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"SUPPLYING THE PUBLIC WITH A COMPREHENSIVE TELEGRAPH SYSTEM": SWITZERLAND AND TELEGRAPHIC COMMUNICATION, 1860-1915

Roland Wenzlhuemer

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KEY WORDS

Switzerland, telegraphy, global communication, telegraph network, global history

ABSTRACT

Historical research has recently discovered its interest in the study of transregional and global networks of communication and their significance for the so-called "shrinking of the world". In this context, the emergence and the role of a global telegraph network since the middle of the nineteenth century has started to attract scholarly attention. The foundations of this network have mostly been laid by actors from the United Kingdom, the United States, and other important colonial powers. The role of smaller European or non-European states and their position in the emerging global network has rarely been examined. Switzerland usually only enters this discussion as the host of the International Telegraph Union (ITU), which played a decisive role in the development of international telegraphic standards. However, Switzerland's role within the network and the ways Swiss actors made use of telegraphic communication during the nineteenth century have not been studied so far. This study seeks to fill this gap by examining the development of telegraphy in Switzerland as well as the position of the country within a wider European and global communication network. It looks at a number of markers regarding telegraphic development in Switzerland, both from a structural and from a use perspective. The overall goal is to test how well-developed the Swiss telegraph network was during the period of observation and how the country compares to other European (and some non-European) countries. It aims to shed light on how Switzerland was structurally integrated into a wider European and global network, and on how intensively the existing infrastructure was put to use. Furthermore, the study aims to reveal what other countries across the globe the Swiss chose to communicate with telegraphically.

ROLAND WENZLHUEMER

Roland Wenzlhuemer has studied modern history and communication studies and earned a doctoral degree in history at the University of Salzburg in 2002. In 2003, he joined the Centre for Modern Oriental Studies in Berlin and then moved on to the Centre for British Studies at the Humboldt-Universität zu Berlin, where he worked as lecturer and researcher in British History from 2005 to 2008. In October 2008, Wenzlhuemer joined the Cluster of Excellence "Asia and Europe in a Global Context" at the University of Heidelberg as a research group leader. In 2012, he became a Heisenberg fellow of the German Research Foundation. From April 2013 to March 2014, Wenzlhuemer was Visiting Professor at the Institute for European Global Studies at the University of Basel. In September 2014, he took up the Professorship for Modern History at the University of Heidelberg.

Content

1 Introduction

After a long time of electrical experiments and practical demonstrations, the first telegraph lines were opened to the public during the mid-1840s by the United States and the United Kingdom. The new technology quickly caught on. National telegraph networks started to emerge in the course of the next decades and soon trans- and intercontinental lines connected many of these networks with each other. The "wiring of the world" had begun and steadily picked up more pace. At the turn of the century, a worldwide telegraph network had come into existence that connected all continents and brought far-flung territories in almost immediate communicational touch. The telegraph added a new channel to distance communication and introduced a new quality to this domain. It dematerialized[1] a good part of the global flow of information and, in doing so, transformed the relationship between space and time.[2] This had significant economic, social, and cultural implications and was a development closely intertwined with the contemporary processes of industrialization and globalization. Historians have now started to acknowledge the significance of telegraphic communication in this regard and pay attention to the role that the medium played in such processes.[3] The focus of most existing studies usually rests on the emergence of a global telegraph network[4] or on the development of the most important landline systems, for instance in the United States[5] or the United Kingdom.[6] In this regard, the linking-up of different national landline systems through bi- or multilateral treaties, technological standardization, and eventually the emergence of international organizations in the field received a fair share of attention. It is usually in this context, where Switzerland enters the historiographical limelight. The Swiss telegraph administration and its staff acted

1 For a detailed discussion of the idea of dematerialization see Roland Wenzlhuemer, "The Dematerialization of Telecommunication: Communication Centres and Peripheries in Europe, 1850-1920," *Journal of Global History* 2, no. 3 (2007); Roland Wenzlhuemer, *Connecting the Nineteenth-Century World: The Telegraph and Globalization* (Cambridge: Cambridge University Press, 2013), 30-37.

2 For a detailed discussion of the relationship between telegraphy, space and time see Roland Wenzlhuemer, "Globalization, Communication and the Concept of Space in Global History," in *Historical Social Research - Historische Sozialforschung. Global Communication: Telecommunication and Global Flows of Information in the Late 19th and Early 20th Century*, ed. Roland Wenzlhuemer (Köln: Center for Historical Social Research, 2010); Roland Wenzlhuemer, "Less Than No Time: Zum Verhältnis von Telegrafie und Zeit," *Geschichte und Gesellschaft* (2011).

3 For a detailed discussion of the existing research literature see Wenzlhuemer, *Connecting the Nineteenth-Century World: The Telegraph and Globalization*, 77-96.

4 See, for instance, Dwayne R. Winseck and Robert M. Pike, *Communication and Empire. Media, Markets, and Globalization, 1860-1930* (Durham, London: Duke University Press, 2007); Daniel R. Headrick, *The Invisible Weapon: Telecommunications and International Politics, 1851-1945* (New York: Oxford University Press, 1991); Bernard Finn and Daqing Yang, eds., *Communications under the Seas. The Evolving Cable Network and Its Implications*, Dibner Institute Studies in the History of Science and Technology (Cambridge MA/London: The MIT Press, 2009); Peter J. Hugill, *Global Communications since 1844: Geopolitics and Technology* (Baltimore: Johns Hopkins University Press, 1999).

5 See, for instance Richard R. John, *Network Nation. Inventing American Telecommunications* (Cambridge MA/London: The Belknap Press of Harvard University Press, 2010).

6 See, for instance, Jeffrey L. Kieve, *The Electric Telegraph: A Social and Economic History* (Newton Abbot: David & Charles, 1973); Steven Roberts, Distant Writing. A History of Telegraph Companies in Britain between 1838 and 1868, (2007), http://distantwriting.co.uk/default.aspx.

as an important broker in this process of telegraph standardization and played a decisive role in bringing about the International Telegraph Union (ITU).[7] In telegraph and communication history, Switzerland has therefore mostly been discussed in its role as home to the union, which was first housed at Berne and later at Geneva. However, the country's role within the actual network has only rarely been examined.

This study seeks fill this gap and provide more information on the development of telegraphy in Switzerland itself as well as on the position of the country within a wider European and global communication network. Switzerland is a particularly interesting example for such a study: being itself not a major political power, the country was (and still is) home to a sizeable and influential business community that maintained close relations with partners all over Europe and the wider world. Geographically, it occupied a central position on the continent and was conveniently located close to France, southern Germany, Austria, and Italy – politically and economically much more important players in Europe. This position at the heart of the continent, but with little political influence as regards the shaping of greater geostrategic or economic policies, makes the country an excellent example for probing into the make-up and rationale of global connections and the role local and regional configurations played therein. In the following, Switzerland's position in the emerging European and global telegraph network shall be examined from a number of different, complementary perspectives. First, the development of the Swiss domestic telegraph network between 1860 and 1910 – the formative period in the emergence of a global telegraph infrastructure – will be put into comparison with other European and some non-European countries. Both structural as well as use patterns will be examined in order to assess how much importance the national telegraph administrators ascribed to the new technology and how much acceptance it found among the customers. In a second step, the structural design of the European and worldwide telegraph network will be analyzed in order to identify the position and role of the principal Swiss cities within the web. A social network analysis will be employed to this end. In a third section, we will have to ask how intensively the telegraphic connections have been put to use with the rest of the world, and which regions were involved in communicational exchange to what extent.

The case of Switzerland is a particularly suitable example to ask these questions, as Swiss telegraph administrators collected an extensive amount of statistical information about the network and the traffic within it. Taken together with the material collected and standardized by the International Telegraph Union, this provides a stable statistical basis for an assessment of Swiss telegraphic development in a wider comparative context. Especially in regard to the available data on incoming and outgoing international messages, the Swiss case is exceptionally well-documented and allows an in-depth analysis that would not be possible for most other countries during the period of observation.

7 Gabriele Balbi et al., "'Bringing together the two large electric currents that divide Europe'. Switzerland's Role in Promoting the Creation of a Common European Telegraph Space (1849-1865)," *ICON*, no. 15 (2009).

2 The Swiss Domestic Telegraph Network in Comparison

2.1 National Networks

International telegraphic connections have been established very early in the history of technology. The first international telegraph message crossed the US-Canadian border already in 1847[8] and only five years later, in 1851, the first submarine cable connected England and France via the English Channel.[9] In 1850, the Deutsch-Österreichische Telegraphenverein (DÖTV; Austrian-German Telegraph Union) was founded in order to facilitate the exchange of telegraph messages between the member states.[10] And only another five years later, in 1855, France, Belgium, Spain, Sardinia, and Switzerland harmonized their telegraphic exchange with the creation of the Western European Telegraph Union.[11] These early examples of international telegraphic contact and attempts at standardizing telegraphic exchange emphasize the importance of the technology for nineteenth-century processes of the integration of the globe. At the same time, however, they clearly illustrate that telegraph networks mostly evolved from national contexts. The telegraph is often described as a tool (and a feature) of globalization. Of course, this is correct, but it does not give enough consideration to the local branches of the evolving network. Globalization itself is *in nuce* a process that connects a number of geographically distant locales in different ways. To achieve this, connections need to be made both on the global and on the local level. Beyond doubt, international and even intercontinental trunk connections are of the essence. They bundle all the traffic between the larger destinations and are pivotal parts of the network. They would not be of much help, however, without the local branches of the network that bring connectivity to specific places. Global networks need local connections because the "global sphere" only comes into existence when various locales get in close contact. Even the most global of networks depends on the availability and proper functioning of the so-called "last mile". Hence, the telegraph did not exclusively belong to an elusive global sphere, but was a very real concern for national governments and the local public.

Most of the important international and intercontinental trunk connections were established and run by

8 Anton A. Huurdeman, *The Worldwide History of Telecommunications* (New York: John Wiley & Sons, Inc., 2003), 66.

9 "Nomenclature des Cables Formant le Réseau Sous-Marin du Globe Dressée D'Après des Documents Officiels par le Bureau International des Administration Télégraphiques," *Journal Télégraphique* 3, no. 29 (1877): 576.

10 Roland Wenzlhuemer, "The History of Standardisation in Europe," *Europäische Geschichte Online* (2010), http://www.ieg-ego.eu/wenzlhuemerr-2010-en.

11 Josef Reindl, "Partikularstaatliche Politik und technische Dynamik: Die drahtgebundene Telegraphie und der Deutsch-Österreichische Telegraphenverein von 1850," in *Vom Flügeltelegraphen zum Internet: Geschichte der modernen Telekommunikation*, ed. Hans-Jürgen Teuteberg and Cornelius Neutsch (Stuttgart: Franz Steiner Verlag, 1998), 42.

private companies. In many cases, governments subsidized these companies and their endeavours,[12] but only rarely did state administrations themselves erect international landlines or lay submarine cables. The establishment and maintenance of the global connections was mainly left to private interest.[13] The local branches of the global network, however, were usually built and administered in national frameworks, where the parameters for their growth were set. Depending on the respective country, either the governments, private companies (operating on a regional or national level), or co-operations between these actors ran these national networks. The principal aims of these institutions differed widely. National governments generally focused on the administrative, economic, and strategic integration of the country. Private railway companies mainly cared about the coordination of their trains. And private telegraph companies basically followed the money and connected the principal business and population centers that promised to produce lucrative telegraphic traffic. Accordingly, domestic telegraph networks were shaped for the most part by national or regional interest, but had to serve both intra-national as well as international telegraphic exchange.

Some governments – for instance the French one – held and vigorously protected a monopoly over telegraphic communication, while others – for instance in the United States of America – completely entrusted the matter into private hands. Others again – for instance in the United Kingdom – first relied on the initiative of private companies and later decided to nationalize the domestic telegraph network. Depending on the constellation of partaking institutions, varying national priorities and – more often than not – the availability of capital, national telegraph networks could look very different from country to country. Their varying structural and use patterns are revealing, both about the internal telegraphic development of a country and about its position in the global telegraph network. It is the principal aim of this section to examine the different structural and use patterns of various domestic networks. The available data on the development of the Swiss national telegraph network will be compared to that of other (mostly European) countries. First, attention will be given to the general structure of the network. It shall be asked how dense telegraphic coverage has been and how many stations have been open to the public. In a second step, network traffic will be analyzed and it will be examined how intensively the existing structures have been put to use.

Reasonably reliable data in this regard is available from about 1860 onwards and has been consulted until just before the outbreak of the First World War. While data for the early years of this period of ob-

12 See, for instance, Winseck and Pike, *Communication and Empire. Media, Markets, and Globalization, 1860-1930*.

13 In the year 1877, only around 7 percent of the total length of the global submarine cable network were owned and run by state administrations. The remaining 93 percent were under private ownership. Wenzlhuemer, *Connecting the Nineteenth-Century World: The Telegraph and Globalization*, 120.

servation is still scarce, a broader basis of information is available for later decades. Both the tables produced in this section as well as the generalizability of the interpretations offered reflect this imbalance of the source material. For the same reason, European countries are clearly overrepresented in the following analysis. Reliable information on non-European countries, colonies, or territories becomes available only towards the end of the nineteenth century. And even then it is neither plenty nor particularly trustworthy. Despite every effort to include as many non-European entities as possible, this imbalance is also reflected in the following passages.

In Article 61 of the convention issued by the Conférence Télégraphique Internationale, which took place in Vienna in June 1868, the signing parties decided to found a Bureau International des Administrations Télégraphiques that would mainly be concerned with standardization and compatibility in European telegraphic transmissions.[14] In the attached *Règlement de Service International* that was attached to the convention, the Swiss telegraph administration was authorized to organize the international bureau, which was founded in Berne and eventually became the International Telegraph Union.[15] In order to facilitate the bureau's task, the telegraph administrations of the participating countries provided annual statistics on their telegraphic systems. These statistics were then centrally processed, printed, and distributed by the Bureau International. The *Statistique Générale de la Télégraphie* is still held by and accessible at the ITU library and archives in Geneva. The data compiled in these statistics informs the following analysis. Despite the bureau's efforts to compile statistical data on telegraphy in the years preceding its own foundation, the available figures become reliable and comparable only in the early 1860s. The year 1860 has therefore been chosen as the earliest possible starting date, providing data of reasonable reliability available. Data samples have then been drawn every ten years until 1910, only years before the onset of the First World War.[16] The period of observation thus covers a time span of fifty years and has certainly been formative in the development of both national and global telegraphy.

In order to compile its statistics, the Bureau International had to rely on the information submitted by the participating countries. The parameters for gathering such information varied considerably from country

14 *Documents de la Conférence Télégraphique Internationale de Vienne* (Vienne: Imprimerie Impériale et Royale de la Cour et de L'État, 1868), 86-90.

15 Since 1934, ITU stands for *International Telecommunication Union*. In 1947, it was made a specialized agency of the United Nations. A year later, it moved from Berne to Geneva where the ITU still resides today and remains to be the world's oldest international organization.

16 Bureau International des Administrations Télégraphiques, "Statistique Générale de la Télégraphie dans les Différents Pays de L'Ancien Continent," (Geneva 1849-1869); Bureau International des Administrations Télégraphiques, "Statistique Générale de la Télégraphie dans les Différents Pays de L'Ancien Continent," (Geneva 1870); Bureau International des Administrations Télégraphiques, "Statistique Générale de la Télégraphie," (Geneva 1880); Bureau International des Administrations Télégraphiques, "Statistique Générale de la Télégraphie," (Geneva 1890); Bureau International des Administrations Télégraphiques, "Statistique Générale de la Télégraphie," (Geneva 1900); Bureau International de L'Union Télégraphique, "Statistique Générale de la Télégraphie," (Geneva 1910).

to country – as did the accuracy and diligence with which the data was then prepared and forwarded to Berne. A flood of explanatory footnotes in the statistics – each one specifying the special circumstances in a particular country – are testimony to the varying standards of the submitted information. While the statisticians at the Bureau International did what they could to make the data comparable, this has to be considered in any contemporary consultation of the statistics. Accordingly, incomplete or obviously inconclusive entries have not been included in the analysis. Only data categories that are generally comparable have been selected – these include length of lines, number of stations, or messages sent. Furthermore, all data presented in the following has been indexed with a selected European average in the respective year equaling 100.[17] In combination, these measures ensure the comparability of the data and its accuracy, at least in relation to each other.

Networks consist of nodes and the connections between these nodes. Depending on both the research interest and the theoretical outlook of the researcher, these elements have different equivalents in a telegraph network. From a cultural studies vantage point, the actors – meaning the senders, receivers, and transmitters of telegraph messages – constitute the nodes of the network. The telegrams that they exchange create the connections. From a more materialist viewpoint, telegraph stations and their machinery provide the nodes, while the telegraph lines and cables form the connections. For most analytical purposes, however, the exclusive focus on either one of these two representations makes little sense, as they are mutually dependent. Lines, wires, cables, apparatuses, switches, stations, and many more material things form the structure of the network. Human actors use this structure to send, receive, and transmit their messages. The structures themselves have no meaning and no purpose, if they are not created and perused. And the specified actors cannot act without recognizing the structures. Accordingly, scholarly attention must focus on both structure and use without essentializing either one. Both can reveal very different sets of information about the network in question. In the following, the material aspects of domestic telegraph networks between 1860 and 1910 shall therefore first be examined, before then turning to the question how these structures have actually been put to use.

2.2 Network Structure

The Statistique Générale de la Télégraphie is available from 1849 onwards. However, information for the years preceding the foundation of the Bureau International has been collected retrospectively. For

17 Eleven European countries have been included in the selected European average: Austria, Belgium, Denmark, France, Germany, Hungary, Netherlands, Romania, Spain, Sweden, and Switzerland. In every sample year, the data of these eleven countries has been summed up in one of the defined data categories and an average has been calculated. This average equals 100 in the data index. These countries have been selected for the simple reason that they have been included in the statistics for all sample years. Only in very rare cases, one or two countries were dropped from the index for a single category in a single year. If this has been done, it is clearly indicated in the tables.

this period, data is only available for a small number of countries – all of them European. Before 1860, the material is so approximate and incomplete that it has not been included in this discussion. The first sample year considered here is 1860. For that year, information about the domestic telegraph networks of thirteen European countries, including Switzerland – which opened its first lines in the year 1852[18] – is available. Regarding the material structure of these networks, the *Statistique Générale* contains details about the length of telegraph lines, the length of telegraph wires, the number of telegraph stations, and the telegraph apparatuses available in each country. This study considers only the first three categories, as numbers about the different apparatuses in use are neither easy to compare nor particularly instructive in the context of this research. Table 1 presents the data available for these thirteen countries. Within each category, the left column displays the absolute number of either the length of lines, the length of wires (both in kilometers), or the number of stations existing in each country in 1860. These absolute numbers are in themselves not easy to compare, as the featured countries vary considerable both in area and population. The left column in the lines category, for instance, shows that France boasted 22,919 kilometers of telegraph lines in 1860, while the Swiss government operated only a meager 2,886 kilometers. However, these numbers need to be put into relation to the area and population of a country. France was about thirteen times the size of Switzerland and had fourteen times its population in 1860. Therefore, the second column in the lines category displays the length of lines per square kilometer. The second and third columns in the wires category give the corresponding relative numbers per capita and per square kilometer – and so do the second and third columns in the stations category.

In addition, all these relative numbers have been indexed with a selected European average equaling 100. France, for instance, reaches a value of 150 in the lines-per area column. This means that the country's telegraph network was 1.5 times denser in terms of existing lines per area than the European average. A similar observation can be made for the wires and stations categories: the French network scores high in wires per area (187), wires per capita (164), stations per area (133), and stations per capita (135) – despite the fact that telegraph lines and wires maintained by the railways have not been included in the French statistics. The good scores in the wires categories suggest that there was a high traffic capacity. In the stations categories, they indicate broadly available access to the network. This implies that the French telegraph system was exceptionally well-integrated at this early point in time. None of the other major European powers (with the exception of Great Britain, which has not been included in the 1860 *Statistique Générale*) were able to compete in terms of structural density. Austria-Hungary already boasted a network of 12,813 kilometers of lines, but scores significantly below the average in terms of

18 See, for instance, Generaldirektion PTT, ed. *Hundert Jahre elektrisches Nachrichtenwesen in der Schweiz, 1852-1952. Band 1: Telegraph* (Berne: 1952).

lines per area (69), wires per area (51), wires per capita (57), stations per area (57), and stations per capita (73). Germany[19] exhibits similarly low values in the first four of these categories (54, 65, 73, 80), but even slightly exceeds the European average in terms of stations per capita (104). Data for Russia is also available, but at least in the per area categories the values are completely distorted by the sheer size of the country – the biggest part of which remained practically untouched by telegraphy. The per capita categories are a bit more instructive and indicate that Russia in general could neither compete in terms of wires (34) nor in terms of stations (10). However, it is reasonable to assume that – would information on this part of the country be available individually – European Russia would score significantly higher.[20]

Interestingly, several smaller European countries exhibit impressive values in almost all relative categories. And Switzerland, with its seemingly meager 2,886 kilometers of telegraph lines, stands out in particular. Put into relation to the country's size and population, the Swiss telegraph network proves to have been among the densest in the world in 1860. Its performance in the categories wires per area (241), stations per area (249), and stations per capita (284) is exceptional. Other smaller countries such as Belgium, the Netherlands, or Denmark also display impressively high values in certain categories. The former two performed particularly well in the per-area fields, while the latter exhibited peaks in the per-capita categories. The domestic telegraph networks of all three could certainly compete with the French system in 1860, while the Swiss network has probably been structurally the best-integrated in the world by that year – even though the Swiss figures for 1860, just like the French and Dutch, do not include railway telegraph lines and wires.

Writing in 1869, George Sauer opened the chapter on Switzerland in his comprehensive study *The Telegraph in Europe* by saying that "[t]he Government of Switzerland seems to have been foremost in appreciating the importance of supplying the public with a comprehensive telegraph system".[21] And indeed, as Table 2 illustrates, the Swiss telegraph network still exhibited impressive scores in practically all categories (197, 164, 181, 247, 292) in 1870. Belgium and the Netherlands also showed values just as remarkable as ten years earlier. Denmark had fallen behind in the per-area fields but managed to keep up in per-capita terms. Of course, the outstanding development of the telegraph infrastructure in

19 When the Bureau International was founded in 1868, the German Empire did not yet exist. In the very first years, data was collected individually for Baden, Bavaria, the North-German Confederation and Wurttemberg. For the sake of comparability, the numbers of these four entities have been added up for the years 1860 and 1870 and approximate the later German Empire. Please note that although the North-German Confederation did not exist in 1860, data does exist for this entity, because it has been collected retrospectively in 1868.

20 In the 1870s, the *Statistique Générale* contained separate figures for the length of telegraph lines in European and Asian Russia in a footnote. In the year 1870, for instance, 34,658 km of lines ran through the European part, while only 8,802 km were in Asia (these figures do not include railway and private company lines). The Russian territory in Asia is, however, more than three times the size of the European part.

21 George Sauer, *The Telegraph in Europe* (Paris: Private, 1869), 85.

these small countries did not remain unnoticed. When the British inland telegraph system was nationalized and put under General Post Office (GPO) administration in early 1870,[22] Frank Ives Scudamore, Second Secretary to the Postmaster General and mastermind behind the telegraph take-over, sent Malcolm J. Brown of the GPO on a tour through continental Europe to investigate the telegraph systems of France, Belgium, and Switzerland. The choice of countries was certainly no coincidence. France was Great Britain's counterpart on the mainland in terms of territory, population size and, not least, imperial ambitions. Belgium and Switzerland would have been unlikely models for the United Kingdom had it not been for their exemplary domestic telegraph systems. Brown wrote that "[i]n many respects the Belgian and Swiss systems closely resemble each other, as for instance in the compulsory powers which are held in each country with regard to the erection of telegraph lines on railways; in the amount charged for the transmission of messages; in the absence of any special facilities for the transmission of press news; and in the total length of the lines and wire in each country."[23]

In France and Germany, the ten years between 1860 and 1870 also witnessed an explosive increase of the infrastructural development of telegraphy. The length of lines in France almost doubled, in Germany it more than trebled. The increase in the number of telegraph stations available to the public was even more pronounced. The German network grew particularly fast. Table 3 shows the average annual growth rates as regards telegraphic infrastructure between 1860 and 1910. During the ten years after 1860, the German network grew at a remarkable annual rate (12 percent annually in lines, 15 percent annually in wires, 16 percent annually in stations). In 1870, it exhibited above-average values in all structural categories. In terms of density and capacity, it could already compete with the French network, which had grown a little slower (except in the number of telegraph stations with an annual growth of 13 percent), but still showed above-average values.

From 1870 onwards, structural information is available individually for Austria and Hungary. Austria was the telegraphically better-developed part of the dual monarchy (see Table 2). Hungary reached only about 50 percent of the European average in most categories, while Austria achieved between 68 percent and 97 percent. In the year 1870, fragmentary data for Great Britain and Ireland became available as well. As had to be expected, the British telegraph network was by far the best-integrated among the major European powers. In terms of wires per area (191, with railway telegraph wires not included), stations per area (255), and stations per capita (182), it reached a degree of telegraphic saturation that could only be matched by Belgium and Switzerland, both of which were very small in

22 For a thorough description of the nationalization process see "Telegraphs. Report by Mr. Scudamore on the Re-Organizarion of the Telegraph System of the United Kingdom," (1871).

23 "Telegraph Systems in France, Belgium and Switzerland, by Malcolm J Brown of the GPO, with Maps," (London 1870), 16.

area and population. Data for one non-European entity has also been collected in 1870. With a total length of 24,056 kilometers of telegraph lines, British India supported a network significantly smaller than those of Austria and Hungary combined – despite the size of the subcontinent. In relative terms, this amounts to approximately 9 percent of the European average. With only 197 telegraph stations open in 1870 within the whole of British India, only 1 percent of the European average could be reached in both stations per area and stations per capita.

Between 1870 and 1880, most domestic telegraph networks within Europe still grew at quite a significant pace, although not as explosively as in the decade before. For most countries, the average annual growth rates were somewhere between 5 and 10 percent in the structural categories. In comparison, the average annual growth rate of 22 percent in British Indian telegraph stations is outstanding. The number of stations open to the public had increased from 197 in 1870 to 1,437 in 1880 (see Table 4). While this still amounted to only 3 percent of the European average in terms of stations per area (and 4 percent in stations per capita), it constituted a remarkable expansion of telegraphic services in India. In 1880, the Bureau International received reasonably reliable information on their telegraph networks from non-European territories other than British India as well. As the figures in Table 4 clearly indicate, none of those had networks nearly as dense as those of the major European countries. Algeria and Tunisia – handled as one entity under French control in the 1880 *Statistique Générale* – exhibited the highest value in the lines-per-area category among the non-European countries (43), New Zealand did best in wires per area (31) and stations per area (13). In the latter category it was en par with the Western Union Telegraph Company, which held a quasi-monopoly in the United States of America. Western Union reached clearly above-average values in the per-capita fields, indicating that the American private telegraph system was quite well-integrated, at least in and around the population centers.[24]

In Europe, the major powers now all supported domestic telegraph networks that were comparable at least in terms of density per area. France (134), Germany (135), and Great Britain (138) all show practically identical values in the lines-per-area field. Great Britain still featured the highest capacity with a value of 197 in wires per area (even though railway telegraph wires have not been included). Capacity per population, however, was equally high in all three countries at around 130 percent of the European average. Interestingly, Germany had practically trebled the number of telegraph stations between 1870 and 1880 (at an average annual growth rate of 11 percent as against 5 percent in France and only

24 The exceptionally high values in the per-capita categories for the white settler colonies New Zealand and Victoria stem mainly from the big disproportion in the size of territory and population. For instance, New Zealand scored 735 (i.e. 7.3 times the European average) in wires-per-capita. Long connections between population centers and the small number of inhabitants were responsible for this, rather than an exceptionally dense telegraph network.

2 percent in Great Britain; see Table 3) and had by far the highest stations ratios among the important powers. Austria had developed at a considerable pace during the previous ten years, but still could not compete with the other major countries in Europe in terms of telegraph network density.

