Cáceres García, and Mariano Ros Giner, an expert in shortwave reception techniques, who oversaw the sations of Alcobendas, Las Palmas, and Barcelona from the headquarters in Madrid. Engineer José Ruiz de Valdivia had a different path, with different experiences in Sociedad Anónima Radio Argentina, TESA, and CIRESA (Romeo 2020).

ENTEL's investment plan for the four-year period 1968-1971 amounted to 373.97 million pesetas, which represented only 0.54% of the total planned expenditure and, in comparative terms, a lower percentage than that of the Post Office (1.68%), and significantly less than that of telephones (94.39%). These figures leave little doubt about the clear improvement in radiotelegraphy services, although it did not prevent occasional overlook of the needs of some remote territories. A public call for works and installations for the radiocommunication project in the Sahara colony, to which both national and foreign companies could apply, was unsuccessful[33].

Of course, inflation, which was the lowest in a decade, must be considered in the 1963 investment peak. But it seems clear that the investment was primarily due to the construction of a new radio relay network with France to communicate with other countries via two different routes. This network connected Madrid to Irun and Barcelona to the French border on the Mediterranean, covering distances of 500 km and 700 km. The equipment used was the FM 60-900 type, developed and manufactured by the Belgian Bell Telephone Manufacturing Company. All repeaters were unattended[34]. ENTEL projected and installed in 1965-1966 automatic telex exchanges (or telex) in three main cities (Madrid, Barcelona, and Bilbao) with a capacity of 200 subscribers per unit. The total investment amounted to 168,483,725 pesetas (Tardío, 2006)[35].

The company's income came from various types of telegrams, the leasing of national or international circuits, and the provision of services. The rates for domestic telegrams were proposed by the Directorate General

[33] *BOE*, Presidency of the Government, 19 February 1964, p. 2252.
[34] *Electrical Communications*, 43:4, 1968, p. 405.
[35] Telex is a public service based on automatic circuit-switching technology, which facilitates remote printed communication between its subscribers by means of teleprinters. In Spain this service was aimed at the group of private stations of Telegraph subscribers to communicate directly with each other by tele-typographs and through a switching center under the conditions defined in the Regulations adopted by the International Telecommunication Consultative Committee at its meeting in Brussels in 1948. It was approved in Spain in 1952 (*BOE*, 16 January 1952, p. 231) and operating began on 8 February 1954 with a single 100-subscriber exchange in Madrid with eighteen subscribers connected to the international network via Paris and Frankfurt. The number of subscribers grew slowly until 1975, when the number of subscribers amounted to 12,000. Between 1972 and 1983 the number of telex subscribers per 10,000 inhabitants increased by a factor of more than four from 1.9 telexes per 10,000 inhabitants to 8.3. (Martín de la Vega, 2011, pp. 849-850).

of Post and Telecommunications (DGPT) and approved by the government. Similarly, international telegrams' fares were approved in international conventions and ratified by the government (in gold francs and collected in pesetas according to an exchange rate stipulated by the government). The profitability of operations relied on efficient management, the absence of competition, and the amount of traffic, which was closely tied to the commercial, industrial, and tourist development of the country (*Comisión de Telecomunicaciones y Correos*, 1967, pp. 74-75).

Communications could be national or international. National communications referred to long-distance radiotelegraphic communications from Madrid to Las Palmas de Gran Canaria, to Santa Cruz de Tenerife (via Las Palmas), and to Santa Isabel (capital of Fernando Poo colony)[36].

Direct radiotelegraphic communication with national and foreign ships on high seas was added to the service. Radiotelephonic communications with the fishing fleet were carried out by its own coastal network, which consisted of seven mainland stations in the northern and southern coast (San Sebastián, Ondárroa, Gijón, La Coruña, Vigo, Cádiz, and Barbate) and an island station in Las Palmas. The main coastal radiotelegraphic station at Aranjuez provided the most important service, which was complemented by that of Vallecas. ENTEL established direct communication with major countries worldwide through two primary systems (submarine cable and radio) and the very extensive network of correspondents, especially the English, American, Italian, and French.

