

**International Competition in the Telephone System:
The Switchboard Problem of the 1880s.**

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International Competition in the Telephone System: The Switchboard Problem of the 1880s.

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From 1890 to 1920, an enormous gap appeared in the use of the telephone in United States and the European countries respectively. In the 1940s, a thousand inhabitants of the United States shared 200 telephones, whereas the European countries reached a similar density of the telephone network not before the 1960s.¹ Scholars mostly explain this differing paths of development by the efficiency of the regulatory regimes in both parts of the world, the market-driven system with more or less competition in the United States after the dissolution of the Bell-Patent and the dominance of state administrations and monopolies in most of the European countries.² Surely, this explanation seem to be convincing in the long run and especially convenient during a period, when the state monopolies had been privatised in Europe in the 1980s. But from a business historian's point of view it must trigger further questions: In most European countries the prehistory of the telephone in fact was not a state-monopolistic one, but the introduction begun by private initiative like in the USA. Only during the process of the popularising telephony the government decided to took over the private companies: The French government bought the private telephone-lines in the 1890s. In Norway and Sweden only the long-distance lines had been taken over by the state in the 1890s and in Great Britain it was not before 1912, when the state decided to monopolize the telephone completely.³ Hence, we have to come to the conclusion, that the "battle of the systems"-perspective on the early history of telephony is rather superficial. Furthermore, that perspective is strongly influenced by the American development (and literature as well). A large literature in the past decade was concerned with the examination of national telecommunication networks and regulation strategies in Europe.⁴ From that literature it comes quite clear, that we cannot simply treat different market orders as the starting point for historical analysis on the economic effects of telephone systems (as Scott Wallsten, 2001 and 2005 does). Much more, the market order was the result of a long and controversial communication process, in which the final institutional arrangement came into existence as a historically specific solution to particular allocation problems: Each national institutional arrangement had its own justification. It would have been just not replaceable by another institutional structure that seems to work better in the sense of current economic efficiency.

Of course, it existed a "battle of ideas" apart from the "battle of the system" as far as the market order for telephony is concerned. For a very long time telecommunication networks were regarded as „natural monopolies“ in economic theory and for an even longer time in German economic theory. Economic theory should have influenced the regulatory strategy of the countries at the turn of the 19th century strongly, even though this aspect of the story is not yet examined in depth. But in recent literature, economic theory is often used as a fix reference for the explanation of the historical development of the telephone systems instead of considering the theory as part of historical development itself and the predominance of the one or the other regulation model as part of historic fashions.

Both "battles", that I described above, rested on another assumption, that is rather unrealistic: In nearly all international comparative literature the telephone systems had been considered as closed national entities as long as transatlantic telephone cable were technologically

unreachable since the 1920s. In fact, national separation of the telephone system never was the case as far as the organisation and management are concerned. This critique on the “battle of the system”-approach as well as the “battle of ideas”-approach never evolved in the past debates and this is perhaps the most remarkable result of the discussion: We talk about the most advanced part of the communication system of the late 19th century, a time period that is usually perceived as the “era of globalisation” because of the transport-revolution and the revolution of the communication system!⁵ But in respect of the history of telephony the transfer of technological and organisational knowledge between countries was not taken into account so far.⁶ However, within this completely new communication system international knowledge was widely used to erect national telephone systems. The aim of the paper is to integrate this aspect into the discussion of institutional structures of telephony around the world. Therefore, I choose a German perspective. The question to be answered here is, in how far the German *Reichs-Post- und Telegraphenverwaltung* (Post- and Telegraph Administration) tried to use foreign knowledge in order to erect a national telephone system and vice versa: in how far the German system was used as a model abroad? In the process of evolution, national telephone systems could much more often profit from alternative institutional settings and operational approaches that contemporary had been applied to the telephone system abroad. It is the aim of this paper, to show that the use of this international knowledge was a systematic part of telephone enterprises even of state administrations at the turn of the 19th century.

Two main fields for international transfer of knowledge could be identified in the course of the research: On the one hand there was a strong search for the transfer of technology especially in the construction of telephone exchanges. On the other hand the issue of how to price telephone service was an important issue in the international exchange on behalf of the telephone system. A very short summary of the different national regulatory paths into the telephone age will introduce the topic.

A short summary of telephone history and regulation in the US, Great Britain, Sweden and Germany¹

In 1876, nobody could know about the enormous influence the telephone would have for the economy and society. It was impossible to anticipate its market success. Especially in the early years, when the investment risk was high, states neither undertake own investment nor cared about a durable legal market order. The telephone met with a market situation in the European as well as the American big cities, where many providers offered different communication services to the public at comparatively low rates. Private enterprises as well as state administrations offered telegraph service specialised on the communication demand of the cities’ business people. Telegraphs even had been built to private houses in the pre-telephone era. In London for example the “City Telegraph Company” operated since 1854.⁷ Besides electrical communication via the telegraph in most major cities highly efficient postal service was offered, even growing in the late 19th century: There had been private boy messenger-companies as well as specialised city mail systems, run by state administrations. In Berlin, the state administration delivered letters within less than one hour at the end of the 19th century. The market for postal service was so promising in the large cities that even in the highly state orientated German Reich private owned city post enterprises sprang up like

¹ Skip that part if you feel sufficiently familiar with the basics of telephone history in Europe and US.

mushrooms in almost all bigger cities during the 1880s in order to deliver especially advertisement and other business correspondence.⁸

The telephone appeared on the scene in a highly competitive situation of local communication. Bell's invention appeared as a gadget to improve and accelerate mainly inner-firm communication. The first telephone lines had been peer-to-peer lines between the home and the office of business men or (often) small banks. As a totally private issue (the transformation of private communication), the field needed no legal regulation at all during the first years. In Germany, an early and prominent customer of the new technology was the post- and telegraph administration itself, led by the famous general post master, Heinrich von Stephan. Stephan discovered the description in the journal "Scientific American" and ordered two of the new gadgets in 1877. After he had examined the gadgets he introduced the telephone within the administration to extend the telegraph network to the rural parts of Germany, since the telephone would not need highly skilled personal for the operation so that the extension could have been undertaken at low costs.⁹ Hence the first public use of the telephone in Europe was in fact a technological improvement of inner-firm communication.