Among the smaller European countries, Switzerland – together with Belgium and the Netherlands – still had an impressively well-integrated network. Between 1870 and 1880, the already dense Swiss network had grown a little slower than most others in length of lines and wires, but it had almost doubled the number of telegraph stations open to the public. Therefore, Switzerland exhibits values of 253 and 277 in stations per area and stations per capita. In terms of network access, the Swiss network was still the best-integrated in the world (leaving aside white settler colonies such as New Zealand). The Belgian network had grown faster than the Dutch system between 1870 and 1880 and was particularly dense in relation to the size of the country. In the Netherlands, network density per capita had not been growing at the same pace as in Europe on average. But still, both countries supported well-developed networks that were comparable the rest of the continent, let alone to non-European countries.

In overall terms, the decade leading up to 1890 saw growth in telegraph network structures roughly similar to the previous one. Belgium and the Netherlands maintained and further extended their dense networks, even if at a slow growth rate of around 3 percent annually. The latter focused particularly on building new telegraph stations and almost doubled their number within ten years, reaching 754 in 1890 (see Table 5). In the Swiss network, wire capacity grew considerably. All other structural components saw a modest growth of about 2 percent annually. This sufficed for the Swiss telegraph network to remain the most accessible in the world (again, excluding white settler colonies). But in terms of line density and capacity, Switzerland by and by lost ground to the major European powers. Among those, Germany had seen the biggest expansion of its telegraph network between 1880 and 1890. It had an average annual growth of 6 percent in all structural categories. Both the French and the British networks grew at a considerably slower pace. Accordingly, Germany boasted the densest network in lines per area (175), stations per area (205), and stations per capita (177). Only in terms of wire capacity, the British network scored higher (211, wires per area), or at least almost on par (135, wires per capita) – again with the railway telegraph wires not counted in.

In 1890, 14 non-European countries (including the Western Union Telegraph Company for the United States of America) submitted data to the Bureau International. The Indian network still expanded at a fast pace and catered well to the European and indigenous elites of the subcontinent. In relation to the size and population of India, however, the network was nowhere as well-integrated as the European networks on average. It reached values between 6 and 13 only in all structural categories. Again, white settler

colonies such as Victoria or New Zealand reached about a fifth of the European average in lines, wires, and stations per area. Their exorbitant per-capita values, however, stem largely from the discrepancy between territorial size and population number. Given the vastness of the United States, Western Union reached rather good scores in line (28) and wire (32) ratios. With more than 1,100,000 kilometers of wire and more than 20,000 telegraph stations open to the public, the company had an impressive capacity and accessibility per potential customer and outperformed the top European countries in these categories. In Japan, the modernization of the country since the Meiji restoration also had effects on the telegraph network.[25] The line and wire network had been considerably extended between 1880 and 1890 and reached per-capita and per-area values of about a fifth and a fourth of the European average. While the number of telegraph stations open to the public had also increased by 5 percent annually, the coverage was still comparably low and reached values between 4 and 6 percent of the European average.

In the following decade, however, the Japanese network growth reached new dimensions. Growth rates in most European countries had dropped to between 1 and 4 percent annually in most structural categories (see Table 3). Japan, on the other hand, exhibited growth rates of 8 percent (lines), 12 percent (wires), and 17 percent (stations) annually between 1890 and 1900. The modernization of the country had come into full swing and by the turn of the century, Japan reached about half of the European average in terms of network density per area (see Table 6). Despite the massive growth rate in the number of stations, the public accessibility of the network still remained very low. In British India, growth levels had dropped to European values. Accordingly, its telegraphic development was in relation to the European average almost the same as one decade before. And practically the same is true for the American monopolist Western Union.

Among the major European powers, roles had been switched in terms of structural growth. After a furious development in the preceding decades, the German network grew at a slower pace of between 1 and 3 percent between 1890 and 1900. The French and British networks, however, had once again started to expand more quickly. Germany still had the best lines and station ratios, but both France (at least in the length of lines) and Great Britain had caught up. Britain – again excluding railway telegraph wires – had reached an unprecedented level of telegraph capacity with a value of almost three times the European average in wires per area. Leaving tiny Luxembourg aside, Belgium, the Netherlands, and Switzerland still had the densest networks among the smaller European countries. Belgium had lost some ground towards the European average. The networks of the other two had grown at roughly the same pace as

25 See for instance Marie Anchordoguy, "Nippon Telegraph and Telephone Company (NTT) and the Building of a Telecommunications Industry in Japan," *The Business History Review* 75, no. 3 (2001).

most other networks on the continent. Their relative positions had therefore changed only marginally in comparison to 1890.

About the same can be said for the structural telegraphic development of these small countries in the ten years after the turn of the century – with the notable exception that network development in Switzerland practically stalled (see Table 3). While still considerably above average, the country gradually approached the European average in terms of telegraphic connectivity. The German network, on the other hand, started to grow at a high rate again. The expansion in wire capacity is particularly impressive at 16 percent per annum. By 1910, Germany had higher wire values than Great Britain (see Table 7), in the case of which information on railway telegraph lines and wires had not been submitted to Berne. With French network growth considerably lower, Germany now boasted the structurally best-integrated telegraph network in the world, limiting the rivalry with Great Britain to terms of network capacity. Outside of Europe, Japan had further expanded its telegraph system and more than doubled the number of existing stations.

Of course, the *Statistique Générale* includes figures only for a selection of countries with a distinct European focus. Important players such as China,[26] Turkey, or Persia[27] are only rarely or not at all considered in these statistics. In other cases, for instance in those of Russia or British India, figures are available but allow for only superficial analysis on the aggregate level. Therefore, a comprehensive comparative assessment of domestic telegraph networks around the globe is not possible at the moment. As long as the enormous amounts of data stored in the national telegraph archives have not been discovered in their entirety, let alone interpreted and made comparable, the statistics of the Bureau International are as close to the subject matter as it is currently possible to get. Nevertheless, there are several solid conclusions that can be drawn from the interpretation of the data. At least throughout our period of observation between 1860 and 1910, European countries supported the densest and best-integrated telegraph networks on the globe. Among the major European powers, France, Great Britain, and Germany were telegraphically well-developed. France led the table early, but was later outperformed by the German Empire, which invested heavily in the telegraph system after the German unification. By the turn of the century, the coun-

26 For a history of the telegraph in China see Yongming Zhou, *Historicizing Online Politics. Telegraphy, the Internet, and Political Participation in China* (Stanford: Stanford University Press, 2006); Erik Baark, *Lightning Wires: The Telegraph and China's Technological Modernization, 1860-1890*, Contributions in Asian Studies (Westport CT: Greenwood Press, 1997). For Korea see Ung Kang, "The Development of the Telegraph in Korea in the Late 19th Century," *1991* 30 (1991).

27 On the role of telegraphs in the Ottoman Empire and Persia see Soli Shahvar, "Iron Poles, Wooden Poles: The Electric Telegraph and the Ottoman–Iranian Boundary Conflict, 1863–1865," *British Journal of Middle Eastern Studies* 34, no. 1 (2007); Soli Shahvar, "Tribes and Telegraphs in Lower Iraq: The Muntafiq and the Baghdad-Basrah Telegraph Line of 1863-65," *Middle Eastern Studies* 39, no. 1 (2003); Soli Shahvar, "Concession Hunting in the Age of Reform: British Companies and the Search for Government Guarantees; Telegraph Concessions through Ottoman Territories, 1855-58," *Middle Eastern Studies* 38, no. 4 (2002); Yakup Bektas, "The Sultan's Messenger: Cultural Constructions of Ottoman Telegraphy, 1847-1880," *Technology and Culture* 41, no. 4 (2000).

try boasted the densest domestic network of the world. Development in France had almost stalled. Only Great Britain had been able to maintain a highest-standard network throughout the period of observation and was still able to compete with Germany in terms of network capacity by 1910.

Interestingly, there was a second group of smaller European countries – often with a stake in international trade – that supported very well-developed telegraph networks at an early point in time. Belgium, the Netherlands, and for some years even Denmark were among those countries. For a long time during the nineteenth century, however, it was Switzerland that operated the best-integrated domestic network of all – both in relation to the size of the country and to the number of inhabitants. Towards the end of the century the network growth rates in these smaller countries slowed down. Telegraphic expansion, so it seems, had reached saturation point. While their networks remained above average in most respects, neither Belgium, nor the Netherlands, nor Switzerland was able to compete with the major European powers any longer.

It is important to highlight that by far not all European countries were able to maintain such extensive telegraph networks. Indeed, Europe was informationally divided throughout the long nineteenth century. The important powers Austria and Italy[28] had networks with density levels usually around the European average. But the countries on the Iberian Peninsula as well as many Eastern European countries supported only rudimentary telegraph systems that reached at best about 50 percent of the European average in most evaluated categories. While Europe was very unevenly developed throughout the period of observation, there is, of course, an even more striking imbalance between Europe and the rest of the world, with the single exception of the United States of America, represented in the statistics by its quasi-monopolist Western Union. The number of non-European countries included in the statistics has grown in the course of the nineteenth century, but in many cases the data submitted is not very reliable. When it is reliable enough to allow for analysis, it shows that the telegraphic development outside of Europe was in most cases rudimentary and distinctly below the European average. There are at least two types of networks that become discernible from the data: in most white settler colonies, big territories housed only small populations that consisted for the largest part of European immigrants. In these cases, the population centers were usually reasonably well-connected, but the network concentrated on minuscule parts of the country, namely the big cities. There were many holes in the network, but the white settler population in and around the centers usually had satisfactory access to the system as can be seen from the inflated values in the per-capita categories. In other countries with a sizeable indigenous population, these per-capita values were very small, and so were the per-area values. This emphasizes that basic

28 On the development of telegraphy in Italy see Simone Fari, "La Telegrafia in Italia dal 1861 al 1866. Origini della Rete Telegrafica Nazionale," *Archivio per la Storia Postale*, no. 14-15 (2003).

telegraph systems focused almost exclusively on the business and administrative centers and were only accessible to (and affordable for) the elites.

Little relative change is detectable throughout the nineteenth century. The telegraph networks were expanded, but rarely at a faster pace than in Europe. Therefore, most non-European countries never came close to the telegraphic connectivity of their European counterparts. Japan constitutes the exception to the rule. In the course of the industrialization and modernization triggered by the Meiji restoration, the country also expanded its telegraph network dramatically. From about 1880 onwards, Japan started to invest so massively in telecommunication expansion that it reached about 50 percent of the European average by 1910 – after it had started almost from scratch. This roughly equals the domestic telegraph development of European countries such as Spain, Denmark, Hungary, or Greece and constitutes quite a remarkable achievement in terms of industrialization and modernization. Therefore, it is fair to say that by that time, Japan had developed into a communicational center within Asia and the Pacific region.

2.3 Network Use

In the preceding section only structural data has been consulted and interpreted. Despite its insightfulness, it is important to keep in mind that such information about the material aspects of communication networks, about their routes, switches, and capacities, is always information about an ideal condition. The infrastructure of a network provides the possibility for use. It is a prerequisite for communication, but it is a limitation at the same time. It offers a certain maximum potential that can or cannot be realized by use. Of course, this structural offer is in most cases a reaction to some real or perceived demand. Therefore, the structural condition of a network does tell something about the demand for communication as well. And in any case, it is revealing about the priorities, perceptions, and policies of the designers and administrators of the network.

While normally there is at least some correlation, the actual use of a network can differ from its structural patterns. There is a multitude of possible reasons for this. Governments or other institutions operating a telegraph network can, for instance, impose access barriers to the network. In the very early days of telegraphy, several national governments have initially tried to reserve the new technology as the exclusive prerogative of the administration – most prominently in France.[29] These restrictions were usually lifted quickly, but in most cases not all existing telegraph stations were actually open to the public. As can be learned from the footnotes of the *Statistique Générale*, the Italian government reserved a substantial

29 See for instance Patrice A. Carré, "From the Telegraph to the Telex: A History of Technology, Early Networks and Issues in France in the 19th and 20th Centuries," *Flux*, no. 11 (1993), 21-22.

number of stations for its own and the railways' exclusive use – as many as 510 in the year 1910.[30] In other cases, high tariffs could severely limit the use of the network – despite an existing demand for communication. A prominent example from the realm of international, submarine telegraphy can be found in Dwayne Winseck's and Robert Pike's work on cable companies and their business policies. Not only did these companies build almost unbreakable cartels in order to maintain high prices and avoid "ruinous competition", their chief customers also silently approved of their tariff scheme. "[H]igh rates served the cable company and its premium clients equally well. So, in addition to enriching the cable company's coffers, high rates helped to deter competition in their best customers' markets and thus the incentive for cheap rates was unlikely to come from that quarter."[31] In yet other instances, the telegraph can be brought to a region for strategic reasons or simply accompanying a railway line. But there might not be the public demand to realize the full potential of the connection. These are just a few factors that can bring about significant differences between the structural and the use patterns of both domestic and international networks. To understand how contemporary networks were used, it is therefore necessary to consult a different sort of data.

But why is it important to look at telegraph use in the first place when there is such detailed information about the structure of the network available? David Edgerton has explained in some detail why historians of technology should first and foremost be interested in technologies-in-use. "The history of innovation, while interesting and important, cannot address many issues which should be central to the history of technology, and cannot answer many of the questions historians of technology pretend to ask. A history of technology-in-use does so, and at the same time, opens up new areas of investigation".[32] In other words, with only a few rare exceptions, technologies interact with society, with people, only once they are in widespread use. In the case of network technologies, the history of their infrastructure occupies a place somewhere between the history of invention and innovation and the history of network use. The geography and sociology of the infrastructure is much nearer to that of network use than to the geography and sociology of innovation – but it is not identical. Therefore, it is necessary to look at network use patterns whenever it is possible, if the interplay between a particular network technology and society shall be assessed.

In many cases, however, detailed use data is not as readily available as structural information – especially not beneath the aggregate national level. We can only assume that for nineteenth-century tele-

30 Bureau International des Administrations Télégraphiques, "Statistique Générale de la Télégraphie," 11, footnote Italie 3.

31 Winseck and Pike, *Communication and Empire. Media, Markets, and Globalization, 1860-1930*: 149.

32 David Edgerton, "From Innovation to Use: Ten Eclectic Theses on the Historiography of Technology," *History and Technology 16* (1999), 111.

graph administrators, structural data was both easier to gather as well as more important to have. Exact knowledge about the structure and capacity of a network is a prerequisite for its maintenance and expansion. However, administrators were also interested in information on the traffic in a network and, above all, in the money earned with telegraphic services. Almost all telegraph administrations – no matter if they were government departments or private companies – have therefore gathered information about the telegraphic traffic in their networks in some form. In most cases, a distinction has also been made between internal messages – meaning messages sent as well as received within a particular national or private network – and external messages – meaning messages that originated from or were destined for some place outside the network. Together with the structural data, such information was also submitted to the Bureau international. It is available in the *Statistique Générale* and informs the following paragraphs. The use patterns correspond closely to the structural data consulted in the previous section. On the aggregate national level, this use data is extremely instructive and allows for the detailed examination of Switzerland's informational development compared to other European and non-European countries. Thirteen European countries submitted reasonably accurate statistical information to Berne in 1860. For twelve of them, use data is also available. Except for the case of Romania, the *Statistique Générale* contains figures about the number of both internal and external telegraphic messages transported by the network. External messages are further subdivided in messages sent to international destinations, messages received from thereabouts, and messages that merely passed through the network on their way between two foreign places. This subdivision will be of more central concern in a later section zooming in on international telegram traffic (see chapter 4.1). For now, only information about internal, external,[33] and the total number of messages[34] will be analyzed. Again, absolute numbers have been put into relation to the population size of a country and indexed with a selected European average equaling 100.

In 1860, Switzerland and several other small European countries that already performed well in the structural statistics exhibited exceptionally high use rates as well (see Table 8). With 208,311 messages transacted in that year and an indexed per-capita value of 332, Switzerland again tops the table. People in the Netherlands and the Scandinavian countries also used their telegraph systems in large numbers. Interestingly, Norway and Sweden – both countries with rather small populations but big dis-

33 Strictly speaking, the number and percentage of external messages is only of limited value when analyzing the domestic telegraphic development of a country. External messages have, nevertheless, been included in the following tables and discussions in order to give a complete picture of telegraph use.

34 The total number of messages constitutes the sum of all internal and external messages. Unlike in the *Statistique Générale*, service messages have not been included. Service messages are telegrams sent by the telegraph or railway administrations for the purpose of running the networks. Whether the number of these telegrams were submitted to the *Bureau International* and if so, which services were included, differed significantly from member state to member state. Therefore, no meaningful comparison is possible in this category and service messages have been excluded from the total number of messages transported.

tances to cover – display high internal-messages-per-capita scores (287 and 117 respectively), but seem to have had little international traffic (83 and 65). In the case of Belgium, it is the other way round. Just like the Netherlands, the country occupied a central position in European traffic, which can be seen in the number of external messages handled per capita (146). Significantly ahead of Switzerland (181), the Netherlands have the biggest relative proportion of external messages per capita and reach a staggering 307 points in this category. From these figures, it becomes clear that Switzerland as well as the Netherlands and Belgium – to a lesser extent Denmark – occupied central positions in the European telegraph network very early on. They had a well-developed domestic network infrastructure and made good use of it, both in internal and external telegraphic traffic. The per-capita use of internal telegrams in Switzerland is particularly impressive – but also external use rates are almost twice the European average.

In terms of use of their networks, the bigger European powers lagged far behind in 1860. In comparison to Switzerland, Germany produced little more than twice the amount of internal messages, and thus reached not even half of the European average. It did slightly better regarding international messages. With 572,848 external messages sent, received, and transmitted, it scored about three quarters of the average. It must be kept in mind, however, that the "Germany" of 1860 is an artificial construct comprised of Baden, Bavaria, the North-German Confederation, and Wurttemberg and is provided as such for the sake of comparison only. Had these entities already been unified, many messages between them that counted as external would actually have been internal telegrams. Therefore, the relative values for Germany would have been higher in the internal category and lower in the external one. Exact values, however, cannot be computed for 1860 and 1870. France and Austria-Hungary have similarly low use rates at 63 and 56 respectively in the internal per-capita category and 54 and 30 in the external one. Great Britain has not submitted data for 1860. At that time, British domestic telegraphy was still in the hands of several private companies and there was no central administration in charge of the entire network that would send information to Berne. Some figures are, however, available for one individual telegraph company. In 1860, the Electric and International Telegraph Company – the biggest player in the United Kingdom, but far from a monopoly – transported 1,117,364 messages (excluding railway and press messages).[35] This alone amounts to over 100,000 messages more than what would go through the German and French networks. It is, therefore, reasonable to assume that Great Britain featured by far the highest use rates among the principal European powers, even though there is no exact data for this early period.

Norway and Sweden have enthusiastically taken to the new technology of telegraphy very early in its his-

35 "Estimates of Revenues and Expenditure under the Post Office with Returns of Staff, Accounts, Telegrams, Offices, etc of Telegraph Companies," (London 1866-1869).

tory, when other countries were only just beginning to see the potential of telecommunication. But in the formative phase between 1860 and 1870, development slowed down in the north – at least compared to other parts of Europe (see Table 9). Both Norway and Sweden exhibited growth rates of 14 percent in the total number of messages transported annually during that period. This is still very impressive, but France and Germany reached annual growth rates of 24 and 29 percent respectively in internal traffic and 21 and 25 percent in total traffic. In Belgium, the number of domestic messages increased by 33 percent annually. Switzerland, with its already flourishing telegram traffic, still saw an average annual growth of 18 percent in all categories.

Consequently, Norway levelled off at around the European average in 1870 and Sweden even dropped to about 60 percent of the average in all categories (see Table 10). In France and Germany, telegraphic traffic expanded explosively between 1860 and 1870. Internal traffic in France increased almost nine-fold from 568,365 to 5,042,302 messages. The German network saw a thirteen-fold increase to almost 5.5 million internal messages (even though the 1870 statistics for Germany were still collected from Baden, Bavaria, the North-German Confederation, and Wurttemberg individually). Both countries, therefore, came closer to the European average in per-capita use of the telegraph, with Germany taking to the new means of communication faster than France. In Great Britain, the domestic telegraph system had recently been nationalized and the Post Office did submit some information about the number of handled messages to Berne. There was, however, no distinction between internal and external messages, but merely an aggregate number of all telegrams transported. This amounts to almost 10 million. Relative to the population, this is significantly higher than the European average. Among the major European powers, Great Britain had by far the highest use rates per capita.

Cognizant of this fact, a table published by George Sauer in the afore-mentioned book *The Telegraph in Europe* seems all the more surprising. Sauer compared the proportion of telegrams to letters in Great Britain, Belgium, and Switzerland during the 1860s. His figures confirm the explosive growth of the use of telegrams in that period. While 296 letters have been written for every telegram in the year 1860 in Great Britain, the number had dropped to only 121 six years later. But Sauer's figures also show that telegrams were given preference over letters significantly more often in Belgium and Switzerland than in Great Britain – even though the latter had the highest use rates of all major European countries. The letter-to-telegram ratio in Belgium was 251 to 1 in 1860 and 37 to 1 in 1866. In Switzerland the ratio was 84 to 1 and 69 to 1 at the same time of observation. This is telling in regard to the widespread use of telegrams in Belgium and Switzerland. Data from the *Statistique Générale* of 1870 confirms the exceptional position that these two countries, together with the Netherlands, held in this regard. Per-capita use rates in all categories surpassed those of the bigger countries by far, even if growth rates in

Switzerland and the Netherlands had been slightly lower than in France and Germany, for instance. This is also confirmed by the above-mentioned report by Malcolm J. Brown about the French, Belgian, and Swiss telegraph systems, where he writes in the chapter on Belgium: "It is no doubt in consequence of the lower rates charged in Belgium that telegraph business is so much more active in that country than in France, which although possessing a population more than seven times as large, only sends three times the number of messages, and I am unable to find anything in the proportion of offices to the population in either country to sufficiently account for this difference."[36]

The 1870 statistics also include information about British India as the only extra-European entity. The structural data presented in the previous section has already made it very clear that access to the telegraph system in India was the privilege of a tiny minority. Due to the great distances between the major population centers on the Indian subcontinent, the structural figures on the length of lines and wires, which lay at about 10 percent of the European average or slightly lower in 1870, do not reveal the real extent of exclusiveness of the system. The number of telegraph stations open to the public has already been more revealing with less than 200 stations open on the entire subcontinent. But the use-per-capita values paint an even less delectable picture of the accessibility of the system. In the whole of British India, only 548,605 telegrams have been sent, received, or transmitted throughout the year 1870 – despite the great distances that had to be covered (which made the telegraph a particularly attractive form of delivery) and despite the huge number of inhabitants. This is about an eighteenth of the absolute traffic of Great Britain and amounts to only 1 percent of the European per-capita average. Only a meagre 62,329 of these telegrams were external messages – in absolute numbers less than Portugal and amounting to only 0.33 percent of the per-capita average. These figures show that access to the telegraph was the privilege of a happy few, mainly the top colonial elite, interspersed with only a handful of indigenous entrepreneurs and administrators.

In the following decade, however, British India entered into a period of rapid expansion of telegraphic services. As the previous section has demonstrated, the number of telegraph stations available to the public grew by 22 percent annually between 1870 and 1880. This increasing accessibility of the network is also reflected by the average annual growth of network traffic, especially in the realm of external messages. Here, traffic grew by 17 percent annually (see Table 9) over the entire ten-year period, leading to an almost five-fold increase in the absolute number of external messages handled. Such a rapid growth in international traffic was also a partial consequence of the upgrading of the telegraphic link between Europe and India that occurred in 1870. In January, the so-called Siemens line was opened,

36 "Telegraph Systems in France, Belgium and Switzerland, by Malcolm J Brown of the GPO, with Maps," 11.

ranging from the United Kingdom via Prussia, Russia, and Persia to India. And only within months, the inauguration of the first fully submarine telegraph connection that linked the subcontinent with Europe followed. These new telegraph routes to and from India provided good alternatives to the slow and often unreliable line through Turkey and brought new and much-needed capacity to the international system. Looking at other non-European countries, the white settler colonies display the usual exorbitant per-capita values. Their small population numbers certainly produced sizeable statistical distortion for that category, but domestic use of the technology still remains impressive. Both New Zealand and Victoria saw more than one million internal messages each pass through their networks. There is currently no convincing study that can explain why use rates in white settler colonies were often so high so early in the history of the technology. Therefore, it can only be guessed that the lack of established alternative communication networks, the high concentration of the population in a few centers, and the great distances that had to be covered all made telegraphy particularly interesting for domestic use. Before a conclusive answer can be provided in this regard, much more research that goes beyond the aggregate figures of the Bureau International will have to be undertaken. The same is true in the case of Algeria (in 1880 treated as one entity with Tunisia), which exhibited extraordinarily high internal use rates at about the European average throughout the period of observation. In terms of external messages, the French colony reached only half of the European average per capita, which still amounts to the highest non-European value – significantly ahead of New Zealand or Victoria.

In Europe, Great Britain exhibited growth rates in messages comparable to those of its Indian colony. With almost 30 million messages handled in 1880, British network traffic had grown by 12 percent annually. In per-capita terms, this was more than twice the European average of the time. Internal use was particularly high (275). Great Britain had still by far the highest use rates among the major European powers. The figures for Germany reflect the statistical effects of the German unification (see Table 11). A substantial number of messages that had been counted as external in the statistics for 1860 and 1870 are now correctly registered as internal. Accordingly, we see some good growth (7 percent *per annum*) in the latter category, while there is almost none in the former (2 percent *per annum*). Compared to Britain or France, it appears as if the use of telegrams expanded slowly in unified Germany. France, on the other hand, has been able to massively extend domestic use. It more than trebled the number of internal messages and surpassed Germany both in terms of absolute and per-capita use. Regarding the smaller, well-positioned countries such Switzerland, Belgium, or the Netherlands, the picture has changed but little. All of them exhibit top values in terms of telegrams per capita – particularly, however, in the external messages category. This further confirms their central roles in international telegraphic traffic in Europe.

Ten years later, however, growth of internal messages in these smaller countries seems to have reached

a limit. Average annual growth rates in Switzerland, Belgium, and the Netherlands ranged between 1 percent and 3 percent. The number of external messages still grew fast and all three countries have been able to maintain their high per-capita values in this category. In terms of internal communication, France and Great Britain easily surpassed their smaller competitors at that point (see Table 12). Both countries had massively expanded their internal services between 1880 and 1890. The French system handled almost 30 million internal messages in 1890. The British system, however, saw almost 61 million internal messages go through its lines. This amounts to more than 4.5 times the European per-capita average and marks by far the highest use-rate outside the white settler colonies. German internal network use grew slower at only 5 percent annually in the ten years leading up to 1890 and reached only about the European average in that year. Germany, therefore, exhibited much smaller per-capita traffic than France and Great Britain – despite its better structural development in terms of lines, wires, and especially telegraph stations open to the public (see previous section).

Outside of Europe, the development up to 1890 is very similar to that of the previous decade. The white settler colonies (and to a lesser extent French Algeria) still show unusually high per-capita rates in the internal message category. British India has been able to maintain good growth rates and has increased the number of internal messages handled by its network to almost three million per year (still amounting to only 3 percent of the European average per capita). In Japan, however, network use slowly started to grow from 1880 onwards, exhibiting even slightly higher growth rates than in the structural categories (see previous section). The number of internal messages grew by 8 percent annually, the number of external messages even by an impressive 15 percent. But still, the total number of external messages transacted in 1890 was less than 100,000. Despite its excellent growth rates, in absolute numbers Japan ranged between Luxembourg and Serbia.

The real boost in Japanese network use came in the decade leading up to the turn of the century, with annual growth rates between 13 and 17 percent. While external telegraphic communication remained comparatively insignificant with only 476,672 messages transacted in 1900 (see Table 13), domestic telegraph use now reached almost three quarters of the European per-capita average. In 1880, this value had been at 19 percent. This massive extension of the use of the inland telegraph corresponds closely with the structural expansion of the Japanese domestic network in this decade. Growth rates in British India remained stable and on a good level. In 1900, more than 5.5 million internal messages were handled by the Indian system. In France and Great Britain, the respective numbers were 40,947,137 and 81,935,871 amounting to per-capita values of 247 and 464. Nevertheless, growth rates in both countries had leveled off and Germany had been able to slightly catch up, handling 32,452,383 internal messages and reaching a value of 134. Regarding Swiss network use, the figures for 1900 confirm

that the country had reached saturation point in terms of internal messages per capita and leveled off slightly above the European average. In terms of external messages per capita, however, it was still easily above average. Practically the same can be said for the Belgian and Dutch network use patterns.