The company had direct submarine cable connections with England (via Bilbao) and radio links with five European nations (France, Germany, Switzerland, Belgium, and Austria), the Vatican City, the Philippines, and six American countries (USA, Mexico, Cuba, Chile, Brazil, and Argentina). It provided rented channels, radio reception, and transmission of information to several European countries (Portugal, France, Germany, Italy, and England) and meteorological information, among other services.

Additionally, ENTEL provided two distinct types of mobile coastal service. The telegraph service was offered to ships at sea and was carried out on short waves by three transmitters in permanent operation in the

[36] The works for the installation of the radiotelegraphic station in Santa Isabel of Fernando Poo implied the transfer of the station to Bata (132 miles away) with a total cost of 880.276 pesetas (*GM*, 204, 23 July 1927, p. 469; 24, 3 September 1927, p. 1324; *La Vanguardia*, 4 September 1927, p. 20).

Aranjuez coastal station. This service connected and carried traffic with national and foreign ships in all seas and latitudes. The radio-telephonic service was carried out on medium wave with the ships of the fishing fleets that subscribed to the service on ENTEL network and on the General Directorate of Telecommunications. The list of specialized agencies served by ENTEL included NASA, which benefited from radiotelegraphic and radiotelephone services to link the Maspalomas tracking station with the space flight center in North America via London.

Regarding special modes of service (specific traffic or networks or tariff policy), the 1952 Buenos Aires International Telecommunications Convention and the 1958 Geneva revision for international traffic regulated special service telegrams. Nine categories of telegrams were distinguished, depending on the addressee, purpose, mode, and urgency. The Geneva International Telecommunication Convention of 1958 recognized the desirability of keeping the number of frequencies and the spectrum space used to the minimum necessary so that those services were provided in a satisfactory manner (Article 45). Main features of previous regulations were maintained regarding the exchange of radiocommunications, the radio system adopted, and the use of radio systems without proper compatibility (*International Telecommunication Convention*, 1959, pp. 35-37).

ENTEL's experts handled the traffic messages, which were sent by specialized correspondents, most of them by teletypewriter. The coastal radiotelegraph service was carried out directly with ships at sea, with personal intervention by ENTEL operators, especially in reception, which was carried out by ear, although transmission was automatic and at low speed. The coastal radiotelephone service was carried out with ships and only by telephone.

As for the nature of the networks, three types can be distinguished. The message service involved various relay networks, domestic and international; the coastal radiotelegraphic services used dispersed mobile stations installed on domestic and foreign ships (it did not constitute a network per se). The coastal radio-telephone service involved a network of stations on ships which subscribed to the service and that only occasionally formed private networks. Regarding tariff policy, shortwave coastal radiotelegraphic traffic with foreign ships was very low due to the higher price of the coastal rate in Spain (0.60 gold francs per word in addition to the Spanish terminal rate of 0.10 gold francs per word) compared to the French rate (0.40 gold francs per word). On the contrary, the rate of the national

coastal or Spanish ships was much cheaper and lower than that of the Canary Islands traffic (*Comisión de Telecomunicaciones y Correos*, 1967, pp. 79-80).

By 1966, ENTEL had almost tripled the traffic served by its predecessor company in 1945, an increase that relied more on incoming than outgoing traffic (Chart 2). Revenues increased 17.79 times, a performance that was limited by growing inflation (yearly average 7.4% between 1956-1966). Overall, figures show an initial period of relative stability, a moderate upturn at the beginning of the 1950s, and a more vigorous increase at the end of the decade (Chart 3).

