국제학박사학위논문

Decoupling through "Network Balancing" Strategy:

Anglo-German Rivalry over Telecommunication Networks, 1858-1912

"네트워크 균형" 전략을 통한 국가 간 디커플링:

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Abstract

Decoupling through "Network Balancing" Strategy:

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The development of technology has accompanied every crucial transformation of the international system as a decisive factor closely linked to the principle concepts of international relations such as power and security. Among different types of technologies, those that enhance connectivity among states are the ones with the strongest implications on international politics as they can reap disproportionate benefits for certain industries of certain countries, generating possibilities for violation of sovereignty that can evoke serious security concerns. In this regard, history has shown that telecommunication technologies, sitting at the core of enabling such connectivity, have often taken an important part in great power competition with their political history paralleling and amplifying trends in international relations. However, while the importance of such technologies has been recognized for their impact on the contours of world politics in existing studies, their conceptualization within the discipline has remained quite limited; they are mostly taken as an exogenous factor—an environmental condition or set of instrumental possibilities, rather than something integral

to how international politics are carried out. The lack of clear conceptual and analytical frameworks with which to investigate how technology is developed and implemented, why it is developed and implemented in certain ways, and how these processes impact the order of international politics, makes it difficult to incorporate technology as a core component of international relations discussions.

Against this backdrop, this study takes a heuristic approach to show the link between network technology and the balancing strategies taken by great powers. In order to do so, it introduces a new analytical framework, the 'network balancing model,' by incorporating the network effect, an intrinsic property of network technologies, as a key explanatory variable into the balance-of-power theory, in an attempt to show that, theoretically and empirically, the network effect influences balance-of-power politics in ways that have not been appreciated by extant literature in the field of international relations. The model is then applied to analyze the very first case of network effect taking place among the states connected within transnational telecommunication networks and the consequent great power rivalry over the dominance of those networks—the Anglo-German rivalry in the first period of globalization.

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Keywords: Network Balancing, Balance of Power, Telecommunication Technology Anglo-German Relations, Submarine Cables, Wireless Telegraphy

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CHAPTER 1. INTRODUCTION

The development of technology has accompanied every crucial transformation of the international system as a decisive factor closely linked to the principle concepts of international relations such as power and security, which explains how technological confrontations between great powers date back to the nineteenth century when a series of technological development began to connect and integrate the states and the markets across the borders (Arrighi 1999). These technologies such as the steam engine, railways, and telegraph broke down "the barriers to transportation and communication that used to isolate the local markets, thereby extending the distribution of goods and services to national and global markets (Durkheim 1893 cited in Beniger 1986, 11)." As the basic engine of the first globalization during the late nineteenth and early twentieth centuries, the connectivity enabled by these technologies was often treated as non-political enablers for cross-border flows of people, goods, services, and information without receiving much political or public attention (Headrick 1991, chap.1). However, connectivity is, in its basic form, "about lines of communication and lines of supply," providing access to and developing markets and resources. And once established, these lines have to be protected and regulated, hence connectivity

inherently includes security components (Biscop 2020). In this respect, among different types of technologies, those that enhance connectivity between states can be considered as the ones with the strongest implications on international politics as they can reap disproportionate benefits for certain industries of certain states, generating possibilities for violation of sovereignty or invasion of privacy thereby evoking serious security concerns (Krasner 1991; Drezner 2004; Grewal 2008; Seaman 2020). In this regard, history has shown that telecommunication,[1] sitting at the center of enabling such connectivity, has often taken an important part in great power competition with its political history paralleling and amplifying trends in international relations as noted by some scholars.[2]

[1] Composed of the Greek *τηλε* (tele) for "distant" and the Latin *communicatio* for "connection," the word "telecommunication", denotes the conveyance of information over a great distance (Wenzlhuemer 2010, 62). However, in most cases, the term is usually defined without "the pre-electric means of negotiating distance and it is applied solely on techniques of transmitting, emitting or receiving information via electric, electromagnetic or optical systems (Wenzlhuemer 2010, 9-10)." Although it was not officially used until 1982 at the International Communications Conference held in Madrid, telecommunications technology played a significant role in what James Beniger (1986) calls the "control revolution" of the late nineteenth century—"a complex of rapid changes in the technological and economic arrangements by which information is collected, processed, and communicated, and through which formal or programmed decisions might effect social control (Beniger 1986, vi as cited in Yang 2010, 2-3)."

[2] These scholars include Cherie Steele & Arthur Stein (2002), Rush Doshi & Kevin McGuiness (2020), Daniel Headrick (1991) and many more. Nebeker (2009) also noted that telecommunication technologies are also closely related to the military capabilities of states because enhanced communication allows for improved information, both in quantity and in quality, to be used in decision-making and makes "concerted action to be larger, more rapid, and more flexible (van Creveld 1989, 169-170)."

While the importance of such technologies has been recognized for their impact on the contours of world politics in existing studies, the portrayal of them has been largely limited to an exogenous factor—an environmental condition or set of instrumental possibilities, rather than something integral to how international politics are carried out. The lack of clear conceptual and analytical frameworks with which to investigate how and why technologies are developed and implemented in certain ways and how these processes impact the order of international politics makes it difficult to incorporate technology as a core component of international relations discussions. Against this backdrop, this study is an investigation of the network effect of telecommunication networks in international cooperation and conflict, and it attempts to examine the first period of globalization—from the late nineteenth century to the early twentieth century—when the advent of the first generation of transnational telecommunication technologies played a crucial role in the globalization. By helping to overcome national and geographical barriers, these technologies increased connectivity and interdependence among states with reduced costs for all forms of transactions. However, because such technologies are inherently political, as mentioned earlier, great powers have constantly competed over securing access to and control of those technologies. This study places a particular focus on the latter aspect of these technologies in which states compete over their access and control by attempting to examine how telecommunication technologies have affected

great power competition during the period. In order to do so, it draws from the history of the Anglo-German rivalry over dominance in telecommunication networks in the late nineteenth and early twentieth centuries. To elaborate on the puzzle of this study, a brief summary of the history is necessary.

A Historical Preview

The submarine cable, first laid across the English Channel in 1850, was first monopolized and later dominated by Great Britain until 1912. Equipped with sufficient demands, infrastructural support as well as its beneficial geographic location, the British had the field to themselves, especially in the very important formative years.[3] By the end of the century, Great Britain controlled most of the global telegraph network with the British cable counting up to more than sixty percent share of the world's submarine cable network (Steele and Stein 2002). Until then, other European states including Germany were willing to allow this medium of communication to be controlled by the British without realizing both the significance of telecommunication networks and the magnitude of British dominance of the

[3] By infrastructural support, I mean having proper commercial and banking systems to finance and support a cable-manufacturing industry and its cable ships (Headrick and Griset 2011, 553).

networks (Steele and Stein 2002; Kurbalija 2013). However, as the reliance of states on their communications increased, so did their fears of losing them, which were proven real when a series of irritations involving cable issues ensued in the Spanish-American war, the Fashoda incident in Sudan, and the Boer Wars (Headrick and Griset 2011). Faced with enduring threats deriving from the British monopoly on cables, Germany took several counterbalancing measures which were eventually frustrated by the British, failing to break free from the existing British submarine cable network. However, when the British once again took the lead in wireless telegraph network with Guglielmo Marconi, who created wireless telegraphy, affording the country a monopoly over radio transmissions, Germany ushered in early enough to take measures to balance against Britain. Threatened by Great Britain's growing dominance in wireless telegraph network, and in part by his infatuation with new technologies, Kaiser Wilhelm II authorized state support for German scientists and engineers from early on to compete against the British monopoly. Even so, Marconi's British-backed company was about to become the global standard, allowing Marconi to leverage its position to pursue a policy of "non-intercommunication" that prohibited Marconi operators from communicating with non-Marconi operators (Satia 2010). Kaiser intensified German industrial policy to contest the British apparatus and established the definitive German alternative, *Telefunken*. Berlin also pursued protectionism by banning the Marconi systems while tapping into emerging markets of

South America and Africa by selling them its technology to set the standard in those regions. Moreover, the crucial step taken by Germany was to utilize international conferences to gather the support of other states that were indispensable in constraining the further expansion of the British Marconi Company. Although it took more than ten years, a series of international conferences, together with Germany's remarkable progress in its technological development, eventually broke the British monopoly, allowing Germany to decouple from the existing British network and establish an alternative network of its own that was strong enough to vie with the British, thereby effectively establishing an Anglo-German duopoly.[4]

[4] While the term "decouple" or "decoupling" has become the buzzword in the current field of international relations, especially in regards to the changing relationship between the United States and China, since the late-2010s, it has remained contested, sometimes politically charged, and even misleading with most scholars and policymakers using the term without providing a clear definition. In its simplest meaning, to decouple is "to separate, disengage, disconnect, or dissociate." When the term "decoupling" is applied to IR discussions, it usually refers to the process of weakening or severing interdependence between two nations or blocs of nations (Witt et al. 2023). While such decoupling can occur in a wide range of sectors, this study focuses on the decoupling of "technology"—the telecommunication technologies in particular—which can be also referred to as "technological decoupling." As Jon Bateman (2020) noted, "decoupling" can take the strongest form of complete segregation between two nations or blocs of nations while it can also take the weaker form of a marginal reduction in interdependence. As such, while there indeed exist variations in the form of decoupling, this study considers that the highest goal of technological decoupling would entail the deliberate dismantling of the connection to the pre-existing network created by technological connection and eventually establishing its own network. It should be noted, however, that establishing an alternative network does not necessarily entail displacing the existing network; an alternative may extend large enough to share the field with the existing network, which is here described as establishing a duopoly.

Empirical Puzzle and Research Question

Tracing back a brief history of rivalry between Great Britain and Germany over the dominance of telecommunication networks leads to a puzzle that has not yet been fully explained within the international relations literature. When the British took and held a virtual monopoly on the submarine cables from the mid-nineteenth century (Hugill 1999), Germany took several measures to counterbalance the monopoly but eventually failed to fully avoid or bypass the British network by establishing its own network to dislodge the British from its monopoly—what I term as 'network balancing.' With the advent of wireless telegraphy, the Marconi Company, a British wireless telegraph company, again, took a head start in dominating the wireless telegraph network around the world in the late nineteenth century, allowing Great Britain to secure its monopoly once again. Faced with the fear that the British may they may have to bear the British control over the telecommunication network again, the Germans took multi-dimensional measures to counterbalance British dominance by establishing its own network which eventually succeeded in decoupling itself from the British network and establishing its own network that was strong enough to accomplish a duopoly with the British. Given that both telecommunication technologies—submarine cables and wireless telegraph—had similar strategic importance and posed similar security threats, it is puzzling to see Germany react

differently toward the British dominance in each telecommunication network which resulted in different outcomes. In order to find reasons for such differences in the outcome of Germany's balancing strategies, this study aims to explore possible explanations for the following puzzle: *Why did Germany fail to take balancing measures against the British monopoly in the submarine cable network but succeeded in counterbalancing the monopoly in the wireless telegraph network when the British dominance in both telecommunication networks posed similar security threats to Germany?* Differently put, how did Germany manage to counterbalance Britain's dominance in the submarine cable network but not in the wireless telegraph network?