Only a year later, the first public telephone systems had been opened in Boston, and some months later in large European cities as well, where Bell founded subsidiaries in London, Paris and Antwerp in 1878. That was of course the major accomplishment in the history of telephony, because a totally new business model was invented by that step: The older forms of communication service (that still remain in existence) had been modelled after the letter. Local letters as well as local telegrams had to be brought to a post office or a service point and paid piece by piece. Inner-firm telephone-networks (as well as most private telegraph networks) had been bought completely by the customer, who operated the network his own after the deal. With the introduction of the local telephone exchange-system Bell no longer sold the telephones but the customers rented gadgets and lines for a time period and the telephone enterprise sold the service.¹⁰ This was a very far reaching decision for the development of the telephone with flat-rate taxation as instant consequence, because there was no way to measure neither the number of telephone-calls nor the costs of service for each single call.¹¹ Only with such a business strategy the network and the enterprises would be confronted with network-externalities, because now the value of the network depended on the number of subscribers rather than on the privately judged value of the peer-to-peer line. But since each new subscription would increase the benefits of the pre existent subscribers on the expenses of the new, network externalities are seen as prohibitive to expansion.¹²

Since the telephone was limited to local distanced for technical reasons up to the 1890s, doubts because of military relevance of the new communication system did not gain ground other than in the case of the telegraph that was run by the state in most European countries. Most state administrations in Europe hesitated to step into the new market that would require large investment for the network and the telephone exchanges. The result was, that in most European countries telephone exchanges had been established by private entrepreneurs, while the authorities did not feel responsible to regulate that part of a nation's communication system, that was mainly private interest. But the new media almost instantly experienced a breathtaking fast development: Within months after the erection of the first telephone exchanges the demand reached the number of a thousand subscribers in the largest cities such as Boston, Chicago and New York, or London, Paris and Berlin respectively. No wonder, that several private initiatives tried to profit from that promising market.

Even in the US, where the Bell-patent largely dominated the market structure, competitors appeared, offering local telephone service from the early 1880s. Western Electric was granted an own patent for a telephone. Some of the smaller telephone-exchanges arisen at the end of

the 1880s had own patents. Whereas the Bell-system with rented gadgets and paid service prevailed the telephone market, differing institutional arrangements had developed as well. The farm-telephones for instance belonged to the users and were not bounded together in a central telephone-exchange, but were organised as a kind of communication chain.¹³ In Sweden some networks were run as cooperatives with telephones and lines in the property of the members and an operator paid by community of subscribers.¹⁴ Hence, just from the institutional structure of the early telephone systems the regulatory regimes must have been numerous.

Besides the questions of property and the legal structure almost all telephone systems of the early period until the mid 1890s faced the same core problem: With the rapid expansion of the telephone networks, the telephone exchanges got increasingly overloaded. The switching of telephone calls remained handwork until the 1920s. All telephone lines came together in local telephone exchanges, where they were arranged by number at large boards looking like cupboards in the very beginning. The operator had to plug a piece of cable into one line and attached the other end to the plug the calling subscriber demanded. That very simple system worked quite well as long as telephone exchanges had been small. But even a medium sized telephone exchange – as the one in the German city Bremen, that provided service to 700 subscribers in 1891 – had to process around 2.000 telephone calls an hour in average with only 10 to 14 operators. Operators at this time had to connect two or three calls a minute, which was a lot, because each connection required conversation with the calling subscriber and the colleague working at the switch board on which the demanded telephone line arrived.¹⁵ The situation got even worse, when long-distance telephony was introduced (in Germany) during the late 1880s. Now, every subscriber in general was enabled to demand a connection to almost every subscriber within Germany. The time to arrange such a connection via a long chain of different telephone exchanges and an even longer chain of operators increased tremendously. In the 1880s and 1890s the capacity problem of the telephone exchanges was the most pressing problem to be solved for the extension of the telephone network all over the world. With reference to the contemporary term Milton Mueller called it “the switchboard problem”.¹⁶

In the age of fast technological development it was no wonder that engineers tried to find a technical solution to the switchboard problem. As early as in 1890 an American inventor built a electro-mechanical machine, the Strowger switch, that was not only expensive but could only cope with a small number of 100 telephone lines. If telephone exchanges wanted to make use of the new gadget they must combine several Strowger switches so that the investment got unreachable and the mechanical dialling process took even longer time than the work of human operators. Satisfying and economically feasible technical solutions to the switchboard-problem had been introduced not before the 1920s.

Furthermore, the “switchboard problem” was a question of market order. The larger the telephone networks grew, the more pressing the switchboard problem would be. Hence, separated small networks, that had not been interconnected, gained slightly a comparative advantage in the early years of telephone history. On the other hand, the switchboard-problem caused sudden trouble, if telephone-companies wanted to merger (for example when Bell tried to integrate the “independents” of the southern US-American states) or if connections had been opened in large monopoly-structured telephone markets as in Germany. To understand the particular national solution to the switchboard-problem more deeply, a broader understanding of the legal framework and the institutional organisation of the telephone system in each national context is required. Eventually, the nationalisation wave in Europe of

the 1890s was influenced by the aim for a more homogenous telephone network promising more an efficient solution to the switchboard problem.

In most European countries the early history of the telephone system was a private one – Germany was one of the rare exemptions, but even in Germany the state monopoly was not taken for granted from the very beginning. In my research, I found a fully developed draft for a law dated from 1881 that would have permitted private telephone companies in Germany.¹⁷ The *Reichs-Post- und Telegraphenverwaltung* (state post- and telegraph-administration), which was responsible for all communication infrastructure in most of the German territory, saw itself unable to fully satisfy the rapidly increasing demand for the telephone out of the public. Since the state-administration lacked of investment to erect the demanded number of telephone exchanges, the postmaster general, Heinrich Stephan, wrote to the head of the ministry of justice (Reichsjustizamt), that it would be necessary to give concession to private enterprises in order to meet the whole demand. His proposal was part of a deeper liberal economic policy at the central management of the German post office. He trusted deeply in the strong market position of the state administration. Therefore, it neither seemed necessary for the general post office to prohibit competitors nor to enact a monopoly-law to secure its market share. Until 1892, no particular monopoly-law on the behalf of telephone and telegraph existed in Germany. The monopoly, that was claimed by parts of the state administration with reference on the monopoly law in postal service was contested even by German courts. A small article in the German constitution from 1871 says nothing more than that the central authority, the Reich, and not the federal states, had to be in charge of the organisation of post and telegraph service. But whereas the parliament enacted a particular monopoly law for the postal service short after the constitution, a similar law for the telegraph did not follow. In fact, telephony remained monopoly in Germany and the post administration the monopolist. But the legal ground for that market order was incomplete until 1892.¹⁸