During the first ten years of the new century, neither the major powers France, Germany, and Great Britain, nor the smaller communicational centers Switzerland, Belgium and the Netherlands had any noteworthy growth in the number of internal messages handled. The rest of Europe exhibited much higher growth rates and accordingly, these powers' per-capita rates dropped in comparison to the European average, except in the case of France. The number of messages handled by the British Indian and Japanese networks was still growing fast. By 1910, British India reached 8 percent of the European average per-capita value in terms of internal messages (see Table 14). In consideration of the size of the Indian population, this service expansion is a respectable achievement. It does, however, not alter the fact that telegraphic communication in India remained the exclusive privilege of a small minority group. With more than 25 million internal messages, Japan even slightly surpassed the European per-capita average, but its external traffic remained minuscule with only 1,115,285 messages in 1910 (or 5 percent of the average). Interestingly, most white settler colonies eventually also started to exhibit very high per-capita figures in the external messages category.

This detailed analysis of the development of domestic network use between 1860 and 1910 confirms several observations made in the previous section and contrasts others. The central role of Switzerland (and also of Belgium and the Netherlands), for instance, becomes even more obvious. Not only did all three countries maintain a dense telegraph network at a very early point in time, they also made good and heavy use of it. Unlike Norway and Sweden, which were also among the early users of telegraphy, these three managed to keep up good growth rates for quite some time until they reached a natural growth limit between 1880 and 1890. It is particularly interesting to note that throughout the period of observation, the Swiss network saw a disproportionately large amount of external messages.

Among the major European powers, only Great Britain made heavy use of its telegraph infrastructure early on. And it kept up high growth rates and expanded use throughout the period of observation. Unlike the cases of Switzerland, Belgium, and the Netherlands, there seemed to be no constraint to domestic telegraph use in Britain. After some initial stagnation, use of the French telegraph network expanded massively from 1870 onwards. Towards the end of the century, France even showed the highest internal per-capita use rates in Europe after Great Britain. Germany, however, never exhibited network use significantly above the average. By 1900, the nation reached its highest messages-per-population ratio at 134. This compares very unfavorably to the country's unusually well-developed and well-functioning

telegraph network infrastructure in the late nineteenth and early twentieth century (see previous section). Already before the German unification, George Sauer had noted the following in a very similar vein: "The telegraph system in Prussia works side by side with the Post-Office, and although the axiom, that «time is money» has not taken root in any part of Germany, it is a well-known fact that the regularity and accuracy which prevails throughout the establishment is beyond all praise."[37] It seems as if the demand for internal telegraphic communication could not keep up with the ever-increasing supply provided by the expansion of the infrastructure.

Outside of Europe, several unusual constellations have been witnessed. First, the white settler colonies exhibited extremely high use values per capita. This has, of course, to do with the composition of their populations consisting mainly of European immigrants concentrated in a few population centers with long distances between them. Even if statistical distortion is taken into account, it has to be acknowledged that the inhabitants of Australia, for instance, took very readily to telegraphic communication and used their networks heavily. There are currently no in-depth studies about the domestic telegraph systems of Australia or other white settler colonies that would provide a satisfactory explanation beyond the above-mentioned suggestions for such heavy use. Further studies in this field should, therefore, be encouraged. The same is true for the case of Algeria. The French colony did not display per-capita numbers in the region of the white settler colonies, but exhibited both wires-per-capita and internal-use values of about the European average. Accordingly, both capacity and capacity utilization were easily comparable to those of many European countries. This is truly remarkable for a colony with a considerable indigenous population and only a comparatively small elite of French administrators and merchants.

Telegraph use in British India contrasts the case of French Algeria rather pronouncedly. Despite the sheer size of the subcontinent, which should have been an incentive for the use of the new technology, merely 24,056 internal messages had been handled in 1870. After that year, both internal and external traffic grew at quite high rates, but the per-capita values showed that telegraphic communication remained the exclusive privilege of the European administrators and a handful of members of the indigenous elite. In the year 1910, after a period of 40 years of continual growth of internal telegraph traffic in India, the colony still reached only 8 percent of the European average in internal messages per capita, while French Algeria had already surpassed that average.

Looking at Japan, the analysis of telegraph use confirms the findings of the previous section. The industrialization and modernization of the country were reflected by the fast growth of the telegraph network. Network infrastructure and network use started to grow at about the same time and at the same explosive

37 Sauer, *The Telegraph in Europe*, 104.

rate, with supply and demand closely corresponding. Growth was so fast that towards the end of the nineteenth century, Japanese internal telegraphic communication reached European levels. Interestingly, however, this is true for internal messages only. While annual growth rates were even higher, regarding the number of external messages handled, the absolute numbers were minuscule. As late as 1910, the entire Japanese network saw only 1,115,285 external messages pass through its lines.

3 Switzerland in the European and Global Telegraph Networks

3.1 Network Analysis

The previous section compared the development of European and some non-European telegraph networks within a national framework and assessed the state of the Swiss network in this context. Such an analysis is instructive as to the role that the technology played in a particular country. It hints at the importance that governments and private investors attached to the telegraph and even allows for some preliminary assumptions about the acceptance and use of the medium in the wider public. However, the data does not allow making any statement about the position of a particular country – in this case Switzerland –, let alone its cities within the wider European or global network. To this end, we must look at different source material. This section will be concerned with the identification of centers and peripheries in the European and global communication networks of the late nineteenth and early twentieth century and it will do so in three different settings based on three different types of sources. Two studies examine the structural design of the European telegraph network in 1906 and 1923: they seek to identify centers and peripheries in this web and assess the positions of Swiss nodes in it. The third study seeks to do the same thing for the worldwide network. It is less detailed but considers and compares the structure of the global net at three different points in time: 1881, 1892, and 1902. All three studies make use of social network analysis, a tool designed not only to identify central and less central nodes in networks but also to reveal the specific functions and characteristics of particular nodes.

Social network analysis has originally been developed in the social and behavioral sciences during the 1970s (although its roots reach back into the 1930s). "It is grounded in the observation that social actors are interdependent and that the links among them have important consequences for every individual. [...] Social network analysis involves theorizing, model building and empirical research focused on uncovering the patterning of links among actors."[38] The method can be applied to practically any form

38 Linton C. Freeman, "Social Network Analysis: Definition and History," in *Encyclopedia of Psychology*, ed. A. E. Kazdan (New York: Oxford University Press, 2000), 350.

of network. It does not matter much whether the entities connected in a network are people, institutions, states, or something entirely different.[39] And it does not make a difference whether the connections in the network are technologically mediated (as in the case of the telegraph network) or not. Social network analysis simply looks at the pattern of connections in a given network and examines the position of the different network nodes as to their centrality (and function) in the structure. It is, therefore, ideally suited to identify centers and peripheries in a network and also to further identify the factors that contributed to the position of a particular node. Social network analysis software usually provides a great number of analytical tools to establish different forms of centrality in a network. Here, only four of these tools will be applied – *degree, closeness, betweenness* and *eigenvector*. These tools are particularly insightful regarding the analysis of centrality in a telecommunication network. What exactly these four values signify will be explained in detail in the course of the studies.[40]

While the application of social network analysis methods on technologically-mediated networks, such as the nineteenth-century telegraph network, does not raise any procedural problems, the incompleteness (or unavailability) of historical data can be problematic. In order to produce accurate results, the network analysis has to be conducted for the entire network. If parts of the network are truncated (because of missing or inaccurate data, for instance), centers and peripheries tend to shift. Such truncations, therefore, distort the analysis of the network structure. In the case of historical data, however, incompleteness and inaccuracy are often the rule rather than the exception. Especially when regarding such a complex structure as the global telegraph network of the nineteenth century, it is practically impossible to acquire and later prepare data on the entire network structure. In theory, every interconnected telegraph line – from the intercontinental trunk routes to the village level – would have to be considered in a full network analysis. In practice, this is (and will remain) impossible, simply for reasons of missing and incomparable data. Therefore, we can only work with incomplete datasets and will have to acknowledge and consider the distortions (some of them slight, others more critical) arising from this incompleteness. It is one way of reducing the impact of such distortions to conduct several network analyses with different sets of data

39 Boris Holzer, *Netzwerke* (Bielefeld: transcript, 2006), 34.

40 For a more detailed introduction to social network analysis and its fields of application see, for instance Linton C. Freeman, "Centrality in Networks: I. Conceptual Clarification," *Social Networks* 1, no. 3 (1979); Linton C. Freeman, "The Gatekeeper, Pair-Dependency and Structural Centrality," *Quality and Quantity* 14 (1980); Freeman, "Social Network Analysis: Definition and History."; Linton C. Freeman, *The Development of Social Network Analysis: A Study in the Sociology of Science* (Vancouver: Empirical Press, 2004); Linton C. Freeman, *Social Network Analysis*, 4 vols. (London: Sage Publications, 2007); Linton C. Freeman, Douglas R. White, and A. Kimball Romney, eds., *Research Methods in Social Network Analysis* (Fairfax: George Mason University Press, 1989); Stanley Wasserman and Katherine Faust, *Social Network Analysis: Methods and Applications*, Structural Analysis in the Social Sciences (Cambridge MA: Cambridge University Press, 1994); Peter J. Carrington, John Scott, and Stanley Wasserman, *Models and Methods in Social Network Analysis*, Structural Analysis in the Social Sciences (Cambridge: Cambridge University Press, 2005); John Scott, *Social Network Analysis: A Handbook*, 2nd ed. (London: Sage Publications, 2000); Mustafa Emirbayer and Jeff Goodwin, "Network Analysis, Culture, and the Problem of Agency," *The American Journal of Sociology* 99, no. 6 (1994); Han Woo Park, "Hyperlink Network Analysis: A New Method for the Study of Social Structure on the Web," *Connection* 25, no. 1 (2003).

which are all incomplete in different ways. It then becomes possible to look for overlaps as well as contradictions between the analyses, making it easier to account for any distortions arising from the truncation of the network data. Therefore, three different datasets will subsequently be analyzed.

The first study will use the information on telegraphic connections within Europe given in the *Liste des Communications Télégraphiques Internationales Directes du Régime Européen* published by the Bureau International des Administrations Télégraphiques in 1906. This list contains all direct connections between places in Europe that existed during that year, but leaves out intermediary stations in the circuits that were considered comparatively unimportant by the Bureau. "Outre les communications directes du régime européen, la liste mentionne aussi celles des communications internationals du régime extra-européen qui figurant sur la carte du régime européen."[41] This means that in addition to the purely European telegraph connections, those starting (or ending) in Europe have also been included, but the parts of the network at the other ends of these lines have been truncated. The second study also focuses on Europe and is based not on a list of connections but on a map. In the year 1923, the Bureau International published a map showing all direct circuits existing in Europe and their wire capacities for the first time. The connections are weighed and the social network analysis software can differ between weaker (i.e. fewer circuits between two places) and stronger (more circuits) connections. Extra-European connections with one end in Europe are also considered, but the network parts at the other end are also truncated. Due to the richness of data, both studies allow to clearly identify centers and peripheries in Europe – but only in Europe. No compatible data on direct telegraphic circuits is available for these years outside of Europe. The third study tries to remedy this shortcoming and employs a global perspective. It is based on the *Cartes des Communications Télégraphiques du Régime Extra-Européen* published by the Bureau International in irregular intervals. These maps depict telegraph connections all around the globe, but focus on the most important connections only. The data they provide is by far not as detailed as the data on the European network. In combination, however, these different perspectives allow for an identification of centers and peripheries in the European and global telegraph network.

3.2 European Telegraph Circuits 1906 and 1923

As laid out above, social network analysis offers valuable instruments for identifying centers and peripheries in a network, but it also needs comparatively large and compatible amounts of data. In historical research, the acquisition of such suitable data often requires a number of compromises. In this first case study, at least two such compromises are necessary – an exclusive focus on Europe and the point of ob-

41 Bureau International des Administrations Télégraphiques, "Liste des Communications Télégraphiques Internationales Directes du Régime Européen. Annexe a la Carte des Communications Télégraphiques du Régime Européen - Édition 1906," (Geneva 1906), 2.

servation in 1906, even though an earlier date might have been better suited for the comparison to several other case studies presented here. The data that informs the following social network analysis comes from the *Liste des Communications Télégraphiques Internationales Directes du Régime Européen*, published by the Bureau International for the first time in 1906.[42] Before this date, comprehensive information on the international telegraph network can only be read from maps dressed by the same institution. These maps are extremely valuable, as they depict the existing stations and telegraphic connections at a given year in some detail and are the only source available that allows for a truly global analysis of the telegraph network (as will be done in the following subsection). Unfortunately, however, no circuit data can be read from these maps (prior to the *Carte Schématique des Grandes Communications Télégraphiques Internationales du Régime Européen* of the year 1923, which does contain circuit data and informs the network analysis conducted in the second case study in this subsection). This means that the *Liste des Communications* is the first source to contain information on communication circuits and, therefore, on existing direct communication between two places. The list clearly shows which stations were in direct telegraphic contact without the need to relay or re-patch. While such communication circuits, of course, depended on the telegraph connections usually depicted in telegraph maps, they are much closer to the practice of communicating telegraphically. A social network analysis drawing on such circuit data therefore comes closer to the practical use patterns within the network than a study of mere connections. On an international level, this can only be done from 1906 onwards.

The second compromise has already been discussed in the previous section. In theory, a network analysis can only yield perfectly accurate results when conducted on the entire network. Truncations of parts of the network must influence and distort the results of the analysis. In the case of historical networks, however, such distortions can rarely be avoided and must, therefore, be taken into account in the interpretation of the results. In the case at hand, the *Liste des Communications* focuses exclusively on the European telegraph network. Other parts are radically truncated. Sometimes extra-European connections are not considered at all, sometimes they are truncated halfway. Some transatlantic connections, for instance, terminate on the Azores, and the Indo-European line goes no further than Tehran. The submarine connection to Asia via Suez ends in Alexandria. Of course, such truncations decrease the centrality of the gate-keeping places – in our case mostly of London and southern England (transatlantic, Asia, Africa) and Berlin (transatlantic via Emden, Indo-European line). Seen from a global perspective, these places have certainly been more central than becomes discernible from the network analysis.

In the first edition published in 1906, the *Liste des Communications Télégraphiques Internationales Direc-*

42 Ibid.

tes du Régime Européen contains a 39-page list of direct telegraph communications between places in Europe. All in all, this list features 632 stations – most of them located in Europe with only some being part of a half-way truncated intercontinental route. Of course, many more telegraph stations have been open for public service in Europe in the year 1906. But for both, the sheer mass of information as well as the lack of suitable compatible data, it is not possible to consider every existing station and every existing route in the network analysis. A selection needs to be made. In the case at hand, this selection has already been made by the Bureau International which has decided to include only 632 stations and the circuits between them in their list. The people conducting this selection were contemporary experts in the field and extremely well-placed to do this. It is, therefore, reasonable to assume that the information included in the *Liste des Communications* is much more representative than any such selections made by historians in retrospect. The 632 telegraph stations and their circuit connections have been entered into a spreadsheet and prepared for computation by the social network analysis software UCINET.[43] It is important to note that the connection data given in the *Liste des Communications* is unvalued. There is no additional information on the strength of the connection which in the case of a telegraph network means the number of wires in a circuit. Each circuit therefore counted for an unvalued connection. If, however, the list contained several circuits between the same two places, this was entered into the spreadsheet as valued information. Accordingly, the social network analysis was conducted on valued data and thus acknowledged that some connections between places were stronger than others. Altogether, four different centrality measurements were performed on the data – *degree, closeness, betweenness* and *eigenvector*.

The calculation of the Freeman *degree* is one of the most widely used centrality measures in social network analysis and simply counts the number of connections that a node has to other nodes. Valued data is recognized by the Freeman *degree* measure, and therefore multiple circuits between two given places are weighted accordingly. For the same reason, the normalized *degree* (*nDegree*) has not been included in the table as it should only be calculated for binary data, that is for data that does not recognize the different strengths of connections but merely takes into account whether there is a connection or not. The comparatively unsophisticated *degree* count shows that the major European capital cities maintained the highest number of direct telegraphic connections to other cities (see Table 15 for a complete list of the top nodes). London is conveniently in the lead, being directly tapped into 45 direct circuits. Berlin, Vienna, and Paris are very close together with 37, 34 and 33 circuits respectively. After this group of four, there

43 Ucinet for Windows: Software for Social Network Analysis Ver. 6.288, Analytic Technologies, Cambridge MA.

is a sizeable gap until cities such as Hamburg, Budapest, Milan, Antwerp, or Cologne follow.[44] This does not come as a surprise and simply confirms that the imperial and national centers of late nineteenth and early twentieth century Europe also stood at the core of the respective national and international telegraph networks. It corresponds closely with the findings of the previous section which identified Great Britain, Germany, and France as locally and internationally very well-connected countries. The central roles of Vienna and Budapest, however, are slightly more surprising as, Austria-Hungary lagged behind in telegraphic development throughout the nineteenth century and never came close to the structural and traffic density of Great Britain, Germany, and France. Nevertheless both cities in the dual monarchy acted as important central European hubs and gateways between Western and Eastern Europe. In Belgium and the Netherlands, no single city was able to compete with the aforementioned metropolises in terms of *degree* centrality, but the region as such exhibited an unusually dense web of secondary places. This, again, corresponds with the findings of the previous section that identified the Dutch, Belgian, and Swiss domestic networks as extremely well-developed and well-used. Interestingly, however, the principal Swiss cities did not exhibit the high values one might expect in the light of national telegraph use and lagged behind their Dutch and Belgian counterparts. Only the city of Basel did reasonably well in the *degree* count (13) and featured a sizeable number of direct connections to other major European cities. Geneva already lagged relatively far behind (9). And Zurich had a *degree* centrality of only 6 and is not to be found among the top European nodes.

The Freeman *degree* analysis merely highlights how many direct connections a specific node maintained to other nodes in the network. While this is, of course, instructive in many ways, it reveals little about the qualitative position of a node in a network. In his categorization of network analysis methods, Linton Freeman presents two other ways of calculating centrality in a network that go beyond the simple *degree* value – *farness/closeness* and *betweenness*.[45] Both only operate with binary connections and do not recognize valued data. They ignore the strength of the link between two nodes and are only interested in their positions within a network. *Farness* is the sum of connections that it takes for a node to reach each and every other network node. The higher the number of connections, the less central the node is. *Closeness* is the reciprocal value of *farness*. In its normalized form as *nCloseness* it shows the percentage of the highest possible *closeness* value. Generally, the best-connected places in terms of *degree* centrality also feature the highest *nCloseness* values. This means that from places with many circuit connections it was easiest to reach the rest of Europe – or the rest of the world. Accordingly, Vienna, Berlin, London,

44 As a general rule, place names are used in a standardized, usually modernized form in the text of this study. The tables, however, reproduce place names as used in the original sources.

45 Freeman, "Centrality in Networks: I. Conceptual Clarification."; Freeman, "The Gatekeeper, Pair-Dependency and Structural Centrality."

and Paris exhibit the highest values here (between 0.686 and 0.685). It is, however, far more interesting how close together the individual cities are in terms of *closeness* centrality. Of the 632 places in the *Liste des Communications*, 489 were connected to the main network body. Of course, the remaining 143 nodes were in practice also part of the network, but their connections to the main body were considered to be minor by the Bureau International and were therefore not included in the list. Technically, *farness* for these nodes is infinite, as in the dataset at hand they have no connection to the 489 places constituting the main network. Interestingly, within these 489 nodes, the one with the lowest *farness* value (Vienna with 92,029) and the one with the highest value (Neisse with 96,671) are only some thousand steps apart. Translated into normalized *closeness* Vienna reaches 0.686 percent of the lowest (theoretically) possible *farness* value, while Neisse reaches 0.656 percent. This accounts for a very small difference in terms of *closeness* centrality between the most central and the least central node in the network. There were, of course, differences in the *farness* and *closeness* of places in the European telegraph network of 1906. From some places – usually from the ones with higher degree values – it was comparatively easier and faster to reach all other places in the web. Importantly, however, the fact that these prevailing differences were not as pronounced shows how densely integrated the telegraph network in Europe was at this point in time.

The third social network analysis measure used for calculation in this study – Freeman *betweenness* – produces significantly different results. *Betweenness* refers to the centrality of a network node in terms of its mediating position in the network. It describes how often the shortest connection between two nodes passes through a certain node and is therefore a clear indicator for the importance of a particular city or town as regards the efficient functioning of the entire network. The normalized value *nBetweenness* is the original value divided by the maximum number of node pairs, excluding the evaluated node. Nodes with high *betweenness* values are centrally placed, regarding the network traffic and can therefore exert control over the flow of information. While there are only small differences in the *closeness* values, *betweenness* is very unevenly distributed within the network (see Table 16). Only the European metropolises achieve notable values in this category. Vienna (22.374) and Berlin (17.55) lead the table, followed already at some distance by Paris (12.612) and London (8.943). Due to the aforementioned truncation of the telegraphic connection across the Atlantic, to Africa and Asia, the value for London seems to be distorted. In this regard, the British capital occupied a crucial gatekeeper position that is not represented by the data on which the network analysis is based on. In reality, London should rather be seen on a par with Berlin and Paris here. And all three of them should probably be seen closer to the leader Vienna as the values for Berlin and Paris also partially suffered from the truncations. To a certain degree, Berlin and Paris were gatekeepers to America, Africa, and Asia as well, while Vienna occupied no such role

in intercontinental telegraph traffic, but rather one as the most important gate to the east of Europe that has not been truncated. Taking this into account, the top four nodes should be seen as reasonably close together and a significant gap between them and the other network nodes becomes apparent in terms of *betweenness* centrality. It seems clear that the role of central traffic hubs in the European and global telegraph network was exclusively filled by the big imperial capitals of the day. Control over the global flow of information rested there. The major cities of Switzerland – as well as those of Belgium and the Netherlands – did not exhibit notable *betweenness* values and were conveniently outperformed by secondary nodes such as Budapest, Breslau, Milano, Munich, Sarajevo, and several others. In combination with the results of the *degree* measurement and the findings of the domestic network study, this seems to suggest that Switzerland and the other two countries featured well-developed networks with high use rates but were not placed centrally in terms of control over the telegraphic information flow. Geneva is the Swiss city with the highest *betweenness* value but only comes at rank eighteen in the table. Compared to the top of the table, its significance as a relay station thus seems to have been mediocre at best. Even though it was well-connected to stations in France and Germany, Basel played an even less important role as a routing station. Interestingly, Chur and Splügen in Graubünden can be found among the top forty *betweenness* nodes. This is probably because they acted to a certain degree as gateways to Italy and have seen some through-traffic in this direction. All in all, however, the structural analysis suggests that Swiss telegraph stations have played a marginal role as relay stations in the European network – despite the country's geographically central position and well-developed domestic network.

The results of the fourth network analysis method – the Bonacich *eigenvector* – largely confirm the results of the *betweenness* measure. Here, a node is central when it is connected to other central nodes.[46] London, Berlin, and Paris top the ranking, with London in a very convenient lead, despite the various truncations of the network (see Table 17). Interestingly, Vienna clearly falls behind. While the Austrian capital occupied an important role as a hub and relay station to Eastern Europe, it did not maintain so many direct connections with other centrally placed nodes. In short, this means that London, and to a lesser degree also Berlin and Paris, were on the most important circuits together with other important European cities, while Vienna – despite its many connections and the high *betweenness* value – found itself on relatively less important telegraphic routes. In addition, several places in Belgium, the Netherlands, and Switzerland feature notable *eigenvector* values. Amsterdam, Antwerp, Rotterdam, Brussels, Zurich, and Basel can all be found among the top twenty nodes in this category. Therefore, the results of the *eigenvector* measurement first of all support the central role of London, Berlin, Paris, and Vienna in the

46 Phillip Bonacich, "Factoring and Weighting Approaches to Status Scores and Clique Identification," *Journal of Mathematical Sociology* 2(1972); Phillip Bonacich, "Power and Centrality: A Family of Measures," *The American Journal of Sociology* 92, no. 5 (1987).

European telegraph network of the late nineteenth and early twentieth century. These were beyond doubt the most important hubs and control centers of telegraphic information flows in the period under study. Secondly, however, the *eigenvector* values also confirm the assumption that several stations in Belgium, the Netherlands and also in Switzerland were placed at privileged positions near these control centers. The principal Swiss cities were therefore able to tap into the information flows rather easily, while they had little controlling power over these flows.

The second case study shares some of the limitations of the *Liste des Communications* analysis. It is based on the *Carte Schématique des Grandes Communications Télégraphiques Internationales du Régime Européen* issued by the Bureau International in Berne in the year 1923.[47] As the name of the map already signifies, only European nodes and circuits as well as intercontinental connections with one end in Europe are shown and can therefore be considered in the network analysis. In comparison to the *Liste des Communications*, however, many more transatlantic and transmediterranean cables are included and accordingly the truncations do not weight quite as heavily here – although they do, of course, distort the network analysis results nevertheless. In addition to that, the *Carte Schématique* is the first available source that actually carries information about the capacity of a circuit. The resulting network analysis can therefore work with valued circuit data and will produce more refined results. The map has been published in 1923 and thus covers a period somewhat later than that looked at in previous chapters. The 1906 and 1923 network analyses can, however, mutually control each other. Statements on the centrality and non-centrality of cities and regions in Europe that are confirmed by both case studies will indeed have a very high accuracy. In total, the map shows 289 cities or towns in Europe. Of those, 248 are connected to the main network body and thus exhibit meaningful network analysis results. All in all, 554 circuit connections between these nodes have been considered in the social network analysis that encompasses the same four centrality measures as in the previous section.

The Freeman *degree* centrality analysis of cities and towns included on the *Carte Schématique* shows that London (69), Paris (58), and Berlin (50) maintained the highest number of direct connections to other places (see Table 18 and Map 1). Vienna followed at some distance. Budapest came fifth before Amsterdam, Antwerp, Brussels, and Rotterdam started to represent the Belgian-Dutch region that has done so well in the domestic telegraph study as well as in the *Liste des Communication* analysis. Zurich and Basel rank twentieth and twenty-first in the list and again were not quite able to live up to Switzerland's the excellent performance in the domestic statistics. It is interesting to see that seemingly remote places such as Malta, Gibraltar, Penzance, or Waterville are among the top 25 *degree* nodes. This reflects

47 Bureau International de l'Union Télégraphique, "Carte Schématique des Grandes Communications Télégraphiques Internationales du Régime Européen," (Geneva 1923).

the gateway function of these cities, which all occupied strategically important positions in the global telegraph network. Together with, for instance, Brest and Porthcurno, Penzance, and Waterville served as landing sites for most of the Atlantic submarine cables. Gibraltar and Malta were British stations in the Mediterranean and practically all Asian connections via Alexandria and Suez had to pass through them. Similarly, Carcavelos was an important junction for the Atlantic and Mediterranean cables.

In terms of *closeness* centrality, the nodes of the *Carte Schématique* were very near together. Paris reached every other node in the network in 12,460 steps. Ranking 40th, Kristiania needed only 216 steps more than that. And even Benghazi, which ranked last within the main network body, needed only 13,541 steps. The *nCloseness* ranges from 2.311 percent in the case of Paris via 2.272 percent for Kristiania to 2.127 percent for Benghazi. Paris, Berlin, and London are again topping the list, but were only marginally closer to the rest of the network than other nodes. The network was very well integrated and all the cities and towns connected to its main part were reasonably easy to reach from any other position in the net. There were marginal advantages for the French, German, and British metropolises, but, as a matter of fact, most places were – telegraphically speaking – almost equally close to each other.

Berlin, Paris, and London (all around 20 percent) clearly ranked highest in terms of *betweenness* centrality and thus also in terms of control over the flow of information (see Table 19 and Map 2). Vienna followed fourth but reached only around 12 percent in *nBetweenness*. Prague and Budapest already lagged far behind with slightly over 8 percent each. At rank 24, Basel was the first representative of the well-developed countries Belgium, the Netherlands and Switzerland. With Zurich (28th), Geneva (34th), and Berne (39th), three other Swiss cities can be found in the top 40. Rotterdam only comes in 27th in this category and is the only Dutch city in the top group. At rank 37, Brussels is the only Belgian node in this class. In comparison to the values from 1906, Swiss nodes occupy more central positions in the 1923 network and even outperform their Dutch and Belgian counterparts. All in all, however, the overall position of the Swiss telegraph stations in relation to the top nodes had changed but little. The high *betweenness* values for Berlin, Paris, London and, to a lesser extent, Vienna emphasize these cities' central positions in the telegraphic information flow. It was highly likely that a message sent between two European places would pass through one of these central junctions. And especially for London an even higher value could reasonably have been expected had the dataset used for the social network analysis included the North American and South Asian networks as well. While only a few more Swiss, Dutch, and Belgian cities rank among the top 40 *betweenness* nodes than in the *Liste des Communications* analysis, the results of both studies are very similar. In terms of *betweenness* and control over the information flow, these places exerted only little influence.