This empirical puzzle generates a series of questions that leads up to finding explanations for the puzzle: Why did Great Britain and Germany compete over both telecommunication networks? How did Britain come to monopolize or dominate the submarine cable network? What was so threatening about the British having the dominance over telecommunication networks? Why did Germany ultimately remain within the British network of submarine cables instead of establishing its own? Was the stay voluntary or compulsory, and if compulsory, why? How did Britain, once again, come to dominate the wireless telegraph network? What motivated Germany to challenge British dominance? What kind of measures did Germany take to

compete against Britain? Did Germany succeed in establishing its own network? If so, how or if not, why not? Going back to the puzzle, it can be reformulated into the research question of this study as follows: *How and why did great powers in Europe compete over telecommunication networks during the first period of globalization? And what was the role of network technologies, more specifically their network effect, in international conflict and states' balancing behavior?* This study argues that the answer to the first question lies in a focus on the network effect, an inherent feature of network technology. It attempts to show that, theoretically and empirically, the network effect affects the balance-of-power politics in ways that have not been appreciated by extant literature in international relations by answering the latter part of the question. In finding answers to the above question, this study strives to achieve two goals. First, it aims to theoretically connect technology with the existing literature on balance-of-power politics, the discipline's foundational logic of thinking. Second, it attempts to postulate a framework to examine how technology and power interact in international relations.

Summary of the thesis

Analytical Framework

In order to find an answer to above questions, this study introduces a new

analytical framework, the 'network balancing model,' by incorporating the network effect, an intrinsic property of network technologies, as a key explanatory variable in an attempt to show that, theoretically and empirically, the network effect influences balance-of-power politics in ways that have not been appreciated by the preceding discussions in international relations. The network balancing model follows a neoclassical realist approach to the balance-of-power theory to formulate a model with an integrated analytical framework to explain Anglo-German rivalry over telecommunication networks in the first period of globalization.

Built on neoclassical realism's balance-of-power theory in conjunction with insights from discussions of techno-politics and vulnerability interdependence, the network balancing model considers how the strategies of great powers in balance-of-power politics are affected by the nature of network technologies, the so-called network effect. It identifies the mechanism of *network balancing*—i.e., *a balancing strategy adopted by great powers to counter external threats coming from the pre-existing network undergirded by network technologies such as telecommunication technologies by decoupling from the pre-existing network to establish one's own network*—as an overlooked realist strategy for states to pursue their security under anarchy. In doing so, the model modifies the key assumption of the balance-of-power hypothesis by introducing intervening causal

linkages such as state learning, emergence of new technology, and internal capabilities to specify as to how certain technologies may affect states' decisions to take network balancing measures as well as the likelihood of their success. I argue that the network effect, a distinctive feature generated by network technologies, creates a distortion within the balancing process of a state by transforming the character and shape of balancing acts, thereby affecting the balance-of-power politics in ways that have not been appreciated by extant literature in the field of international relations.

The Case

This study is a heuristic single case study; it is 'heuristic' in that its purpose is to identify a new theoretical variable and postulate a new causal mechanism in a way that has not received much or sufficient attention within the IR scholarship, which stimulates much further research within the field (George and Bennet 2005, 81).[5] Therefore, the case was selected on its heuristic value; the Anglo-German rivalry over telecommunication networks in the late nineteenth to early twentieth centuries allows the observation of the first

[5] The revelatory nature or "heuristic purposes" of a study is one of the rationales suggested by scholars for conducting a single-case study (Yin 2009, 47; George and Bennett 2005, 81). For example, Robert Yin (2014, 47) suggests four conditions which offer rationale for single-case study: 1) when the case "represents the critical case in testing a well-formulated theory"; 2) where the case represents an extreme or unique case; 3) when the case is the representative or typical case; 4) when the case is revelatory.

period of globalization undergirded by the very first telecommunication networks in which states involved were affected by the network effect for the first time An investigation of this time period is expected to demonstrate similar dynamics of technology, inter-state relationship, international cooperation and conflict, and sovereignty issues as we witness these days. Another reason for choosing the case, which is in line with the first reason, is that while a vast amount of literature exists on the rivalry between Great Britain and Germany,[6] less academic attention has been given to the technological aspect of the rivalry despite its importance in terms of balance-of-power politics in Anglo-German relations at the time. Hence, an analysis of the rivalry between the two great powers in the technological domain may provide unique insights to better understand the logic of balance-of-power politics and enrich the explanatory power of the balance-of-power theories. Lastly, it is almost imperative to focus on Britain and Germany in the discussion of the development of a global telegraph network as the companies or government departments of the former had by far the biggest share of international telegraph cables with the latter being the biggest competition to

[6] During the first period of globalization, Great Britain and Germany were undoubtedly the pivotal actors in European balance-of-power politics until the outbreak of the First World War. By then, as Paul Kennedy (1980, 466) noted, Germany had grown out of its position as "a cluster of insignificant States under insignificant princelings." Among the three major newcomers to the international system—Germany, France, and Japan, Germany had the most impact upon the Great Power balances of the time (Kennedy 1989, 209).

the former (Wenzlhuemer 2013).

Methods

The approach taken by this study to answer the research question is of qualitative nature. In particular, among the three explanatory approaches in case study research—co-variational analysis, process-tracing, and congruence (Blatter and Haverland 2012; Ulrksen and Dadalauri 2016), this study engages in process-tracing as its primary method. As noted by Little (1991) and Keohane (2009), "causal mechanisms exist independently of directly measurable relationships between variables" and thus, process tracing can be regarded as the most appropriate and effective way of illuminating those details hidden under the surface. In a similar vein, as noted by Ulrksen and Dadalauri (2016), the process tracing method also allows the researcher "to probe into how variables are interrelated." Keohane (2009) has also emphasized that causal mechanisms are best elucidated with case studies and narratives, conducted in an analytically rigorous way. Both primary and secondary sources are utilized for research. While it primarily relies on secondary sources, this study uses some of the important, and accessible, original documents (official documents, government documents, letters, and news articles) to provide the basis for my conclusions on the case.

Significance of the study

Likewise, by taking a heuristic approach, this study aims to open a new academic space in international relations by drawing attention to a phenomenon that has received little attention in the field: the link between technology and international relations. Despite the fact that "massive technological and political changes have reconfigured the entirety of global politics during the nineteenth century (Buzan and Lawson 2015)," this aspect has been given scant attention within the field. In this respect, this study aims to provide the instruments necessary to bring technology into the core discussion of the international relations field and to show that it matters to do so. Moreover, by applying the new model to examine the case of the very first occurrence of network effect taking place among states connected within transnational telecommunication networks and the consequent great power rivalry over the dominance of those networks in the first period of globalization, this study took a heuristic approach to show the link between network technology and the balancing strategies taken by great powers. The findings are expected to have both theoretical and practical significance as it attempts to show that the link between power and technology is worth paying attention to, not only in theory but also for understanding significant events in the current international relations.

Overview of the chapters

This dissertation is composed of six chapters. Following the introduction, Chapter two starts by outlining the main shortcomings in the preceding discussions and elaborates on the reasons why existing literature cannot provide sufficient explanations for the questions raised by this study. It is then followed by a comprehensive review of the existing literature on balance-of-power theories and the preceding discussion on technology within the field of international relations in order to build upon their arguments in the following chapter as an attempt to fulfill their shortcomings. The chapter also provides a conceptual analysis of network and network effect in relation to the existing discussions on vulnerability interdependence to elaborate on why this study makes a particular focus on telecommunication technologies. The chapter ends with an overview of preceding discussions on 'learning' within the IR literature in order to incorporate the learning process into the causal linkage between the network effect and state behavior. The third chapter lays the analytical framework that is necessary to answer the research question of this study. First, prior to introducing the concept of network balancing, it first clarifies what it means for states to 'balance' by showcasing the most prominent approaches to defining the term in international relations, and then outlines the working definition of the term to serve the purpose of this study. Based on the specific definition of balancing, the concept of 'network

balancing' will then be introduced. The new concept is introduced in an attempt to bring 'technology' into the core discussions of international relations. In order to explain the concept as a response to an external threat, a sub-section is devoted to show exactly how telecommunication networks can bring about threats to participating states. The chapter then proposes a new analytical framework of the "network balancing model" in an effort to meet the shortcomings of the preceding discussions on related topics and to resolve the empirical and theoretical puzzle raised in the previous chapter. The two subsequent chapters, chapter four and chapter five, are dedicated to the empirical illustration of the competition between Great Britain and Germany over dominating the submarine cable network and the wireless telegraph network, respectively. Both chapters apply the network-balancing model, introduced in chapter three, in the process of tracing the historical record of the case. By analyzing Anglo-German rivalry over the submarine cable network, chapter four attempts to show the context in which Germany, despite its efforts, fails to take network balancing measures against the pre-existing undersea cable network dominated by Great Britain. The chapter demonstrates that the Germans, although they came close to partially decoupling themselves from the British, eventually failed to break free from the existing network due its strong network effect that locked in its participating states. Chapter five starts with a similar story in which the British took the lead in the global communication network undergirded by a

different communication technology that emerged about half a decade after the submarine cable telegraphy was first introduced—the wireless telegraphy. By learning the mechanism of the network effect generated by telecommunication networks and its significance upon sovereignty, Germany ushered in quickly to take network balancing measures against the British. By effectively gathering support from other states that were yet to be trapped into the British network in constraining further expansion of the existing network due to its weak network effect, Berlin eventually succeeded in network balancing. The final chapter will recap and evaluate the findings of the case study based on the framework I have introduced in chapter three. Then, the chapter will elaborate on implications for international relations theory and also for the U.S.-China Competition over Information and Communication Technologies (ICTs) in the twenty-first century. The chapter ends with closing thoughts on the limitations and contributions of this study.

CHAPTER 2. LITERATURE REVIEW

The most fundamental underlying question of this study's puzzle—*How and why did Germany manage to counterbalance the British dominance in the wireless telegraph network but failed to break free from the dominance in the submarine cable network?*—relates to the variances in state behavior in a similar external environment. While many scholars such as neoclassical realists have searched for variances in state behavior, this study attempts to answer the question by incorporating 'technology' as an intervening variable.

There are two main approaches—the realist and liberal—to explaining the relationship between technology and international politics within the international relations field. However, state behaviors in the nineteenth century cannot be adequately interpreted from a liberal perspective as the period was characterized by a pre-capitalist market system where the states were yet to be fully connected across borders. Although levels of interdependence started to increase towards the end of the century which partially constrained the policy autonomy of states, the basic unit in the international system was still the national market (Kobrin 2003). In this respect, this study takes a realist approach to explore its research puzzle. In

fact, in most cases, the period has been discussed as “the golden age” of balance-of-power politics, the foundational logic of realism (Levy 2004; Claude 1989). It should be noted, however, that the existing theories of realism still fail to offer sufficient explanations for the puzzle of this study. According to realists, as mentioned earlier, the balance-of-power exists as the fundamentals in explaining state behaviors and interstate relations according to which states are expected to automatically, or semi-automatically, ‘balance’ when faced with threats coming from the dominance of a state—hegemony (Papayoanou 1999). Therefore, according to realist logic, it would have been more sensible for Germany to take balancing measures, or what I call ‘network balancing’ measures, against the British dominance in undersea cables as it did when Britain dominated the wireless telegraph. However, instead, Germany failed to counterbalance British dominance over submarine cables, showing different reactions to similar external threats which resulted in different outcomes.