After France nationalised the telephone system in 1889,¹⁹ in **Germany** a monopoly law for telegraphy was enacted in 1892.²⁰ It should include telephony as part of the telegraph network in the interpretation of the German authority, a heavily combated argument in contemporary Germany. The act was part of a general policy change in Germany during the 1880s to a more protectionist attitude especially in agriculture and international trade. But on the other hand it was the legal method of the German authority to secure an huge investment plan, that was intended to be undertaken by the post office to extend the telephone system after the first decade of a more hesitating and careful strategy.²¹ For a long time the general post office was of the opinion that a monopoly-act would cause large costs for the expropriation of private property and smaller room for manoeuvre in fixing the prices, since a state monopolist would be expected to serve all regions of the country at the same fair tax.²² In fact, the parliament managed to bring an article into the final draft of the telegraphy-law, that allowed increases of the price for telephone service only after the consultation of the parliament. The parliament apparently encompassed a high percentage of telephone customers. But the monopoly law of 1892 was far from being the expression of organised interest. As a true monopoly law of the late 19th century Germany it included a strong demand for extending telephone service over the whole German territory. The article, that allowed private initiative in all cases, where the post administration refused to erect telephone exchanges, has to be interpreted in this direction. However, the German “monopoly law” of 1892 left a small legal opportunity for privately run telephone exchanges, even though it was only a theoretical choice, because the monopolist (the state administration) itself received the power to grant concessions.²³

Systematic observation of telephone markets in the UK, the US, in France and the Scandinavian countries contributed deeply to the institutional arrangement of the telephone

market in Germany. Heinrich von Stephan rested his strong plea for the integration of the telegraph-administration, that was separated from the post-administration in Germany until 1875, on the tendency to nationalise telegraphy and the erection of a strong state administration responsible for nationwide communication in several European countries.²⁴ The **United Kingdom**, as the leading industrial country, was among the first targets of observation for the German post- and telegraph administration. The UK showed a rather contradictory development as far as the telephone system is concerned: Only six years before the telephone was invented, the British Government decided to nationalize the telegraphs under extremely high expenses. A major mistake of the British officials had been, to announce the nationalisation act years in advance so that the telegraph companies increased their profits without further investments. Because the state's compensation for the telegraph companies was related to the profits the state bought a telegraph-network of inferior quality to an exorbitant price.²⁵ After that experience it is hard to understand why the state made the same mistake in relation to the telephone only few years later: In the early years, private enterprises erect telephone exchanges only in the major cities, whereas the state administration started running exchanges in the rural and economically unattractive parts of the country. Poorly trained technicians of the state administration proved unable to run the telephone network efficiently.²⁶ Especially the split between competing closed and mostly not interconnected exchanges in the big cities on the one hand and the more or less state driven network with poor service in the rural part of the countries made the British telephone network inferior to most of its European neighbours. When the German telephone engineer Julius Ludewig visited the British telephone system in 1879, he came back with a strong plea for an organised telephone network, operated by a state monopoly in Germany. "As the English administration confessed its mistake, not to take over the international telegraphy by the hand of the state authority, but to give it to business, a similar attitude apparently comes into existence with respect to the telephone. [...] I would like to remark, that I would recommend to take over the whole thing by the hand of the state administration from the very beginning."²⁷ In the UK, a decision for a stronger role of the state was made not before 1901. In analogy to the nationalisation of the telegraph, it took another eleven years to transfer that purpose into a monopoly law in 1912, when the private telephone companies in the UK had been taken over by the state, again a costly experience for the state.²⁸

The development of the telephone system in the Kingdoms of **Sweden and Norway** is even more remarkable. In the early 1880s several different telephone exchanges had been erected in these countries through local, entrepreneurial or individual activities. When long-distance telephony was strongly demanded in these countries during the 1890s, the differing systems had to be connected. Often the different technical systems and standards, the selfmade local networks were not compatible and the government was unable to band the local networks together to a nationwide communication structure. The state-owned Royal Electric Telegraph Administration, „Televerket“, bought more and more private networks and trunk-lines as well as built some of their own. Since 1889 *Televerket* received a monopoly for long-distance-telephony in Sweden. In rural districts the state-owned enterprise grew as well. In 1902, 97% of the telephones out of Stockholm belonged to *Televerket*. But in Stockholm, by far the most important market in Sweden, a private enterprise took leadership. The „Stockholm Allmänna Telefon Aktiebolag“ (Stockholm Common Telephone joint-stock company) developed in close connection with the telephone-manufacturer L.M.Ericsson to a large influential enterprise since it succeeded pushing the Bell-subsiary out of the Stockholm market in 1883. Until 1903 the private and the state-owned enterprise had agreements concerning the regional activity. But after that there were phases of hard competition including ruinous prices. *Televerket* tried to receive a monopoly for local service as well by the parliament, but did not succeed until 1918.²⁹ Conclusively the particular Swedish path in telephone-regulation

was a very slow step by step forward into a state monopoly connected with phases of intensive competition between state and private enterprises. Sweden had the second dense telephone network in the world after the USA (measured in telephones per capita), but the quality of the network was following the American and even the continental European with great distance.

The evolution of the market structure in telephony shows a complex interaction of different actors and historically unique situations. We can observe an increasing dominance of the state administrations in almost all European countries, starting from a comparatively open situation in the 1870s. Three different issues caused the turn to a stronger role of the state: 1. the wave of connecting local telephone exchanges to a nation-wide telephone network, 2. problems of capacity especially in the central telephone exchanges of which the “switchboard-problems” was one of the most demanding, 3. a strong incentive for international cooperation to solve problems of capacity. The nationalisation projects of the 1890s had far from being isolated from each other. At least in parts the process of national decision making rested on a broad knowledge of the advantages and disadvantages of the various market structures abroad. I will exemplify this process for the German post administration. Two aspects of the organisation of telephone service will serve as examples for the study of a strong interaction between German and foreign telephone administrations: The exchange in respect to the “switchboard-problem” as it was introduced above and the exchange concerning the price systems of telephone service. Both issues had been closely connected: Since the flat rate-tax, that was in practice in almost all countries, produced incentives to use the telephone frequently, the solution to the capacity problem had been seen in a new pricing system that would produce incentives for an infrequent use via call-by-call taxation.

International Contacts in German Perspective

When international cooperation became a core feature to solve technical and organisational problems of the telephone exchanges during the 1880s, the national players could refer to a well established structure of international organisations on that field. International organisations in communication and transport belonged to the earliest international organizations in history. Without such organizations and international agreements the value of for instance the telegraph would have been very much smaller especially in the patchwork of small territories of 19th century Europe. The International Telegraph Union for institutionalizing these contacts was founded in Paris already in 1865. Its predecessor, the „Deutsch-Österreichischer Telegraphenverein“ (Telegraph-Society of Austria and the German states) was founded even fifteen years before.³⁰ It was very important for the European states to have agreements about both technical standards and economic behaviour in border-crossing telegraphs but also regulations according state telegrams and the codifying.³¹ Because the international lines over sea were run through private enterprises the ITU already encompassed states and private enterprises. We find the same situation indeed without private participation after the foundation of the International Postal Union in 1874 on this sector.³² When in Germany at the end of the 1870s the question arose that the state wanted to run public telephone-exchanges like the private enterprises in the USA and other European large cities the *Reichs-Post und Telegraphenverwaltung* could make use of a broad structure of international contacts to share experiences with states and even private enterprises confronted with similar questions and situations.