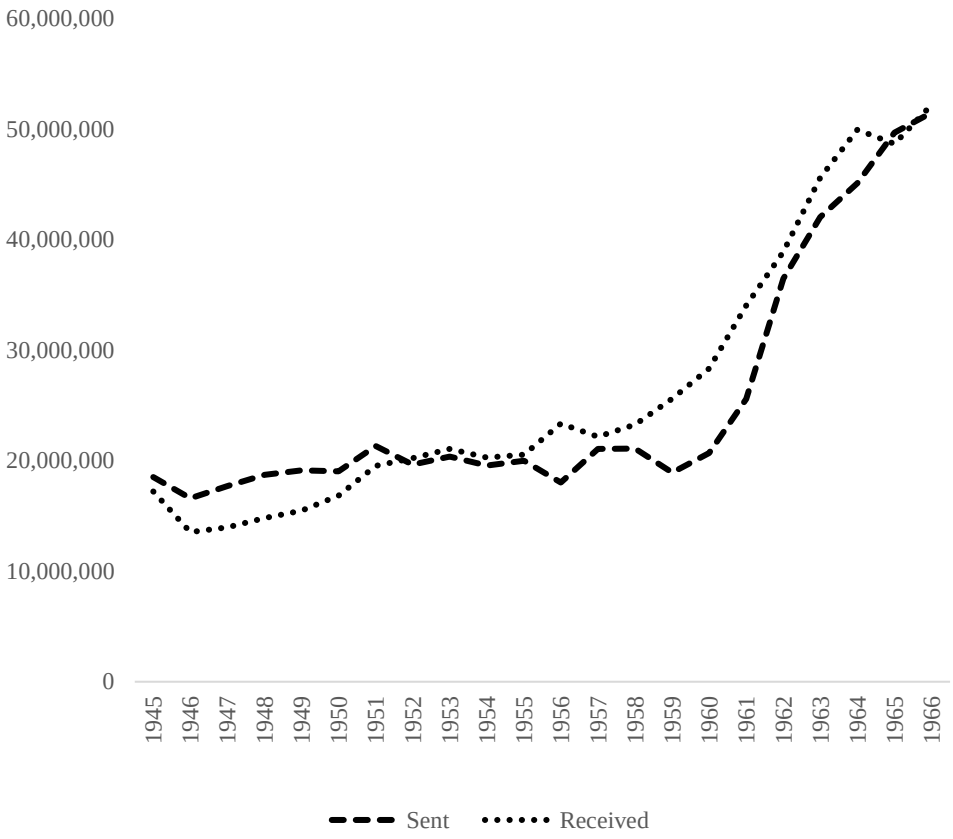
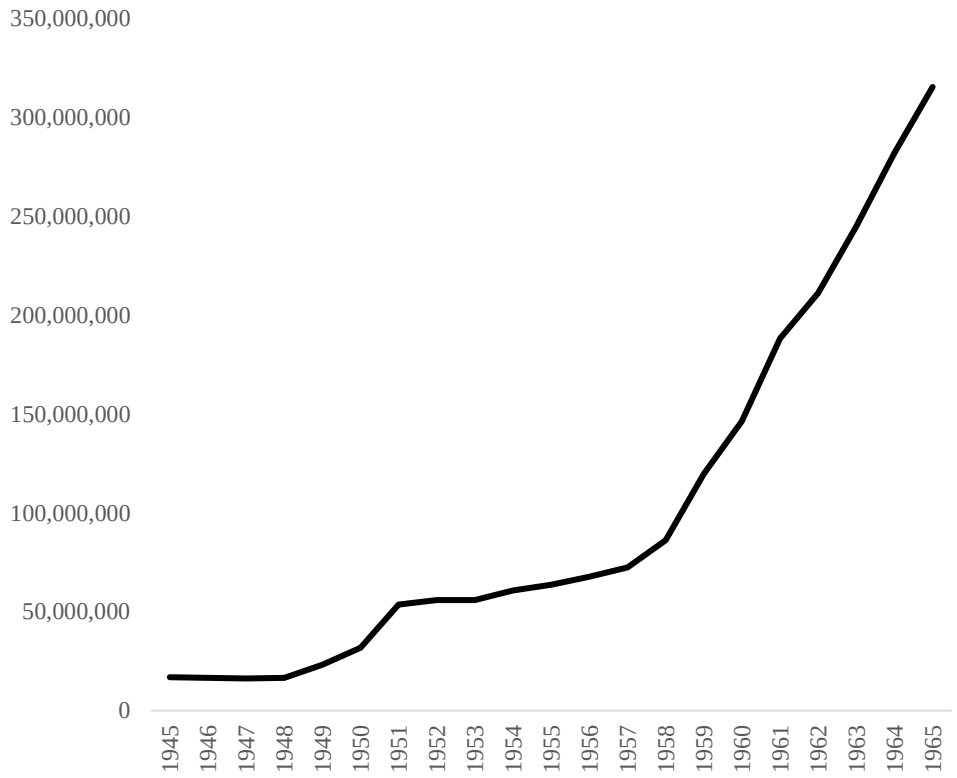


Chart 2. Radiotelegraph traffic in ENTEL and previous companies, 1945-1966 (number of words)
Source: Author's elaboration from *Comisión de Telecomunicaciones y Correos*, 1967, p. 87.