The problem of the traditional theory of balance-of-power in failing to account for such variance in the strategies pursued by great powers has been addressed and complemented by neoclassical realists such as Randall Schweller, Aaron Friedberg, Jack Snyder, Fareed Zakaria, William Wohlforth, Paul A. Papayoanou, Robert Pape, and T.V. Paul, just to name but a few. These neoclassical realists claim that structural conditions at a systemic level are

filtered through intervening variables such as internal characteristics of states, political motivations of leaders, and economic interdependence "to produce foreign policy behaviors, which sometimes cause late, uncertain, or nonexistent balancing behavior (Powell 1999, 196)." Although neoclassical realists provide useful insights for understanding the variations in states' balancing behavior, they still fail to provide sufficient answers to the questions raised in this study for the following reasons. First and foremost, while technology has been recognized for its impact on the contours of world politics through shifts in the distribution of military and economic power in the field of international relations—especially in the area of security studies (Drezner 2019), the way technology has been treated was mostly limited as an exogenous factor—an environmental condition or set of instrumental possibilities, rather than "something integral to how politics and world affairs are carried out (Eriksson and Newlove-Eriksson 2021)," without receiving a more explicit focus within the IR scholarship (Goodin and Tilly 2006; McCarthy 2015; Taylor 2016; Eriksson and Newlove-Eriksson 2021). Most of both realist and liberal approaches have shown deterministic and instrumental views on technologies: while "the realists perceive technology as an independent variable that is crucial for building national power and state capacity (Sajduk 2019)," liberals treat technology as "a key enabler of economic growth and the force fueling interdependence that connects actors in the international system (Singh 2002; Sylvest 2013; Mayer et al. 2014;

Sajduk 2019).” Herrera (2006, 29) points to works of Kenneth Waltz and Robert Keohane as examples that show deterministic understandings of technology embedded in the IR scholarship. According to Waltz (1979, 127-128), new technologies can increase the military capabilities of actors, thereby altering the distribution of power in the system but operating in an exogenous fashion. As Herrera notes, Waltz’s view well represents that there is no room for political conception of technology in neorealism. Keohane also demonstrates the way neoliberal institutionalism treats technology; the role of technology is marginal and discussed in a deterministic way. According to him, the benefits of cooperation coming from the reduced transaction costs can be augmented and the costs of enforcement enabled by monitoring can be scaled down by the application of technology—particularly surveillance and communications technologies (Keohane 1984, 85-109).

As such, the lack of clear conceptual and analytical frameworks with which to explore how technology is developed and implemented, why it is developed and implemented in certain ways, and how these processes impact on the structure of international politics, makes it difficult to incorporate technology as a core component of IR discussions (Mayer et al. 2014; McCarthy 2015; Mayer 2017; Eriksson and Newlove-Eriksson 2021).[7] In

[7] Geoffrey L. Herrera identifies two approaches to examining the role of a technological factor in international relations literature (Herrera 2003, 559 and 562-563): The first approach does take technology as a central factor, but provides “an

fact, compared to extensive works on technology in economics, much less attention has been given to the political aspects of technological development. However, it should be noted that technology development is inherently political as it involves decisions over the allocation of resources and values. In other words, it is 'politics' that determine the possibility, rate, and direction of scientific progress and technological change. And at the same time, it is also 'technology' that can have a pronounced effect on changing the interests of states and the role of government by concentrating power, allowing new activities, and producing new markets. Preceding studies have failed to provide such reciprocal interactions between technology and politics by taking a 'one way or another' approach. There is now certainly an increasing number of, albeit diverse and rather "fragmented, literature on technology within various subfields of IR (Eriksson and Newlove-Eriksson 2021)," but technology has mostly received selective attention within the IR field and most of the time taken as static "givens" or as emanating from unobservable black boxes that somehow affects politics without probing it in any depth.

Another limitation can be found within the balance-of-power

ad hoc explanation of a given situation or change (e.g. taking into account the impact of nuclear weapons and their means of delivery; see Brodie, 1946), or the impact of telecommunications technologies on the growing interdependence (Keohane & Nye, 2012) (Sajduk 2019)." The second approach also perceives the importance of technology; however, its impact is considered indirect as it is "a determinant of economic growth and thus indirectly of the distribution of potential and power in the international system (Gilpin, 1981 as cited in Sajduk 2019)."

literature. Realists in general, with some notable exceptions of works done by neoclassical realists (Schweller 2004, 2006; Snyder 1991, Davidson 2002, and so on),[8] view the world through the lens of a satisfied, status quo state (Schweller 1996, 101 in Rynning and Ringsmose 2008, 25) with less focus on revisionist states and wrongfully treat them as anomalies, leaving them out of the purview of the balance-of-power logic (Rauch 2018). Although realists have never ceased to study revisionist states, they usually draw "attention to the threat to the existing international system emanating from a revisionist state" and give less recognition to "the reversed threat posed by the existing system to such a state" (Rynning and Ringsmose 2008; Buzan 1991, 308 in Chan 2004). Realists have subsumed "revisionism under structure and treated it either as an anomaly or orthodoxy assuming that states tend to behave as 'defensive positionalists' or satisfied status quo powers" (Posen 1984, 69; Grieco 1993, 303; Schweller 1996, 101 as cited in Rynning and Rinsmose 2008)." For example, defensive realists argue "that states have no real incentives to become revisionist and expansionist state is the rare exemption that requires auxiliary assumptions and hypotheses related to first and second image variables" (Rose 1998, 150; Rynning & Guzzini 2001 in Rynning and Ringsmose 2008).

[8] According to Davidson (2002), rising states becomes revisionist "only when they are pressured by domestic political groups or concerns with their security or autonomy and have the opportunity to achieve revisionist objectives."

1. Theories of Balance of Power

When it comes to the theories of power politics, the balance-of-power theory may be the most fundamental law, among the variants of theories. As a central concept of international relations, the balance-of-power theory has been a guiding principle of states' decisions and strategies. While many IR scholars hold that the balance-of-power is central to the studies of international relations, critics of the theory say that the balance-of-power is no longer a relevant principle of international relations in contemporary international politics, arguing that big post-war changes in the international system, including the collapse of the Soviet Union, economic interdependence, the emergence of international institutions and global actors, and the spread of democracy, have reduced concern for traditional hard balancing, causing the balance-of-power to lose its utility, relevance, and hence much of its importance as a device of power management in international politics (Fortmann et al. 2004; Paul 2004). Yet, many—in particular, realists—propose that the balance-of-power still operates as the central theoretical concept in international relations in varying forms and intensities (Snyder 1961; Paul 2004; Fortmann et al. 2004). It is argued that the concept of balance-of-power will likely continue as long as "the nation-state is the prevailing pattern of international society" and "so long as the struggle for power among them continues to characterize international relations (Palmer

and Perkins 2005/1957, 219).” These claims are supported by the current setbacks of globalization, or hyper-globalization as some would say, we are now witnessing through the outbreak of coronavirus and Russia’s attack on Ukraine. These major setbacks show that we “no longer live in the age of hyper-globalization where power politics would be meaningless,” which is what the critics of balance-of-power have argued until recently. The balance-of-power system is making a comeback as “the globalization process will likely lose its appeal in the post-coronavirus” and the post-Ukrainian war as the tensions among states and regions are rapidly escalating with each passing day (Oguzlu 2020). However, as noted by Fortmann et al. (2004), we may need to broaden our understanding of the concept by taking alternative or nontraditional approaches in order to understand the multi-faceted and complex fronts of balancing behavior, which is what this study is attempting to do in the later chapters. However, in order to situate this study within the existing literature, the following section will first look into earlier discussions on balance-of-power politics.

The Traditional Balance-of-Power Theory

While there are many versions of balance-of-power theory with no agreed-upon definition of the concept, a core thread that runs through them is that the concept refers to “the interaction among states that assures the survival of the

system by preventing the empire or hegemony of any state or coalition of states (Doyle 1997, 161-2; Waltz 1979 as cited in Boucoyannis 2007).” It is treated as a device for power management used by major powers to maintain a balance in their power relations. In this process, they preserve a sort of equilibrium in their power relations and do not approve of any state violating the balance. In case any state tries to disturb or violate the balance-of-power, the other states individually or collectively would take corresponding actions to weaken the power of the violator as well as to restore the balance. As the core principle of the realist approaches to IR, all versions of balance-of-power theory “fall within a realist theory that strictly defines the balance of power in terms of power and interest (Fortmann et al. 2004)” and therefore predicated on the premises that are held in realism (Paul 2005; Levy 2004): the system is anarchic with territorial states as its key actors who act rationally to promote their goal of power or security maximization (Levy 2004). To elaborate, with no central governing authority to control or protect individual states under the anarchic international system, states are compelled to increase their power to ensure their own security and survival by maintaining their power capacity or becoming stronger than others, which in turn makes power competition a fact of international politics (Paul 2005; Oguzlu 2020). Waltz also noted that the balance-of-power theory “depicts international politics as a competitive realm (Waltz 1979, 127).”

And because “the power preponderance of one actor or a single coalition of actors (Fortmann et al. 2004)” is perceived as unstable and undesirable due to the concern that the dominant actor may engage in aggressive behavior that may harm one’s security (Paul 2004), threatened states are expected to take balancing measures, as a defensive reaction, by forming countervailing coalitions or acquiring appropriate military capabilities—which are often referred to as internal balancing and external balancing, respectively (Paul 2005, 51; Papa 1999; Snyder 2001; Oguzlu 2020)[9]—to prevent any one actor to preponderate (Gulick 1955 in Paul 2005). Such balancing behavior is regarded as “an optimal response by states and conducive to international stability” and survival (Waltz 1979; Papayoanou 1999; Snyder 2001; Schweller 2008, 2016). Thus, it can be argued that the most important goal of balance-of-power system is “the avoidance of hegemony, a situation in which one state amasses so much power that it is capable of dominating the rest of the states in the system (Levy 2004, 32),” and as noted by Schweller (1994) and Levy (2003, 135), it involves a situation

[9] William C. Wohlforth and other scholars (2007) add ‘emulation’—"adopting the successful power-generating practices of the prospective hegemon”—as a separate balancing behavior other than internal and external balancing. Jeffrey Taliaferro has noted that not all states succeed in developing their military strategies to deal with external vulnerability. An international system provides motives for states to counter external threats through “emulating the most successful political, military, and technological practices of leading states, but domestic variables limit the efficiency of their responses (Taliaferro, 2006, 467).” Therefore, confronting external pressures, states with high capacity of mobilizing resources are likely to emulate successful examples to pursue their technological, military, and political innovation (Yoo 2012).

in which "state is not directly menaced by a predatory state but decides to balance against it anyway to protect its long-term security interests." Therefore, in more general terms, balancing can be understood as equalizing the odds in a contest between the strong and the weak.

The structural realists describe an "automatic version" of the balance-of-power theory, whereby the balance is "a spontaneously generated, self-regulating, and entirely unintended outcome of states pursuing their narrow self-interests under the anarchic structure of the international system" (Schweller 2016; Oguzlu 2020; Layne 1997, 117). Because there is no higher authority to guarantee one's security if the rising power turns aggressive, the stronger state will always appear threatening to the weaker states, regardless of the stronger state's real intention (Smith 2019; Vasquez 1998). Such an anarchic environment of a self-help system "generates powerful incentives for states to behave in certain ways as opposed to others" (Walt 1979, 186; Schroeder 1994).[10] Schweller (2014) describes such incentives as "structural constraints" that lead states to act in a similar way. In Waltz's words, states are forced "to behave in ways that tend toward the creation of balances of

[10] According to Waltz, a "self-help system is one in which those who do not help themselves, or who do so less effectively than others, will fail to prosper, will lay themselves open to dangers, will suffer (Waltz 1979, 118)."

power (Waltz 1979, 118).

Balance-of-Threat Theory

Stephen Walt modifies the traditional balance-of-power theory by presenting a balance-of-threat theory with which he emphasizes the role of threat perceptions in encouraging balancing behavior among states, claiming that states will balance against threats, not power capabilities *per se* (Fortmann et al. 2004; Paul 2004). Walt suggests that threat perception develops from a combination of four key variables: aggregate power, geography or proximity, offensive capability, and perceptions of aggressive intentions (Walt 1985, 9-13; 1987, 22-26). According to the balance-of-threat theory, states would sometimes pursue bandwagoning with a powerful state, "especially if that state could offer them security and economic advantages (Walt 1987, 9)." The two strongest motives for bandwagoning, suggested by Walt, include avoiding an attack on oneself and sharing the spoils of victory (Fortmann et al. 2004)." The theory directly counters the core proposition of the traditional balance-of-power theory that states would try to prevent a potential hegemon through balancing measures (Waltz 1979, 118-121 in Bock 2013). In a similar vein, Michael Mastanduno (1997) also finds that the balance-of-power in the security area does not always occur the way it is expected by the traditional perspective to operate. Based on the balance-of-threat theory, he suggests that

it would be more rational for states to pursue policies that signal "restraint and reassurance" which echoes Walt's claim that if states were to weigh intentions in deciding whether to balance, it would make much more sense for them to adopt "foreign and defense policies that minimize the threat one pose to others (Walt 1987, 27)." Mastanduno also claims that such logic of thinking would, in turn, affect the calculations of other major states as well to avoid engaging in unnecessary balancing behavior that would provoke other states to feel threatened (1997, 60). As Mastanduno (1997) puts it, "[j]ust as the behavior of potential challenges will be affected by how they view the intentions of the dominant state, so, too, the behavior of the dominant state will be influenced by its understanding of the foreign policy intentions of potential challengers."