As regards their *eigenvector* values, Paris, Berlin, and London can again be found at the top end of the list – but London interestingly did worse than the other two (see Table 20 and Map 3). Vienna comes as the usual fourth, quickly followed by places such as Antwerp (5th), Brussels (8th), Amsterdam (9th), Rotterdam (11th), or Zurich (12th). Therefore, the *eigenvector* ranking generally supports the findings of both the domestic telegraphy analysis and the analysis of the *Liste des Communications* presented in the previous section. Antwerp, Brussels and Amsterdam exhibited normalized *eigenvector* values of between 30 percent and 28 percent. They are, therefore, in the range of Hamburg or Prague and even relatively close to Vienna, while their normalized *betweenness* values are marginal in comparison to those of their competitors. A little further down the table, the same holds true for the Swiss cities Zurich, Basel, and Berne. As to their position in the European telegraph network, this means that Belgium, the Netherlands, and Switzerland were not central in terms of being situated on the main routes of communication. They were of only limited importance for the actual flow of information between other network nodes. However, they enjoyed excellent access to the control centers of the network – the Dutch and Belgian stations even more so than most Swiss ones.

To summarize, the results of the *Carte Schématique* network analysis confirm practically all of the important findings of the *Liste des Communications* study. The major cities of Switzerland – which exhibited very impressive structure and use rates regarding the development of their domestic networks – scored fairly good *degree*, not quite so good *betweenness* and impressive *eigenvector* values in both studies. As already pointed out, this means that they were well placed within the network, densely connected to the central nodes, but with little control over the information flow themselves. The similarity of the results of both studies suggests that these general findings have a high degree of accuracy.

3.3 Global Telegraph Connections 1881, 1892 and 1902

Both of the studies above relied on actual circuit data, but were confined to Europe in their geographical focus. In the following analysis, this focus is extended to cover the entire globe. Furthermore, data is available for three different years – 1881, 1892, and 1902. Therefore, the analysis gains a chronological dimension and allows for interpretations of the structural development of the global telegraph network during the last twenty years of the nineteenth century. However, the study has, of course, other drawbacks. The only available sources, on which such an analysis can be based, are the global communication maps dressed by the Bureau International in Berne. These maps were published at regular intervals during the late nineteenth century and showed the telegraph lines of the world – both terrestrial and submarine. While the maps are admirably detailed, they can, of course, not provide micro-level information and are forced to focus on the principal connections. Also, they depict telegraph lines, not

circuits. Therefore, the maps show the practical course of the telegraph lines, but do not contain information about which nodes were directly connected with which other nodes. These two shortcomings have an impact on the accuracy of the network analysis. This has to be taken into account in the interpretation of the results. Nevertheless, the maps are the best sources available if telegraphic centers and peripheries and their development over time shall be examined on a global scale.

The network analysis has been based on information taken from three different maps at approximately ten year intervals. In each case, the connections depicted on the map have been entered into a data matrix which has then been fed into the network analysis software. The first map shows the global telegraph network during the year 1881.[48] It contains 1,954 network nodes and 2,450 connections between them. The second map depicts the situation in 1892 containing 2,949 nodes and 3,938 different connections.[49] The third map is for the year 1902.[50] By then, the network had expanded to 3,813 nodes and 5,160 connections. This quantitative increase of information depicted on the maps is already testimony to the fast growth of the network in the last decades of the nineteenth century. The two transpacific cables are already shown as projected routes in the 1902 map, but have not been taken into account in the calculations.

As regards *degree* centrality, London, Paris, and Vienna led the ranking in all three years under observation (see Table 21). Berlin was always among the top six nodes. This confirms the findings of the previous sections and shows that even on a global scale the biggest number of telegraphic connections converged on these European metropolises.[51] Other nodes at the top end of the list throughout the period of observation include the French cities of Marseille and Lyon, St. Louis in the United States, and the Mediterranean island of Malta. Marseille controlled much of the European traffic with, North Africa and other places around the Mediterranean. Malta was a central relay station *en route* to Alexandria, Suez, and thus to Asia. And Lyon and St. Louis were important mainland hubs in France and the United States. Places such as Cincinnati, Chicago, Brussels, Munich, or Halle – to name but a few – had similar roles. St. Pierre and Cape Canso, on the other hand, lay on the transatlantic route and occupied a pivotal relay function there. Havana had already emerged as an important regional hub in the Caribbean by 1881.

48 Bureau International des Administrations Télégraphiques, "Carte des Communications Télégraphiques du Régime Extra-Européen," (Geneva 1881).

49 Bureau International des Administrations Télégraphiques, "Carte des Communications Telegraphiques de Régime Extra-Européen," (Geneva 1892).

50 Bureau International des Administrations Télégraphiques, "Cartes des Communications Télégraphiques du Régime Extra-Européen," (Geneva 1902).

51 However, it also signifies the extent to which the micro-level is missing in the maps that serve as sources. In the *degree* ranking, stemming from the analysis of the *Liste des Communications* of the year 1906, London reached a value of 45 as compared to only 15 in the global connections map of 1902.

Taken together, the *degree* results confirm the findings of earlier sections. A few big European metropolises stood at the structural center of the system, followed by a number of regional centers, mostly in Europe and the United States. The transatlantic route and the cable network in the Mediterranean – being the telegraphic gateway to the East – also featured important nodes. Only minor variations occurred in this general structural pattern during the period of observation. The most notable of these is probably the rise in importance of South American nodes, such as Rio de Janeiro or Recife in Brazil at the turn of the century. As regards Swiss telegraph stations, only the city of Basel made it into the top ranking nodes – and only in 1881. While several cities in Switzerland occupied more or less central positions in the European telegraph network, their importance certainly shrank from a global vantage point.

As regards *closeness* centrality, almost all places featuring high values were port cities with direct access to the submarine cable network. Mediterranean nodes such as Malta, Gibraltar, or Alexandria are prominent in this respect – especially those that acted as relay stations on the submarine route to Asia (or on its short overland stretch between Alexandria and Suez via Tantah). The same is true for Penzance (practically next to Porthcurno, where most Eastern cables landed), Exeter and Dartmouth in England, Vigo in Spain, and Lisbon in Portugal. All these places were on the main route from England to Asia. Many Atlantic or Mediterranean stations nearby connected to this route – such as Coimbra, Lanarca, Sitia, Malaga, or Modica – also achieved high *closeness* values. Places such as Brest, Funchal, St. Pierre, and Cape Canso, on the other hand, derived their centrality from their position on the principal transatlantic routes. Interestingly, London is the only metropolis with reasonably high *closeness* values. This shows how closely London was connected to the central axes of global communication going through port cities. Altogether, three points become discernible from the analysis of *closeness* centrality. First, it emphasizes the importance of access to the submarine cable network that carried practically all the long-distance communication. Those stations with either direct or secondary access to this part of the network exhibited the highest *closeness* values. Second, a clear central axis of global telegraphic communication started to emerge from the United States' east coast via the European Atlantic coast, the Mediterranean and the Red Sea on to Asia. And third, there was practically no change in these structural focuses throughout the period of observation. At least in terms of *closeness*, the core region of the global network did not shift in the slightest during this time.

The results of the *betweenness* analysis largely confirm these findings. The same central west-east axis becomes discernible as well (see also Table 22). Nodes such as St. Pierre, Cape Canso, Duxbury, New York, Brest, or Funchal saw a considerable portion of the transatlantic traffic pass through them. Similarly, most of the important relay stations *en route* from England to India also feature high values – such as Penzance, Lisbon, Gibraltar, Malta, Alexandria, Tantah, Suez, Aden, or Bombay. For 1902, a number

of Indian cities exhibit, together with Penang, high values that prolonged this axis further to the east. This was due to the expansion of the telegraph network in and around South-East Asia and Australia, taking place towards the end of the nineteenth century. Ten years earlier, a cluster of relatively high *betweenness* values is visible along a route from the Mediterranean across Turkey and via Tiflis into Russia. There had indeed been an expansion of the Russian telegraph network taking place since 1881 that rendered the intermediary stations in the Caucasus more important. However, this structural importance seems to have been short-lived, as by 1902 none of these nodes were among the top one hundred anymore. While the *closeness* values show relatively little variance between the top and the bottom values, the *betweenness* values do. Here, nodes such as Alexandria, Lisbon, Malta, and later Aden and Suez exhibited much higher values than their pursuers. This, again, emphasizes the central role that the Mediterranean (and its western and eastern extensions) played in the global telegraph network of the late nineteenth century. Maybe unsurprisingly Switzerland and Swiss telegraph stations were of little relevance as relay posts from a global viewpoint. Swiss *betweenness* values had already been low in a European framework. In the worldwide web they were marginal.

After the mutually reconfirming results of the *degree, closeness* and *betweenness* analyses, the *eigenvector* measure presents a more or less inconclusive picture. In each year under study, a different cluster of network nodes ranks particularly high in terms of *eigenvector* centrality. In 1881, western Mediterranean places such as Marseille, Algiers, or Malta and their neighboring nodes are in the lead. By 1892, they have been supplanted by an exclusively Caribbean cluster arranged around Key West at the southern tip of Florida and Havana and several other cities in Cuba. Another ten years later, those nodes have in turn been replaced by stations located mostly on the transatlantic route, such as Cape Canso, Waterville, New York, Valentia, Penzance, or Heart's Content. Acknowledging the expansion of transatlantic connections towards the end of the century, this shift in focus on the transatlantic route is credible. Regarding the previous two cases, however, the *eigenvector* clusters in the western Mediterranean and in the Caribbean seem arbitrary and without grounding. The inconclusiveness of these results might stem from two different factors. First, they might originate in the limitations of the sources explained above. The lack of circuit data is especially limiting when calculating the *eigenvector* as it does not reflect direct circuit connections between major nodes but lists all intermediary stations. Second, the confusing results may to some degree be a cause of the *eigenvector* calculations, which have been conducted for this section by employing a faster but less accurate mode of computation. This has been necessary due to the sheer number of nodes and the resulting size of the data matrix. However, this method could have impacted the accuracy of the findings, which should therefore be treated with caution.

To sum up, social network analyses of the worldwide telegraph network in the late nineteenth and early

twentieth century confirm the leading positions of a handful of central nodes and switches that were usually either major European or American cities or gateways to important intercontinental connections. While several Swiss cities occupied a fairly important and well-connected position within the European part of the network, they seem to have been insignificant from a global vantage point. Neither Basel, nor Geneva, nor Zurich was well-placed in the global network. The important global connections utilized other places (such as London, Paris, or Berlin) as their principal routing nodes.

4 Switzerland and International Telegraphic Traffic

4.1 Comparing European External Telegraph Messages, 1860-1910

The data analyzed in the previous section was exclusively of structural origin. It represented the connections between network nodes, not the actual communication. Yet, in order to provide information not just about the possibility of communication but about the actual realization of this potential, structural data needs to be put into perspective. It needs a corrective – ideally in the form of use data. Earlier in this piece, we have already looked at Swiss domestic telegraphic traffic in comparison to other (mostly European) countries. With the help of this data it was possible to show that Switzerland did not only boast an exceptionally well-developed landline network, but that the public also made extensive use of the technology. So far, however, only brief reference has been made to external, that is the international, telegraphic traffic. The *Statistique Générale de la Télégraphie* contains aggregate information on the international telegraphic traffic of the included countries. The total number of external telegrams handled is broken down into three categories: messages sent, received, and transmitted. While the first two categories are self-explanatory, the third features all messages that passed through the country in question on their way between two other countries. Thanks to this detailed breakdown, the data does not merely provide insight into the quantitative participation of a country in global communication, but also about its qualitative role as producer, consumer, or transmitter of information. Again, samples have been drawn from the available statistical material every ten years between 1860 and 1910. The absolute numbers of messages handled have been put into relation to the population of the country and have then been indexed with a selected European average equaling 100.

As regards external telegraphic traffic in the year 1860, the major European powers France, Germany, and Austria-Hungary have very little external traffic compared to the European average (see Table 23). France and the dual monarchy have particularly little transit traffic. The values for Germany – which did not yet exist as a political entity in 1860 – are generally inflated, as the traffic between the individual

German states counted as external rather than internal here. The highest values can be found for countries that also did well in the analyses presented earlier in this text. The Netherlands exhibit the highest per capita values in terms of international telegraphic traffic with approximately three times the European average in international messages per capita. Belgium, Denmark, and in the first two categories Norway also perform very well and feature per capita rates of around 1.5 times the European average. For Switzerland, the data is not broken down into all categories individually. The amount of transit messages passing through the country is 1.5 times higher than the average. Switzerland has thus seen some transit traffic early in the history of the technology – but the conclusions that we can draw from these numbers are limited, as the per-capita rates of transit messages (i.e. messages originating and terminating in another country) are computed against the Swiss population. A comparison to sent and received external messages would be more instructive, but no information about these categories is available for 1860. In total, 95,619 external telegrams have been transacted during that year at Swiss telegraph stations (see Table 8). This amounts to almost twice the European average in this regard and is second only to the Netherlands. Thus, a sizeable proportion of Swiss telegraphic traffic originated or terminated outside the country already in 1860. And as we will see, external traffic gained massively on internal telegrams over the decades – by 1900, more international messages were sent over Swiss wires than domestic ones. This has been a general tendency in the period of observation (see Table 24). In most cases, external telegram traffic grew at higher rates than internal traffic.

In the year 1870, Germany was the only major European power to exhibit per-capita values above the European average regarding sent and received international messages (see Table 25). However, the country's transit value is considerably below average. While Germany does not seem to have been a central hub for international telegraphic traffic in 1870, the situation is exactly the other way round in Austria. Here, performance in the first two categories is significantly below average, while the transit value is at 124 percent of the average. France has interestingly low per-capita values in the region of Austria as well. The highest international traffic per capita can, as ten years before, be found in Belgium, Denmark, the Netherlands – and again Switzerland which exhibited the top rates among sent and received telegrams. Swiss through-traffic was a little less pronounced but still impressive when compared to the population size of the country. Denmark and the Netherlands, on the other hand, did best in this third category and seem to have been central relay countries. This is surprising, as it does not confirm the findings of the structural studies in the previous sections of this chapter that ascribed very little *betweenness* to nodes in these countries. Outside of Europe, the *Statistique Générale* gives meaningful information only for British India, which exhibited minuscule values in all categories. In absolute numbers, the international messages sent and received are similar to those of Portugal. In the per-capita measures,

the indexed values accordingly tend towards zero.

Just as in the previous decade, international telegraphic traffic grew rather evenly between 1870 and 1880. There were only a few exceptions to this: Hungary exhibited extraordinarily high growth rates during this period. And both British India and Portugal significantly increased their number of transit messages. This reflects the two countries' position in the global telegraph network. From 1870 onwards, the Portuguese port city of Carcavelos became a relay station in the submarine route to India. And through the eastward extension of the network, British India itself became a through-station for all traffic between Europe and South-East Asia, East Asia and Australia. Interestingly, Germany exhibited minuscule growth in external traffic and even negative growth in terms of absolute transit messages handled. The country ceased to perform above the index average (see Table 26). Together with the other major European powers France and Great Britain it was significantly below average in all categories – especially in the transit category. In the first two categories, Great Britain still did best with values of 87 and 71 percent of the average. The Netherlands and Belgium (and to a lesser degree Denmark and Norway) once again exhibited impressive per-capita values. In 1880, Denmark was one of the principal international traffic hubs with almost as many through-messages as Great Britain. Switzerland still held the top per-capita rates in the sent and received categories, and by 1880 also played an important role in European transit traffic. In that year, the Swiss network saw more than one million international telegrams go through its wires (see Table 11). The Netherlands, on the other hand, have by then lost the hub position they had held ten years earlier. Outside of Europe, Algeria and Tunisia (in 1880 treated as one entity in the statistics) participated very actively in global telegraphic communication with per capita values of 63 percent and 52 percent of the European average.

Again, growth values were very evenly distributed across all countries for the decade from 1880 to 1890. The only notable digressions can be found in the growth of transit traffic in France, Hungary, Romania, and Portugal. While absolute numbers in this category remained rather small in the cases of the former three, Portugal had become an important international transit country by 1890 (see Table 27). To an even more pronounced degree, the same is true for Denmark – and Switzerland, which almost doubled the amount of international through-messages in ten years. Both countries now handled about 2.7 times of the average per-capita transit traffic. In combination with its top values in the other two categories, the importance of international telegraphic communication in Switzerland became even more pronounced. The country's landlines now carried almost as many international messages as it saw domestic telegrams (see Table 12). Interestingly, the Netherlands have also partially regained the status as a transit country which they had lost during the previous decade. The German and French performances remained largely unchanged. Both countries exhibited per-capita values significantly below the average. Among the

major European powers, only Great Britain managed to exceed the average in at least one category. Outside of Europe, Algerian traffic had collapsed completely by 1890. This is due to the fact that from 1888 onwards, French Algeria and the French protectorate Tunisia were treated as separate entities in the *Statistique Générale*. Through this division, it became apparent that the Tunisian part handled most of the international traffic and participated quite actively in global telegraphic communication. Interestingly, regarding internal messages per capita, the situation was the other way round. Here, French Algeria was well within the European average from 1890 until the end of the period of observation, while Tunisia could not even achieve half of the average (see Tables 12-15). In the case of Japan, there is no broken-down data for the year 1890 but merely aggregate figures for the total external traffic handled. Despite the fact that the number of international messages sent, received, or transmitted in Japan grew by an average 15 percent annually between 1880 and 1890, with a total number of 98,036 messages, the country reached only about 1 percent of the European per-capita average in 1890.

By the turn of the century, the absolute growth of international telegraphic communication had further leveled-off – a tendency that had already become discernible in 1890. While there was, of course, still absolute growth, the average annual values rarely exceeded 3, 4, or 5 percent. Japan, for which broken-down data now became available, is a notable exception with 17 percent average annual growth in total external traffic. But while Japan was already approaching European per-capita values in terms of internal traffic around 1900, international traffic was still minuscule, both in absolute and relative numbers (see Table 28). The country reached only 4 percent of the European average in the first two categories. In terms of messages transmitted, the absolute number was 3,972 amounting to a rounded 0 percent of the corresponding European average. British India was the only other exception regarding average annual growth. In the decade leading up to the new century, the number of transit messages handled increased by 10 percent annually, which reflects the growth of the Asian telegraph system and the increasing Euro-Asian and Euro-Australian traffic. Outside of Europe, Australia – and in particular New South Wales – started to participate fully in global communication and immediately exhibited very high per-capita figures. Tunisia had more than doubled its external traffic between 1890 and 1900 and was now even above the European average in the category of messages sent. Apart from that, the situation had remained fairly unchanged. Switzerland, Belgium, the Netherlands, Norway, Denmark, and Luxembourg had the highest per-capita traffic with other countries, while the major European powers stagnated in this regard and showed no development whatsoever. Interestingly, both Belgium and the Netherlands had again lost their hub positions and would not regain it until the end of the period of observation. Denmark, together with Switzerland and Portugal, handled an impressive amount of through-traffic. In absolute numbers, these three small countries each transmitted more than

600,000 messages per year. Switzerland also maintained its high per-capita values in the sent and received categories. With 2,372,188 external messages handled (see Table 13), the Swiss landlines now saw pronouncedly more international than national telegraphic traffic. At a time when the structural development of the Swiss network as well as internal network use seem to have reached a glass ceiling and started to level off, external traffic still grew massively.

Ten years later, in 1910, the established pattern had still seen only slight changes. Overall, growth rates during the first decade of the twentieth century were a little higher than in the previous decade, but also rather evenly distributed. Only Romania and Russia showed unusually high average annual growth rates in transit messages. And Japan exhibited 10 percent annual growth in the number of international messages received. Apart from that, the picture remained mostly unchanged. In Europe, Switzerland and Denmark still occupied central relay positions with per capita transit values of 288 percent and 320 percent respectively (see Table 29). Switzerland handled almost four million external telegraphic messages. While the country's domestic per-capita traffic had dropped even slightly below the European average, international telegraphy boomed. The country now transmitted almost as many international through-telegrams as Great Britain. With a little less than one million transit messages, Denmark was only slightly behind here. The major European powers were still not able to extend their per-capita external traffic and showed little positive or negative development at all. Outside of Europe, Australia gradually came into full swing and participated to an impressive degree in global communication. While further detailed studies about the role of Australia and New Zealand in the worldwide telegraph network are necessary, it seems safe to say that telegraphy was seen as a remedy for the disadvantages of the geographical remoteness of these countries.

Seen over the entire period of observation from 1860 to 1910, there seems to be remarkably little development and change in terms of international traffic handled by the countries that submitted information to the Bureau International. Changes and shifts, if they occur at all, took place in individual categories and within very reasonable limits. In clear difference to the developments in internal telegraphic traffic (as elaborated earlier), the major European powers neither managed to catch-up with initially very well-connected countries such as the Netherlands, Belgium, or Switzerland, nor did these smaller countries level-off in their development and lose their leading positions over time. While international traffic was growing in absolute terms, its country-specific per-capita distribution remained practically unchanged throughout the late nineteenth and early twentieth century. The use analysis also reveals significant differences between the structural make-up of the global telegraph network, its telegraphic use patterns, and Switzerland's position in this regard. The social network analyses in the earlier sections of this chapter have attributed the highest international connectivity to the European metropolises and some other strate-

gically well-placed nodes. Smaller cities in Belgium, the Netherlands, and in Switzerland have generally done well in these analyses, but rather in the *degree* and *eigenvector* measures and not at all as regards *betweenness*. The structural analysis thus did not really identify Switzerland as an important switch in the network or as a telegraphic transit country. The analysis of external telegraphic traffic, however, has shown that together with several other smaller countries it handled extraordinarily high portions of international traffic. This discrepancy can partially be explained by the fact that the highest indexed figures are per-capita values. Accordingly, these figures merely say that the Swiss (like the Belgians, the Dutch, or the Danes) sent, received, and transmitted more international telegrams per capita than the bigger European powers. These are relative numbers that need not necessarily be reflected by the structure of the network which is absolute. On the other hand, however, external traffic in absolute numbers was quite substantial in Switzerland as well, even if it was, of course, not able to reach the dimensions of Great Britain, France, or Germany. It could have been expected that this significant telegraphic flow, especially in the transit category, would have had an impact on the network structure as well and might have shifted the nodes in these countries closer to the central axes of international traffic as revealed in the previous section – but this does not seem to be the case. Most importantly the international use analysis underlined that in the period of observation, the demand for international telegraphy was not saturated. While the amount of internal messages handled stagnated from the late nineteenth century onwards, international telegraphic traffic grew fast in Switzerland. By 1900, the network saw more international than national messages. Ten years later, international traffic was almost 2.5 times larger than domestic traffic. These are impressive figures that tell us something about the actual use of the telegraph in Switzerland and at the same time shed more light on the country's social and economic position in Europe and the world. The question that remains is where all this international traffic originated and terminated outside Switzerland. In short, with whom exactly did the Swiss telegraph users chose to communicate?

4.2 Swiss Foreign Telegrams, 1870-1915

As the previous analyses have demonstrated, information on the actual traffic in telegraph networks has been collected by many administrations and private firms during the late nineteenth and early twentieth century. The format of the data displayed, for instance in the *Statistique Générale de la Télégraphie*, is of great value for the analysis of the degree that a particular country partook in international telegraphic communication – but it says nothing about a country's (or a single node's) position in the wider network. Such traffic data does not contain information about the network nodes that were in correspondence. Hence, it does not contain information about the routes that telegrams took, about the places that interacted. Such information can usually only be gained by looking at the telegrams, as they carry both origin

and destination of the message. But in order to derive generalizable insights from this, an incredible amount of telegraphic messages would have to be examined – messages that have not been systematically archived. Therefore, querying the telegrams directly about message routes and connection patterns is usually only possible in smaller-scale studies with narrow regional limits – and even then the existence of a usable corpus of telegrams constitutes a rare stroke of luck. In most cases, therefore, the structural data about a country's position in the global communication network can only partially be tested against use data – usually only to the degree presented in the previous section.

However, Swiss foreign telegraph communication in our period of observation constitutes a rare exception to this. The Swiss telegraph administration has indeed collected rather detailed data on the origin and destination of the foreign telegrams that it handled and published it in a section of its annual statistical reports (*Schweizerische Post- und Telegraphen-Statistik*). These statistics are today readily available at the historical archives of the Swiss Post, Telephone and Telegraph (PTT) administration in Berne. They illustrate to which countries international telegrams from Switzerland were sent and from which places messages arrived. In the reports, the absolute number of incoming and outgoing telegrams is given. In Tables 30 and 31 these absolute numbers have been transformed in percentages for an observation period from 1870 to 1915. Thus, the figures in these tables indicate how great a portion of the total international telegram traffic came from or went to a particular country or continent. As the incoming and outgoing categories did not exhibit any significant deviation, Tables 30 and 31 do not differ between sent and received telegrams, but cover both categories.

The data in Table 30 focuses on Swiss telegraphic traffic with other European countries. Germany, France, Italy, Austria, England, and Russia are displayed in separate columns.[52] These countries exhibit the highest amounts of telegrams exchanged with Switzerland during the time under consideration. All other European countries, for which individual data has been available in the reports, have been merged into one shared column as their traffic proportions have been marginal throughout the period of observation. Among the six entities represented separately in the table, Germany and France have been the most important telegraphic communication partners of Switzerland. Between the two, Germany usually commanded a slightly bigger share than France. However, throughout the 45 years covered in the table, their combined share of all Swiss foreign telegrams amounts to roughly 60 percent of the total – sometimes a bit more, sometimes a bit less. Thus, roughly two thirds of all international telegrams originating or terminating in Switzerland go to or hail from only two countries – two big and well-populated countries

52 The country names have been taken directly from the report, where they are given in German and French, and have been translated into English. As far as this could be confirmed, the term England actually means Great Britain (and possibly Ireland) and the term Austria refers to the entire Habsburg monarchy.

that were not only direct neighbours but important trading partners. Accordingly, demand for telegraphic communication between Switzerland, Germany, and France was high throughout the late nineteenth and early twentieth century. Switzerland's foreign telegraphic communication was furthermore closely connected to Italy and Austria – the remaining two neighboring countries, if we leave tiny Liechtenstein aside for the moment. While the number of telegrams exchanged with these two neighbors was lower than the number of those exchanged with Germany and France, their proportions were still significant. Italian messages usually constituted between 10 and 15 percent of all foreign messages. Austrian telegrams mostly amounted to just below 10 percent. Great Britain and Russia shared no borders with Switzerland and lay further in the distance, but they were both important European powers with considerable economic and political weight. Therefore, it is surprising that they only saw relatively small amounts of Swiss telegrams in the late nineteenth and twentieth century. In the case of Great Britain, figures vary between 2.8 percent in 1879 and 8.1 percent in 1912. Russian telegrams amounted to between 1.2 percent in the late 1870s and early 1880s to 4.7 percent in 1914. The remaining European countries were in combination responsible for around 4 to 7 percent of all Swiss foreign telegraphic communication.

Taken together this means that an overwhelming proportion of all telegrams going into or coming out of Switzerland were of European origin or destination. As Table 30 highlights, this could amount to as much as 99.1 percent of the entire international traffic in the years 1873 and 1874. But even at its lowest point during our period of observation, in 1913, the European share still comprised 95.6 percent. For the Swiss public, communicating internationally usually meant communicating with European partners during the late nineteenth and twentieth century. Table 30 reveals that this focus on Europe remained very stable between 1870 and 1915, while some – usually minor – shifts in the weighting of the different European countries occurred. The German share reached a high point in the late 1870s, but apart from that fluctuated only marginally. The proportions of French and Italian telegrams, however, gradually decreased, while Great Britain, Russia, and the remaining countries of Europe contributed larger shares over time. However, with the exception of the decreasing numbers of French telegrams these shifts are not dramatic.