Hence, the post administration sent a telegraph engineer Julius Ludewig for a longer research trip to the UK, where he should visit telephone exchanges ran by private business as well as the state administration. Ludewig was employed in the central post office in Berlin as expert for telegraph service and had published an influential textbook on the management of telegraph networks in 1872.³³ Such a field trip was a common way to gain management knowledge. We can find similar journeys in almost all parts of the German industry, that often was suspected to spy the British industry and profit extraordinarily from the follower-position in the process of industrialisation.³⁴ Ludewig's purpose was to find out about the advantages and disadvantages of a state owned compared to a private telephone system. As we have seen, Ludewig was not neutral on this question from the very beginning. But from his report it can be concluded, that another purpose apparently was part of his mission as well. He should collect more information of how to organise and structure telephone service in Germany. Hence, his report included a detailed plan for the erection and operation of telephone exchanges in Berlin. Ironically we can say, that the German state telephone system received its first and early impulses from the private telephone exchanges as they had developed in London during the year 1879. Ludewig suggested to start with a small telephone-exchange in Berlin including 50 subscribers, two officers and a planned 25% pay of interest on the capital. This would mean a price for subscribers of 220 marks a year and a net-return of 100 marks for the administration with a calculated subscriber-line of 2.5 kilometer length. Because of falling net-returns the administration should prevent the expansion of this telephone-exchange, Ludewig recommended rather sophisticated.³⁵ Meanwhile, the general post office had collected information on the price structure of most of the European cities. Subscription would cost between 300 and 320 marks a year in the United States, about 700 marks in Paris, 400 marks at the Bell-subsidiary in Manchester and 240 marks at the Edinson-subsidiary in the same town.³⁶ Intentionally the German post administration fixed the flat rate-tax for the first telephone-exchange in Germany below the competitive price on the Manchester market. Subscription for the Berlin telephone exchange would cost 200 marks a year in 1881.

When the German *Reichs-Post und Telegraphenverwaltung* took notice of the fast development of the telephone in Sweden in 1883 it wrote to the Swedish Post Office to get information about the different prices of telephone service. The Swedish Post Office answered that the prices of the telephone-exchanges of the large private enterprises were up to 271 marks a year, much higher than the German ones. But there existed state-owned and municipal exchanges, where subscription levelled between 90 and 153 marks and the cooperatives offered telephone service between 28 and 57 Marks a year.³⁷ The first reaction of the postmaster general after he received the answer was to prohibit its publication in the German newspapers. Eventually, the price for telephone subscription was reduced in German to only 150 marks a year in 1884.³⁸ Europe did not face a competitive international telephone market at this time, but we have strong reason to believe, that there was a "market price": Because the telephone flat rate was hard to bring together with the real costs of each administrations' expenses, competitive prices had been the only mark for orientation.

But the German *Reichs-Post und Telegraphenverwaltung* not only observed the near European developments it also was interested in the USA. And this transatlantic contacts also based not only on technical interests, interests in the solutions of the switchboard-problem or inventions of microphones and signal amplifying.³⁹ They also were related to the management knowledge and the observation of regularly structures. The first and permanent channel which was used for that purpose was the diplomatic exchange.⁴⁰ The German *Reichs-Post und Telegraphenverwaltung* e.g. tried to get information on the „telephone scandal“ in the USA. In 1886 the Attorney General, Garland, himself share holder of one of the most important competitors of Bell, the Pan Electric Telephone Company, was suspicious to have

strengthened the market power of ‚his‘ enterprise through patent proceedings against Bell.⁴¹ But there were also direct contacts of the Berlin general post office to American telephone enterprises, firstly not to the Bell-company itself but to Bells competitors. Since 1879, the director of the German telegraph administration, Wilhelm Budde, stood in mail contact with the chief electrician of the Western Union Telegraph Company, George B. Prescott, to gather information about the construction of local telephone networks and even on the possibility of inter-city-connections.⁴²

However, diplomatic exchange or contacts via the international postal union did not bring solutions for the technical and organisations questions of the telephone exchanges. Therefore, the German post administration sent high officers to the USA to study the problems in detail at private telephone enterprises. The interest arose when the *Reichs-Post und Telegraphenverwaltung* decided to invest into the erection of the large and dense telephone network after a period of cautious expansion in the 1880s. In summer 1889, the post officer Konrad Wabner visited telephone companies in Boston, New York and Chicago.⁴³ From the 8th to 13th of September the German Officer took part in the conference of the „National Telephone Exchange Association“ in Minneapolis, a common society of the American telephone-enterprises on the switchboard-problem.⁴⁴ When the conference was over, he visited 15 Bell enterprises in the east part of the United States as well as the Bell and AT&T headquarters in Boston. In his report to the Berlin *Reichspostamt* he was concentrated on organisational details and the payment practice. In New York he stressed the great problems resulted from the numerous lines in the streets especially near the exchanges supporting the German policy to put the telephone-lines down to the earth in stone channels. Furthermore, Wabner reported on AT&T’s strategy to prevent competition after the end of its patent by founding the „Electrical Subway“, an enterprise built up underground wire channels. „The appearance of the overhead wire lines in all larger cities but namely in the streets of New York beggar all description. The lines for light, telegraph, telephone and other uses made by 50 and more different companies crossing in the air in all directions and offer an inextricable chaos even for experts. Even when the weather is calm contacts of the wires with different electrical charge were frequent.“⁴⁵ But the report of such optical impressions was not the primary purpose of Wabners trip to the United States. He more intensively (but less nice to quote) devoted his attention to organizational matters. He praised the employment of women in the exchanges, which was not widely spread in Germany because of the employment rules for civil servants.

It seems very probable, that Wabner’s report initiated the development of a new generation of switchboards in Germany, that appeared short after his return. Whereas the dominant German supplier of electronic material, Siemens & Halske, had great success in manufacturing wires and cables and also in manufacturing the telephone gadgets itself, the switchboards in the exchanges had to be imported until the mid 1890s, when small high specialized German enterprises were able to compete with the American and Swedish technology. Very influential for this development was the world exhibition in Chicago in 1893, that the German telegraph engineer and chief of the technical stuff in the German general post office, Karl Grawinkel, attended.⁴⁶ The German telephone entrepreneur, Robert Stock, was also present at the World Exhibition of Chicago. His firm *Robert Stock & Co* (later named: DeTeWe = German Telephone Works), founded in 1886, was based on some patents for switchboards of a new generation..⁴⁷ As a direct consequence of Wabener’s report, the *Reichspost* introduced “control officers” to the telephone exchanges, a practice that Wabener studied at the New York Telephone Company. Control officers connected themselves directly and secretly to the conversations between the operator and the subscriber to supervise the modes of contact and politeness of tone in order to improve the quality of the service later on. We can see the

practice as a forerunner of scientific management in the history of telephony. However, it was not continued at the German post administration after a few months, where all employees worked in the status of civil servants.