Although Walt emphasizes that balancing is "not an instantaneous or automatic process" by suggesting the possibility of bandwagoning, especially among the weaker states (Walt 1992, 32 and 449), he agrees with Waltz in expecting "balancing behavior to be the general tendency in international relations." He suggests two main reasons for the dominant tendency of balancing: First, because states can never be certain about others' intentions, states cannot ignore the possibility of risking their own survival in case they fail to restrain a potential hegemon before it becomes too strong; as Walt puts it, "it is [therefore] safer to balance against potential threats than to hope that

strong states will remain benevolent (1985, 15).” Moreover, joining the more vulnerable side would increase one’s influence as the weaker side would have a greater need for assistance (Walt 1985, 5-6). Likewise, both Waltz and Walt make it clear that they believe balancing occurs much more frequently than bandwagoning (Waltz 1979, 126; Walt 1987, 33; Vasquez 1998, chap.11) based on the assumption that the anarchic international system offers “incentives and imperatives for states to countervail others’ power or threats (He 2012).” Levy and Thompson (2005, 1) also noted that “[t]he central proposition of nearly all balance of power theories is that states tend to balance (as cited in He 2012).”[11]

Neoclassical approaches to Balance-of-Power Theory

Neoclassical realists[12] directly oppose neorealists’ claim that the survival motive of states under an anarchical system will lead them to take actions that will surpass the barriers caused by the “problems of uncertainty, collective

[11] In fact, most realists agree that balancing is the most “typical state behavior under anarchy, though they disagree about what states actually balance against (He 2012).” Aside from the Waltz-Walt debate, other scholars suggest that states pursue balance of interests, risks, and influences (Schweller 1998; Taliaferro 2004; Keller and Rawski 2007).

[12] Gideon Rose (1998) was the first to use the term, neoclassical realism, to categorize theories with two properties: first, a state’s foreign policy is driven primarily by its relative power position and second, the impact of power on foreign policy is indirect and complex (Davidson 2002).

action, and endemic domestic-level hurdles," with the result of 'automatically' bringing the system into balance (Wohlforth et al. 2007). Arguing that the balance-of-power politics does not arise automatically simply because states live in an anarchical environment, neoclassical realists claim that "internal characteristics of states, political motivations of leaders, and dynamics of domestic politics act as 'intervening variables' between structural conditions at a systemic level and through the personal characteristics and judgments of decision-makers at the individual level." Likewise, by incorporating these intervening variables into the balance of power theory, neoclassical realists pay attention to variations in the dynamics of balancing. Schweller (2008), for example, eyed on the fact that states often show different reactions to similar systemic pressures and opportunities and noted that "their responses may be less motivated by systemic-level factors than domestic ones." Differently put, as in Schweller (2008)'s words, "systemic pressures are filtered through intervening variables at the domestic level to produce foreign policy behaviors," which sometimes cause late, uncertain, or nonexistent balancing behavior (Schweller 2016; Powell 1999, 196). Attempting to address and complement deficits in the balance of power literature, Schweller offers four distinct categories of balancing behavior according to the causes and consequences of balancing: appropriate balancing, inappropriate balancing, non-balancing, and under-balancing. He demonstrates a particular focus on under-balancing which takes place when the state does not balance

or does so inefficiently in response to an unappeasable, or potentially dangerous, aggressor, when "the state's efforts are absolutely essential to deter or defeat it." Yoo Hyon Joo (2012) also claimed that a state's policy behavior towards external threats does not take a simple form of balancing as expected by the balance of threat theory. She noted that "the influence of domestic hurdles yields various forms of balancing: an effective balancing response, a slow balancing response, an inconsistent balancing response, and a chaotic response." Her model emphasizes domestic obstacles to a system-driven behavior in explaining variance in state behavior. Likewise, neoclassical realists point to the fact that neorealism, which "assumes that balancing is the most likely response because it best serves the purpose of survival" under the anarchical international system, cannot offer appropriate explanations for questions like "what causes states to choose dissimilar policies faced with the similar international environment?," and tackles these questions by considering both international and domestic variables (Barnett and Levy, 1991; Rose 1998; Schweller 2004, 2006; Taliaferro, 2006; Lobell et al., 2009; Yoo 2012). As Papayoanou (1999) pointed out, "[a]lthough the balance-of-power still exists as the fundamentals in explaining state behaviors and interstate relations, it fails to account for the variance in the strategies pursued by great powers. The conception leaves unexplained the different balancing measures taken by different states."

Contrary to the conventional realist wisdom that balancing occurs more commonly than bandwagoning behavior (Walt 1987), Schweller (1994) claimed that the latter is more prevalent "because alliances among revisionist states, whose behavior has been ignored by modern realists, are driven by the search for profit, not security." Other scholars have also noted the fact that states sometimes fail to balance—under-balancing—against aggressive states (Papayoanou 1999; Powell 1999). For example, Papayoanou points to the significant empirical shortcomings of the balance-of-power by successfully demonstrating that international economic interdependence, or interaction, can constrain state behavior, even when the security of the state and the balance of international system is at stake. While Schweller (2006, 2008) focuses on the domestic-political reasons for under-balancing, Papayoanou grounds such balancing behavior to the economic ties among states—more precisely, among status quo states and between status quo and revisionist states.[13] Robert Powell (1999) took even stronger position by arguing that "balancing is relatively rare in the model." He adds that "[b]alance-of-power sometimes form, but there is no general tendency toward this outcome. Nor do states generally balance against threat (contrary to Walt's argument).

[13] Papayoanou (1999) hypothesizes that firm balancing behavior is most likely when there are strong economic ties among the status quo powers and weak economic ties between these powers and the perceived revisionist states. In chapter four, he demonstrates that the strong economic ties between Britain and Germany inhibited the British leadership in its strategy of balancing against the Germans prior to the First World War.

States frequently wait, bandwagon, or, much less often, balance (Powell 1999, 196).” Likewise, in order to show that systemic factors and relative power distributions define the parameters of a state’s behavior while domestic processes work as “a secondary influence to guide state responses to the international environment (Lobell et al. 2009),” neoclassical realists attempt to explain “variation in the foreign policies of the same state over time or across different states facing similar external constraints (Taliaferro et al. 2009, 21).” Gideon Rose, the scholar who first used the term neoclassical realism, also highlighted the importance of systemic factors because “over the long run a state’s foreign policy cannot transcend the limits and opportunities thrown up by the international environment (Rose 1998, 151; Yoo 2012).

The concept of balancing, which has traditionally been understood as a military-security concept, also has been broadened by some neoclassical realists such as Kai He, P. Papayoanou, R.Schweller, T.V. Paul, and R. Pape who attempted to understand the various means states adopt to accomplish “the ultimate purpose of balancing strategy to reduce or match the capabilities of a powerful state or a threatening actor, besides increasing their military strength or forming alliances (Paul 2004, 2005; Pape 2005).” Conventionally, scholars have defined balancing in military terms. As it was mentioned earlier, Waltz confined the balancing measures to aggregating military power through

either international mobilization or the forging of alliances (Waltz 1979, 128). Stephen M. Walt, albeit with a different view from Waltz on the motivation underlying balancing behavior, also placed his focus almost exclusively on military capabilities with a particular emphasis on the founding of alliances as the typical form of balancing behavior (Walt 1987, 1990 as cited in Bock 2013).[14] Both internal balancing and external balancing discussed by neorealists "emphasize the usage of military means to achieve security and deter threats (He 2012)." Such military-focused approaches to balancing have been labeled as "hard balancing" by later supporters of soft balancing (He 2012). However, balancing means more than cumulating military capabilities and forming military alliances. As Kai He puts it: "military alliances and arms buildups are not the only balancing strategies states can use to pursue security under anarchy (He 2012, 156)." In fact, Daniel H. Nexon noted that a broader understanding of balancing has already been "detected in the definition [used by] Morgenthau and Thompson (1950, 103) who defined balancing as "the attempt on the part of one nation to counteract the power of another by increasing its strength to a point where it is at least equal, if not superior, to the other nation's strength." Such definition of balancing tells us that "there is no compelling reason to exclude strategies that involve nonmilitary instruments (Nexon 2009, 344)" and "that states can rely on many tactics and

[14] Walt (1987, 17) defines balancing as "allying with others against prevailing threat."

strategies to achieve their security goals (He 2012)," as suggested by many scholars in neoclassical realism. Paul also rightly points out that "if balancing implies restraining the power and threatening behavior of the hegemonic actor, strategies other than military buildups and alliance formation should be included (Paul 2005, 52-53 and 71)." Similarly, in the soft balancing debate, Robert Art also claims that "Balancing refers to behavior designed to create a better range of outcomes for a state vis-à-vis a state or coalition of states by adding to the power assets at its disposal, in an attempt to offset or diminish the advantage enjoyed by that other state or coalition (as cited in Nexon 2009, 342)." All of these definitions "go beyond military alliances in defining balancing" with an emphasis on the importance of relative power, strength, or "capability in conceptualizing balancing (He 2012)."

The balancing behavior can be broken down into two categories according to the type of measures taken for balancing: hard balancing and soft balancing. As mentioned earlier, the traditional realist conceptions of balancing are mainly confined to hard balancing which refers to the strategies of building and updating military capabilities as well as creating and maintaining formal alliances and counter-alliances "to balance a strong state or to forestall the rise of a power or a threatening state (Fortmann et al. 2004)." Soft balancing, on the other hand, refers to "a calculated, focused and nonmilitary strategy that may involve economic statecraft, institutional

binding or exclusion, diplomatic entangling and political integration practiced in order to constrain and restrict an emerging power from pursuing its threatening policies (Saltzman 2012, 132)." In a similar but a bit different way, T.V. Paul defines soft power as "restraining the power of aggressive policies of a state through international institutions, concerted diplomacy via limited, informal ententes, and economic sanctions in order to make its aggressive actions less legitimate in the eyes of the world and hence its strategic goals more difficult to obtain (Paul 2018: 20 cited in Brooks and Wohlforth 2008, 60)." These two types of balancing can again be broken down into negative balancing and positive balancing with the former referring to strengthening "a state's own power in world politics (He 2012)" while the latter means taking balancing measures directed against the threat or threatening state (He 2012, 156-157).[15]

[15] Kai He (2012) introduces "a new analytical framework for states' countervailing strategies," called a negative balancing strategy model, based on Walt's balance-of-threat theory with which he attempts to search for the reason why traditional balance-of-power theory became less convincing after the Cold War. His model suggests that while 'negative balancing' refers to "a state's strategies or diplomatic efforts aiming to undermine a rival's power," positive balancing "means to strengthen a state's own power in world politics." Arguing that "a state's balancing strategies are shaped by the level of threat perception regarding a rival," he claims that "[t]he lower the threat perception, the more likely it is for a state to choose a negative balancing strategy (He 2012, 157)."