Graph 3. ENTEL and previous companies' revenues, 1945-1966 (current pesetas)
Source: Author's elaboration from *Comisión de Telecomunicaciones y Correos*, 1967), p. 87.

The company's revenues were generated from fares determined by governmental regulations for national service and by the international agreements (Buenos Aires, 1952, and Geneva, 1958). In Geneva, tariffs were determined by the countries involved in the transmission of the services. Settlement of the revenues was done through the exchange of accounts between countries. ENTEL did not receive any subsidies for the services it provided. Tariff exemptions did not include spare parts for telegraph equipment, radio valves, and telegraph punch tape paper, as these items were necessary for the regular operation and maintenance of installations.

ENTEL did not face any obstacles in importing the necessary equipment, which was facilitated by licenses issued and generally approved in due time. Sometimes ENTEL presented certificates attesting the lack of national production and customs exemption. There were some issues with the punch tape, despite being manufactured domestically. The quality of the national paper tape caused significant problems due to transmission errors and resulting incidents.

4. ENTEL IN THE COMPUTER ERA

In the 1960s, a political debate erupted over connecting telegraph technology to telephones. This clashed with the long-standing need for independent telegraph services. However, the focus of the dispute was on the management of specific services such as telex, international telegraph service, and data transmission, which were highly profitable (Diez, 1977).

In 1967, the Spanish government created an Interministerial Commission to study the organization and distribution of competences within the country's telecommunications services to solve the disputes between DGPT and ENTEL, which began in 1965. ENTEL sought to maintain its position, anticipating the hypothetical future extension of its concession and, if possible, to extend it in international telex and data transmission (Tardío, 2006).

ENTEL's history includes a milestone related to CTNE, the monopolistic operator of telephone services in Spain. The project for ENTEL's participation dates to at least the early months of 1968, coinciding with the launch of Franco's Second Development Plan. This plan led to increased state involvement in research into private companies[37]. After some time, CTNE made the decision to focus on the acquisition of ENTEL. This required the assessment of the company's assets and the identification of which services CTNE would take care of[38]. In the end, the telephone operator reached an agreement with INI and ENTEL to get different levels of ownership in three companies, aiming to enhance their own position.

[37] Archive of INI, SEPI; Archivo del Ministerio de Asuntos Exteriores, ENTEL, *Memoria, 1964-1965, 1967*; *Actas del Consejo de Administración de la CTNE* (*ACA-CTNE*), 24 April 1968 and 14 October 1970.

[38] *ACA-CTNE*, November 1970. In the acquisition of ENTEL shares, certain assets were excluded from the price, which were to be incorporated into the State's patrimony (*ACA-CTNE*, 21 June 1972).

The plan involved the acquisition of all ENTEL's shares, half of INI's equity in Empresa Nacional Radio Marítima, a quarter of the latter's equity held by Empresa Nacional Elcano, and 9% of the share capital of Sociedad Urbana Ibérica, held by Torres Quevedo.

As a result, ENTEL's shares in Agencia EFE, representing one third of its capital, were sold to INI. As part of this transaction, the telegraph services of ENTEL were transferred to the DGPT, which took over the international telegram service and that in Canary Islands. Coastal and harbor services were taken over by CTNE that could either acquire the stations it needed or get the right to use them for an annual fee of 5%. CTNE opted for the first solution and purchased the dismountable equipment and installations from the telecommunications agency for 63.3 million pesetas. They were in the coastal and harbor stations, according with the concession granted to CTNE[39].

Ultimately, ENTEL underwent a restructuring process, and its services were transferred to CTNE and DGPT. The company was instrumental in designing, developing, and operating important projects in state and private organizations. These included the creation of a unified employment management system for the trade union organization and the implementation of an electronic hotel reservation system, both carried out by Lieutenant General Pérez Viñeta. Both involved a diversification of the company's operations beyond traditional services, for example telecommunications engineering in the sense of transmission of information[40].