Another place of interest for the German *Reichs-Post und Telegraphenverwaltung* had been the Scandinavian countries, especially Stockholm. One of the largest telephone networks of the world of the 1890s was located in the Swedish capital, a good object of study for the German officers and much easier to reach. In the beginning of 1891 the chief of the office of telephony at the general post office in Berlin, Johannes Triebel, started for a trip via Denmark to Sweden and Norway. Short before the discussion on the telegraph monopoly act in Germany the *Reichs-Post und Telegraphenverwaltung* and the postmaster general, Heinrich von Stephan, personally, were interested in the situation of competition between state and private enterprises in Stockholm. The state-owned *Televerket* then tried to ruin the larger *Telephon Aktiebolag* with „cutthroat“ prices – to use the term of Lipartito.⁴⁸ But one effect of the low prices of only 11 marks a year and the rapid expansion of telephone that it caused – so the report of the German officer Triebel – was the poor quality of lines and service. The telephone system of Sweden was described as „unhealthy“ and the velocity of growth was compared with epidemics not only in the German report to Berlin but in local newspapers in Stockholm. The German officer pleasurably reported the expression “telephone-plague” to Berlin.⁴⁹ Soon after Triebel’s trip to Sweden the decision must have grown even among the more liberal German experts that a state monopoly would be the most important precondition for a more orderly and „healthy“ expansion of telephone network.

But Triebel’s report was not only about the question of market order and the effects of “cutthroat competition”. He studied the technical and organisational arrangement of the exchanges as well. In one of telephone-exchanges of the *Telephon Aktiebolag* in Stockholm he discovered that most of the organization was modelled after the German experience: „The technical interior is quite similar to our newer exchanges respectively will be built up like these even in small details. This perception, which was spectacular to me, finds an explanation in the fact, that a technician is employed here, who worked as a mechanic of one of our subcontractor in the telephone-exchanges in Hamburg and in Berlin. That is one of the less loyal means, which Mr. Cedergreen (the director of the Telephone-Aktiebolag, J. H.) applies to bring himself in the possession of proven organizational knowledge without spending a lot of money.“⁵⁰ In Triebel’s perspective competition had effects even on the moral behaviour of business, another argument for him to favour state monopoly. However, in Triebel’s view a state monopoly was the natural effect of the current market condition. The state-owned *Televerket* succeeded in raising its market share in buying small private enterprises outside from Stockholm and had the power to enforced expropriation for the building of telephone lines. „Through the improvement of their organisation in connection with low rates the state-owned telegraph administration tried to win back the trust and the acknowledgement of the customers – In my view with success. This strategy will push the attitude among the customers that the running of telephone networks by state has many advantages.“⁵¹ If the jurisdiction would allow *Televerket* to continue this strategy, so the conclusion of Triebel, the private enterprises would disappear in some years and the rates would raise to a normal and „healthy“ level. In consequence for Triebel a nationalization act would not even be necessary in the Swedish case.⁵² In Norway and Denmark Triebel made similar experiences. In Norway existed a state-monopoly since 1881 excluding inner-firm networks, the railways and the telephone exchanges within cities. In Denmark the state administration did not operate an own telephone network. For both countries Triebel emphasised especially the problems of unorganized telephone-lines crossing the cities. But like Wabner, Triebel described the particular organisation of telephone networks to be

separated from the question of state monopoly. He certainly thought, that competition automatically would lead to negative effects on telephone-markets. But both were concentrated on operational questions. They were interested in taxation-systems, in employment forms, in switching technology and the organization of exchanges. A similar trip as Triebel's had been undertaken by the post officer *Feuersänger* in 1896 to study the technical progress in the Northern countries again.⁵³

In the mid of the 1890s the direction of knowledge-transfer apparently have changed for a while. The German post administration now received several visitors from abroad, who wanted to study the organisation of large telephone exchanges, that were said to be at maximum efficiency in Germany by that time compared to the organisation in other countries. Especially the telephone-exchanges of Hamburg and Berlin were reported to cope perfectly with a very large number of subscribers. The German switchboards of this time worked with a maximum of 1.000 telephone-subscribers. In order to provide service to networks of 50.000 subscribers the telephone exchanges had to combine the switchboards, that were interlinked in a hierarchical order. As long as technical solutions for the large scale did not exist, the combination of switchboards was the dominant strategy for the large exchanges, so that contemporary telephone switching required organizational innovations much more than technical solutions. It seemed to have been the particular strength of the German *Reichspost* to arrange the working processes at the combined telephone switchboards, whereas the technical solution like the Strowger switch received stronger push in the USA.⁵⁴ Since the mid 1890s English, Swedish and even American engineers came to Germany to study the organisation of the large telephone exchanges. Because it was not very easy to persuade the German administration to give the permission for such visitations, the requests were often put in a servile tone: „The telephone system of Berlin [...] has received a greater development than that of any other city of the world“ ends the request of the London General Post Office for a permission to send two high engineers to Berlin and Hamburg.⁵⁵ It might have been servile politeness. But Berlin and Hamburg were also targets of high officers of the powerful and progressive enterprises of the United States and Sweden. We can observe a small wave of Germany-trips of foreign telephone engineers starting with a British expert of a private enterprise in 1894. The National Telephone Company, located in London, asked for the permission to visit Hamburg in May 1894. Some month later the new director of the same company, A.R. Bennett, who had already visited Sweden and Norway,⁵⁶ wanted to study the large telephone-exchanges. Even though Bennett had no relation to the British post administration, the *Reichs-Post und Telegraphenverwaltung* made its permission conditional on the approval of the British General Post Office.⁵⁷ In Summer 1895 engineer Johannson of the *Telephon Aktiebolag* of Stockholm visited the exchanges of Hamburg, Berlin and Frankfurt/Main.⁵⁸ In January 1896 S. H. Mildenburg, the General Manager of the „New York and Eastern Telegraph and Telephone Company“ asked for a visit, followed by August S. Hibbard of the „Chicago Telephone Company“ and a delegation of Swedish technical civil servants a year later.⁵⁹ Probably the list of international contacts and visits of foreign engineers was even longer. All the cases are taken from the archive of the central authority, the *Reichspostamt*, but apparently permissions for field studies were also granted by the federal authorities, the *Oberpostdirektionen*. Nevertheless, it can be concluded, that the organization of the German telephone-network was interesting even for the more advanced American enterprises. And it can further be concluded, that the reason of interest was not primary the technological aspects of switching but the organizational means, because otherwise the engineers would contact Siemens or other firms and not the *Reichspost*.