2. Technology in International Relations

The dynamics of international politics have changed from protecting territories to protecting domestic markets and further to protecting and stabilizing the international market through international cooperation (Lee 2021). Accordingly, the tool for acquiring greater power changed in parallel with the changing dynamics of international politics, and so did the battlefield of competition among states (Afshan and Ali 2021); what used to be about expanding territory has changed into securing greater market and acquiring advanced technologies which have increasingly become crucial in the way of acquiring both military superiority and economic prosperity, invulnerability, and dominance (Strange 1988, 136). Technology has always been a key indicator of national power and a key determinant of world order and hence its development has "contributed to a profound evolution of the details and substance of national and international affairs, serving as a major driving force for every qualitative shift (Skolnikoff 1993)" throughout the history. Eugene B. Skolnikoff emphasized the contribution of science and technology to "a profound evolution of the details and substances of national and international affairs," through a case study on the impact of technological change "in the disintegration of communication in Eastern Europe and the Soviet Union (Skolnikoff 1994). James N. Rosenau (1990) also claimed that the dynamics of technology served as a major driving force in fundamental

transformations in world politics.[16] In light of such importance and centrality in shaping IR's subject matter (McCarthy 2015), technology has been "admittedly present in theories of international relations," and, as noted by Geoffrey L. Herrera (2006, 3), it "looms across disciplines as a source of social, economic, and/or political change." In what follows, the ways in which technology has been portrayed and treated by IR theories will be discussed in order to demonstrate how these theories provide valuable insights for this study's topic and to propose modifications to improve the discipline's explanatory capacities in the following chapter. Investigating the role of technological factors in all theories apparently exceeds the capacity of this paper, however, for the sake of argumentation, I will focus on the two leading paradigms—realism and liberalism, followed by an eclectic approach of techno-politics (Fritsch 2011; Sajduk 2019).

Realist approach

Within realism, technology has been traditionally regarded as a passive and exogenous factor belonging to the category of 'material capabilities' of

[16] Rosenau (1990)'s argument is that "breakpoints or discontinuities occur when the primary parameters of the international system have been transformed; and he believes and seeks to demonstrate analytically that such transformations have now taken place, largely as a result of the effects of technological change (as cited in Skolnikoff 1994)."

states—as a source of economic and military power capabilities of states, which strive for security and welfare in an anarchic environment (Mearsheimer 2001; Eriksson and Giacomello 2007; Fritsch 2011, 2014; Eriksson and Newlove-Eriksson 2021; Lewis 2022). William McNeill (1984) also noted that emerging technologies primarily shape the balance of power through military and economic means. Horowitz (2018) elaborates McNeill's claim by explaining the two ways of technologies' influence on the balance of power: (1) Technologies can directly influence countries' abilities to fight and win wars; (2) They can also indirectly affect the balance of power by impacting a country's economic power. After all, as pointed out by Baldwin (1979) and Gilpin (1981), countries cannot maintain military superiority over the medium to long term without an underlying economic basis for that power.

This stress on technology as one of the material resources that define power has, in many ways, defined our understanding of technology as a tool of power in global politics, "to the extent that scholars arguing for alternative perspectives effectively cede this ground to a Realist understanding (Guzzini 2005 in McCarthy 2015)." The realist focus on the importance of the technological factor as a key indicator of national power[17] or a key determinant of world power is "particularly evident in the area of security

[17] As James A. Lewis (2022) noted in a commentary, technology affect all three components of national power: the economic strength, military capabilities, and political influences.

studies with each of the leading paradigms of security description in the field of IR acknowledging the role of the technological factor in their explanations (Sajduk 2019).” Kenneth Waltz, the founding father of structural realism, generally acknowledge the role played by technology in shaping the capabilities of “the states and thus indirectly the structure of the international system (Sajduk 2019).” He argues that “economic competition is often as keen as military competition, and since nuclear weapons limit the use of force among great powers at the strategic level, we may expect economic and technological competition among them to be more intense (Waltz, 1993, 59).” In his later writings, he admitted that “realist theory, old and new alike, draws attention to the crucial role of military technology and strategy among the forces that fix the fate of states and their systems (Waltz, 1998, 48–49).” Robert Gilpin also indicated the importance of technology as one of the main factors responsible for systemic disequilibrium: “a military or technological innovation may dramatically reduce the cost and increase the benefits of territorial conquest and thereby encourage military expansion (Gilpin, 1981, 22).” Therefore, as noted by John Mearsheimer (2001, 55), technology is particularly crucial for “great powers to build military forces and to fight wars … with rival states.” Likewise, realists have considered “technology as an independent variable affecting the economic and military potential of a state, and thus co-responsible for a systemic change (Sajduk 2019).”

Despite such recognition of the significance of technology as a means of power and its impact on warfare by leading scholars in the paradigm, realists tend to nevertheless hold the view that technology, notwithstanding its contribution to shifts in power relations, does not qualify as a core component of international relations that would directly change the nature of international relations (Drezner, 2019; Eriksson and Giacomello, 2007; Fritsch 2011, 2014; Herrera 2006 as cited in Fritsch 2011). Even in a globally connected and highly technologized society, they argue that basic realist conceptualizations persist: "the conception of a state-centric and 'anarchic' international system; the strategic notions of hegemony, the balance of power, bandwagoning, buck-passing, and so forth; and the supremacy of material power capabilities (Eriksson and Newlove-Eriksson 2021)." From a realist perspective, technology, as a pivotal factor for power, may change and may also impact international relations, yet cannot be regarded as a dynamic factor that could also transform the basic interaction patterns between the system units or the character of the system at large (Fritsch 2011).[18]

Liberal approach

[18] A rare exception is Barry Buzan who, by advancing a neorealist approach, attempted to grant technologies a critical role by suggesting that technological progress changes the "interaction capacity," and therefore the properties of international systems (Buzan et al. 1993).

As for the liberals, in general, technology has been observed and discussed primarily from an optimistic perspective, perceiving its progress—in information and communication technologies and transportation in particular—as an important push for transformations of the international system. Based on the assumption that greater interdependence means more transactions and greater complexity which brings in a greater need to coordinate activities and policies, technological innovations were thus noted as "a fundamental source of economic globalization, essential for the creation of new international institutions, and a condition for increasing interdependence (Keohane and Nye 2001/1977, 211-223 as cited in Sajduk 2019)." In a similar vein, technology is also often described as a crucial driving force behind the emergence of new actors, interaction patterns (integration and cooperation), or system structures such as interdependences (Fritsch 2011; Eriksson and Newlove-Eriksson 2021). Moreover, with the rapid development of information and communication technologies (ICTs), especially in regards to the diffusion of the Internet and social networks, the optimistic narrative that these technologies, as a powerful medium for the spread of liberal democracy, will pose an existential challenge to authoritarian regimes became pervasive and popular, particularly after the Arab Spring in the early 2010s when Egypt's 'Facebook Revolution', Syria's 'YouTube Uprising', and Iran's 'Twitter Uprising" were all hailed as movements in a 'social media revolution,' bringing about considerable hope for "the fourth

wave of democratization." However, the subsequent retreat of political transition across the states in the Middle East has led to much reflection on the ICTs. While their use can definitely shape politics, they can as well become a tool whose effects would differ depending upon the context in which it is used which led to a reconsideration of their function as a driving force of democratization. The following successful adaptation of ICTs to authoritarian contexts, especially with the further development of artificial intelligence (AI) technology, has led to an opposite argument that these technologies have in fact consolidated authoritarian system, contrary to the earlier expectations; China is probably the most frequently mentioned and most successful example of this response.

In fact, some liberal scholars have noted such negative aspects of technology-driven transformations such as "complex interdependence, network society, and the dangers of technological dependency (Eriksson and Newlove-Eriksson 2021)" (Sagan and Waltz 2002; Drezner et al. 2019). For example, Ulrich Beck (1992, 2012) and Charles Perrow (1999) have demonstrated that complex "socio-infrastructural systems—such as airports, electricity infrastructure and railway interchanges—imply not only interdependency, but also high levels of risks (Eriksson and Newlove-Eriksson 2021)." In other words, societies that are dependent on highly complex and integrated infrastructures and technologies are also highly

vulnerable and exposed to serious accidents and disasters. Moreover, Scott Sagan also emphasizes the risk and dangers that may come from accident, theft or intentional decisions to use nuclear weapons, which directly contrasts with Waltz's claim that the spread of nuclear weapons would lower the possibility of war (Sagan 1994; Sagan and Waltz 2002).

An eclectic approach: techno-politics

Developed from Thomas P. Hughes's concept of the "technological system,"[19] the term 'techno-politics' was first conceptualized by Timothy Mitchell (2002) and Gabriel Hecht (2009). While Mitchell put emphasis on the unforeseen power effects of technological designs and assemblages—what Hecht (2011, 3) refers to as "the unintentional effects of the (re)distribution of agency that they enacted," Hecht refers to techno-politics

[19] The concept of "technological system" was first introduced by Thomas P. Hughes (1969) in an attempt to offer "a synthesizing approach to combine deterministic and constructivist arguments (Fritsch 2011)"; Hughes focused on the fact that while the constructivists "have a key to understanding the behavior of young systems; technical determinists come into their own with the mature ones (Hughes 1994, 112)" because "as [the technological system] grow larger and more complex, [they] tend to be more shaping of society and less shaped by it (Frisch 2011). Skolnikoff nicely describes Hughes' understanding of technological system: *"[Even though technology is] in fact a product of human choice, in practice it has to be treated both as a dependent and as an independent variable. Technological change comes about as a result of human decision and is in that sense a dependent variable. But society is also often confronted with new situations in which technological change brought into being for one purpose has consequences in other and broader areas—for which it is, in effect, an independent variable (Skolnikoff 1994)."*

as the performance of power via technology—that is, the "strategic practice of designing or using technology to enact political goals (Hughes et al. 2001, 14)" (as cited in Karas 2014). By placing power at the core of analysis in understanding politics, she acknowledges technology's constitutive role of empowering actors in various degrees or empowering a single actor against others. Moreover, she points out that "[t]hese technologies are not in and of themselves technopolitical. Rather, the practice of using them in political processes and/or toward political aims constitutes techno-politics (Edwards and Hecht 2010, 256-257)." Although Hecht developed her conceptualization of techno-politics, she differs from Hughes' approach in that she "isolates a specific technology in order to see its role in constituting political power" with less focus on the design process involved in the innovation and implementation of new technologies (Kurban et al. 2016). Some scholars note that Hecht's approach allows for a much more dynamic understanding of how political positions are shaped in the design process of technologies. For example, Kellner follows Hecht's approach in analyzing the ways in which oppositional politics utilize new technologies to intervene within the global restructuring of capitalism to promote democratic and anti-capitalist social movements aiming at radical structural transformation (Kellner 2001, 15). By treating technology as an independent variable, she presents how technologies can be strategically utilized by conflicting actors for different political purposes.

Techno-politics imply that epistemic communities, scientific practices, and technical designs should not be observed as simply objective and neutral phenomena but rather as something that are "deeply interwoven with the fabric of power" (Litfin 1994, Adler and Bernstein 2005 as cited in Mayer et al. 2014); technology and power are inevitably inter-connected. Although techno-politics "draws heavily on the multidisciplinary field of science and technology studies (STS)" in which international relations theory plays a limited role, a few scholars have recently attempted to incorporate techno-politics within the discipline of IR (Eriksson and Newlove-Eriksson 2021).[20] One of the primary assumptions shared among these scholars is that, in contrast to major IR paradigms, technology is "neither good, bad, nor neutral" (Fritsch, 2014, 115; Kranzberg, 1986), but, in fact, deeply and inherently political as it involves decisions over the allocation of resources or values;[21] thus, it is intertwined with or embedded within politics (Eriksson and Newlove-Eriksson 2021). In other words, it is 'politics' that determine the rate and direction of scientific progress and technological change, and, at

[20] These scholars include Madeline Carr (2016), Stefan Fritsch (2014), Marijn Hoijtink and Matthias Leese (2019), Carolin Kaltofen, Madelin Carr and Michele Acuteo (2019), Maximilian Mayer, Mariana Carpes and Ruth Knoblich (2014) Daniel R. McCarthy (2018), and J.P. Singh, Madeline Carr and Renee Marlin-Bennett (2019).