In comparative terms, in Portugal, in the mid-1980s, Companhia Portuguesa Rádio Marconi diversified its services to public telecommunications such as maritime mobile services and telecommunication engineering. A decade later it was integrated into Portugal Telecom (Major, 2005, pp. 110-116). It followed a different path from ENTEL, including some delays and different imperatives, although the end of the process was the same: liberalization and the creation of a European telecommunication market.

The Spanish government requested ENTEL to refrain from interfering in the concession of telex services[41]. During the 1970s, a computer-controlled telex system was developed using a program identical to the AXE

[39] *ACA-CTNE*, 22 December 1971.
[40] *ACA-CTNE*, 16 June 1971 and 12 December 1973.
[41] Historical Archives of INI, E-4.388, 18 April 1967.

telephone system. As a result, a new, fully electronic, and processor-controlled system known as AZ was created. In 1985, a new electronic telex terminal was introduced, which included word processing and storage functions (Tahvanainen, s. d.)[42].

Details of ENTEL's performance do not abound. When a Decree reorganized communications and obligations, ENTEL was devoid of duties, although it maintained a patrimonial existence. At that time, CTNE entrusted ENTEL with the development of IT activities in the country. Through ENTEL, CTNE created new firms, including Ibermática for IT, and Teliber Consult for technical assistance to other countries[43]. The first gave birth to the subsidiary ENTEL-Ibermática. In 1972, several projects contributed to promote data transmission services as well as to bring it closer to users (Entel-Ibermática, 1978)[44].

In the late 1970s and early 1980s, Ibermática expanded from Bilbao (1979) to Madrid (1981) and Barcelona (1982). Although the entry of consulting firms and computer manufacturers posed a challenge, these were years of remarkable growth that overshadowed the crisis. However, in the 1990s, the sector faced significant competition due to the entry of multinational companies and a mature market. Ibermática completed its consolidation by opening new offices, ultimately becoming a subsidiary of Eritel, a new company created by the merger of ENTEL with Eria, a firm of INI. This change marked a turning point in the relationship with its parent company, which culminated in its exit from the capital in December 1993 (Calvo, 2024, pp. 105 and 117)[45].

ENTEL organized the supply of computer services through two major divisions. The first, Infonet, was a powerful complement to telex and a remote processing service that allowed subscribers to use the processing capabilities of network's large computers from terminals installed at their premises (Molina, 1970, pp. 15-17)[46]. The second, Consulta, specialized

[42] *Tele*, 28-31, 1976, p. 4.
[43] Telefónica, *Memoria del ejercicio social 1971*, p. 35.
[44] Telefónica, *Annual Report 1972*, p. 45.
[45] *El País*, 29 June 1998.
[46] In 1969, Computer Sciences Corporation (CSC) launched Infonet, a network of interconnected computers using Remote Computer Concentrators (RCCs) based on Comten 20 equipment and Univac 1108 computers to provide remote processing services to its clients. Infonet was operated under the control of the Computer Sciences Teleprocessing System (CSTS) operating system, which coincided with the launch of ARPANET. During the mid-1970s, Infonet was able to expand its services to 125 cities and provide support to nearly all US gov-

in the manufacture of complete products and services. It owned 35% of Ibermática and 33% of the Italian company Informática Distribuita (with Geda and CSIT groups).

ENTEL's clients included banking institutions (La Caixa and Banco Atlántico), commercial institutions (El Corte Inglés), and research institutions (Centro de Investigaciones Sociales), among other companies and organizations. Entel developed a total management program for Campsa, one of the most advanced in Europe (some 200 million pesetas, apart from IBM's share). It also carried out important projects for Seat, Alúmina de San Ciprián and the Dirección General de Tráfico.

ENTEL started several projects during 1972 that involved a significant promotion of the data transmission service, while bringing it progressively closer to the users[47].