Table 31 illustrates what already became clear in the previous paragraphs from a different perspective. It shows how much Swiss telegraphic traffic clung to Europe. While the administration statistics do contain data for several individual non-European countries, their proportions have been so small that Table 31 only gives percentages for entire continents. And even merged in this way, the shares of all continents other than Europe are minuscule. Despite the fact that Swiss companies had a sizeable interest in trade with European colonies, Asia and Africa both saw significantly less than 1 percent each of Swiss foreign telegraphic traffic. Australia and New Zealand saw so little traffic that their share is rounded down to

0 percent throughout the entire period of observation. Even the Americas – including the colonies in the Caribbean – attracted only as little as 0.3 percent of all Swiss foreign telegrams in the early 1870s. Their share increased later in the century and reached almost 3 percent shortly before the outbreak of the First World War. However, given the importance of transatlantic financial and trade relations, this proportion is interestingly low.

The relative proportions illustrated in Tables 30 and 31 make it very clear that the overwhelming part of Swiss foreign telegrams originated from or terminated in Switzerland's direct neighborhood. Only a minuscule share of all traffic reached beyond the borders of the European continent. Taken together with the fact that these figures include only border-crossing telegrams and do not consider the substantial amount of messages exchanged within Switzerland, it becomes clear that Swiss telegraph use concentrated closely on a comparatively small territory in and around the country. This emphasizes the point that, despite its power to bridge large distances in little time (and thus to seemingly annihilate space and time[53]), the technology was mainly employed for established purposes, to communicate with existing partners within well-known terrain. First and foremost, the telegraph as a means of communication had to be integrated into an established system of networks and connections – many of these were of a local or regional rather than global character. The communicational focus on Switzerland and its direct neighbors strongly emphasizes this point.

Tables 32 and 33, however, reveal that beyond all concentration on the local and regional, there has always been significant communication between Switzerland and the rest of the globe throughout the period of observation – but in relative compilation this becomes obscured by the sheer mass of internal and European telegrams. Tables 32 and 33 present the absolute numbers behind the relative shares discussed so far. Of course, in terms of communicational importance nothing changes. The neighboring countries, Great Britain and Russia saw by far the greatest number of Swiss telegrams. The absolute numbers illustrate and emphasize the rapid growth of international telegraphic communication that has already been presented. In the case of Germany, for instance, the number of telegrams exchanged with Switzerland grew from 117,652 in the year 1870 to 1,253,947 in 1914. Such impressive figures combined with a tenfold growth within the period of observation (which can also be found for the cases of Italy, Austria, and England) statistically swallowed up the comparatively insignificant communication with the rest of the world. In absolute numbers, however, the picture looks slightly differently. Table 33

53 For the origin and application of the phrase see, for instance, Iwan R. Morus, "The Nervous System of Britain: Space, Time and the Electric Telegraph in the Victorian Age," *The British Journal for the History of Science* 33(2000); Jeremy Stein, "Annihilating Space and Time: The Modernization of Fire-Fighting in Late Nineteenth Century Cornwall, Ontario," *Urban History Review* 24, no. 2 (1996); Jeremy Stein, "Reflections on Time, Time-Space Compression and Technology in the Nineteenth Century," in *Timespace. Geographies of Temporality*, ed. Jon May and Nigel Thrift (London, New York: Routledge, 2001).

shows that already in 1870 1,673 telegrams came from or went to places in Asia. The figure for Africa is 1,322. The Americas saw almost twice this amount. These are not very impressive figures when compared to the international traffic of other countries or, indeed, to Swiss internal telegraphic traffic. But they show that there has been frequent and stable telegraphic contact with non-European partners. In the case of the Americas, the number of messages increased to just below 100,000 in 1914. Asia and Africa each attracted roughly a quarter of this amount during the same year. This is a steady enough flow of messages between Switzerland and the continents to secure and expand Swiss business interest, even if it does seem small in comparison to other European powers. A comparison with the total amount of messages exchanged between Europe and Asia via submarine cable in the 1870s suggests that Switzerland contributed a fairly steady share of 2 percent of all telegrams in this regard.[54] Again, this seems to be low and insignificant – but given that the country was relatively small and had no stake in colonial administration, it shows that the Swiss business community did make good and regular use of the telegraph.

5 Conclusion

This study set out to look at the place of Switzerland in nineteenth-century communication history beyond the country's role in bringing about and hosting the International Telegraph Union. The Swiss telegraph administration was chosen to organize the Bureau International des Administrations Télégraphiques for a variety of reasons. Switzerland was ideally located at the heart of Europe. It was a small and largely non-aligning country, seemingly without much of an own stake in global communication. And at the same time, it had decided to invest in the new technology of the telegraph early on and had opened a well-integrated network to the public already in 1852. Swiss telegraph administrators and operators were well-trained and well-respected in Europe as Malcolm J. Brown, among others, aptly demonstrated during his mission to Switzerland and in his subsequent report. Therefore, Berne was a natural choice as home of the international bureau and the Swiss role in international telegraph standardization is well-worth the historiographical attention it has received. At the same time, it seems clear that the country's early investment in the technology has been a necessary prerequisite for this role and deserves a closer examination as well.

This study has accordingly looked at a number of markers regarding telegraphic development in Swit-

54 This calculation is based on data from the administration reports of the Swiss postal and telegraph services as well as on information from the British Indo-European Telegraph Department that maintained several of the submarine telegraph cables to Asia. Archives of Swiss PTT. Schweizerische Post- und Telegraphen-Statistik 1880-1915; British Library. Oriental Collections IOR/V/24/4289. Administration Report of the Indo- European Telegraph Department for 1873-74, 1874; British Library. Oriental Collections IOR/V/24/4289. Administration Report of the Indo-European Telegraph Department for 1878-79, 1879.

zerland – both from a structural and from a use perspective. It was the overall goal to test how well-developed the Swiss telegraph network was in the period of observation when compared to other European (and some non-European) countries; how it was structurally integrated in a wider European and global network; how intensively the existing infrastructure was put to use; and with which other countries across the globe the Swiss chose to communicate telegraphically. The data consulted in order to follow this research interest was largely of a quantitative nature. The greatest part of the sources came from the archives of the International Telegraph Union (today housed in Geneva) which was the only body collecting information beyond the merely national scope of the individual telegraph administrations for a long time. These sources have been complemented with data from several national or private telegraph bodies – mainly, of course, from the Swiss telegraph administration. Whenever suitable, qualitative sources have been drawn upon to cross-check and corroborate the results of the quantitative analysis.

In a first step, quantitative data on the development of several national telegraph networks in the late nineteenth and early twentieth century have been examined. Factors such as the existing length of telegraph lines and wires or the number of telegraph stations have been put into relation to the size and population of a country. As regards its structural development between 1860 and 1910, the Swiss national telegraph network boasted one of the densest and best integrated systems not only of Europe but of the world. Particularly in the early days of the technology, the relative density and accessibility of the network were exceptional. This early development also explains why network growth rates began to drop later in the century and ground was lost against countries such as France, Germany, or Great Britain. The Swiss network simply seemed to have reached saturation point in terms of its structural density. It should also be noted here that most of Switzerland's neighboring countries maintained very (France, Germany) or at least reasonably (Austria, Italy) well-developed domestic telegraph networks. The Swiss national network was thus both exceptionally well-integrated and situated at the very heart of the greater European telegraph system.

A subsequent look at the actual traffic that occurred within the Swiss network (again in comparison to other countries) corroborated the findings of the structural analysis. Like Belgium and the Netherlands, Switzerland exhibited unusually high use rates very early in the history of telegraphy – and this traffic grew heavily until the 1880s and 1890s. Only then did growth rates drop and other European powers begin to increase their telegraphic traffic faster than the Swiss (who nevertheless maintained very good use rates throughout the period of observation). This is mainly true for internal telegrams sent from place to place within Switzerland. Foreign messages, however, saw continuous growth. Put into relation to its size and population, the country transacted an incredible amount of international telegrams – and unlike the internal messages, local growth rates did not stall at the end of the nineteenth century. Ergo, while

the number of domestic messages reached saturation point in the 1880s and 1890s (a fact that confirms the structural findings), there seems to have been almost no limit to the expansion of foreign telegraphic traffic in Switzerland.

The following section assessed the place and role of the principal Swiss cities in the wider European and global telegraph network. Here, it was not the density and use of the national network that was most instructive but rather the position and function of the individual network nodes. Several social network analyses revealed that only a handful of European places occupied crucial positions in the structure – and these were mainly important metropolises, such as London, Paris, Berlin, or Vienna. Swiss cities, just like their Belgian or Dutch counterparts, played a much lesser role in this respect. Basel, Geneva, or Zurich were reasonably well-connected in Europe, but compared to bigger cities, they had next to no control over the telegraphic traffic flow. They did not function as relays. However, they tended to be closely linked to the metropolises and were able to tap into the flow of information rather easily. In combination with the analyses of national network structure and use this means that Switzerland had a very dense and heavily used domestic telegraph network early in the period of observation. However, it was too small a country to occupy a decisive position in the European and global network of the day. Its infrastructure was, however, so well-developed that it had direct connections to the information centers of the continent. Swiss telegraph customers thus enjoyed easy access to the wider network – even if Switzerland could exert little influence on flow patterns.

The final section of this study examined Swiss foreign telegraph traffic in more detail. The findings largely corroborated earlier insights, but differed in regard to Switzerland's position as an informational transit country at first glance. Throughout the period of observation Switzerland exhibits extraordinarily high levels of foreign telegrams per population. In relative terms, it is the leading country worldwide in this regard. Nowhere else were so many telegrams per capita sent to or received from other countries. By the turn of the century, Switzerland saw more foreign telegrams go over its wires than internal ones. This emphasizes once more how exceptionally well-used the Swiss structure was. While not in the absolute top position, Swiss nodes also transacted a large number of transit telegrams – many more than the relatively insignificant *betweenness* values in the social network analyses would suggest. Here seems to be a discrepancy between the findings of the structural analysis and those of the use analysis. However, once we looked closer at the origins and destinations of Swiss foreign telegrams, it became clear that an overwhelming proportion of all these messages was exchanged with the neighboring countries Germany, France, Italy, and Austria. Only a comparatively small part came from other European countries, and a minuscule portion from other continents. It seems reasonable to assume that the Swiss network structure reflected this focus on the local and regional dimension as well. It was well-integrated within its own

region and also managed to handle some transit traffic, but was not able to not play a similar role on the European, or let alone on the global level.

This brief summary of the findings of the present study identifies Switzerland as a country that was telegraphically exceptionally well-developed during the nineteenth and early twentieth century. It shows that the Swiss were very aware of the potential benefits of the technology and put it to good and frequent use. At the same time, however, it becomes clear that such use overwhelmingly focused either on Switzerland itself or on its neighboring countries. Of course, telegrams were exchanged with business partners on other continents as well – but the focus clearly rested on the local and regional level. This is not altogether surprising. Even a new and highly innovative technology such as the telegraph did not exist in a sociocultural vacuum, but had to be integrated into an established social, economic, and cultural context. In short, the telegraph was, of course, heavily used to communicate within already existing social networks. And these often had a local and regional focus. Nevertheless it seems surprising that Swiss customers over the years do not seem to have responded much to the one key quality of telegraphy – the redefinition of the relation of time and space. The benefit that could be derived from telegraphic communication was often largest when the technology was employed over great distances. The Swiss use patterns, however, do not reflect this at all. Here, we will have to take a much closer look at the telegraphic communication of, for instance, Swiss merchant houses or financiers in order to assess the reasons for this striking neglect.

6 References

6.1 Sources

Archives of Swiss PTT. Schweizerische Post- und Telegraphen-Statistik 1880-1915.

British Library. Oriental Collections IOR/V/24/4289. Administration Report of the Indo- European Telegraph Department for 1873-74, 1874.

British Library. Oriental Collections IOR/V/24/4289. Administration Report of the Indo-European Telegraph Department for 1878-79, 1879.

Bureau International de l'Union Télégraphique. "Carte Schématique Des Grandes Communications Télégraphiques Internationales Du Régime Européen." Geneva, 1923.

———. "Statistique Générale De La Télégraphie." Geneva, 1910.

Bureau International des Administrations Télégraphiques. "Carte Des Communications Telegraphiques De Régime Extra-Européen." Geneva, 1892.

———. "Carte Des Communications Télégraphiques Du Régime Extra-Européen." Geneva, 1881.

———. "Cartes Des Communications Télégraphiques Du Régime Extra-Européen." Geneva, 1902.

———. "Liste Des Communications Télégraphiques Internationales Directes Du Régime Européen. Annexe a La Carte Des Communications Télégraphiques Du Régime Européen - Édition 1906." Geneva, 1906.

———. "Statistique Générale De La Télégraphie." Geneva, 1880.

———. „Statistique Générale De La Télégraphie." Geneva, 1890.

———. "Statistique Générale De La Télégraphie." Geneva, 1900.

———. "Statistique Générale De La Télégraphie Dans Les Différents Pays De L'ancien Continent." Geneva, 1870.

———. "Statistique Générale De La Télégraphie Dans Les Différents Pays De L'ancien Continent." Geneva, 1849-1869.

Documents De La Conférence Télégraphique Internationale De Vienne. Vienne: Imprimerie Impériale et Royale de la Cour et de L'État, 1868.

"Estimates of Revenues and Expenditure under the Post Office with Returns of Staff, Accounts, Telegrams, Offices, Etc of Telegraph Companies." London, 1866-1869.

"Nomenclature Des Cables Formant Le Réseau Sous-Marin Du Globe Dressée D'après Des Documents Officiels Par Le Bureau International Des Administration Télégraphiques." *Journal Télégraphique* 3, no. 29 (1877), 575-90.

"Telegraph Systems in France, Belgium and Switzerland, by Malcolm J Brown of the GPO, with Maps." London, 1870.

"Telegraphs. Report by Mr. Scudamore on the Re-Organizarion of the Telegraph System of the United Kingdom." 1871.

6.2 Literature

Anchordoguy, Marie. "Nippon Telegraph and Telephone Company (NTT) and the Building of a Telecommunications Industry in Japan." *The Business History Review* 75, no. 3 (2001), 507-41.

Baark, Erik. *Lightning Wires: The Telegraph and China's Technological Modernization, 1860-1890*. Contributions in Asian Studies. Westport CT: Greenwood Press, 1997.

Balbi, Gabriele, Spartaco Calvo, Simone Fari, and Giuseppe Richeri. "'Bringing Together the Two Large Electric Currents That Divide Europe'. Switzerland's Role in Promoting the Creation of a Common European Telegraph Space (1849-1865)." *ICON*, no. 15 (2009), 61-80.

Bektas, Yakup. "The Sultan's Messenger: Cultural Constructions of Ottoman Telegraphy, 1847-1880." *Technology and Culture* 41, no. 4 (2000), 669-96.

Bonacich, Phillip. "Factoring and Weighting Approaches to Status Scores and Clique Identification." *Journal of Mathematical Sociology* 2 (1972), 113-20.

———. "Power and Centrality: A Family of Measures." *The American Journal of Sociology* 92, no. 5 (1987), 1170-82.

Ucinet for Windows: Software for Social Network Analysis Version 6.288. Analytic Technologies, Cambridge MA.

Carré, Patrice A. "From the Telegraph to the Telex: A History of Technology, Early Networks and Issues in France in the 19th and 20th Centuries." *Flux*, no. 11 (1993), 17-31.

Carrington, Peter J., John Scott, and Stanley Wasserman. *Models and Methods in Social Network Analysis*. Structural Analysis in the Social Sciences. Cambridge: Cambridge University Press, 2005.

Edgerton, David. "From Innovation to Use: Ten Eclectic Theses on the Historiography of Technology." *History and Technology* 16 (1999), 111-36.

Emirbayer, Mustafa, and Jeff Goodwin. "Network Analysis, Culture, and the Problem of Agency." *The American Journal of Sociology* 99, no. 6 (1994), 1411-54.

Fari, Simone. "La Telegrafia in Italia Dal 1861 Al 1866. Origini Della Rete Telegrafica Nazionale." *Archivio per la Storia Postale*, no. 14-15 (2003), 81-126.

Finn, Bernard , and Daqing Yang, eds. *Communications under the Seas. The Evolving Cable Network and Its Implications*. Cambridge MA, London: The MIT Press, 2009.

Freeman, Linton C. "Centrality in Networks: I. Conceptual Clarification." *Social Networks* 1, no. 3 (1979), 215-39.

———. *The Development of Social Network Analysis: A Study in the Sociology of Science*. Vancouver: Empirical Press, 2004.

———. "The Gatekeeper, Pair-Dependency and Structural Centrality." *Quality and Quantity* 14 (1980), 585-92.

———. *Social Network Analysis*. 4 vols London: Sage Publications, 2007.

———. "Social Network Analysis: Definition and History." In *Encyclopedia of Psychology*, edited by A. E. Kazdan, 350-51. New York: Oxford University Press, 2000.

Freeman, Linton C., Douglas R. White, and A. Kimball Romney, eds. *Research Methods in Social Network Analysis*. Fairfax: George Mason University Press, 1989.

Headrick, Daniel R. *The Invisible Weapon: Telecommunications and International Politics, 1851-1945*. New York: Oxford University Press, 1991.

Holzer, Boris. *Netzwerke*. Bielefeld: transcript, 2006.

Hugill, Peter J. *Global Communications since 1844: Geopolitics and Technology.* Baltimore: Johns Hopkins University Press, 1999.

Huurdeman, Anton A. *The Worldwide History of Telecommunications*. New York: John Wiley & Sons, Inc., 2003.

John, Richard R. *Network Nation. Inventing American Telecommunications*. Cambridge MA - London: The Belknap Press of Harvard University Press, 2010.

Kang, Ung. "The Development of the Telegraph in Korea in the Late 19th Century." *1991* 30 (1991), 161-69.

Kieve, Jeffrey L. *The Electric Telegraph: A Social and Economic History*. Newton Abbot: David & Charles, 1973.

Morus, Iwan R. "The Nervous System of Britain: Space, Time and the Electric Telegraph in the Victorian Age." *The British Journal for the History of Science* 33 (2000), 455-75.

Park, Han Woo. "Hyperlink Network Analysis: A New Method for the Study of Social Structure on the Web." *Connection* 25, no. 1 (2003), 49-61.

PTT, Generaldirektion, ed. *Hundert Jahre Elektrisches Nachrichtenwesen in der Schweiz, 1852-1952. Band 1: Telegraph*. Berne, 1952.

Reindl, Josef. "Partikularstaatliche Politik und technische Dynamik: Die drahtgebundene Telegraphie und der Deutsch-Österreichische Telegraphenverein von 1850." In *Vom Flügeltelegraphen zum Internet: Geschichte der modernen Telekommunikation*, edited by Hans-Jürgen Teuteberg and Cornelius Neutsch. 27-46. Stuttgart: Franz Steiner Verlag, 1998.

Roberts, Steven. *Distant Writing. A History of Telegraph Companies in Britain between 1838 and 1868*. 2007. http://distantwriting.co.uk/default.aspx.

Sauer, George. *The Telegraph in Europe*. Paris: Private, 1869.

Scott, John. *Social Network Analysis: A Handbook*. 2nd ed. London: Sage Publications, 2000.

Shahvar, Soli. "Concession Hunting in the Age of Reform: British Companies and the Search for Government Guarantees; Telegraph Concessions through Ottoman Territories, 1855-58." *Middle Eastern Studies* 38, no. 4 (2002), 169-93.

———. "Iron Poles, Wooden Poles: The Electric Telegraph and the Ottoman–Iranian Boundary Conflict, 1863–1865." *British Journal of Middle Eastern Studies* 34, no. 1 (2007), 23–42.

———. "Tribes and Telegraphs in Lower Iraq: The Muntafiq and the Baghdad-Basrah Telegraph Line of 1863-65." *Middle Eastern Studies* 39, no. 1 (2003), 89-116.

Stein, Jeremy. "Annihilating Space and Time: The Modernization of Fire-Fighting in Late Nineteenth Century Cornwall, Ontario." *Urban History Review* 24, no. 2 (1996), 3-11.

———. "Reflections on Time, Time-Space Compression and Technology in the Nineteenth Century." In *Timespace. Geographies of Temporality*, edited by Jon May and Nigel Thrift. 106-19. London, New York: Routledge, 2001.

Wasserman, Stanley, and Katherine Faust. *Social Network Analysis: Methods and Applications*. Structural Analysis in the Social Sciences. Cambridge MA: Cambridge University Press, 1994.

Wenzlhuemer, Roland. *Connecting the Nineteenth-Century World: The Telegraph and Globalization*. Cambridge: Cambridge University Press, 2013.

———. "The Dematerialization of Telecommunication: Communication Centres and Peripheries in Europe, 1850-1920." *Journal of Global History* 2, no. 3 (2007), 345-72.

———. "Globalization, Communication and the Concept of Space in Global History." In *Historical Social Research - Historische Sozialforschung. Global Communication: Telecommunication and Global Flows of Information in the Late 19th and Early 20th Century*, edited by Roland Wenzlhuemer. 19-47. Köln: Center for Historical Social Research, 2010.

———. "The History of Standardisation in Europe." In *Europäische Geschichte Online* (2010). http://www.ieg-ego.eu/wenzlhuemerr-2010-en.

———. "Less Than No Time: Zum Verhältnis von Telegrafie und Zeit." *Geschichte und Gesellschaft* (2011).

Winseck, Dwayne R., and Robert M. Pike. *Communication and Empire. Media, Markets, and Globalization, 1860-1930*. Durham, London: Duke University Press, 2007.

Zhou, Yongming. *Historicizing Online Politics. Telegraphy, the Internet, and Political Participation in China*. Stanford: Stanford University Press, 2006.

Appendices

1860	Lines		Wires			Stations		
	abs. (in km)	p. Area (indexed)	abs. (in km)	p. Area (indexed)	p. Pop. (indexed)	abs.	p. Area (indexed)	p. Pop. (indexed)
Austria-Hungary	12,813	69	20,152	51	57	516	57	73
Belgium	1,465	172	4,111	230	85	141	340	147
Denmark	1,635	100	4,165	122	157	47	59	89
France[a]	22,919	150	59,976	187	164	989	133	135
Germany[b]	10,894	54	27,704	65	73	793	80	104
Netherlands[a]	1,512	159	3,526	177	104	61	132	90
Norway	2,599	29	3,284	17	217	62	14	205
Portugal	2,000	77	2,750	51	75	57	45	78
Romania	2,389	68	2,509	34	49	32	19	32
Russia	17,574	3	27,049	2	34	160	1	10
Spain	7,215	49	14,557	47	91	122	17	38
Sweden	4,735	37	6,238	23	159	85	14	108
Switzerland[a]	2,886	241	4,104	163	161	145	249	284

Table 1: Domestic Telegraph Network Structure, 1860. Indexed with Selected European Average = 100.

Source: ITU Archives. Bureau International des Administrations Télégraphiques, Statistique Générale de la Télégraphie dans les Différents Pays de l'Ancien Continent, 1849-1869.

Notes: a Railway lines not included.
b "Germany" means Bavaria, Baden, the North German Confederation, and Wurttemberg.

1870	Lines		Wires			Stations		
	abs. (in km)	p. Area (indexed)	abs. (in km)	p. Area (indexed)	p. Pop. (indexed)	abs.	p. Area (indexed)	p. Pop. (indexed)
Austria	18,428	85	58,750	94	97	1,210	68	75
Belgium	4,342	226	14,153	256	105	445	283	124
Denmark	1,960	77	5,123	70	103	150	71	113
France	42,986	122	119,115	117	112	3,231	112	114
Germany	34,623	101	111,461	113	105	3,478	124	123
Gr Britain & Ireland[a]	n.a.	n.a.	112,087	191	127	4,274	255	182
Greece	1,791	55	2,021	22	50	37	14	34
Hungary	9,514	52	28,062	53	70	487	32	46
Italy	16,930	92	49,768	94	73	1,063	70	59
Netherlands	2,989	140	10,140	165	99	234	134	86
Norway	6,170	30	9,029	15	179	142	8	106
Portugal	2,888	50	5,390	32	50	118	25	41
Romania	3,319	42	4,369	19	31	65	10	17
Russia	50,664	4	102,411	3	47	704	1	12
Spain	11,601	35	26,553	28	57	197	7	16
Sweden	6,518	23	16,263	20	140	286	12	92
Switzerland	5,313	197	12,702	164	181	546	247	292
Outside Europe								
British India	24,056	9	39,497	5	7	197	1	1

Table 2: Domestic Telegraph Network Structure, 1870. Indexed with Selected European Average = 100.

Source: ITU Archives. Bureau International des Administrations Télégraphiques, Statistique Générale de la Télégraphie dans les Différents Pays de l'Ancien Continent, 1870.

Notes: a Railway lines not included. Figure for size of British population given in the *Statistique Générale* of 1870 was clearly incorrect. Figure from 1871 has been used.

1860-1910	1860-1870			1870-1880			1880-1890			1890-1900			1900-1910		
	Lin-es	Wir-es	Stat-ions	Lin-es	Wir-es	Stat-ions	Lin-es	Wir-es	Stat-ions	Lin-es	Wir-es	Stat-ions	Lin-es	Wir-es	Stat-ions
Austria	n.a.	n.a.	n.a.	7	5	8	2	2	4	-1	5	4	2	3	-2
Belgium	11	13	12	3	6	6	2	3	2	0	1	2	2	1	4
British India	n.a.	n.a.	n.a.	3	9	22	7	8	8	3	4	5	3	5	3
Denmarka	2	2	12	6	6	6	6	6	3	0	2	5	-5	-4	1
France	6	7	13	5	5	5	3	4	6	4	6	3	3	3	4
Germany[b]	12	15	16	7	9	11	6	6	6	2	1	3	5	16	6
Gr Britain & Ireland[a]	n.a.	n.a.	n.a.	n.a.	6	2	2	5	3	4	6	4	3	5	2
Hungary	n.a.	n.a.	n.a.	4	6	7	4	4	6	1	4	6	1	2	3
Italy	n.a.	n.a.	n.a.	4	6	8	4	5	6	2	2	4	1	2	3
Japan	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	6	8	5	8	12	17	3	4	10
Luxembourg	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	5	11	4	7	2	6	-3	0	6
Netherlands	7	11	14	2	3	5	3	3	7	2	2	3	2	5	3
Norway	9	11	9	3	6	6	1	1	4	3	9	9	n.a.	n.a.	n.a.
Portugal	4	7	8	4	7	5	5	3	7	2	2	1	n.a.	n.a.	n.a.
Romania	3	6	7	5	7	12	1	4	6	2	4	5	0	1	18
Russia	11	14	16	6	8	14	3	3	4	3	5	4	2	4	4
Spain	5	6	5	4	4	6	8	8	12	-1	-1	3	3	2	2
Sweden	3	10	13	6	6	11	1	2	3	2	2	8	3	4	3
Switzerland	6	12	14	2	2	7	2	5	2	1	4	4	0	2	1

Table 3: Average Annual Growth Rates of Domestic Telegraph Network Structures, 1860-1910.

Source: ITU Archives. Bureau International des Administrations Télégraphiques, Statistique Générale de la Télégraphie dans les Différents Pays de l'Ancien Continent, 1849-1869; ITU Archives. Bureau International des Administrations Télégraphiques, Statistique Générale de la Télégraphie dans les Différents Pays de l'Ancien Continent, 1870; ITU Archives. Bureau International des Administrations Télégraphiques, Statistique Générale de la Télégraphie, 1880; ITU Archives. Bureau International des Administrations Télégraphiques, Statistique Générale de la Télégraphie, 1890; ITU Archives. Bureau International des Administrations Télégraphiques, Statistique Générale de la Télégraphie, 1900; ITU Archives. Bureau International de l'Union Télégraphique, Statistique Générale de la Télégraphie, 1910.