After the turn to the 20th century the interest for the German telephone system from the leading industrialised nations declined. The number of requests decreased and countries like

Turkey and Spain now were the interested parties.⁶⁰ On the other hand, the German administration intensified its interest in the technological development in the USA. In connection with the introduction of a new pricing system in Germany the *Reichs-Post und Telegraphenverwaltung* prepared for further studying trips of its leading technical officers. Until 1900 the price for telephone subscription was 150 marks a year for local service. Additional, the subscribers had to pay for each supra-regional call depending on the distance. Long-distance calls were measured in three different zones. The Postmaster General, Victor von Podbielski, planned to reform this price system in order to make telephony cheaper in rural districts and for persons with smaller demand. In 1900 a new system was set in force, that discriminated between ten flat-rates, starting at 80 marks a year for small networks. In Berlin, the new flat-rate would cost 180 marks a year. The aim of the new price system was to bring the price closer to the real use of the telephone. Since a workable call-counter was not available, the pricing system operated with an average use of the telephone, that was dependent on the size of the local telephone exchange, as the experts in the *Reichspost* found out. Not before 1906 the enterprise noticed that the financial result of the new rate system was disastrous.⁶¹ Meanwhile the management of the *Reichs-Post und Telegraphenverwaltung* had tried to get information of better service and better pricing from the practice of American telephone companies.

In the reports of telegraph engineers visiting the US after the turn of the century questions of market structure and regulation played no role any longer. The reports had been strongly focused on technical and organizational details of the telephone exchanges as well as the structures of the enterprises and their employment policy. In the preparation of some trips the German electrical industry apparently had been involved. The small German firm, *Telephon Apparate Fabrik, E. O. Zwietsch*, which used Bell-patents for the production of switchboards and related equipment, arranged a contact to the „New York Telephone Company“, a former subsidiary of Western Electric, that was sold to AT&T in 1907.⁶² The General Manager of the NYTC, U. N. Bethell, stood in close contact with the director of the technical division of the general post office, Reinhold Sydow, who later became Prussian minister of commerce. Since 1901 the private enterprise and the state administration routinely corresponded on rate systems and the development of the telephone network in both countries.⁶³ A sequence of new field trips to the United States followed the next years. At the end of 1902 the post-officer Braun and the telegraph-engineer and chief of the procurement office of the *Reichs-Post und Telegraphenverwaltung* Ernst Feyerabend travelled to the United States for a couple of months. They mainly inspected telephone exchanges of different enterprises and brought useful information for the management of the *Reichs-Post und Telegraphenverwaltung* back to Germany (together with a wife for Feyerabend). The German officers had been very impressed by the development of telephone networks in the USA since the discontinuation of the Bell Patents in 1893. „Even though there was heavy competition“, says the report of the German officers, „some innovations at the field of telephone technology had putting through very fast in almost all larger telephone networks of the United states with only marginal variations, nevertheless if it was an innovation of the independents or not.“⁶⁴ At this time there was no doubt in Germany, neither in economic theory nor in policy nor in the management of the *Reichspost*, that the state-owned and nationalized market structure alone was the effective market structure for telephone service. That also competition would cause useful results was amazing to German officers.

The main technical development, that was highlighted by the report of the German officers, was the central battery system of switching together with the use of internal lines for the internal communication of medium-sized exchanges. Particularly the products of the „Kollegg Switchboard & Supply Company“ in Chicago were recommended by Braun and Feyerabend.

They even worked out how the technology could be implemented into the German networks. The claim for the decentralization of telephone exchanges was a major result of Feyerabend's field trip, who plea for an end of the German policy to work with large exchanges. This was not only a technical but more an organizational claim. It was connected with long explanations on the working-process in the exchanges and the rate-systems. The Germans emphasised the celebrity of the female operators. Furthermore, they highlighted the „value of the exhaustive statistical investigations in the city telephone networks [...]. They give not only a clear view of the extent of traffic, they let also recognize the load of the single workplace, so that on the one side a sufficient filling at the gadgets is secured and on the other side each waste of personal could be prevented.“⁶⁵ Because of the introduction of electrical call counters in the NYTC-exchange in the 38th Street in New York it was reached a great cost reduction because each operator was responsible for a larger number of lines and subscribers. The women were well trained and got a bonus, when they had great numbers of exchanges. Conclusively, the German officers supported the forerunners of scientific management in telephone switching and tried to introduce similar practices in Germany.

The price system evolved in close connection with the organisation of the telephone exchanges on both sides of the Atlantic. The American company already turned away from flat rate taxation. The customers should be brought to single call taxation with comparatively expensive flat rates of 221 marks (75\$) for 600 calls a year in New York. Because of the high share of single rate subscribers the average load of a normal subscriber line was with 7,6 calls a day or 2300 a year (for the NYCT-example) much lower than the data in Germany, where a subscriber used the telephone 2860 times a year in average.⁶⁶ This high load lead to capacity problems in the exchanges in Germany, but under the rule of the Telegraph monopoly law of 1892 the *Reichs-Post und Telegraphenverwaltung* was unable to introduce a new price system against the vote of the parliament. A similar problem arose of the much to low rates in long-distance telephony in Germany. Conclusively the main problem of German telephony was the allocation dilemma of the rate-system. The engineers, who visited the USA in 1902, recognized this problems very clearly, but the management of the *Reichs-Post und Telegraphenverwaltung* was unable to change its policy under the existing institutional structure. Since the enterprise was a core piece within a larger policy of strengthening the rural parts of the German society it was impossible after the turn of the century to change the institutional structure.⁶⁷

Conclusion

The description of the foreign relations of the German *Reichspost* in relation to the telephone gives rise to the conclusion that there never existed nationally closed telephone systems. The telephone networks had been interconnected intellectually long before technological interconnection had been accomplished. It was the strong demand for practical experience in the organisation of the telephone exchanges as well as experience of the effects of price systems that triggered the first initiatives to study foreign telephone systems. We therefore can conclude that the state-monopolist in Germany profited from the competition in the USA as well as American enterprises profited from the monopolies in Europe. The profit was only partly a business profit measured in cash: one third of the production of Bell was exported in 1882.⁶⁸ The larger surplus resulted from the implementation of new organisational ideas into each national telephone system.

On the background of the past literature on international comparison of telephone markets and regulatory regimes this insight causes some rather far reaching consequences: In my opinion, it makes no sense to treat the telephone networks of the late 19th century as separated national objects, that can be compared for the question of their economic effects which could be lead back to either the state-monopolistic or the competitive institutional frameworks. Much more we must think of “contestability” of markets and conditions in the sense of the Industrial Economics.⁶⁹ “Contestability” might be studied by the effects of a sort of “virtual competition”, meaning the competition a national system would receive from price structures or strength of service in another country, which is considered inferior by the home country’s public.