[21] Politics is widely defined as "the authoritative allocation of values (Easton 1953)" and, as noted by Douglass North (1990), decisions of such allocation made by governments through laws, regulations, subsidies, and taxes "may substantially affect whether actors invest in the new technology (as cited in Milner 2006, 181)."

the same time, 'technology' may change the interests of states and the role of government by concentrating power, allowing new activities, and producing new markets; technology and politics continuously shape each other in complex and unpredictable ways (Mayer et al., 2014; cf. Singh et al., 2019 in Eriksson and Newlove-Eriksson 2021). Therefore, as Fritsch pointed out, technology should be regarded as an "endogenous core component of the global system (2014, 115)" rather than be treated as an exogenous factor. Among the scholars who have turned their attention to the political aspects of technology, many of them present their discussions in relation to the role of institutions, ruling elites, public policy, etc.[22] For example, North (1990) analyzed the ways communication technologies may enable states to monitor the transaction and the economic activity of other states more efficiently. Moreover, Helen V. Milner (2006) examined whether "the nature of a country's democratic institutions determined how quickly it adopted online technologies" by attempting to demonstrate how technological development can affect changes in political institutions by examining whether a country's regime type affects its rate of Internet adoption. She concluded that it is far more likely for democracies to facilitate the spread of online technologies than authoritarian regimes. Mark Taylor (2016), on the other hand, takes a contrasting approach to argue that democracy is neither necessary nor

[22] These scholars include Douglass North (1990), Helen V. Milner (2006), Daniel W. Drezner (2004, 2019) and many more.

sufficient to explain why some countries show better progress in science and technology than others. The recent technological development seems to support Taylor's argument as the lack of societal checks and balances allow for rapid development of digital technology in authoritarian regime; namely, in China (Zeng 2020, 1452). Likewise, there are burgeoning discussions revolving around the political aspects of technology. However, many of them are still largely limited to taking technology as a given black-boxed factor which fails to provide discussions on reciprocal interactions between technology and politics.

3. Balance of Power and Telecommunication Network

Given the diversity of technology and different qualitative impacts on the international system generated by different technologies, it is neither appropriate nor possible to draw general conclusions about the effect of a singular 'technology' on international relations (Herrera 2006; Fritsch 2011). Therefore, some narrowing or classifying must be preceded in discussing 'technology.' In this regard, this study focuses on those technologies "that are able to change patterns of interaction within the international system and thus the structure of that system itself (Sajduk 2019)"—what Herrera (2006, 26)

terms ‘systemic technologies.’ These systemic technologies can spur changes in the interaction capacity of the international system; typical examples would be communication and transportation technologies. Buzan and Little (2000, 80-84) define interaction capacity as “the physical and organizational capability of a system to move ideas, goods, people, money and armed force across the system.”[23] In this sense, the infrastructures built on these systemic technologies become essential for the function and maintenance of cities, regions, countries, and entire continents, and any disruption of which would have a significant impact on entire systems (Silvast et al. 2020). The primary reason why this study makes a particular focus on telecommunication technologies among other systemic technologies lies on their peculiar propensity to become increasingly entrenched as their user base expands, a phenomenon that is often attributed to the “network effect.” To elaborate, unlike gas or water networks, telecommunications networks become more valuable to individual users as they expand because the expansion facilitates the linkage of a larger number of nodes, all things being equal (Balbi and John 2015). In fact, such a feature of network technologies has been examined in the economic and political science literature mostly in relation to path dependence (Druzin 2021). However, to my knowledge, there have not been

[23] Following Buzan and Little (2000)’s definition, Butcher (2021) conceptualizes interaction capacity as “a function of the speed and cost with which information and goods can travel across a system that constrains the frequency of interactions without determining the nature of those interactions.”

enough studies that have given a thorough investigation of the feature in relation to the core discussion of the IR.[24] Therefore, in order to examine the ways in which the 'network effect,' a distinctive feature exhibited by network technologies, relates to the principle concepts of the IR, this section begins with a conceptual analysis on the network effect and network technologies as a basis to answer the following questions: what is 'network effect' and why does it matter? how does the 'network effect' affect states' balancing strategies? And what aspects of 'network effect' sometimes constrain states from taking balancing measures?

Network Technologies and Network Effect

A network refers to a set of interconnected nodes, "each representing a specific actor or location within the network" (Castells 2010; Drezner et al 2021). It can be also described as "a system, the performance of which depends on the performance of individual links and nodes (UNESCAP & AITD 2007)." Networks can be created in various types of structure depending on the pattern or structure of nodes and links between them, through which many forms of influence channel. In a broad sense, the

[24] In a similar, but slightly different, way, Herrera discussed partly on how "significant technologies are politically malleable in their development and diffusion phases, yet grow increasingly harder to change, and have a greater impact on politics, once mature (Herrera 2006, 199).

network can have either point-to-point topology, central-hub topology, or multi-hub topology. These structures of network can have important consequences for power distribution as a source of dramatic reorganization of power relationships (Castells 2010, 501-502). In the case of the latter two topologies, the network takes an asymmetric structure in which some states are able to leverage their position (as a hub or a switching node) to manipulate or coerce others. In particular, a state positioned as the central node—the hub—within a central-hub network is "uniquely positioned to impose costs on others" by having the capacity to limit or penalize others who are asymmetrically connected to the hub—what Farrell and Newman refer to as having a 'choke point effect' (Farrell and Newman 2019).[25] While states positioned as the hubs, again, have greater power than others within the multi-hub networks, the switching nodes—the nodes that connect the hubs—can also take the privileged instruments of power by becoming "the fundamental sources in shaping, guiding, and misguiding" the connection between the networks (Castells 2010, 501-502).[26] Telecommunication networks are the most typical example of networks with asymmetric structure in which the nodes are connected by a communication channel. In such networks, nodes

[25] According to Farrell and Newman (2019, 55-56), the "chokepoint effect," refers to "privileged states' capacity to limit or penalize use of hubs by third parties (e.g., other states or private actors)."

[26] These switching nodes are also called gateways if they act as "connections among otherwise incompatible networks (Puffert 2000, 12)."

are literally connected to each other through some sort of communication technology.[27] As Liebowitz and Margolis (1994, 135-6) describe, these literal networks require an investment of capital for their physical manifestation which inevitably leads to having ownership or control of the networks. Such ownership would enable the owner, which naturally becomes the hub, to require those attached to the network to adhere to their own rules if they wish to retain their connection to the network. The vulnerability among the states positioned as a 'general' node as well as the power given to the hub in an asymmetric network in terms of international relations can be better understood from the preceding discussions on asymmetric interdependence.

Vulnerability interdependence

Among the scholars who focused on asymmetric interdependence as a source of power in international relations, Albert O. Hirschman was the first to emphasize that unequal economic relations, more specifically trade, can have significant political consequences in his emblematic book *National Power and the Structure of Foreign Trade* (1945). He pointed out that trade between countries is not simply about the provision of goods but rather about competitive national advantage fraught with both economic and political

[27] Telecommunication network can be understood in a similar way as we currently use the term "digital network" by which we refer to as a network built through the use of digital technologies.

consequences (Hudson 2022), because, as he claims, the gains from trade often accrue to states in a disproportionate way which could in turn affect interstate power relations where states could use trade as an instrument of statecraft (Mansfield and Pollins 2003; Tucker 2013). In explaining such an impact of foreign trade on power politics, Hirschman presents two main effects of foreign trade upon the power position of a country (1980/1945, 14-18): the supply effect coming from the goods states trade and the influence effect deriving from states' ability to influence whom they trade the goods with. The first effect—the supply effect—enhances the potential military force of a country by providing a more plentiful supply of goods or by replacing goods wanted less with those wanted more through trade. As Hirschman noted, the supply effect acts as an indirect instrument of power in that it serves as a means of increasing the efficiency of military pressure. The second effect is the influence effect which makes foreign trade become a direct source of power by providing a method of coercion of its own in the relations between sovereign states. It refers to the conditions created by trade "which make the interruption of trade of much graver concern to its trading partners than itself (Hirschman 1980, 16)." Hirschman demonstrates the mechanism of influence effect through the example of Great Britain holding a strategic position in trade with other states. By having its control over strategic bases such as Gibraltar, Suez, and Singapore, the British not only could guarantee the security of its trade but also had the ability to cut off the

trade of other countries passing through these points, which "gave her considerable "direct power" over, and influence in, other countries, in that they were always exposed to the potential threat of a sudden stoppage of their trade at Britain's will." He also asserted that once an export relationship has been established with a nation, it is extremely difficult for the non-industrialized nation to disentangle itself from it (Hirschman 1980, 108-109).

Drawing on the work of Hirschman, Keohane and Nye (2001/1977) matured the concept of asymmetric interdependence in their book, *Power and Interdependence*, by establishing a framework of complex interdependence to better explain power relations. By acknowledging that increasing economic interdependence between states would lead to different degrees of economic dependency, they focused on the role of power in interdependence and suggested that interdependence can be observed along two different dimensions: sensitivity and vulnerability. First, sensitivity "refers to the costly effects of cross-border flows on societies and governments, within an unchanged framework of basic policies (2001, 232)." As a step further from sensitivity, vulnerability interdependence is defined as "relative availability and costliness of alternatives (2001, 11)" in case of facing a disruption in an interdependent relationship.[28] In other words, vulnerability denotes the costs

[28] As Baldwin (1980, 475) noted, although the distinction between sensitivity interdependence and vulnerability interdependence is commonly attributed to Keohane and Nye (2001/1977), it was, in fact, first put forth by Kenneth

that are inflicted even after an actor takes policy measures to react. Among these two dimensions of interdependence, many scholars argue that it is the latter that is crucial in evaluating the power asymmetries within interdependent relationships (Christies and Gratz 2009; Mansfield and Pollins 2003; Farrell and Newman 2019). Keohane and Nye, in analyzing Germany's strategies to deepen economic dependency, have also stated that vulnerability interdependence can be more consequential than sensitivity because weaker actors in the former predicament would find it "costly to adjust or extricate themselves and thus are highly susceptible to coercion attempts (2001/1977, 11-18)" (Christie and Gratz 2009; Farrell and Newman 2019, 2021).

More recent studies on asymmetric interdependence include the work by Farrell and Newman (2019) who have shown that interdependence among states may produce mutual benefits, but also will provide certain countries in critical positions with significant opportunities for political leverage which would also offer them option to "weaponize particular networks for their benefits by transforming them into a source of coercion aiming to cut the access of third parties, control the information flows, gather critical data or manipulate prices (Parepa 2021)." Likewise, Farrell and Newman (2021) moved beyond the traditional literature on asymmetric interdependence

N. Waltz (1970) in his article, *The Myth of National Interdependence,* published in 1970 as a chapter in Charles P. Kindleberger's book.

which focused on dyadic relations between states to consider the interdependence in terms of the broader network structures, which allows for examining "extradyadic relations among states and other actors in the international system (Dorussen et al. 2016)."