Notes: a In 1910 railway lines not included.
b In 1860, "Germany" means Bavaria, Baden, the North German Confederation, and Wurttemberg

1880	Lines		Wires			Stations		
	abs. (in km)	p. Area (indexed)	abs. (in km)	p. Area (indexed)	p. Pop. (indexed)	abs.	p. Area (indexed)	p. Pop. (indexed)
Austria	35,056	120	91,712	97	96	2,554	80	82
Belgium	5,608	196	26,153	283	109	772	248	99
Bosnia-Herzegovina[a]	1,986	36	2,820	16	56	67	11	41
Bulgaria	2,094	35	3,062	16	35	32	5	11
Denmark	3,528	92	9,345	76	109	281	67	100
France	69,030	134	200,420	121	125	5,476	98	105
Germany	70,826	135	255,859	151	131	10,021	176	157
Gr Britain & Ireland[b]	42,347	138	194,772	197	130	5,443	163	112
Greece	3,573	73	4,580	29	63	88	17	37
Hungary	14,569	47	52,227	52	78	996	29	46
Italy[c]	26,280	91	85,900	92	70	2,324	74	58
Luxembourg	310	123	536	66	60	63	230	218
Netherlands	3,821	119	13,817	133	79	396	113	69
Norway	8,679	28	15,975	16	197	249	7	94
Portugal[d]	4,369	50	10,889	38	59	196	21	32
Romania	5,209	33	8,280	16	38	203	12	29
Russia	94,533	4	215,253	3	55	2,621	1	21
Serbia	2,180	46	3,135	21	43	62	12	26
Spain	16,474	33	40,978	26	56	365	7	15
Sweden	11,520	27	29,440	21	149	784	17	122
Switzerland	6,555	163	16,017	123	131	1,108	253	277
Outside Europe								
Algeria	6,591	43	12,226	25	82	175	10	36
Brazil	18,708	2	27,012	1	52	373	0	22
British India	32,554	8	89,740	7	9	1,437	3	4
Cochinchina	1,535	30	1,732	10	26	32	6	15
Dutch Indies	5,862	4	7,412	1	7	80	0	2
Egypt	8,339	8	13,699	4	57	164	2	21
Japan	7,527	18	17,135	13	11	221	5	4
New Zealand	6,220	40	15,428	31	735	227	13	331
Victoria	5,209	23	9,807	14	261	284	12	232
Western Union	177,537	23	526,418	21	241	10,737	13	151

Table 4: Domestic Telegraph Network Structure, 1880. Indexed with Selected European Average = 100.

Source: ITU Archives. Bureau International des Administrations Télégraphiques, Statistique Générale de la Télégraphie, 1880.

Notes: a Railway lines not included.
b Railway lines not included, submarine telegraph stations not included.
c 361 stations reserved for government use not included.
d Railway and private lines not included.

1890	Lines		Wires			Stations		
	abs. (in km)	p. Area (indexed)	abs. (in km)	p. Area (indexed)	p. Pop. (indexed)	abs.	p. Area (indexed)	p. Pop. (indexed)
Austria	42,249	102	112,944	81	78	3,781	80	80
Belgium	7,116	175	35,165	255	95	942	202	78
Bosnia-Herzegovina	2,809	40	5,966	25	73	103	13	39
Bulgaria	4,583	34	7,855	17	41	143	9	23
Denmark	6,062	114	17,057	95	129	373	62	86
France	96,632	132	305,461	124	131	9,729	116	128
Germany	130,692	175	444,676	176	147	17,454	205	177
Gr Britain & Ireland[a]	50,918	117	310,899	211	135	7,627	153	101
Greece	7,501	85	8,919	30	66	178	18	40
Hungary	21,014	47	75,221	50	71	1,844	36	53
Italy[b]	38,234	93	136,367	98	75	4,031	86	68
Luxembourg	505	141	1,567	130	122	95	232	226
Netherlands	5,243	115	18,283	118	66	754	144	83
Norway	9,170	21	17,175	11	141	354	7	89
Portugal[c]	6,830	55	14,663	35	56	395	28	46
Romania	5,490	25	11,796	16	38	381	15	38
Russia	125,522	4	296,753	3	45	3,885	1	18
Serbia	2,958	44	4,961	22	38	120	16	28
Spain	35,031	50	85,299	36	79	1,138	14	32
Sweden	12,241	20	36,108	17	124	1,011	14	106
Switzerland	8,339	145	25,473	132	143	1,384	211	238
Outside Europe								
Algeria	6,890	8	15,946	6	68	356	4	47
British India	63,521	13	194,085	12	13	3,103	6	6
Cochinchina	2,448	7	3,813	3	24	70	2	13
Cuba	3,548	22	5,354	10	54	167	9	51
Dutch Indies[d]	7,773	3	10,045	1	6	265	1	5
Japan	12,883	24	36,598	20	15	345	6	4
New Zealand	8,470	23	20,883	17	512	520	12	391
Philippines	2,301	6	2,762	2	7	63	1	5
Porto-Rico	778	60	1,082	25	22	38	26	24
South Australia	8,996	3	19,484	2	964	218	1	331
The Senegal	4,795	11	5,661	4	n.a.	33	1	n.a.
Tunisia	3,063	17	4,883	8	53	63	3	21
Victoria	6,437	20	14,034	13	229	733	20	366
Western Union[e]	302,649	28	1,152,101	32	298	20,098	16	159

Table 5: Domestic Telegraph Network Structure, 1890. Selected European Average = 100.
Source: ITU Archives. Bureau International des Administrations Télégraphiques, Statistique Générale de la Télégraphie, 1890.

Notes:
a Railway lines not included, submarine telegraph stations not included.
b 422 stations reserved for government use not included.
c Railway and private lines not included.
d Railway lines not included.
e Figure for size of US American population not given in the Statistique Générale of 1890. Averages of 1880 and 1901 have been used.

1900	Lines		Wires			Stations		
	abs. (in km)	p. Area (indexed)	abs. (in km)	p. Area (indexed)	p. Pop. (indexed)	abs.	p. Area (indexed)	p. Pop. (indexed)
Austria	39,405	85	176,651	99	93	5,463	82	76
Belgium	6,788	149	37,159	213	75	1,128	172	60
Bosnia-Herzegovina	2,870	36	7,481	25	65	125	11	29
Bulgaria	5,182	34	10,858	19	40	228	10	22
Denmark	5,784	97	20,030	88	112	626	73	93
France	140,713	170	529,317	167	188	13,078	109	123
Germany	165,490	198	474,820	148	116	24,471	203	158
Gr Britain & Ireland[a]	73,725	151	556,421	298	186	11,512	164	102
Hungary	22,824	46	114,741	60	90	3,256	45	68
Italy[b]	44,957	101	168,787	99	73	5,890	92	68
Luxembourg	979	244	1,986	129	115	170	294	261
Montenegro	552	36	688	12	31	21	9	25
Netherlands	6,165	120	22,884	117	61	1,003	136	70
Norway	12,010	24	41,700	22	265	831	12	140
Portugal[c]	8,345	59	18,453	34	50	443	22	32
Romania	6,996	28	18,110	19	46	613	17	41
Russia	165,158	5	497,562	4	53	5,789	1	16
Spain	32,494	42	75,578	25	57	1,491	13	30
Sweden	15,218	22	42,412	16	113	2,117	21	150
Switzerland	9,178	143	36,137	147	150	2,108	228	231
Outside Europe								
Algeria	10,182	11	28,614	8	82	516	4	39
Angola	2,275	1	2,293	0	2	28	0	1
Brazil	23,686	2	44,645	1	34	1,603	1	32
British India	88,562	15	291,487	13	14	5,178	6	6
Cochinchina	4,307	9	6,757	4	22	98	1	8
Dutch Indies[d]	8,784	3	12,985	1	5	421	1	5
Japan	27,478	46	112,324	50	34	1,645	19	13
Natal	2,291	27	5,844	18	134	148	12	90
New Caledonia	928	31	1,799	16	397	35	8	205
New South Wales	22,648	18	66,816	14	670	961	5	255
New Zealand	12,123	29	33,751	21	562	991	16	438
Portuguese Indies	95	16	95	4	2	5	6	3
The Senegal	2,241	6	2,666	2	32	34	1	11
Tunisia	3,893	19	8,864	12	81	116	4	28
Victoria	10,310	29	21,426	16	245	445	9	135
Western Union	312,057	26	1,531,517	33	275	22,954	13	109

Table 6: Domestic Telegraph Network Structure, 1900. Selected European Average = 100.
Source: ITU Archives. Bureau International des Administrations Télégraphiques, Statistique Générale de la Télégraphie, 1900.

Notes: a Railway lines not included, submarine telegraph stations not included.
b 510 stations reserved for government use not included.
c Railway and private lines not included.
d Railway lines not included.

1910	Lines		Wires			Stations		
	abs. (in km)	p. Area (indexed)	abs. (in km)	p. Area (indexed)	p. Pop. (indexed)	abs.	p. Area (indexed)	p. Pop. (indexed)
Austria	46,952	83	235,493	81	81	4,520	46	44
Belgium	7,880	141	42,378	148	56	1,634	171	60
Bosnia-Herzegovina	3,231	33	7,374	15	46	173	10	30
Bulgaria	5,935	33	12,760	14	29	350	11	22
Denmark[a]	3,644	49	12,842	34	46	709	56	71
France	182,794	180	690,636	132	174	20,303	117	142
Germany	274,593	268	2,050,332	389	312	45,116	257	191
Gr Britain & Ireland[a]	98,625	165	931,532	304	205	13,959	137	85
Greece[a]	8,130	67	15,555	25	58	624	30	65
Hungary	25,068	41	144,124	46	68	4,592	44	61
Italy	49,443	91	203,711	73	61	7,664	82	64
Luxembourg	701	142	2,061	81	78	316	375	332
Netherlands	7,526	120	36,884	114	62	1,393	130	65
Romania	7,321	29	20,841	16	30	3,127	73	124
Russia	199,502	5	705,752	3	47	8,423	1	15
Serbia	4,350	48	8,289	18	28	208	13	20
Spain	42,935	45	92,109	19	49	1,902	12	28
Sweden	19,785	23	59,915	14	107	2,849	20	142
Switzerland	9,444	121	43,516	108	115	2,361	176	173
Outside Europe								
Algeria	15,199	17	39,652	8	75	720	5	38
Bolivia[b]	5,007	2	6,683	0	29	154	0	19
British India	121,237	17	472,269	13	15	7,265	6	6
Cochinchina[a]	14,086	9	24,434	3	12	362	1	5
Dutch Indies	15,167	4	22,479	1	6	598	1	4
Japan	38,022	52	169,265	45	33	4,268	34	23
New South Wales	23,676	16	48,489	6	292	1,399	5	234
New Zealand	18,893	37	60,569	23	563	1,963	22	508
Queensland	17,015	5	36,869	2	610	607	1	280
Siam	7,285	7	10,628	2	15	135	1	5
South Australia	9,112	2	22,633	1	547	376	0	253
Tasmania	3,363	26	5,754	9	304	262	12	385
The Senegal	2,325	5	4,084	2	35	53	1	13
Tunisia	4,630	19	16,004	13	82	204	5	29
Union of Sth. Africa	22,246	15	81,336	11	151	1,282	5	66
Victoria	11,491	27	26,248	12	200	1,374	19	291
Western Australia	11,112	2	18,215	1	618	334	0	315

Table 7: Domestic Telegraph Network Structure, 1910. Selected European Average = 100.
Source: ITU Archives. Bureau International de l'Union Télégraphique, Statistique Générale de la Télégraphie, 1910.
Notes: a Railway lines not included.
b Data for 1910 not available. Data for 1909 has been used.

1860	Internal		External		Total	
	abs.	p. Pop. (indexed)	abs.	p. Pop. (indexed)	abs.	p. Pop. (indexed)
Austria-Hungary	491,119	56	222,233	30	713,352	42
Belgium	80,216	68	145,603	146	225,819	98
Denmark	75,044	115	70,957	129	146,001	115
France	568,365	63	408,916	54	977,281	56
Germany[a]	425,096	45	572,848	73	997,944	55
Netherlands	198,078	237	215,367	307	413,445	255
Norway	107,061	287	25,934	83	132,995	184
Portugal	45,776	51	16,224	22	62,000	36
Romania[b]	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Russia	303,008	15	98,471	6	401,479	11
Spain	259,909	66	47,446	14	307,355	40
Sweden	113,126	117	53,187	65	166,313	89
Switzerland[c]	208,311	332	95,619	181	303,930	249

Table 8: Domestic Telegraph Network Use, 1860. Indexed with Selected European Average = 100.

Source: ITU Archives. Bureau International des Administrations Télégraphiques, Statistique Générale de la Télégraphie dans les Différents Pays de l'Ancien Continent, 1849-1869.

Notes: a "Germany" means Bavaria, Baden, North German Confederation, and Wurttemberg. Therefore, the figures of external messages are inflated.
b Not included in Selected European Average in all categories of external messages.
c Not included in Selected European Average in external messages sent and received.

1860-1910	1860-1870			1870-1880			1880-1890			1890-1900			1900-1910		
	Int.	Ext.	Tot.[a]	Int.	Ext.	Tot.[a]	Int.	Ext.	Tot.[a]	Int.	Ext.	Tot.[a]	Int.	Ext.	Tot.[a]
Austria	n.a.	n.a.	n.a.	6	3	4	2	8	5	7	4	5	2	5	3
Belgium	33	16	24	4	8	6	3	7	4	2	2	2	1	4	2
British India	n.a.	n.a.	n.a.	11	17	12	8	5	7	7	6	7	8	5	8
Denmark	11	15	13	8	8	8	2	4	3	2	5	4	3	5	4
France	24	14	21	12	8	11	7	7	7	3	2	3	2	4	2
Germany[b]	29	21	25	7	2	6	5	6	5	6	4	5	1	5	2
Gr Britain & Ireland	n.a.	n.a.	n.a.	n.a.	n.a.	12	9	7	9	3	3	3	-1	4	0
Hungary	n.a.	n.a.	n.a.	3	25	8	4	4	4	6	4	5	5	5	5
Italy	n.a.	n.a.	n.a.	12	5	11	3	3	3	2	4	2	4	3	3
Japan	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	8	15	8	13	17	14	6	9	6
Luxembourg	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	-2	5	3	5	7	6	-1	2	1
Netherlands	19	13	16	6	5	5	1	6	3	3	2	2	0	3	2
Norway	10	22	14	6	5	6	7	5	7	3	5	4	n.a.	n.a.	n.a.
Portugal	14	15	14	9	14	11	6	10	8	2	5	3	n.a.	n.a.	n.a.
Romania	n.a.	n.a.	n.a.	5	5	5	3	4	4	5	4	5	4	8	5
Russia	21	17	20	11	8	10	4	4	4	6	5	6	6	7	6
Spain	12	16	12	7	9	8	7	8	7	2	1	1	1	6	2
Sweden	14	15	14	5	7	6	5	6	5	3	5	3	2	6	4
Switzerland	18	18	18	4	7	5	1	5	3	-2	3	1	0	5	4

Table 9: Average Annual Growth Rates of Domestic Telegraph Network Use, 1860-1910.

Source: ITU Archives. Bureau International des Administrations Télégraphiques, Statistique Générale de la Télégraphie dans les Différents Pays de l'Ancien Continent, 1849-1869; ITU Archives. Bureau International des Administrations Télégraphiques, Statistique Générale de la Télégraphie dans les Différents Pays de l'Ancien Continent, 1870; ITU Archives. Bureau International des Administrations Télégraphiques, Statistique Générale de la Télégraphie, 1880; ITU Archives. Bureau International des Administrations Télégraphiques, Statistique Générale de la Télégraphie, 1890; ITU Archives. Bureau International des Administrations Télégraphiques, Statistique Générale de la Télégraphie, 1900; ITU Archives. Bureau International de l'Union Télégraphique, Statistique Générale de la Télégraphie, 1910.

Notes: a Total number of messages excluding service messages.
b In 1860, "Germany" means Bavaria, Baden, the North German Confederation, and Wurttemberg

1870	Internal		External		Total	
	abs.	p. Pop. (indexed)	abs.	p. Pop. (indexed)	abs.	p. Pop. (indexed)
Austria	1,923,442	53	1,545,923	77	3,469,365	62
Belgium	1,343,118	166	655,294	147	1,998,412	159
Denmark	218,832	73	294,791	178	513,623	111
France	5,042,302	79	1,557,198	44	6,599,500	67
Germany	5,495,539	87	3,727,400	106	9,222,939	94
Gr Britain & Ireland[a]	n.a.	n.a.	n.a.	n.a.	9,837,920	120
Greece	107,090	44	16,204	12	123,294	33
Hungary	1,225,706	51	130,582	10	1,356,288	37
Italy	1,790,185	44	725,453	32	2,515,638	40
Netherlands	1,105,621	181	732,141	217	1,837,762	194
Norway	285,632	94	186,258	111	471,890	100
Portugal	172,399	27	67,466	19	239,865	24
Romania	432,892	52	159,862	35	592,754	46
Russia	2,103,367	16	473,491	7	2,576,858	13
Spain	775,862	28	214,606	14	990,468	23
Sweden	417,128	60	224,325	58	641,453	59
Switzerland	1,132,029	270	497,206	214	1,629,235	250
Outside Europe						
British India	486,276	1	62,329	0	548,605	1

Table 10: Domestic Telegraph Network Use, 1870. Indexed with Selected European Average = 100.

Source: ITU Archives. Bureau International des Administrations Télégraphiques, Statistique Générale de la Télégraphie dans les Différents Pays de l'Ancien Continent, 1870.

Notes: a Railway lines not included. Figure for size of British population given in the Statistique Générale of 1870 was clearly incorrect. Figure from 1871 has been used.

1880	Internal		External		Total	
	abs.	p. Pop. (indexed)	abs.	p. Pop. (indexed)	abs.	p. Pop. (indexed)
Austria	3,307,776	55	1,999,372	56	5,307,148	55
Belgium	2,031,426	134	1,392,389	157	3,423,815	143
Bosnia-Herzegovina	175,824	56	5,067	3	180,891	36
Bulgaria	147,491	27	48,755	15	196,246	23
Denmark	464,379	86	644,394	203	1,108,773	129
France	15,864,298	157	3,393,330	57	19,257,628	120
Germany	11,313,443	92	4,474,860	62	15,788,303	81
Gr Britain & Ireland	25,913,534	275	3,906,911	71	29,820,445	200
Greece	293,928	64	103,407	38	397,335	55
Hungary	1,587,107	38	1,254,836	51	2,841,943	43
Italy	5,693,832	74	1,173,623	26	6,867,455	56
Luxembourg	26,150	47	44,272	135	70,422	79
Netherlands	1,915,349	173	1,167,368	179	3,082,717	175
Norway	491,929	96	316,337	106	808,266	100
Portugal	423,937	36	253,417	37	677,354	36
Romania	685,642	50	252,398	31	938,040	43
Russia	5,796,268	24	1,065,427	7	6,861,695	18
Serbia	152,372	33	56,567	21	208,939	28
Spain[a]	1,593,562	35	488,417	18	2,081,979	28
Sweden	686,862	55	450,224	61	1,137,086	57
Switzerland	1,751,018	226	1,016,220	224	2,767,238	225
Outside Europe						
Algeria	934,305	99	257,943	47	1,192,248	80
Brazil	286,558	9	10,083	1	296,641	6
British India	1,360,894	2	297,753	1	1,658,647	2
Cochinchina	39,613	9	9,792	4	49,405	7
Dutch Indies	333,339	5	58,118	2	391,457	4
Egypt	238,800	16	19,474	2	258,274	11
Japan	1,830,578	19	24,155	0	1,854,733	12
New Zealand	1,304,712	985	24,492	32	1,329,204	632
Victoria	1,160,912	490	9,503	7	1,170,415	311
Western Union	n.a.	n.a.	n.a.	n.a.	32,500,000	149

Table 11: Domestic Telegraph Network Use, 1880. Indexed with Selected European Average = 100.

Source: ITU Archives. Bureau International des Administrations Télégraphiques, Statistique Générale de la Télégraphie, 1880.

Notes: a Not included in Selected European Average in all categories of external messages.

1890	Internal		External		Total	
	abs.	p. Pop. (indexed)	abs.	p. Pop. (indexed)	abs.	p. Pop. (indexed)
Austria	4,073,214	48	4,308,306	69	8,381,520	57
Belgium	2,661,173	123	2,651,172	167	5,312,345	141
Bosnia-Herzegovina	98,376	21	169,553	49	267,929	33
Bulgaria	623,186	55	159,751	19	782,937	40
Denmark	567,224	73	948,399	168	1,515,623	113
France	29,902,041	220	6,680,242	67	36,582,283	155
Germany	18,403,223	104	8,207,475	64	26,610,698	87
Gr Britain & Ireland	60,991,188	453	7,630,929	78	68,622,117	295
Greece	808,220	102	276,045	48	1,084,265	79
Hungary	2,297,289	37	1,900,022	42	4,197,311	39
Italy	7,944,132	75	1,626,613	21	9,570,745	52
Luxembourg	21,774	29	69,336	126	91,110	70
Netherlands	2,185,116	134	2,100,400	177	4,285,516	152
Norway	1,008,105	141	523,927	101	1,532,032	124
Portugal	745,156	49	673,491	60	1,418,647	54
Romania	964,742	54	388,486	30	1,353,228	44
Russia	8,761,896	23	1,594,712	6	10,356,608	15
Serbia	493,165	64	122,843	22	616,008	46
Spain	3,191,428	51	1,098,388	24	4,289,816	39
Sweden	1,145,088	67	793,869	64	1,938,957	66
Switzerland	1,965,862	189	1,730,126	228	3,695,988	205
Outside Europe						
Algeria	1,297,050	95	60,792	6	1,357,842	58
British India	2,920,025	3	489,636	1	3,409,661	2
Cochinchina	122,215	13	26,779	4	148,994	9
Cuba	260,318	45	125,190	29	385,508	38
Dutch Indies[a]	349,099	3	128,846	2	477,945	3
Japan	4,040,901	28	98,036	1	4,138,937	17
New Zealand	1,939,889	815	47,277	27	1,987,166	483
Philippines	116,963	5	21,285	1	138,248	3
Porto-Rico	121,364	42	16,629	8	137,993	28
South Australia	1,001,216	849	67,066	78	1,068,282	523
The Senegal	55,456	n.a.	5,991	n.a.	61,447	n.a.
Tunisia	195,915	37	175,320	45	371,235	40
Victoria	2,594,565	724	438,327	168	3,032,892	489
Western Union	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.

Table 12: Domestic Telegraph Network Use, 1890. Indexed with Selected European Average = 100.

Source: ITU Archives. Bureau International des Administrations Télégraphiques, Statistique Générale de la Télégraphie, 1890.

Notes: a Railway and private messages not included.

1900	Internal		External		Total	
	abs.	p. Pop. (indexed)	abs.	p. Pop. (indexed)	abs.	p. Pop. (indexed)
Austria	7,876,866	70	6,381,316	75	14,258,182	72
Belgium	3,377,910	115	3,358,577	152	6,736,487	131
Bosnia-Herzegovina	165,152	24	368,193	72	533,345	45
Bulgaria	988,027	61	181,945	15	1,169,972	41
Denmark	662,979	63	1,504,211	189	2,167,190	117
France	40,947,137	247	7,788,021	62	48,735,158	168
Germany	32,452,383	134	12,282,253	67	44,734,636	105
Gr Britain & Ireland	81,935,871	464	10,712,466	81	92,648,337	299
Hungary	4,155,909	55	2,828,458	50	6,984,367	53
Italy	9,640,392	71	2,345,224	23	11,985,616	50
Luxembourg	37,134	36	132,212	172	169,346	95
Montenegro	57,934	45	20,744	21	78,678	35
Netherlands	2,799,910	125	2,593,962	154	5,393,872	138
Norway	1,359,323	146	835,274	120	2,194,597	135
Portugal	878,974	40	1,075,613	66	1,954,587	51
Romania	1,544,744	66	577,940	33	2,122,684	52
Russia	15,497,255	28	2,651,601	6	18,148,856	19
Spain	3,779,389	48	1,177,643	20	4,957,032	36
Sweden	1,476,137	67	1,253,471	75	2,729,608	70
Switzerland	1,577,974	110	2,372,188	221	3,950,162	158
Outside Europe						
Algeria	2,017,984	98	59,549	4	2,077,533	58
Angola	14,554	0	278	0	14,832	0
Brazil	1,256,225	16	43,778	1	1,300,003	10
British India	5,562,301	4	899,977	1	6,462,278	3
Cochinchina	329,648	18	71,938	5	401,586	12
Dutch Indies	393,460	3	293,178	3	686,638	3
Japan	14,280,230	73	476,672	3	14,756,902	43
Natal	2,324,833	901	64,782	33	2,389,615	529
New Caledonia	50,160	187	5,670	28	55,830	119
New South Wales	2,060,632	349	1,159,275	261	3,219,907	312
New Zealand	3,898,128	1,099	122,576	46	4,020,704	647
Portuguese Indies	3,868	2	7,660	4	11,528	3
The Senegal	96,897	20	9,542	3	106,439	12
Tunisia	262,715	41	395,858	81	658,573	58
Victoria	1,522,642	295	297,394	77	1,820,036	201
Western Union	62,269,777	189	1,650,000	7	63,919,777	111

Table 13: Domestic Telegraph Network Use, 1900. Indexed with Selected European Average = 100.

Source: ITU Archives. Bureau International des Administrations Télégraphiques, Statistique Générale de la Télégraphie, 1900.

1910	Internal		External		Total	
	abs.	p. Pop. (indexed)	abs.	p. Pop. (indexed)	abs.	p. Pop. (indexed)
Austria	9,441,332	70	10,035,115	77	19,476,447	73
Belgium	3,849,346	109	4,760,250	139	8,609,596	123
Bosnia-Herzegovina	291,087	39	581,653	81	872,740	60
Bulgaria	1,483,246	73	365,963	19	1,849,209	46
Denmark	928,178	71	2,373,684	188	3,301,862	129
France	50,725,853	274	11,075,720	62	61,801,573	170
Germany	37,127,560	121	20,052,730	68	57,180,290	95
Gr Britain & Ireland	76,029,000	358	15,585,000	76	91,614,000	219
Greece	1,388,623	112	423,112	35	1,811,735	74
Hungary	6,674,860	68	4,722,028	50	11,396,888	59
Italy	13,599,363	87	3,254,240	22	16,853,603	55
Luxembourg	32,048	26	164,342	137	196,390	81
Netherlands	2,905,686	104	3,631,544	135	6,537,230	119
Romania	2,336,936	71	1,213,940	38	3,550,876	55
Russia	27,301,972	39	5,447,271	8	32,749,243	24
Serbia	532,241	39	378,118	28	910,359	34
Spain	4,244,380	48	2,031,070	24	6,275,450	36
Sweden	1,845,777	71	2,241,242	89	4,087,019	80
Switzerland	1,633,093	92	3,975,447	232	5,608,540	161
Outside Europe						
Algeria	2,529,965	103	121,653	5	2,651,618	55
Bolivia[a]	n.a.	n.a.	n.a.	n.a.	246,223	12
British India	11,950,618	8	1,417,094	1	13,367,712	5
Cochinchina	1,039,363	11	105,529	1	1,144,892	6
Dutch Indies	930,837	5	319,667	2	1,250,504	4
Japan	25,018,389	105	1,115,285	5	26,133,674	56
New South Wales	3,947,908	509	2,284,926	304	6,232,834	408
New Zealand	8,360,647	1,668	238,142	49	8,598,789	871
Queensland	2,061,420	732	213,326	78	2,274,746	410
Siam	280,252	8	151,421	5	431,673	7
South Australia	1,629,631	845	258,083	138	1,887,714	497
Tasmania	279,533	317	315,307	369	594,840	342
The Senegal	250,237	46	37,620	7	287,857	27
Tunisia	356,309	39	603,381	69	959,690	54
Union of Sth. Africa	4,851,924	193	269,865	11	5,121,789	103
Victoria	1,993,019	325	1,861,960	314	3,854,979	319
Western Australia	1,369,879	996	30,382	23	1,400,261	517

Table 14: Domestic Telegraph Network Use, 1910. Indexed with Selected European Average = 100.

Source: ITU Archives. Bureau International de l'Union Télégraphique, Statistique Générale de la Télégraphie, 1910.

Notes: a Data for 1910 not available. Data for 1909 has been used.

Degree		
No.	Node	*Degree*
1	London (Londres)	45
2	Berlin	37
3	Wien (Vienne)	34
4	Paris	33
5	Hamburg	20
6	Budapest	18
7	Milano (Milan)	16
8	Anvers	15
9	Cöln (Cologne)	15
10	Amsterdam	14
11	Basel (Bâle)	13
12	München (Munich)	13
13	Göteborg (Gothembourg)	12
14	Zágráb	12
15	Frankfurt/Main	12
16	Sarajevo	11
17	Krakau (Cracovie)	11
18	Bucuresti (Bucarest)	10
19	Emden	10
20	Roma (Rome)	10
21	Innsbruck	10
22	Kattowitz	9
23	Triest	9
24	Arendal	9
25	Bruxelles	9
26	Fredericia	9
27	Kjöbenhavn (Copenhague)	9
28	Genève	9
29	Rotterdam	9
30	Marseille	8
31	Gibraltar	8
32	Öresund	8
33	Sofia	8
34	Varsovie	8
35	Breslau	8
36	Czernowitz	8
37	Le Havre	8
38	Prag (Prague)	8

Table 15: Freeman *Degree* Centrality in the European Telegraph Network, 1906.
Source: ITU Archives. Bureau International des Administrations Télégraphiques, Liste des Communications Télégraphiques Internationales Directes du Régime Européen. Annexe a la Carte des Communications Télégraphiques du Régime Européen – Édition 1906, 1906.
Notes: All place names reflect the language, spelling, etc. in the original source.