¹ See Mitchell, Brian R.: *European historical statistics 1750-1993*. Houndmills u.a.: Macmillan 1998/ Ders.: *American historical Statistics*, ebd.

² Most recent: Wallsten, Scott: *Ringling in the 20th Century: The Effects of State Monopolies, Private Ownership, and Operating Licenses on Telecommunications in Europe 1892-1914* (Stanford Institute for Economic Policy Research, Discussion Paper 00-37). Stanford 2001; Wallsten, Scott J.: *Returning to Victorian Competition, Ownership and Regulation: An Empirical Study of European Telecommunications at the Turn of the Twentieth Century*. In: *Journal of Economic History* 65,3 (2005), S.693-722.

³ France 1889, Sweden 1896 long-distance telephones, Great Britain 1896 long distance, 1912 local telephones.

⁴ The first study on a comparative telephone history in English (after the early works at the beginning of the century) was published in 1994 (Davies, Andrew: *Telecommunications and Politics. The Decentralised Alternative*. London, New York). In the German discussion the first similar study was published in 1999 (Schneider, Volker: *Staat und technische Kommunikation. Die politische Entwicklung der Telekommunikation in den USA, Japan, Großbritannien, Deutschland, Frankreich und Italien*. Opladen: Westdt. Verl. 1999).

⁵ See for example: Osterhammel, Jürgen / Petersson, Niels P.: *Globalization. A short history*. Princeton 2005; O'Rourke, Kevin / Williamson, Jeffrey G.: *Globalization and History. The Evolution of a Nineteenth-Century Atlantic Economy*. London 1999.

⁶ As far as I see, James Foreman-Peck’s article is the only exemption and interestingly it was not quoted in the “battle of the systems”-literature! James Foreman-Peck: *International Technology Transfer in Telephony, 1876-1914*. In: Jeremy, David J. (Hg.) *International Technology Transfer. Europe, Japan and the USA 1700 - 1914*. Aldershot 1991, S.122-152.

⁷ Jeffrey Kieve: *The Electric Telegraph. A Social and Economic History*. New Abbot 1973, p. 138f.

⁸ The private city-post enterprises used a niche in the German monopoly legislation and where prohibited by the reformulation of the monopoly law in 1900. See: Jan-Otmar Hesse: „Postanarchie im Deutschen Reiche!“ Zur ökonomischen Bedeutung von Vertrauen in der Debatte um das deutsche Postmonopol 1886/87. In: *Zeitschrift für Unternehmensgeschichte* 45,1 (2000), p. 79-89.

⁹ Frank Thomas: *Telefonieren in Deutschland. Organisatorische, technische und räumliche Entwicklung eines großtechnischen Systems*. Frankfurt a.M./New York 1995, p. 60-62.

¹⁰ Milton L. Mueller: *The Switchboard Problem. Scale, Signalling and Organization in Manual Telephone Switching 1877-1897*. In: *Technology and Culture* 30 (1989), p. 534-560, esp. p. 540.

¹¹ George David Smith: *The Anatomy of a Business Strategie. Bell, Western Electric and the origins of the American Telephone Industrie*. Baltimore 1985, p. 163-165.

¹² The term “network externalities” was introduced by: Katz, M-L. / Shapiro, C (1985) *Network Externalities, competition and Compatibility*. In: *American Economic Review*, 75, S.424-440. Meanwhile a whole theory was applied to the principle and the hypothesis, that modern societies became “network economies” in the past. See e.g. Shapiro, Carl / Varian, Hal R.: *Information Rules. A Strategic Guide to the Network Economy*. 1999, esp. 183ff. For the theory of network externalities in connection with the historical evolution of the telephone system see: Mueller, Milton L.: *Universal Service. Competition, Interconnection, and Monopoly in the Making of the American Telephone System*. Cambridge/ Mass. 1997.

¹³ Schneider, p. 85-87; Lipartito, Kenneth: “Cutthroat” Competition, Corporate Strategy, And the Growth of Network Industries. In: *Research on Technological Innovation, Management and Policy* 6 (1997), S.1-53, p. 20-22; Mueller, 1997, p. 35; see: Lipartito: *The Bell System and Regional Business: The Telephone in the South*. John Hopkins University 1989.

¹⁴ Davies 1994, p. 75.