Vulnerability interdependence reinforced by the network effect

Based on the preceding discussion on asymmetric interdependence, it can be inferred that an asymmetric network would have the 'vulnerability' aspect of interdependence embedded in the relationship between the hub and the nodes. Such vulnerability interdependence within a network undergirded by network technology can be reinforced by the network's peculiar logic of working that has a strong influence on the nature of relations between those connected in the network (Wenzlhuemer 2013): *the network effect*. Although the term is often used interchangeably with network externalities, it is, in fact, distinctly different from the latter. Network externalities, which is used to describe "how the demand for a product is contingent upon the demand of others buying that product (Katz and Shapiro 1985)," may emerge in a large variety of contexts where "users care about participation and usage decisions of other users and may be positive or negative" depending on the circumstances (Belleflamme and Peitz 2016). While positive network externalities refer to the situation when the utility and value of a good to a user in a network

increases with more users,[29] negative network externalities are usually exhibited with common pool resources with a capacity limit in a network; the greater the use, the less utility and value derived by each user (Katz and Shapiro 1985; Top et al. 2011; Drezner et al. 2021). Among these two types of network externalities, the network effect can be best understood as "the positive [network] externalities that are generated in the interdependence of action, the positive feedback that results from the use of a standard that governs access to other people (Grewal 2008)." Jon Schmid and other scholars (2022) describe the term as "a phenomenon where an increased number of people or participants in a system increases the value of the underlying network and the services it underpins. Such phenomenon takes place when a product, service, technology, or standard provides greater utility to both its new and established consumers as it becomes widely used (Schmid et al. 2022)." Communication networks, such as a network of telephone users, are perhaps the best-known example of the system exhibiting the network effect, or the positive network externalities, as the value of the telephone increases with the increase in the number of people that the user can communicate with; the very raison d'être of communication networks is to

[29] Liebowitz and Margolis (1994) describe such a situation with the term 'synchronization value.'

enable people to interact with others (Robinson 1999; Stapp 2018).[30]

However, as noted by scholars, not all network effects are the same and they can be broken down into direct network effects and indirect network effects (Clements 2004; Barwise 2018; Weitzel et al. 2006; Stobierski 2020). Direct network effects refer to the situation when the value of a product or service to a user increases exponentially as it expands, attracting more people for each user to connect with (Barwise 2018). They occur when the value of a good or service increase simply due to the increased number of users, which causes the network to grow on its own (Farrell and Saloner 1985; Katz and Shapiro 1986; Stobierski 2020McIntyre et al. 2021). As Liebowitz and Margolis (1994) argue, such externalities are generated "through a direct physical effect of the number of purchasers on the quality of the product." Such a value is augmented by indirect network effects which emerge through interdependencies in the consumption of complementary products or services (Weitzel et al. 2006; McIntyre et al. 2021), occurring when participants in

[30] In a 1908 AT&T annual report, Theodore Vail, the Chairman of AT&T, first described the mechanism of network effect, though he does not use the term, by saying that, "A telephone—without a connection at the other end of the line—is not even a toy or a scientific instrument. It is one of the most useless things in the world. Its value depends on the connection with the other telephone—and increases with the number of connections." Saloner and Shepard (1995) claimed that there are in fact two types of effects in regards to the telephone system: first, its benefit to an individual user increases in the number of telephones, which is referred to as accessibility effect; second, the benefit of individual users increases in the number of people on the system. The latter effect of the system works as the source of network effect.

each market become more valuable with the increase in "the number of participants in the other market and vice versa (Barwise 2018)."[31] It refers to any situation where complementary goods become more available and lower in price as the number of users of the good increases (Katz and Shapiro 1994; Liebowitz and Margolis 1994).

The key dynamic generated by network effect pressure is its "lock-in effect" which refers to a situation in which it becomes difficult, if not impossible, for users or participants of a network to uproot or unplug from a network without incurring a loss once they are settled within the network (Tassey 1999; Druzin 2021).[32] When the lock-in effect takes place, a certain standard of product or services becomes increasingly and deeply entrenched among the participants of the network.[33] For example, in a technology-driven

[31] The most frequently mentioned example of indirect network effect would be a situation when the value of a DVD player increases with a larger pool of DVDs available and this pool expands with the increased number of users (Clements 2004, 2).

[32] The lock-in effect, which works on the demand side, may also work on the supply side, and in this case, a parallel effect is called the "installed base effect," which refers to a situation in which substantial resources in developing and providing services to the markets are invested by the dominant supplier(s) of certain technology (Tassey 1999; Barwise 2018).

[33] The aspects of lock-in effect have been explored by economists and political scientists in relation to path dependence. Douglass C. North's work (1990) is probably the most well-known. In his book, *Institution, Institutional Change and Economic Performance*, he argues that increasing returns produce lock-in vis-à-vis institution—a dynamic he terms "institutional lock-in"—which makes institutions to become more locked in over time and, as a consequence, find themselves in a difficult position to dislodge (North 1990, 95; Druzin 2020).

network, developers of related products and services will comply with a certain standard as the lock-in effect proceeds, and the users of the technology devices conforming to the standard will "invest substantial resources in learning to absorb and use it (Tassey 1999, 14)" as well as in equipping themselves with interconnected technologies and infrastructures. Such an investment in the existing network, whether it is in the form of capital or learning, is referred to as 'sunk costs,' the costs that have already been incurred and cannot be recovered due to their little salvage value which makes users reluctant to switch to devices with a new standard. As noted, these costs include "large setup or fixed costs, learning effects, and coordination effects (Arthur 1988, 10)." When these sunk costs are combined with the switching costs, the users become not only reluctant but also extremely difficult, if not impossible, to switch to another network with a different standard. A switching cost is a broader concept that embeds the sunk costs; additional costs result from the user having to make "a [new] physical investment in equipment or in setting up a relationship, an informational investment in finding out how to use a product or about its characteristics," and in risking uncertainty about the quality of untested brands (Klemperer 1995). Simply put, as Stiglitz (1988) noted, all investments for entering and staying in the network become sunk costs and switching costs if those are not compatible with other networks (as cited in Bolisani et al. 1994, 39). The simultaneous presence of both switching costs and sunk costs affect the degree of lock-in

effect, becoming the sources of self-reinforcing mechanisms that may combine to produce path-dependence which may sometimes result in settling for suboptimal standards and technologies (Shapiro and Varian 1999; De Nardis 2014; Drezner 2004)—QWERTY keyboard is a famous example in which "irreversibilities due to learning and habituation" played an important role in creating the lock-in effect that brought about path-dependence to settle for QWERTY version instead of the more efficient version of DVORAK (David 1985). Existing literature on path dependence, the idea that "minor or fleeting advantage or a seemingly inconsequential lead for some technology, product, or standard can have important and irreversible influences on the ultimate allocation of resources (Liebowitz and Margolis 1995)," has mostly focused on its connection to market failure (Liebowitz and Margolis 1995; Druzin 2020).

Taken together, these features will likely lead to a vicious circle of a winner-takes-all situation, or rich-get-richer effects (Drezner et al. 2021; Slaughter 2017), creating a monopolistic power, or what Grewal (2008) refers to as "a quasi-hegemonic network power," for the dominant product, technology, or standard. He offers an in-depth analysis of how such network power could propel successful—but not necessarily the Pareto-optimal—standards to positions of complete monopoly, "giving a single actor enormous power over the relations of sociability where those relations are based on a

proprietary standard (2008, 202).” While these features stayed below the radar for some time, they were brought to public attention when Microsoft was accused of anti-competitive practices, in 2001, which stemmed from its near-absolute dominance of the operating system (OS) market (Grewal 2008). It can be said that the Microsoft case started to hinge on the power coming from the network effect of their operating system. A more recent example would be the case when Qualcomm once monopolized the world’s mobile phone standards through communication chip standards, becoming the ruler of 3G and 4G technologies (de La Bruyère and Picarsic 2020, 5). Likewise, these above-mentioned features that coexist with the network effects have often been observed among private companies which explains why most preceding studies on standards have been primarily conducted at the corporate level. However, it should be noted that when the networks are transnational, states are inadvertently given the necessary levers to extend their influence across the border as market actors build centralized networks (Farrell and Newman 2019, 2021). Thus, networks developed “by market actors in pursuit of efficiency and market power can be put to quite different purposes by states,” becoming a tool of statecraft (Drezner et al. 2021). Moreover, as the network effect act as the force multiplier of network technologies such as telecommunication technologies, the way states pursue their development would most likely resemble a race, “driven by the belief that whoever is the first to implement this technology in its economy and/or armed force, they

will take the 'first-mover advantage' of achieving a strategic advantage over other entities (Sajduk 2019)." In fact, the network effect embeds "a self-reinforcing logic that rewards early entrants, a phenomenon that has been analyzed by many scholars," including Manuel Castells and David Singh Grewal (Balbi and John 2015). Existing studies (like the work by Farrell and Newman) usually identify enabling conditions rather than put forth behavioral expectations. This study attempts to extend these analyses by directly addressing the conditions under which states, especially great powers, are likely to take balancing, and the measures they take to balance against the network hegemony.

Learning the mechanism of network effect

While the network effect of the existing network makes it extremely difficult for already entrapped states to either bypass or break free from the existing network, a window of opportunity opens with the advent of a new generation of network technologies. However, not all states do or can take the opportunity to do so because, as Andrew Farkas (1998) pointed out, not all states perceive the opportunities presented by the international system due to their different perspectives on the international environment. One of the reasons for such different responses or perceptions among states comes from the fact whether the state has *learned* the significance of network effect from

its experience of participating in the pre-existing network to have.[34] In order to incorporate this learning process into the causal linkage between the network effect and state behavior, this section will first overview the preceding discussions on learning in the IR literature.

Learning model in international relations

As in Janice G. Stein (1994)'s words, "not all change is learning, but all learning is change." In this sense, when referring to 'learning' within the field of international relations, the term is often discussed in relation to the changes in states' foreign policy. Learning, in its most basic sense, refers to "a change of beliefs, skills, or procedures based on the observation and interpretation" of new information from experience (Keohane and Nye 1987; Levy 1994). The connotation of an improved ability to cope with one's environment differentiates the term learning from a simple change of beliefs (Nye and Keohane 2001/1973; Knopf 2003).[35] What should be noted is that the improved ability based on learning does not only come from acquiring new knowledge, but also from restructuring and modifying existing schema, or

[34] As pointed out by many studies on learning, learning is by no means the only possible nor the most important explanation for policy change. The alternative explanations include leadership successions, domestic politics, etc.

[35] As noted by Levy (1994), however, the improved ability does not necessarily imply the progress towards peace or cooperation nor regress towards war or conflict.

schemata (Hermann 1990).[36] It means learning is more than acquiring new knowledge or simply having "retrospective regret for a calculated risk that turned out to be a failure (A. O. Bennett 1990, 102)"; on top of that, it involves using that newly acquired knowledge to construct a new representation of the problem, new cause-effect chains and new ways of calculating risks and evaluating potential outcome which together leads to taking a different strategy to approach the problem (A. O. Bennett 1990, 102; Haas 1990, 23; Stein 1994). As stated by Philip E. Tetlock (2018, 45), it "involves a transformation in mode of thinking—a reassessment of fundamental beliefs and values that draws on the consensual knowledge of an epistemic community … [which] entails a systematic restructuring of how policy makers approach a major problem." Differently put, as in words of Zito and Schout (2009, 1103), learning is "a process of exercising a judgement based on an experience or some other kind of input that leads actors to select a different view of how things happen ('learning that') and what courses of action should be taken ('learning how')."[37]

[36] 'Schemata' refers to "a series of mental models that person uses to interpret experiences and that enables the individual to cope with them (Stevens and Collins 1980 as cited in Hermann 1990)."

[37] The distinction between 'learning that' and 'learning how' is essentially the same as the one between a simple acquisition of knowledge and using that knowledge to reconstruct one's schema. For more details, see Breslauer and Tetlock (1991).

The scholars who emphasized the importance of learning in theories of international relations, such as Ernst B. Haas and Joseph Nye, generally differentiated learning into two different kinds: 'simple' learning and 'complex' learning (Haas 1990; Stein 1994; Knopf 2003).[38] In simple, or adaptive, learning, new knowledge leads to adjustments in means but not in ends. Whereas, complex, or actual, learning involves "recognition of conflicts among means and goals in causally complicated situations" which leads to readjustment of ends as well as means (Nye 1987, 380; Haas 1990; Knopf 2003). As Lubit (1997, chap.8) stated, it "entails increased understanding of complexities of the causes of problems, including systemic interactions and the variety of factors affecting policy decision-making." Among these two types of learning, scholars have put greater importance on complex learning in relation to studying foreign policy behavior (Knopf 2003).