Betweenness			
No.	Node	*Betweenness*	*nBetweenness*
1	Wien (Vienne)	44471.262	22.374
2	Berlin	34883.98	17.55
3	Paris	25068.402	12.612
4	London (Londres)	17776.352	8.943
5	Budapest	14206.766	7.148
6	Breslau	12474.142	6.276
7	Milano (Milan)	10688.358	5.377
8	München (Munich)	9858.125	4.96
9	Sarajevo	9577.891	4.819
10	Dresden	8623.071	4.338
11	Königsberg	7632.583	3.84
12	Hamburg	7542.363	3.795
13	Krakau (Cracovie)	7369.183	3.707
14	Cöln (Cologne)	7009.58	3.527
15	Varsovie	6393.587	3.217
16	Bucuresti (Bucarest)	6276.779	3.158
17	Emden	5570.503	2.803
18	Genève	5382.297	2.708
19	Innsbruck	5378.987	2.706
20	Metz	5302.785	2.668
21	Bordeaux	5140.167	2.586
22	Prag (Prague)	5046.236	2.539
23	Danzig	4780	2.405
24	Vigo	4731.53	2.38
25	Chur (Coire)	4581.939	2.305
26	St. Pétersbourg	4558.744	2.294
27	Roma (Rome)	4462.905	2.245
28	Czernowitz	4343	2.185
29	Constantinople	4335.837	2.181
30	Strassburg	4326.333	2.177
31	Alexandrow	4326	2.176
32	Oppeln	4311	2.169
33	Marseille	3981.664	2.003
34	Anvers	3914.618	1.969
35	Basel (Bâle)	3864.857	1.944
36	Ratibor	3847	1.935
37	Splügen	3840	1.932
38	Riga	3789.529	1.907
39	Sofia	3761.565	1.892
40	Salzburg	3684.057	1.853

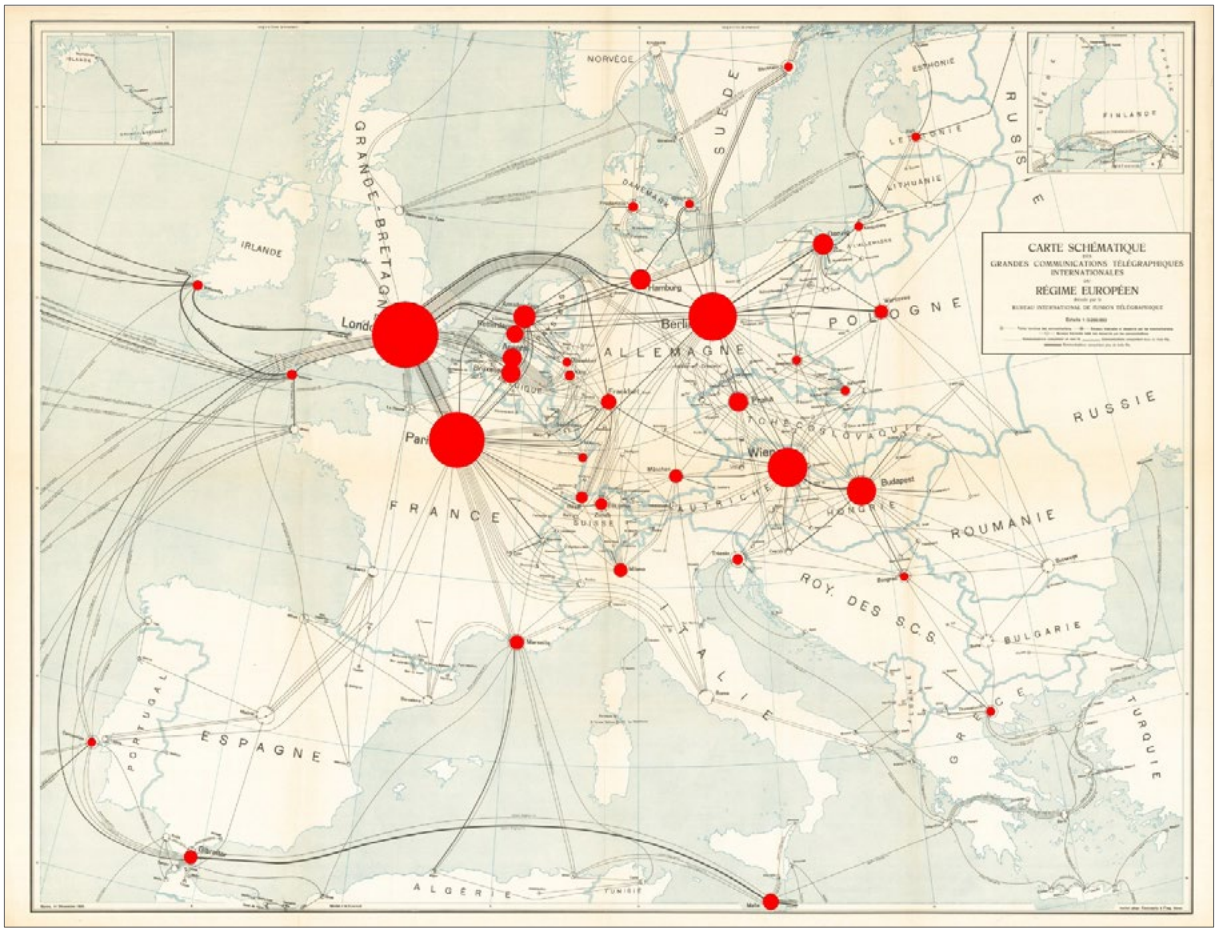
Table 16: Freeman *Betweenness* Centrality in the European Telegraph Network, 1906.
Source: ITU Archives. Bureau International des Administrations Télégraphiques, Liste des Communications Télégraphiques Internationales Directes du Régime Européen. Annexe a la Carte des Communications Télégraphiques du Régime Européen – Édition 1906, 1906.
Notes: All place names reflect the language, spelling, etc. in the original source.

Eigenvector			
No.	Node	*Eigenvector*	*nEigenvector*
1	London (Londres)	-0.445	-62.929
2	Berlin	-0.342	-48.352
3	Paris	-0.296	-41.929
4	Wien (Vienne)	-0.222	-31.424
5	Hamburg	-0.214	-30.238
6	Budapest	-0.207	-29.218
7	Amsterdam	-0.203	-28.746
8	Frankfurt/Main	-0.189	-26.773
9	Cöln (Cologne)	-0.174	-24.601
10	Anvers	-0.172	-24.353
11	Milano (Milan)	-0.171	-24.158
12	Rotterdam	-0.168	-23.716
13	Emden	-0.151	-21.289
14	Roma (Rome)	-0.15	-21.237
15	Bruxelles	-0.142	-20.07
16	Zürich	-0.121	-17.087
17	Basel (Bâle)	-0.116	-16.438
18	Genova (Gênes)	-0.111	-15.706
19	Le Havre	-0.1	-14.195
20	Bucuresti (Bucarest)	-0.099	-13.962
21	München (Munich)	-0.093	-13.177
22	Varsovie	-0.087	-12.286
23	Liverpool	-0.083	-11.799
24	Krakau (Cracovie)	-0.081	-11.437
25	Odessa	-0.077	-10.933
26	Prag (Prague)	-0.075	-10.61
27	Göteborg (Gothembourg)	-0.072	-10.232
28	Arendal	-0.072	-10.226
29	Innsbruck	-0.062	-8.736
30	Lille	-0.061	-8.567
31	Marseille	-0.061	-8.566
32	Bordeaux	-0.059	-8.329
33	Ostende	-0.056	-7.922
34	Lyon	-0.055	-7.775
35	Bremen (Brême)	-0.055	-7.773
36	Strassburg	-0.053	-7.479
37	Stockholm	-0.049	-6.972
38	Zágráb	-0.046	-6.494
39	Lowestoft	-0.045	-6.327
40	Constantinople	-0.044	-6.2

Table 17: Bonacich Eigenvector in the European Telegraph Network, 1906.
Source: ITU Archives. Bureau International des Administrations Télégraphiques, Liste des Communications Télégraphiques Internationales Directes du Régime Européen. Annexe a la Carte des Communications Télégraphiques du Régime Européen – Édition 1906, 1906.
Notes: All place names reflect the language, spelling, etc. in the original source.

Degree		
No.	Node	*Degree*
1	London	69
2	Paris	58
3	Berlin	50
4	Wien	41
5	Budapest	30
6	Amsterdam	23
7	Danzig	21
8	Hamburg	21
9	Praha	20
10	Anvers	20
11	Bruxelles	20
12	Rotterdam	18
13	Malta	17
14	Frankfurt	16
15	Marseille	15
16	Milano	14
17	Gibraltar	14
18	Warschau	14
19	München	14
20	Zürich	13
21	Basel	12
22	Trieste	11
23	Köln	10
24	Penzance	10
25	Waterville	10
26	Fredericia	10
27	Düsseldorf	9
28	Katowice	9
29	Beograd	9
30	Königsberg	9
31	Thessaloniki	9
32	Carcavelos	9
33	Kjöbenhavn	9
34	Breslau	9
35	Strasbourg	9
36	Stockholm	9
37	Riga	9

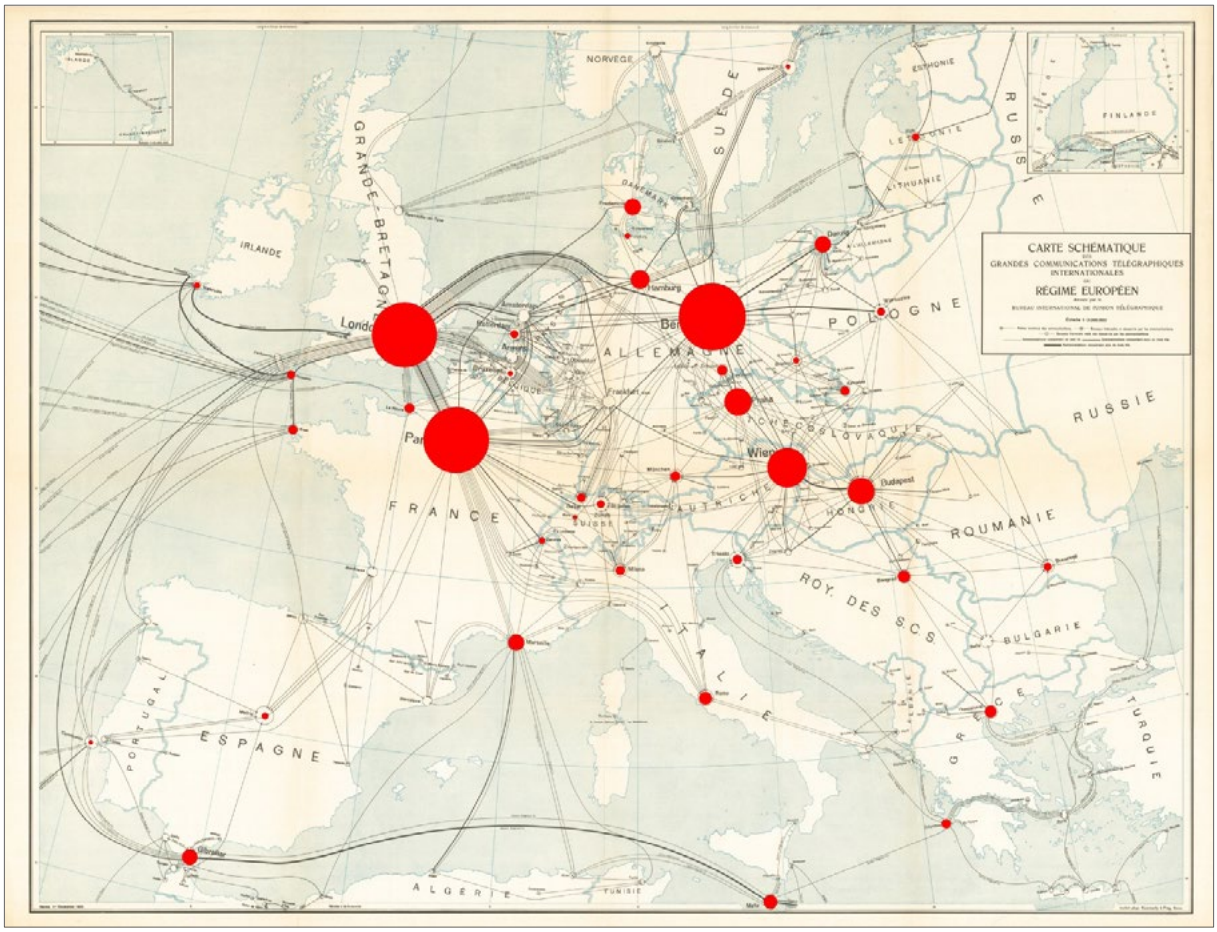
Table 18: Freeman Degree Centrality in the European Telegraph Network, 1923.
Source: ITU Archives. Bureau International de l'Union Télégraphique, Carte Schématique des Grandes Communications Télégraphiques Internationales du Régime Européen, 1923.
Notes: All place names reflect the language, spelling, etc. in the original source.



Map 1: Freeman *Degree* Centrality in the European Telegraph Network, 1923.
Source: ITU Archives. Bureau International de l'Union Télégraphique, Carte Schématique des Grandes Communications Télégraphiques Internationales du Régime Européen, 1923.

Betweenness			
No.	Node	*Betweenness*	*nBetweenness*
1	Berlin	8434.273	20.408
2	Paris	8296.616	20.075
3	London	8204.229	19.852
4	Wien	4983.795	12.059
5	Praha	3462.52	8.378
6	Budapest	3381.937	8.183
7	Hamburg	2319.863	5.613
8	Fredericia	2079.51	5.032
9	Danzig	2018.054	4.883
10	Marseille	1998.448	4.836
11	Gibraltar	1956.103	4.733
12	Malta	1716.444	4.153
13	Roma	1659.672	4.016
14	Beograd	1599.634	3.871
15	Thessaloniki	1459	3.53
16	München	1282.23	3.103
17	Dresden	1271.256	3.076
18	Le Havre	1268.666	3.07
19	Fayal	1210	2.928
20	Brest	1197.683	2.898
21	Milano	1159.954	2.807
22	Trieste	1159.318	2.805
23	Zakynthos	1134.396	2.745
24	Basel	1114.059	2.696
25	Katowice	1081.076	2.616
26	Warschau	1011.425	2.447
27	Rotterdam	1006.408	2.435
28	Zürich	997.097	2.413
29	Bucuresti	984.375	2.382
30	Penzance	977	2.364
31	Riga	933.599	2.259
32	Madrid	886.583	2.145
33	Breslau	761.386	1.842
34	Geneve	756.304	1.83
35	Waterville	753.317	1.823
36	Flensburg	735	1.778
37	Bruxelles	655.575	1.586
38	Stockholm	557.446	1.349
39	Bern	540.178	1.307
40	Carcavelos	538.759	1.304

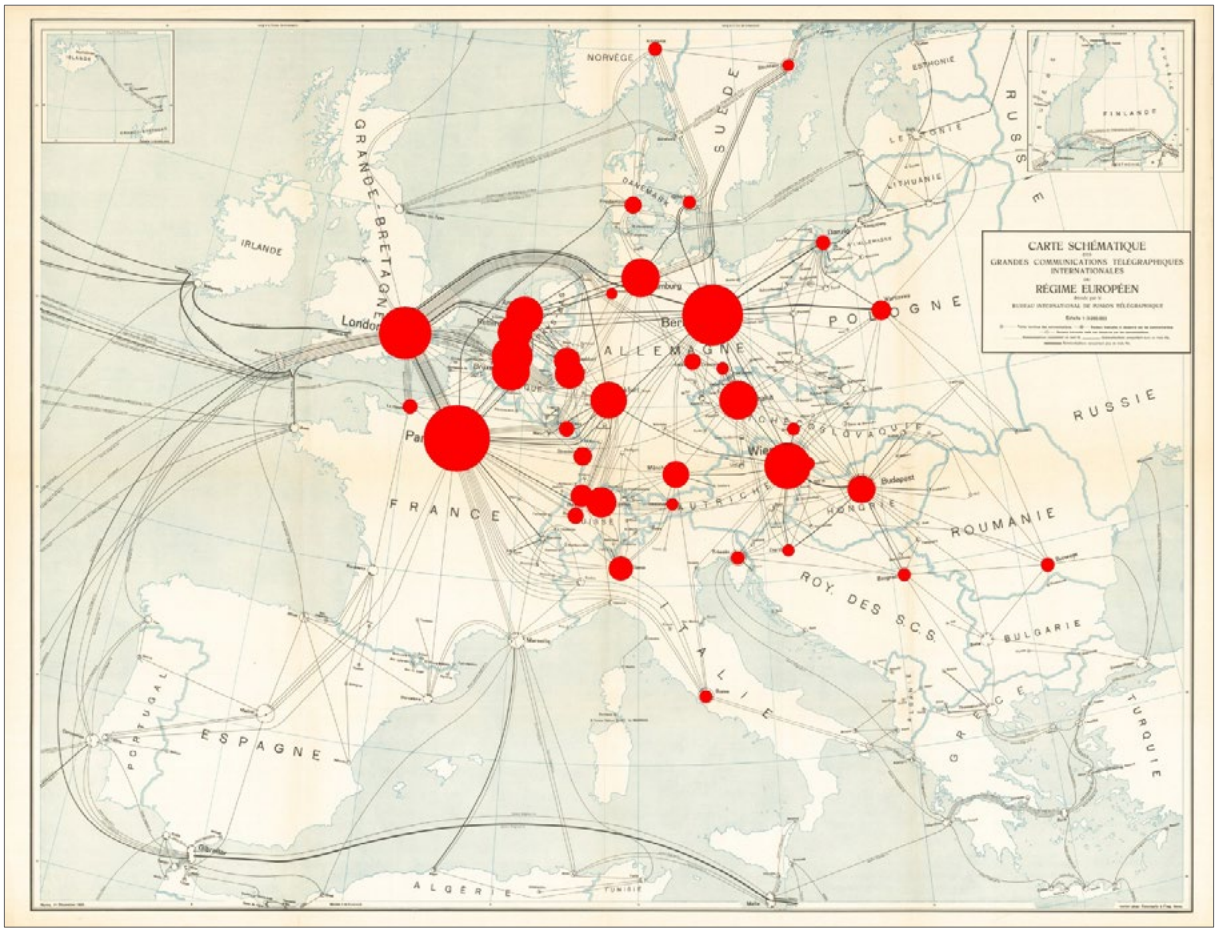
Table 19: Freeman *Betweenness* Centrality in the European Telegraph Network, 1923.
Source: ITU Archives. Bureau International de l'Union Télégraphique, Carte Schématique des Grandes Communications Télégraphiques Internationales du Régime Européen, 1923.
Notes: All place names reflect the language, spelling, etc. in the original source.



Map 2: Freeman *Betweenness* Centrality in the European Telegraph Network, 1923.
Source: ITU Archives. Bureau International de l'Union Télégraphique, Carte Schématique des Grandes Communications Télégraphiques Internationales du Régime Européen, 1923.

Eigenvector		
No.	Node	*nEigenvector*
1	Paris	-49.974
2	Berlin	-45.439
3	London	-39.414
4	Wien	-34.743
5	Anvers	-30.808
6	Hamburg	-28.881
7	Praha	-28.817
8	Bruxelles	-28.446
9	Amsterdam	-28.032
10	Frankfurt	-27.411
11	Rotterdam	-26.077
12	Zürich	-22.689
13	Köln	-22.237
14	Budapest	-20.883
15	München	-20.063
16	Düsseldorf	-19.722
17	Milano	-17.978
18	Basel	-16.885
19	Warschau	-14.671
20	Strasbourg	-13.958
21	Fredericia	-12.938
22	Leipzig	-12.741
23	Gravenhage	-11.898
24	Bern	-11.838
25	Saarbrücken	-11.615
26	Le Havre	-11.338
27	Danzig	-10.713
28	Kristiania	-10.077
29	Trieste	-10.012
30	Bucuresti	-10.005
31	Beograd	-9.791
32	Bratislava	-9.629
33	Kjöbenhavn	-9.627
34	Roma	-9.588
35	Brno	-9.51
36	Zagreb	-9.407
37	Dresden	-9.258
38	Innsbruck	-9.143
39	Stockholm	-8.714
40	Bremen	-8.564

Table 20: Bonacich *Eigenvector* in the European Telegraph Network, 1923.
Source: ITU Archives. Bureau International de l'Union Télégraphique, Carte Schématique des Grandes Communications Télégraphiques Internationales du Régime Européen, 1923.
Notes: All place names reflect the language, spelling, etc. in the original source.



Map 3: Bonacich *Eigenvector* Centrality in the European Telegraph Network, 1923.
Source: ITU Archives. Bureau International de l'Union Télégraphique, Carte Schématique des Grandes Communications Télégraphiques Internationales du Régime Européen, 1923.

1881		1892		1902	
Node	*Degree*	Node	*Degree*	Node	*Degree*
Paris	14	London	15	Wien (Vienne)	16
London	12	Paris	14	London	15
Wien	12	Wien (Vienne)	14	Paris	14
Marseille	11	Berlin	13	Budapest	14
Berlin	10	Cape Canso (CAN)	11	Cape Canso (CAN)	14
Lyon	10	Marseille	10	Berlin	13
St. Louis (US)	9	Lyon	10	Dublin	12
Cincinnati (US)	9	Dublin	10	St. Louis (US)	12
St. Pierre (CAN)	8	Budapest	10	Marseille	12
Bruxelles	8	Cincinnati (US)	9	Gibraltar	11
Halle (GER)	8	Breslau (GER)	9	New York	11
Chicago	7	Memphis	9	Rio de Janeiro	11
La Havane	7	Lublin (RUS)	9	Pernambuco (BRA)	11
Newcastle (UK)	7	Lisboa	9	Breslau (GER)	10
München	7	Malte	9	Lublin (RUS)	10
Basel	7	St. Louis (US)	9	Lisboa	10
Dublin	7	Saratow (RUS)	9	Malte	10
Mexico	7	Halle (GER)	9	Mariinsk (RUS)	10
Madras	7	La Havane	9	Chicago	10
Alger (ALG)	7	Varsovie (RUS)	9	Montreal (CAN)	10
St. Paul (US)	7			Minsk (RUS)	10
Constantinople	7			Lyon	10
Malte	7				
Stockholm	7				

Table 21: Freeman *Degree* in the Global Telegraph Network, 1881, 1892 and 1902.

Source ITU Archives. Bureau International des Administrations Télégraphiques, Carte des Communications Télégraphiques du Régime Extra-Européen, 1881; ITU Archives. Bureau International des Administrations Télégraphiques, Carte des Communications Telegraphiques de Régime Extra-Européen, 1892; ITU Archives. Bureau International des Administrations Télégraphiques, Cartes des Communications Télégraphiques du Régime Extra-Européen, 1902

Notes: All place names reflect the language, spelling, etc. in the original source.
To prevent ambiguity, some place names have been complemented by their country code.

1881		1892		1902	
Node	*nBetweenn.*	Node	*nBetweenn.*	Node	*nBetweenn.*
Alexandrie	30.509	Lisboa	36.145	Aden	44.794
Lisboa	28.479	Malte	34.406	Malte	44.221
Malte	27.435	Alexandrie	31.715	Alexandrie	42.256
Brest (F)	23.553	Gibraltar	30.834	Suez	39.691
St. Pierre (CAN)	23.451	Cape Canso (CAN)	26.119	Gibraltar	38.969
Gibraltar	23.203	Penzance (UK)	24.779	Penzance (UK)	38.19
Penzance (UK)	22.761	New York	23.989	Bombay	31.334
Boston	22.309	Wladikawkas (RUS)	21.043	Cape Canso (CAN)	27.632
Le Caire	21.599	Petrowsk (RUS)	20.901	Poona (IND)	23.494
Tantah (EGY)	21.136	Khabarowka (RUS)	20.654	Dhond (IND)	22.793
Aden	20.701	Puerto Grande (VER)	19.361	Sholapur (IND)	22.769
Suez	19.985	Funchal (MAD)	18.677	Penang	22.323
Bombay	17.476	Pernambuco (BRA)	18.463	Madras	22.173
Albany (US)	16.082	Lattàquié (TUR)	17.964	Shahabad (IND)	22
Exeter (UK)	12.094	Alep (TUR)	17.886	New York	21.584
London	12.039	Tiflis (RUS)	17.834	Guntakal (IND)	21.427
Cape Code (US)	10.808	Diarbekir (TUR)	17.426	Singapore	20.891
Duxbury (US)	10.808	Urfa (TUR)	17.195	Zanzibar (TAN)	20.578
Funchal (MAD)	10.731	Larnaca (TUR)	17.074	Kantara (EGY)	20.167
Puerto Grande (VER)	10.66	Nagasaki	16.959	Le Caire	19.912

Table 22: Freeman *Betweenness* in the Global Telegraph Network, 1881, 1892 and 1902.

Source ITU Archives. Bureau International des Administrations Télégraphiques, Carte des Communications Télégraphiques du Régime Extra-Européen, 1881; ITU Archives. Bureau International des Administrations Télégraphiques, Carte des Communications Telegraphiques de Régime Extra-Européen, 1892; ITU Archives. Bureau International des Administrations Télégraphiques, Cartes des Communications Télégraphiques du Régime Extra-Européen, 1902

Notes: All place names reflect the language, spelling, etc. in the original source.
To prevent ambiguity, some place names have been complemented by their country code.

1860	Sent		Received		Transmitted	
	abs.	p. Pop. (indexed)	abs.	p. Pop. (indexed)	abs.	p. Pop. (indexed)
Austria-Hungary	95,356	45	84,123	37	42,754	17
Belgium	45,278	159	49,921	161	50,404	153
Denmark	23,651	151	23,865	140	23,441	129
France	151,885	70	204,743	87	52,288	21
Germanya	183,456	81	196,361	80	193,031	74
Netherlands	59,348	295	65,700	300	90,319	388
Norway	12,526	140	13,408	137	0	0
Portugal	8,513	39	7,711	33	0	0
Romaniab	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Russia	49,131	10	49,340	10	0	0
Spain	18,264	19	19,650	19	9,532	9
Sweden	18,362	79	19,679	78	15,146	56
Switzerlandc	n.a.	n.a.	n.a.	n.a.	26.967	154

Table 23: External Messages Sent, Received, and Transmitted, 1860. Indexed with Selected European Average = 100.

Source: ITU Archives. Bureau International des Administrations Télégraphiques, Statistique Générale de la Télégraphie dans les Différents Pays de l'Ancien Continent, 1849-1869.

Notes: a "Germany" means Bavaria, Baden, North German Confederation, and Wurttemberg. Therefore, the figures of external messages are inflated.
b Not included in Selected European Average in all categories of external messages.
c Not included in Selected European Average in external messages sent and received.