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- ¹⁵ Jan-Otmar Hesse: Im Netz der Kommunikation. Die Reichs-Post- und Telegraphenverwaltung 1876-1914. München 2001, 203.
- ¹⁶ Mueller 1989, p. 534-560.
- ¹⁷ See: Hesse, 2001, p. 217ff.
- ¹⁸ Kilger, Franz: Die Entwicklung des Telegraphenrechts im 19. Jahrhundert mit besonderer Berücksichtigung der technischen Entwicklung. Frankfurt a.M. 1993, p. 86-97.
- ¹⁹ Schneider, p. 198; Catherine Bertho, Histoire des Télécommunications en France. Toulouse (Érès) 1984.
- ²⁰ Wessel, Horst A.: Die Entwicklung des elektrischen Nachrichtenwesens in Deutschland und die rheinische Industrie. Von den Anfängen bis zum Ausbruch des Ersten Weltkrieges. Wiesbaden 1983.
- ²¹ Hesse, 2001, p. 197-200, 225f.
- ²² Notice of Otto Dambach, Advocate of Reichspostamt, 12.3.1888, Bundesarchiv (i.e. National Archives of the Federal Republic of Germany, Berlin, abbreviated as „BArch“) R 4701/ 4090.
- ²³ Fischer, Paul David: Das neue Telegraphengesetz. In: Jahrbuch für Gesetzgebung, Verwaltung und Volkswirtschaft im Deutschen Reich 16 (1892), S.1-44
- ²⁴ Stephan to Reichskanzler (German Chancellor) Bismarck, 24.1.1875, BArch, R 4701/ 17043, Bl. 40-44.
- ²⁵ Schneider, p. 112-114; Kieve, p. 158f.
- ²⁶ Charles R. Perry: The Victorian Post Office. The Growth of a Bureaucracy. Rochester 1992
- ²⁷ Report of J. Ludewig on his field trip to England, 07.06.1880, BArch (Berlin), R 4701/ 3629.
- ²⁸ The state was shared in the telephones since the beginning with 10% of surplus. Since 1896 government nationalized the long-distance lines. Charles R. Perry: The British Experience 1876-1912: The Impact of the Telephone During the Years of Delay. In: Sola Pool, Ithiel de (Hg.) The social Impact of the Telephone. Cambridge/ Mass., London 1977, S.69-96.
- ²⁹ Lena Andersson-Skog: Political Economy and Institutional Diffusion. The Case of Swedish Railways and Telecommunications up to 1950. In: Lena Andersson-Skog / Olle Krantz (Hg.) Institutions in the Transport and Communications Industries. State and Private Actors in the Making of Institutional Patterns, 1850-1990. Canton/ Mass. 1999, p. 245-266, esp. 254-258.
- ³⁰ Tegge, Andreas: Die Internationale Telekommunikations-Union. Organisation und Entstehung einer Weltorganisation im Wandel. Baden-Baden 1994; George A. Coddig: Evolution of the ITU. In: Telecommunications Policy 15,4 (1991), S.271-285; George A. Coddig, Antony M. Ruthowski: The International Telecommunication Union in a Changing World. Dedham/ Mass. 1982; Josef Reindl: Der Deutsch-Österreichische Telegraphenverein und die Entwicklung des deutschen Telegraphenwesens 1850-1871. Frankfurt a.M. 1993. For the evolution of international economic institutions see also: Pomeranz, Kenneth / Topik, Steven: The world that trade created: Society, culture and present. 2. ed. Armonk 2006.
- ³¹ Daniel R.Headrick: The invisible Weapon. Telecommunications and international Politics 1851-1945. Oxford 1991, p. 45f.
- ³² Albrecht Weber: Geschichte der internationalen Wirtschaftsorganisationen. Wiesbaden 1983; George A. Coddig: The Universal Postal Union. New York 1964.
- ³³ Julius Ludewig: Die Telegraphie in staats- und privatrechtlicher Beziehung vom Standpunkte der Praxis und des geltenden Rechtes. Zur Orientierung für die ausübenden Beamten und das den Telegraphen benutzende Publikum. Leipzig 1872.
- ³⁴ Kleinschmidt, Christian / Welskopp, Thomas (1993) Amerika aus deutscher Perspektive. Reiseeindrücke deutscher Ingenieure über die Eisen- und Stahlindustrie der USA, 1900-1930. In: Zeitschrift für Unternehmensgeschichte 39, S.73-103;
- ³⁵ Report of J. Ludewig on his field trip to England, 07.06.1880, BArch (Berlin), R 4701/ 3629
- ³⁶ Notice Telephone-rates in the foreign countries, 2.4.1880, BArch, R 4701/ 3614.
- ³⁷ Reichspostamt to Swedish Telegraph-Director., 31.8.1883, BArch, R 4701/ 3640.
- ³⁸ Hesse, 2001, p. 261.
- ³⁹ This was the main perspective of James Foreman-Peck: International Technology Transfer in Telephony, 1876-1914. In: Jeremy, David J. (Hg.) International Technology Transfer. Europe, Japan and the USA 1700 - 1914. Aldershot 1991, S.122-152.
- ⁴⁰ German Konsul in New York, Koser, to Reichspostamt, 13.3.1880, BArch, R 4701/ 3617.
- ⁴¹ Copy, German Legation in Washington to Bismarck, 27.2.1886, Ibid.

⁴² Letter of 18.10.1879, Ibid.

⁴³ Report of Wabner on his journey to the USA, 8.11.1889, BArch, R 4701/ 3617. There were some USA-journeys of high German (Post-)Officers before, but this was the first one, which can be proof as only being related with the telephone-service.

⁴⁴ Mueller, 1989, p. 543f.

⁴⁵ Report of Wabner on his journey to the USA, 8.11.1889, BArch, R 4701/ 3617

⁴⁶ Order of Stephan to Grawinkel, Visitation the World Exhibition in Chicago, 22.12.1892, BArch, R 4701/ 5777.

⁴⁷ Leuthold, Dieter: Robert Stock (1858-1912). Ein Berliner Technik-Unternehmer auf dem Gebiet der Nachrichtentechnik, der Metallverarbeitung und der Landtechnik. In: Technikgeschichte 41 (1974), p.132-152 , esp. p. 139.

⁴⁸ Lipartito, 1997, p. 4.

⁴⁹ Report of J. Triebel on his journey to Denmark, Sweden and Norway, 21.2.1891, BArch, R 4701/ 3640, p. 54

⁵⁰ Ibid.

⁵¹ Ibid. Bl. 14.

⁵² Ibid. 16.

⁵³ Notice 1.11.1896, BArch R 4701/3637, the report on this journey couldn't be found.

⁵⁴ Mueller, 1989, p. 552. It is not unlikely, that the devided switchboards, coming to work in the USA since 1894 outgoing from Chicago, were imported from Germany, where they were in use since the late 1880th. For technical history in German telephony see: Ernst Feyerabend: 50 Jahre Fernsprecher in Deutschland. 1877-1927. hrsg. v. Reichspostministerium. Berlin 1927.

⁵⁵ 8.8.1895

⁵⁶ Andersson-Skog, p. 245.

⁵⁷ 5.10.1894, BArch 4701/ 5777.

⁵⁸ Office for Foreign Affairs to Reichspostamt, permission for Johansson Stockholm to visit telephone-exchanges, 4.8.1895, BArch, R 4701/ 5778.

⁵⁹ Permission to Mr. S. H. Mildenburg, 5..1.1896; question of Augus S. Hibbard, 11.9.1896; question of Eckström, Stockholm, 17.4.1897 BArch, R 4701/ 5778. All this contacts have to be proved and controlled with the American archives. In the moment we know that American, British and Scandinavian engineers visited, but we don't konw for which motive yet.

⁶⁰ Office for Foreign Affairs, question Turkish and Spanish engineers, 16.3.1900, BArch, R 4701/ 3615.

⁶¹ Hesse, 2001, p. 405-408.

⁶² Telefon-Apparate-Fabrik, Berlin, to Schwensky, Reichspostamt, 24.2.1899, BArch, R 4701/ 3615

⁶³ U.N. Bethell, General Manager New York Telephone Co. to Sydow, 18.1.1901, BArch, R 4701/ 3617

⁶⁴ Report from Officer Braun on the journey to the USA, 8.1.1903, BArch, R 4701/ 3619.

⁶⁵ Ibid. p. 91f.

⁶⁶ Calculated on Documentation 29.4.1898, Reichspostamt, BArch R 4701/3560. See: Hesse, p. 404.

⁶⁷ One proposal in this direction has been profoundly prepared in the enterprise over two years but trickled away in the machineries of administration and parliament in the years after 1908; Hesse 2001, p. 404f.

⁶⁸ Foremen-Peck 1991, p. 129.

⁶⁹ Jean Tirole: Industrial Economics. 1999; Baumol, William J. / Panzar, John C. / Willig, Robert D.: Contestable markets and the theory of industry sturcture. New York 1982.