As for international presence, in 1970, ENTEL joined a group of eight companies that specialized in the manufacturing of cable, telephone, and radio equipment. The group financed and operated a submarine artery between Mediterranean countries and the USA. The resulting agreement led to the TAT-5/MAT-1 system: a large TAT-5 section with a Spanish mooring at Conil (San Fernando) and a US mooring at Green Hill and an extension -MAT-1- from Estepona to Palo in Italy. The other participating companies were: Italcable, CTNE, Companhia Portuguesa de Radio Marconi, AT&T, IT&T World Communications, Radio Corporation of America, and Western Union International (Calvo, 2010, pp. 321-323). Entel was assigned fifteen joint circuits with IT&T Worldcom, RCA and Western Union International on the US cable of TAT-1 and four more on MAT-1, with 1.11% share of total costs amounting to 69.80 million dollars (Military Communications, 1968, p. 94). ENTEL's foreign market included one European Economic Country, Italy, where it marketed the Infonet system through a technology

ernment agencies. Telefónica assigned Entel with the responsibility of establishing information technology service companies in strategic areas. In 1976, following a series of challenging negotiations, a technology transfer contract was successfully signed. The contract encompassed the use of the latest CSTS, training, technical and commercial support, and documentation. Madrid was one of the most prominent Infonet centers, along with Los Angeles, Montreal, Sydney, and Johannesburg (Arroyo, 2022).

[47] CTNE, *Memoria 1972*, pp. 44-45.

transfer contract between Entel/Ibermática and the Italian company Informática Distribuita, S. p. S.[48]. Moreover, it had a contract with Mexico's Pemex, which led to a plan to create a joint IT company with that country[49].

Overall, ENTEL had a favorable balance of technological payments, including royalties. ENTEL recorded a turnover of around 200 million pesetas in 1976 and more than a billion pesetas in 1980, an increase of 480%[50]. Subsequently, to finance the expansion of the company, ENTEL approved a capital increase of 100 million pesetas, bringing its capital to 300 million pesetas and its reserves to 150 million pesetas[51].

ENTEL increased its profits by 58% in 1986 and its income by more than 37% over 1985. The cash flow amounted to 376 million pesetas and profits were 248 million pesetas[52]. ENTEL's turnover in 1988 was 7,380 million pesetas, an increase of 39.32% over the previous year. ENTEL ended the year with a gross profit of 421 million pesetas, 25% higher than in 1987[53].

A significant aspect was ENTEL's relationship with the Plan Electrónico e Informático Nacional (PEIN) – National Electronic and Informatics Plan. The company showed interest in its development from the very start, believing that it implied a clarification of the work in the field. On the other hand, PEIN set objectives regarding the European context, in a situation of low consumption of IT and IT services.

The growth forecasts and the 1987 horizon seemed favorable for IT consumption and, above all, IT services. The company anticipated changes in the importance that IT would have in society and economic activity and in the role played by similar companies. Looking at the surrounding environment, ENTEL envisioned possibilities to follow the path of France, which, although failing to achieve the desired goals of a plan to manufacture equipment, succeeded in creating a powerful industry based on computer services. ENTEL achieved some milestones regarding PEIN, including participation in the development of the study for the 1992 Barcelona

[48] *El País*, 24 June 1977.
[49] In terms of corporate relationships with international companies, Northrop also sought to establish relations with ENTEL (INI, *Archivo de Altos Cargos*, ENTEL, Box 37, 08-11-67/15-01-68).
[50] *El País*, 1 July 1981.
[51] *El País*, 18 June 1980.
[52] *El País*, 28 May 1987.
[53] *El País*, 31 January 1989.

Olympic Games. It also offered the Ministry of Industry and Energy projects related to the industrialization of software. Additionally, ENTEL worked on projects for courts, hospitals, education, and cadasters, as it considered them an opportunity for the company and for the industry.

ENTEL accounted for 6-7 percent of the IT services market and worked both for CTNE and abroad. CTNE represented about one third of ENTEL's turnover. ENTEL had a role with Telefónica regarding software development and the provision of services. It was not involved in the rest of the telecommunications market, except for supporting the development of specific informatics products (Comparecencia, 1984, p. 6506). In 1991, Telefónica and INI integrated the assets of their subsidiaries ENTEL and ERIA into ERITEL, controlled mainly by INI through Inisel, aiming to develop software. This restructuring of the public sector of ICTs and the birth of Inisel played a prominent role in the future development of the sector, due to its leadership in the setting up of the technological firm Indra (Calvo, 2019a, pp. 145 and 161).