1860-1910	1860-1870			1870-1880			1880-1890			1890-1900			1900-1910		
	St.	Rec.	Trs.	St.	Rec.	Trs.	St.	Rec.	Trs.	St.	Rec.	Trs.	St.	Rec.	Trs.
Austria	n.a.	n.a.	n.a.	5	7	-5	5	7	-5	5	7	-5	4	4	7
Belgium	19	18	11	7	8	9	7	8	9	7	8	9	4	4	2
British India	n.a.	n.a.	n.a.	13	13	36	13	13	36	13	13	36	8	8	0
Denmark	15	14	17	5	7	11	5	7	11	5	7	11	5	5	4
France	18	14	n.a.	7	6	n.a.	7	6	n.a.	7	6	n.a.	3	3	5
Germany[a]	22	23	15	3	2	-3	3	2	-3	3	2	-3	4	5	7
Gr Britain & Ireland	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	4	4	2
Hungary	n.a.	n.a.	n.a.	24	24	n.a.	24	24	n.a.	24	24	n.a.	6	6	-1
Italy	n.a.	n.a.	n.a.	6	6	2	6	6	2	6	6	2	4	3	1
Japan	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	8	10	n.a.
Luxembourg	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	2	2	n.a.
Netherlands	16	15	9	6	7	-1	6	7	-1	6	7	-1	4	4	1
Norway	20	21	n.a.	6	7	-17	6	7	-17	6	7	-17	n.a.	n.a.	n.a.
Portugal	12	13	n.a.	10	11	22	10	11	22	10	11	22	n.a.	n.a.	n.a.
Romania	n.a.	n.a.	n.a.	5	5	-2	5	5	-2	5	5	-2	6	6	17
Russia	16	16	n.a.	9	8	8	9	8	8	9	8	8	7	8	10
Spain	15	16	19	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	6	5	5
Sweden	17	17	12	7	7	7	7	7	7	7	7	7	4	4	9
Switzerland	n.a.	n.a.	15	7	7	9	7	7	9	7	7	9	5	5	6

Table 24: Average Annual Growth Rates of External Traffic, 1860-1910.

Source: ITU Archives. Bureau International des Administrations Télégraphiques, Statistique Générale de la Télégraphie dans les Différents Pays de l'Ancien Continent, 1849-1869; ITU Archives. Bureau International des Administrations Télégraphiques, Statistique Générale de la Télégraphie dans les Différents Pays de l'Ancien Continent, 1870; ITU Archives. Bureau International des Administrations Télégraphiques, Statistique Générale de la Télégraphie, 1880; ITU Archives. Bureau International des Administrations Télégraphiques, Statistique Générale de la Télégraphie, 1890; ITU Archives. Bureau International des Administrations Télégraphiques, Statistique Générale de la Télégraphie, 1900; ITU Archives. Bureau International de l'Union Télégraphique, Statistique Générale de la Télégraphie, 1910.

Notes: a In 1860, "Germany" means Bavaria, Baden, the North German Confederation, and Wurttemberg

1870	Sent		Received		Transmitted	
	abs.	p. Pop. (indexed)	abs.	p. Pop. (indexed)	abs.	p. Pop. (indexed)
Austria	472,471	64	435,275	58	638,177	124
Belgium	248,961	151	258,485	154	147,848	129
Denmark	94,413	155	92,307	149	108,071	255
France	791,842	61	765,356	58	n.a.	n.a.
Germany	1,394,626	108	1,573,620	120	759,154	84
Gr Britain & Ireland[a]	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Greece	6,477	13	9,727	19	0	0
Hungary	63,449	13	67,133	14	0	0
Italy	263,596	32	280,307	33	181,550	32
Netherlands	251,191	201	264,878	209	216,072	249
Norway	78,377	127	89,549	143	18,332	43
Portugal	25,780	20	25,742	19	15,944	18
Romania	73,885	43	71,737	41	14,240	12
Russia	216,104	8	226,371	8	31,016	2
Spain	77,013	13	83,967	14	53,626	14
Sweden	86,522	61	90,753	63	47,050	48
Switzerland	197,032	230	190,620	219	109,554	184
Outside Europe						
British India	29,792	0	28,129	0	4,408	0

Table 25: External Messages Sent, Received, and Transmitted, 1870. Indexed with Selected European Average = 100.

Source: ITU Archives. Bureau International des Administrations Télégraphiques, Statistique Générale de la Télégraphie dans les Différents Pays de l'Ancien Continent, 1870.

Notes: a Railway lines not included. Figure for size of British population given in the *Statistique Générale* of 1870 was clearly incorrect. Figure from 1871 has been used.

1880	Sent		Received		Transmitted	
	abs.	p. Pop. (indexed)	abs.	p. Pop. (indexed)	abs.	p. Pop. (indexed)
Austria	772,924	55	848,124	57	378,324	40
Belgium	500,282	142	535,383	145	356,724	150
Bosnia-Herzegovina	2,680	4	2,387	3	0	0
Bulgaria	23,464	18	22,268	17	3,023	4
Denmark	156,817	125	176,164	133	311,413	365
France	1,582,234	67	1,413,256	57	397,840	25
Germany	1,909,400	66	1,996,454	66	569,006	29
Gr Britain & Ireland	1,907,168	87	1,642,997	71	356,746	24
Greece	29,398	28	33,428	30	40,581	56
Hungary	555,799	57	599,056	58	99,981	15
Italy	474,260	26	487,383	26	211,980	17
Luxembourg	23,095	177	21,163	154	14	0
Netherlands	460,087	178	518,249	191	189,032	108
Norway	144,171	121	169,484	136	2,682	3
Portugal	68,649	25	70,402	25	114,366	62
Romania	120,060	37	120,471	36	11,867	5
Russia	496,955	9	500,126	8	68,346	2
Serbia	27,382	25	27,896	25	1,289	2
Spain[a]	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Sweden	170,705	59	186,411	61	93,108	47
Switzerland	383,247	213	370,640	196	262,333	215
Outside Europe						
Algeria	137,431	63	120,512	52	0	0
Brazil	7,275	1	1,928	0	880	0
British India	103,832	1	95,266	1	98,655	1
Cochinchina	4,867	5	4,925	5	0	0
Dutch Indies	16,016	1	15,265	1	26,837	3
Egypt	9,764	3	7,811	2	1,899	1
Japan	12,040	1	12,115	1	0	0
New Zealand	13,227	43	11,265	35	0	0
Victoria	4,271	8	5,232	9	0	0
Western Union	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.

Table 26: External Messages Sent, Received, and Transmitted, 1880. Indexed with Selected European Average = 100.

Source: ITU Archives. Bureau International des Administrations Télégraphiques, Statistique Générale de la Télégraphie, 1880.

Notes: a Not included in Selected European Average in all categories of external messages.

1890	Sent		Received		Transmitted	
	abs.	p. Pop. (indexed)	abs.	p. Pop. (indexed)	abs.	p. Pop. (indexed)
Austria	1,733,394	79	1,831,080	76	743,832	47
Belgium	952,846	169	1,030,827	167	667,499	165
Bosnia-Herzegovina	54,679	44	47,302	35	67,572	76
Bulgaria	65,157	22	54,050	17	40,544	19
Denmark	254,450	127	297,930	135	396,019	274
France	2,783,148	79	2,631,246	68	1,265,848	50
Germany	3,401,681	75	3,790,641	76	1,015,153	31
Gr Britain & Ireland	3,667,054	105	3,208,299	84	755,576	30
Greece	76,410	37	81,090	36	118,545	80
Hungary	783,159	49	855,931	49	260,932	23
Italy	708,122	26	792,931	26	125,560	6
Luxembourg	36,034	185	33,294	156	8	0
Netherlands	708,938	168	887,550	192	503,912	166
Norway	240,480	130	283,446	140	1	0
Portugal	144,368	36	155,390	36	373,733	131
Romania	183,324	39	161,214	32	43,948	13
Russia	695,836	7	745,679	7	153,197	2
Serbia	46,869	23	55,985	26	19,989	14
Spain	485,460	30	506,250	28	106,678	9
Sweden	286,551	65	316,966	65	190,352	60
Switzerland	591,196	220	628,457	213	510,473	263
Outside Europe						
Algeria	35,079	10	25,713	7	0	0
British India	158,865	1	140,115	1	190,656	1
Cochinchina	7,963	3	9,238	3	9,578	6
Cuba	33,639	22	33,043	20	58,508	54
Dutch Indies[a]	31,110	1	32,195	1	65,541	3
Japan	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
New Zealand	21,272	35	26,005	38	0	0
Philippines	9,837	2	11,448	2	0	0
Porto-Rico	6,776	9	5,411	7	4,442	8
South Australia	3,903	13	6,526	19	56,637	257
The Senegal	3,430	n.a.	2,561	n.a.	0	n.a.
Tunisia	92,198	67	83,122	55	0	0
Victoria	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Western Union	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.

Table 27: External Messages Sent, Received, and Transmitted, 1890. Indexed with Selected European Average = 100.

Source: ITU Archives. Bureau International des Administrations Télégraphiques, Statistique Générale de la Télégraphie, 1890.

Notes: a Railway and private messages not included.

1900	Sent		Received		Transmitted	
	abs.	p. Pop. (indexed)	abs.	p. Pop. (indexed)	abs.	p. Pop. (indexed)
Austria	2,501,944	80	2,639,280	78	1,240,092	63
Belgium	1,393,943	171	1,414,296	161	550,338	108
Bosnia-Herzegovina	124,548	66	106,353	52	137,292	117
Bulgaria	67,151	15	69,459	14	45,335	16
Denmark	394,799	134	460,641	145	648,771	353
France	3,373,740	73	3,291,671	66	1,122,610	39
Germany	4,882,643	72	5,956,613	82	1,442,997	34
Gr Britain & Ireland	5,177,861	105	4,423,287	83	1,111,318	36
Hungary	1,252,352	60	1,212,938	54	363,168	28
Italy	1,052,907	28	1,190,083	29	102,234	4
Luxembourg	70,761	249	61,451	201	0	0
Montenegro	9,754	27	9,383	24	1,607	7
Netherlands	1,033,939	166	1,233,552	184	326,471	84
Norway	389,130	151	446,143	160	1	0
Portugal	196,345	32	214,102	33	665,166	176
Romania	275,748	43	242,627	35	59,565	15
Russia	1,182,719	8	1,255,660	8	213,222	2
Spain	502,192	23	561,201	24	114,250	8
Sweden	417,051	68	472,165	71	364,255	95
Switzerland	835,941	210	858,430	200	677,817	273
Outside Europe						
Algeria	35,044	6	24,505	4	0	0
Angola	127	0	151	0	0	0
Brazil	21,394	1	21,214	1	1,170	0
British India	206,939	1	210,236	1	482,802	2
Cochinchina	29,228	6	28,176	5	14,534	5
Dutch Indies	51,994	1	52,310	1	188,874	7
Japan	234,284	4	238,416	4	3,972	0
Natal	30,658	43	34,124	44	0	0
New Caledonia	2,730	37	2,940	37	0	0
New South Wales	491,301	299	506,787	286	161,187	157
New Zealand	63,309	64	59,267	56	0	0
Portuguese Indies	2,958	4	4,702	6	0	0
The Senegal	7,129	5	2,413	2	0	0
Tunisia	205,714	114	190,144	98	0	0
Victoria	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Western Union	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.

Table 28: External Messages Sent, Received, and Transmitted, 1900. Indexed with Selected European Average = 100.

Source: ITU Archives. Bureau International des Administrations Télégraphiques, Statistique Générale de la Télégraphie, 1900.

1910	Sent		Received		Transmitted	
	abs.	p. Pop. (indexed)	abs.	p. Pop. (indexed)	abs.	p. Pop. (indexed)
Austria	3,758,858	80	3,820,084	74	2,456,173	77
Belgium	2,001,353	162	2,085,957	154	672,940	80
Bosnia-Herzegovina	216,300	84	204,608	72	160,745	91
Bulgaria	174,489	25	174,626	22	16,848	3
Denmark	635,957	140	749,733	151	987,994	320
France	4,684,052	72	4,614,939	65	1,776,729	40
Germany	7,506,290	70	9,578,470	82	2,967,970	41
Gr Britain & Ireland	7,569,000	102	6,691,000	83	1,325,000	26
Greece	107,805	25	197,804	42	117,503	40
Hungary	2,266,528	66	2,130,548	57	324,952	14
Italy	1,534,563	28	1,602,952	27	116,725	3
Luxembourg	87,286	203	77,056	164	0	0
Netherlands	1,472,431	152	1,795,004	169	364,109	55
Romania	479,109	42	452,306	36	282,525	36
Russia	2,253,883	9	2,618,527	10	574,861	3
Serbia	109,128	23	113,105	22	155,885	48
Spain	911,748	30	941,075	28	178,247	9
Sweden	636,385	70	732,016	74	872,841	141
Switzerland	1,341,951	217	1,421,426	210	1,212,070	288
Outside Europe						
Algeria	71,078	8	50,575	5	0	0
Bolivia[a]	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
British India	465,860	1	446,133	1	505,101	1
Cochinchina	36,056	1	35,171	1	34,302	1
Dutch Indies	121,013	2	123,511	2	75,143	2
Japan	520,901	6	594,384	7	0	0
New South Wales	932,841	345	965,869	326	386,216	210
New Zealand	122,860	70	115,282	60	0	0
Queensland	11,898	12	9,699	9	191,729	286
Siam	37,616	3	50,781	4	63,024	8
South Australia	16,615	25	18,208	25	223,260	487
Tasmania	151,290	491	164,017	486	0	0
The Senegal	22,450	12	15,170	7	0	0
Tunisia	309,994	98	293,387	85	0	0
Union of Sth. Africa	134,328	15	118,955	12	16,582	3
Victoria	814,718	381	921,834	394	125,408	86
Western Australia	17,220	36	13,162	25	0	0

Table 29: External Messages Sent, Received, and Transmitted, 1910. Indexed with Selected European Average = 100.

Source: ITU Archives. Bureau International de l'Union Télégraphique, Statistique Générale de la Télégraphie, 1910.

Notes: a Data for 1910 not available. Data for 1909 has been used.

Year	Germany[a]	France	Italy	Austria	England	Russia	Europe Rest	Europe Total
1870	30.3	34.0	13.1	9.5	5.0	1.7	5.0	98.6
1871	35.4	27.7	13.9	9.6	5.1	1.5	5.7	98.9
1872	37.8	27.2	14.7	8.7	4.1	1.8	4.7	99.0
1873	38.8	27.2	14.9	8.2	3.8	1.8	4.3	99.1
1874	41.3	26.6	14.2	7.2	3.5	1.7	4.6	99.1
1875	40.7	27.9	13.4	7.8	3.5	1.7	4.1	99.0
1876	40.1	27.3	13.7	8.0	3.2	1.6	4.6	98.5
1877	42.9	25.6	13.4	8.0	2.9	1.2	4.3	98.2
1878	41.4	27.3	12.9	8.4	2.8	1.2	4.1	98.1
1879	41.7	26.2	13.0	8.4	2.8	1.3	4.4	97.7
1880	36.8	29.1	12.5	8.6	3.7	1.2	5.0	96.8
1881	31.7	35.1	12.7	7.4	4.2	1.2	4.8	97.2
1882	33.0	30.9	13.7	8.1	4.7	1.3	5.1	96.9
1883	33.1	30.4	14.0	7.9	4.6	1.4	5.4	96.8
1884	33.1	31.0	13.7	8.0	4.6	1.4	5.3	97.0
1885	32.0	31.2	13.8	8.5	4.9	1.5	5.1	96.9
1886	32.6	30.7	13.2	8.5	5.1	1.4	4.8	96.5
1887	32.6	30.6	12.4	8.8	5.2	1.3	5.2	96.2
1888	32.1	30.5	12.4	9.3	5.5	1.3	5.3	96.4
1889	31.8	31.7	11.6	9.2	5.9	1.3	5.3	96.8
1890	32.9	31.0	11.4	9.2	5.8	1.4	5.3	96.9
1891	33.4	30.3	11.9	8.8	5.8	1.4	5.4	96.8
1892	32.2	29.8	12.2	8.8	6.2	1.4	5.9	96.5
1893	32.7	27.1	12.3	10.1	6.3	1.8	6.1	96.4
1894	33.3	27.1	11.9	9.4	6.7	2.1	6.1	96.5
1895	33.4	26.7	11.2	8.8	8.0	2.1	6.3	96.5
1896	33.6	27.6	11.3	8.6	6.7	2.2	6.6	96.6
1897	34.2	27.1	11.6	8.1	6.7	2.1	6.6	96.4
1898	34.2	27.5	11.5	7.7	6.6	2.3	6.6	96.4
1899	32.4	28.2	11.8	7.8	7.3	2.4	6.6	96.4
1900	33.0	29.0	11.8	7.3	7.0	2.4	5.9	96.4
1901	33.1	27.2	12.0	7.6	7.4	2.6	6.3	96.2
1902	32.7	27.6	11.9	8.3	6.7	2.5	6.4	96.0
1903	32.8	26.3	12.3	8.1	6.9	2.7	6.5	95.7
1904	33.3	26.3	12.2	7.7	7.3	2.7	6.4	95.8
1905	32.6	26.7	11.7	7.6	7.4	3.5	6.3	95.7
1906	32.9	26.1	12.0	7.8	7.0	3.8	6.0	95.7
1907	32.9	26.7	11.5	7.9	7.0	3.3	6.4	95.6
1908	33.7	26.1	11.1	7.8	7.1	3.4	6.7	95.8
1909	32.9	26.8	10.8	7.7	7.6	3.4	6.6	95.8
1910	33.3	26.0	10.7	7.7	7.7	3.4	7.0	95.8
1911	33.4	25.5	10.7	7.8	7.8	3.5	7.3	95.9
1912	34.3	24.5	10.1	7.9	8.1	3.4	7.6	95.9
1913	34.3	23.7	10.7	7.8	8.0	3.9	7.2	95.6
1914	35.3	23.2	10.6	7.0	7.7	4.7	7.3	95.7
1915	34.2	21.1	15.9	9.4	5.4	3.3	7.4	96.6

Table 30: Percentage of Swiss Foreign Telegrams, 1870-1915 – European Countries.
Source: Archives of Swiss PTT. Schweizerische Post- und Telegraphen-Statistik 1880-1915.
Notes: a Including Luxembourg until 1882.

Year	Europe	Americas	Asia	Africa	Australia	Total
1870	98.6	0.6	0.4	0.3	0.0	100.0
1871	98.9	0.4	0.4	0.4	0.0	100.0
1872	99.0	0.4	0.4	0.3	0.0	100.0
1873	99.1	0.3	0.3	0.3	0.0	100.0
1874	99.1	0.3	0.3	0.3	0.0	100.0
1875	99.0	0.4	0.3	0.3	0.0	100.0
1876	98.5	0.5	0.5	0.4	0.0	100.0
1877	98.2	0.8	0.6	0.4	0.0	100.0
1878	98.1	0.9	0.6	0.4	0.0	100.0
1879	97.7	0.9	0.7	0.6	0.0	100.0
1880	96.8	1.7	0.9	0.6	0.0	100.0
1881	97.2	1.5	0.8	0.6	0.0	100.0
1882	96.9	1.7	0.8	0.6	0.0	100.0
1883	96.8	1.8	0.7	0.6	0.0	100.0
1884	97.0	1.6	0.7	0.7	0.0	100.0
1885	96.9	1.7	0.7	0.7	0.0	100.0
1886	96.5	2.1	0.7	0.7	0.0	100.0
1887	96.2	2.3	0.8	0.7	0.0	100.0
1888	96.4	2.2	0.7	0.6	0.0	100.0
1889	96.8	1.9	0.7	0.6	0.0	100.0
1890	96.9	1.9	0.7	0.5	0.0	100.0
1891	96.8	1.9	0.7	0.5	0.0	100.0
1892	96.5	2.1	0.8	0.6	0.0	100.0
1893	96.4	2.1	0.8	0.6	0.0	100.0
1894	96.5	2.0	0.9	0.6	0.0	100.0
1895	96.5	2.1	0.7	0.6	0.0	100.0
1896	96.6	2.0	0.8	0.7	0.0	100.0
1897	96.4	2.2	0.8	0.6	0.0	100.0
1898	96.4	2.2	0.7	0.6	0.0	100.0
1899	96.4	2.2	0.7	0.7	0.0	100.0
1900	96.4	2.1	0.8	0.7	0.0	100.0
1901	96.2	2.2	0.8	0.8	0.0	100.0
1902	96.0	2.3	0.9	0.8	0.0	100.0
1903	95.7	2.4	0.9	0.9	0.0	100.0
1904	95.8	2.4	0.9	0.9	0.0	100.0
1905	95.7	2.5	0.9	0.9	0.0	100.0
1906	95.7	2.5	1.0	0.9	0.0	100.0
1907	95.6	2.5	1.0	0.9	0.0	100.0
1908	95.8	2.4	0.9	0.8	0.0	100.0
1909	95.8	2.5	0.9	0.8	0.0	100.0
1910	95.8	2.4	0.9	0.8	0.0	100.0
1911	95.9	2.3	0.9	0.9	0.0	100.0
1912	95.9	2.4	0.9	0.8	0.0	100.0
1913	95.6	2.6	0.9	0.8	0.0	100.0
1914	95.7	2.8	0.6	0.8	0.0	100.0
1915	96.6	2.2	0.5	0.7	0.0	100.0

Table 31: Percentage of Swiss Foreign Telegrams, 1870-1915 – Distribution over the Continents.
Source: Archives of Swiss PTT. Schweizerische Post- und Telegraphen-Statistik 1880-1915.

Year	Germany[a]	France	Italy	Austria	England	Russia	Europe Rest	Europe Total
1870	117,652	131,831	50,591	36,686	19,331	6,712	19,453	382,256
1871	173,832	135,721	68,281	47,172	24,769	7,208	28,022	485,005
1872	188,554	135,443	73,466	43,214	20,589	8,829	23,274	493,369
1873	213,852	150,001	82,151	45,224	20,962	9,850	23,837	545,877
1874	232,312	149,324	79,984	40,267	19,698	9,801	25,925	557,311
1875	241,753	165,953	79,480	46,599	20,527	10,004	24,187	588,503
1876	235,466	160,241	80,731	47,152	18,600	9,621	27,290	579,101
1877	247,344	147,502	77,037	46,048	16,875	6,882	24,670	566,358
1878	243,836	160,744	76,120	49,529	16,213	7,191	24,205	577,838
1879	268,946	169,178	83,996	53,947	17,843	8,454	28,091	630,455
1880	277,634	219,325	93,917	64,699	28,009	8,787	37,556	729,927
1881	278,917	308,942	111,769	65,231	36,814	10,465	42,389	854,527
1882	278,516	261,307	116,194	68,858	39,344	11,219	43,224	818,662
1883	277,211	254,190	117,301	66,119	38,621	11,456	44,842	809,740
1884	276,406	258,937	114,306	66,426	38,106	11,764	44,663	810,608
1885	276,846	269,528	119,161	73,041	42,221	13,310	43,760	837,867
1886	312,079	294,202	126,797	81,314	49,034	13,668	46,295	923,389
1887	328,922	308,621	124,945	89,022	52,034	13,146	52,722	969,412
1888	355,213	337,642	137,160	102,612	60,855	14,230	58,916	1,066,628
1889	380,041	379,032	138,055	110,078	69,927	15,949	62,918	1,156,000
1890	400,706	378,201	138,922	112,324	70,374	16,710	64,996	1,182,233
1891	413,554	375,266	146,925	108,708	71,285	17,890	66,515	1,200,143
1892	398,345	368,570	151,515	108,329	76,292	17,766	72,444	1,193,261
1893	413,780	342,937	155,049	127,612	79,440	22,881	76,483	1,218,182
1894	432,803	352,422	154,915	122,170	86,754	27,175	79,739	1,255,978
1895	481,876	385,640	162,175	126,901	115,281	29,679	90,179	1,391,731
1896	484,394	398,028	162,954	123,582	96,612	31,382	95,039	1,391,991
1897	509,015	403,178	172,732	120,385	99,452	31,345	98,594	1,434,701
1898	536,727	431,061	181,216	121,060	103,168	36,023	103,860	1,513,115
1899	550,096	479,496	199,550	131,693	123,857	40,303	111,370	1,636,365
1900	558,885	492,196	199,520	123,639	117,763	40,446	100,428	1,632,877
1901	569,232	467,471	205,580	130,174	127,615	44,445	108,806	1,653,323
1902	589,106	496,019	214,780	148,709	119,779	44,658	114,654	1,727,705
1903	615,996	494,569	231,740	152,605	129,093	50,738	122,134	1,796,875
1904	657,721	519,201	240,291	151,788	143,542	54,348	126,071	1,892,962
1905	703,444	575,831	253,283	163,366	158,793	76,285	135,799	2,066,801
1906	769,909	611,120	281,131	181,401	163,194	90,029	141,434	2,238,218
1907	763,342	618,580	265,577	182,365	162,192	77,064	147,447	2,216,567
1908	785,155	609,782	258,952	180,801	165,797	78,998	155,222	2,234,707
1909	837,121	682,043	273,554	194,972	191,990	86,615	167,412	2,433,707
1910	921,096	717,616	296,915	211,745	213,210	95,141	192,336	2,648,059
1911	999,191	762,687	320,167	232,736	233,143	104,526	219,501	2,871,951
1912	1,081,407	772,716	319,075	248,050	254,266	108,009	241,406	3,024,929
1913	1,091,223	756,249	341,631	249,686	255,167	122,986	229,812	3,046,754
1914	1,253,947	821,988	376,434	249,155	272,245	166,865	258,489	3,399,123
1915	1,238,188	764,182	574,391	340,188	194,679	119,980	267,621	3,499,229

Table 32: Absolute Number of Swiss Foreign Telegrams, 1870-1915 – European Countries.
Source: Archives of Swiss PTT. Schweizerische Post- und Telegraphen-Statistik 1880-1915.
Notes: a Including Luxembourg until 1882.

Year	Europe	Americas	Asia	Africa	Australia	Total
1870	382,256	2,401	1,673	1,322	0	387,652
1871	485,005	1,761	1,798	1,831	0	490,395
1872	493,369	1,750	1,772	1,413	0	498,304
1873	545,877	1,922	1,638	1,449	0	550,886
1874	557,311	1,690	1,699	1,505	0	562,205
1875	588,503	2,337	1,902	1,573	0	594,315
1876	579,101	3,039	3,217	2,313	0	587,670
1877	566,358	4,588	3,329	2,443	0	576,718
1878	577,838	5,511	3,330	2,361	0	589,040
1879	630,455	6,078	4,711	3,940	0	645,184
1880	729,927	13,011	6,666	4,188	0	753,792
1881	854,527	12,893	7,028	5,115	0	879,563
1882	818,662	14,529	6,737	5,158	0	845,086
1883	809,740	14,890	6,150	5,348	106	836,234
1884	810,608	13,283	6,061	5,455	68	835,475
1885	837,867	14,579	5,936	5,828	70	864,280
1886	923,389	20,162	6,770	6,574	108	957,003
1887	969,412	23,603	7,635	7,438	137	1,008,225
1888	1,066,628	24,249	8,111	6,762	148	1,105,898
1889	1,156,000	23,266	8,305	7,116	113	1,194,800
1890	1,182,233	23,090	8,095	6,145	146	1,219,709
1891	1,200,143	23,529	8,847	6,774	197	1,239,490
1892	1,193,261	25,570	10,073	7,872	216	1,236,992
1893	1,218,182	26,904	10,251	7,893	229	1,263,459
1894	1,255,978	26,519	11,139	7,502	238	1,301,376
1895	1,391,731	30,348	10,567	9,167	304	1,442,117
1896	1,391,991	28,594	10,867	9,637	467	1,441,556
1897	1,434,701	32,273	11,258	9,190	371	1,487,793
1898	1,513,115	34,596	11,281	9,824	255	1,569,071
1899	1,636,365	36,835	12,623	11,892	315	1,698,030
1900	1,632,877	36,050	13,175	12,037	232	1,694,371
1901	1,653,323	37,832	14,237	13,477	313	1,719,182
1902	1,727,705	41,293	15,800	14,583	308	1,799,689
1903	1,796,875	45,714	17,797	16,848	393	1,877,627
1904	1,892,962	48,110	18,164	17,102	423	1,976,761
1905	2,066,801	53,270	20,489	18,724	501	2,159,785
1906	2,238,218	58,724	22,521	19,901	592	2,339,956
1907	2,216,567	57,736	22,820	21,107	730	2,318,960
1908	2,234,707	55,912	21,777	19,290	667	2,332,353
1909	2,433,707	63,572	23,572	19,780	823	2,541,454
1910	2,648,059	65,509	25,539	23,250	1,020	2,763,377
1911	2,871,951	70,187	26,529	25,520	1,210	2,995,397
1912	3,024,929	75,765	28,060	25,678	1,341	3,155,773
1913	3,046,754	82,526	28,944	25,959	1,362	3,185,545
1914	3,399,123	99,535	23,070	27,119	1,438	3,550,285
1915	3,499,229	77,910	19,652	23,808	1,346	3,621,945

Table 33: Absolute Number of Swiss Foreign Telegrams, 1870-1915 – Distribution over the Continents.
Source: Archives of Swiss PTT. Schweizerische Post- und Telegraphen-Statistik 1880-1915.

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