Assessing the period 2003-2007, ENTEL claimed it gained the trust of almost a hundred customers and the integration of a team of 650 professionals. Customers were able to combine their policy of supplier concentration with a selective renewal of suppliers. As for the market entry strategy, Entel's qualification as a supplier in Consulting, Technology, and Outsourcing was based first and foremost on its perception as a highly innovative and differentiated company, specializing in Software Engineering, IT Governance and Management, SOA Projects, Open Systems, Managed and Professional Services, Security, and Advanced Training. The excellent reputation of its experts and the development of leading models, architectures and methodologies such as EPM/SOA, neoplatform, ESM and SeGRAT, which reflect the best practices of international standards, were decisive. As for objectives for the following years, it aimed to increase the number of customers and its capabilities with a highly qualified team of more than 1,200 professionals[54].

CONCLUSION

Modern telecommunications in Spain were characterized by the disintegration or horizontal segregation of the telegraphic and telephonic services. Regarding telegraphy, there was an asymmetrical approach by the

[54] *Entelgy*, 23 February 2007.

state, due to the incongruence of the public nature of the telegraphic system and the inexistence of a public network of radiotelegraphy that covered the entire country.

The second inconsistency occurred in telephony. The stage of highly segmented or atomization of concessions by localities overlapped partially with the infancy of radiotelegraphy. When the technology matured, a process of concentration in large companies and a near monopoly in long distance services occurred. It was followed, with few exceptions, by the private monopoly of CTNE, a creature of IT&T, and then by a semi-public monopoly, resulting from the purchase of the North American company's assets by the dictator Franco in 1945.

This monopoly in voice telephony was coupled with another in radiotelegraphy. This integration of telecommunications technology coexisted with niche markets – fishing and coastal shipping, public stations for educational purposes or simpler equipment, and military radiotelegraphy – which differed from the practice of Telefunken technology. In addition, there were isolated installations for experimental purposes and concessions of coastal radio stations to certain industrial companies, like Standard Eléctrica, a Spanish IT&T's subsidiary.

One of the key elements revealed by this investigation concerns the very nature of the monopoly in telecommunications, which is the main cause of the merger.

This research has explored radiotelegraphy in Spain at the stage of advanced maturity – the transistor and computer era – addressing the response of the state and private capital to this new communication technology. It has underscored the intensification of corporate concentration in a regulated sector, already previously concentrated and subject to near monopoly situation. The public sector played a key role in the concentration process, which took place through a dual involvement of the state – as regulator and operator of the system – and a dual market structure – private and public ownership. In this framework, a combination of the pre-existing voice telephony monopoly and the concession to a new company – ENTEL – took place. A clear distinction existed between the two ENTELs that really existed: that created in 1961, to provide radiotelegraphic services in the *transistor era*, and that reconverted in 1971 to carry out various computer activities in the *computer era*.

The concentration process was twofold: first in the radio sector, which had already been concentrated for some time, and then in telecommunications through the integration of ENTEL into the CTNE monopoly. The

monopolistic structure of the market closed the door to other options, although it did push ENTEL into the private sector with strong state participation.

The discrepancy between the usual practice of telegraphy as an exclusive of the Telegraph Corps and the concession of radiotelegraphy as a monopoly to a private company – CNTsH – was noted. Under Franco's dictatorship, a nationalization policy created a Spanish majority in Transradio Española equity, with the direct involvement of the state through the public company Torres Quevedo S. A., which was pivotal to the creation of ENTEL. Corporate concentration existed also in Europe, particularly in Germany with the consumer electronic company AEG-Telefunken, but in this country the process was curtailed by the failure of the merger AEG-Telefunken-Siemens.

CTNE's involvement followed the Spanish pattern of horizontal disintegration, which was distinct from the European model that integrated postal, telegraph, and telephone services into a single entity: PTT (Postal, Telegraphs and Telephones). However, CTNE diversified its activities. A growth in capacity was needed to meet the new needs of *desarrollismo* (developmentalism) and reintegration into the international economy under the Franco era (Tafunell y Carreras, 2018).

Lastly, on the more general question of technology/institution relations and the country's context, the case of ENTEL suggests that the concentration was linked mostly to the new economic orientation than to economic growth, which it anticipated and then became a part of it.

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