There are many different theories regarding the stimulants of new learning among states. Among them, one of the most basic explanations is a failure, especially the ones that were "either unexpected at the time or

[38] Haas (1990) used different labels to differentiate the learning in practically the same way as Nye: respective type of learning was named as mere adaptation and actual learning. Levy (1994) also categorized learning into 'causal learning' and 'diagnostic learning' in which the former refers to a re-interpretation of causal paths while the latter involves a re-examination of the conditions under which causal generalizations apply (Stein 1994). However, such differentiation is not discussed here, as the term 'learning' can often times involve both causal and diagnostic aspects.

unpredictable in retrospect," challenging the existing ways of representing problems (Hermann 1990; Levy 1994; Stein 1994). Farkas (1998, chap.2) puts a particular focus on the type of learning that occurs under environmental uncertainty, arguing that "the most perplexing … types of international change are those that effectively introduce new games" which are often promoted by "new military technologies, new modes of transportation or communication, the discovery or unexpected scarcity of raw materials, the unanticipated rise of a new power, and the unexpected collapse of an old rival." Therefore, in terms of interdependence, states realize the vulnerability embedded within the mutual reliance on one another when "a severance or alteration of a relationship results in the undesirable transformation of a given situation for both actors," and especially so when it is asymmetrically costlier for one actor to rupture or forego their relationship (Mansfield and Pollins 2013, 11).

In regards to the question of how we would know whether learning has occurred or not, Haas (1980) argues that we would know "when the actors adopt new rules of behavior that make use of new information and knowledge, or adopt ways for the search for such knowledge" to deal with similar situations. In this regard, Levy (1994) has also noted that simply spotting the evidence that learning has taken place is not sufficient to validate a learning model of foreign policy. He adds that the causal linkage between learning and

changes in policy also has to be established. In light of the importance in incorporating the causal linkage within a learning model, a model of state learning introduced by Jack S. Levy (1994) involves a two-stage causal chain. First, learning occurs with the observation and interpretation of experience that leads to a change in individual beliefs. As mentioned earlier, the awareness of the constraints may lead to new definitions of problems which can in turn lead to adopting new routines for solving the problem. Learning is differentiated from simple adaptation in that it enables a state to behave differently under the same conditions at different times by leading to different expectations regarding the consequences of one's behavior (A. O. Bennett 1990, 102; Levy 1994, 297). Second, the change in beliefs caused by awareness of newly observed and understood causes of unanticipated, or unwanted, effects causally influences subsequent behavior by adopting different, and (aiming to be) more effective, means to achieve one's goal (Haas 1980, 390).[39] Levy (1994) acutely points out that the critical difference between the learning model and the structural adjustments lies in the fact that learning, unlike the structural adjustment, has a causal impact on behavior.[40] Jervis (2017/1976, 253-4) has also argued that new beliefs of the people in

[39] Keohane and Nye (1987) avoid "having to examine whether a given set of changes in beliefs" caused by learning leads to more or less effective policies.

[40] Levy offers an in-depth discussion on the difference between learning models and "models of structural adjustment or adaptation to environmental change" in his article, *Learning and foreign policy: sweeping a conceptual minefield*, published in 1994.

charge of making foreign policy for a particular state would lead them to change their foreign policy.

CHAPTER 3. ANALYTICAL FRAMEWORK AND RESEARCH DESIGN

1. A New Analytical Framework: A Model of Network Balancing

This chapter lays the theoretical groundwork that is necessary to answer the research question of this study. This is done in two steps. First, the concept of network balancing is introduced. This is done first by clarifying what it means for states to 'balance' by showcasing the most prominent approaches to defining the term in international relations, and by outlining the specific definition of the term that is adopted by this study. Based on the working definition of balancing, the concept of 'network balancing' will then be introduced. This is done against the backdrop of the existing approaches from the field of economics where the network effect is discussed in detail albeit with a different focus, followed by a specific definition elaborated for the purpose of this study. This study, on this basis, introduces the new concept in an attempt to bring technology into the core discussions within the field of international relations. However, it should be noted that the terms used here have no claims to universal validity or general acceptability; they are merely meant to serve the purpose of this study. Second, in order to resolve the

empirical and theoretical puzzle raised in the preceding chapter, I introduce a new analytical framework of "network balancing model." Building on neoclassical realists' approach to balance-of-power theory in conjunction with insights from discussions of techno-politics and vulnerability interdependence, this model considers how the strategies of great powers in balance-of-power politics are affected by the innate feature of network technologies—the network effect. It identifies the mechanisms of 'network balancing' as an overlooked realist strategy for states to pursue security under anarchy. In doing so, the model modifies the key assumption of the balance-of-power hypothesis by introducing an intervening variable—network effect—to specify how certain technologies may affect a state's ability or decision to take network balancing measures to pursue their security. I argue that the network effect exhibited by network technologies creates a distortion within the balancing process by transforming the character and shape of balancing acts and affecting a state's ability or decision on whether to take balancing measures or not. Before elaborating on the mechanism of the network balancing model, I will first describe what network balancing is in the following section.

A concept of 'network balancing'

Definition of balancing behavior

According to the extant literature on balance-of-power, which I have examined at length in the previous chapter, the typical state behavior expected against any external threat under the anarchical international system is balancing, although bandwagoning and buck-passing also happen occasionally (Waltz 1979, 126).[41] However, as mentioned earlier, the term is neither obvious nor agreed upon on what constitutes balancing behavior. It is therefore important to clearly illustrate how I will be using the term to serve the purpose of this study. While some scholars argue that Waltz uses his theory to make predictions or offer explanations of particular state actions (Elman 1996, 10), the fundamental law of international politics for Waltz is the reoccurrence of balance-of-power within the international system, which is a law concerning outcomes, not the behavior of states as some would argue.[42] Its focus is on explaining how changes in the distribution of power under anarchy shape the opportunities, incentives, and constraints faced by states (Martin 2003). In fact, Waltz himself warns that some scholars "mistake a theory of international politics for a theory of foreign policy (1979, 122),"

[41] In particular, great powers are more likely to balance, rather than bandwagon or buck-pass.

[42] Martin (2003, 77) noted that John A. Vasquez (1997) and Stephan Haggard (1991) wrongly interpret it as a law that states will always "balance." For example, Haggard, as Martin claims, "overstates the effect of structure (Martin 2003)" by arguing that "once structural conditions are identified with sufficient precision, behavior can be predicted with little or no reference either to the internal politics and decision making processes of states or to the cognitive processes of individuals (Haggard 1991, 406-407 and 409)."

pointing out that "systemic theories cannot explain behavior *per se*, but they can only help to account for enduring patterns of behavior (Waltz 1979)" that repeatedly occur despite changes in the identities and the motives of the action (Waltz 1979, 117 and 122),[43] adding in his later work that "an international-political theory can explain states' behavior only when external pressures dominate the internal disposition of states, which seldom happens (Waltz 1996, 55)."[44] Therefore, as Martin (2003) emphasizes, when applying neorealism to the study of state behavior, it is necessary to move beyond the systemic level of analysis. In other words, when using a systemic theory as the basis for an explanation of state behavior, adjustments must be made, which David Singer (1961, 91) refers to as "translation from one level to another." In this respect, in order to use a systemic theory as the basis for an understanding of 'balancing' as a state behavior, some adjustments should be preceded.[45] First, because "the only way to identify a balancing strategy is to look at the intentions or motivations behind a state's action (Martin 2003),"

[43] Waltz continues to argue that "the theory makes assumptions about the interests and motive of states, rather than explaining them. [Therefore, w]hat it does explain are the constraints that confine all states. The clear perception of constraints provides many clues to the expected reactions of states, but by itself the theory cannot explain those reactions (Waltz 1979 , 122)."

[44] However, as noted by Levy (2004, 36), Waltz is not always consistent on this issue. While he is clear on the prediction that balance-of-power occur automatically, he leaves open as to how it would occur.

[45] In other words, as Susan Martin (2003) claimed, "propositions about what states tend to do cannot be translated into propositions about what states do" without any adjustments.

the focus of inquiry from international outcomes should be moved to the motivations behind state behavior. Then, based on the systemic balance-of-power theory's assumption that "balances result from the interaction of units who wish to survive in an anarchic environment, the motivation underlying balancing behavior (Martin 2003)" should be narrowed down to survival. However, because not all behavior motivated by survival can be regarded as balancing, the term inevitably "embeds the notion of opposing the most powerful or threatening state"—a potential threat or even a traditional rival—which makes the desire to counter threat as the underlying motivation of balancing behavior (Martin 2003; He 2012).[46] Moreover, the definition of threat should be expanded to include sources of a threat other than military power which would separate the definition used in Walt's balance of threat theory as balancing should not be limited to the formation of alliances.[47] On top of these three adjustments, what should also be clarified is that when claiming that states take balancing measures, the "states" refer to great powers, not small and medium states, as it is the great powers that have the military, as well as the economic and technological, capacity to make a difference (Levy 2004, 38). In fact, most, if not all, balance-of-power theorists imply

[46] In a similar vein, Power defines balancing as "aligning with the weaker side of a conflict," while Walt defines balancing as "allying with others against the prevailing threat" (Walt 1987,17; Powell 1999, 152-153).

[47] Walt claims that threat is "a function of geographic proximity, offensive capabilities, and perceived intentions, not power imbalances alone (Walt 1987, 22)."

great powers in their discussions on states' balancing behavior (Levy 2004; Waltz 1979).[48] On the basis of these adjustments and clarification, the working definition of balancing can be conceptualized as *state strategies adopted by great powers to counter an external threat under anarchy.* Such a definition is especially useful for this study in that it does not limit the study of balancing to the study of alliance formation or aggregation of military capabilities "but allows an exploration of other possible responses to threats (Martin 2003)."[49]

Definition of network balancing

[48] This does not mean that small and medium states do not have willingness to constrain an aspiring hegemon. It is only that, as Levy notes, weaker states, acknowledging their vulnerability and the fact "that they can have only a marginal impact on outcomes, will sometimes balance and sometimes bandwagon, depending on the context (Levy 2004, 38)."

[49] In fact, most discussions on balancing behavior are lopsided to military balancing, especially to the dynamics of alliance—the so-called external balancing (Martin 2003). Colin Elman defines balancing as "a countervailing policy designed to improve abilities to prosecute *military* missions in order to deter and/or defeat another state (as cited in He 2012)." In a similar way, Randall Schweller also presents the definition of the term as "the creation or aggregation of military power through internal mobilization or the forging of alliances to prevent or deter the territorial occupation or the political and *military* domination of the state by a foreign power or coalition (1998 as cited in He 2012)." The similarity of these two definitions of balancing can be found in their focus on "the use of military means for states to achieve security (He 2012)." Although Waltz does not provide a clear definition of balancing, but he does classify balancing into two different forms: internal balancing (i.e., military buildup) and external balancing (i.e., alliance formation). Both internal and external balancing put an emphasis on the usage of military means to deter threats and achieve security. Therefore, Waltz's balancing definition falls into the conventional, military focused category (He 2012).

Based on the working definition of balancing, *network balancing*, can be understood as a type of balancing strategy taken by great powers to counter an external threat**.** It falls under the category of 'soft balancing behavior' as a calculated, focused, and nonmilitary strategy that involves establishing one's own network to balance against the pre-existing network, thereby constraining and restricting the emergence of a preponderance of a state that is regarded as a threat to one's security under anarchy.[50] Although the technology aspect is not specified by the preceding definition of soft power, network balancing can be categorized under soft balancing behavior as a nonmilitary strategy of restraining the hegemony. In fact, the term is introduced precisely to bring in 'technology' within the balance-of-power logic to strengthen the explanatory power of realism. As I have mentioned in the previous chapter, technology has been taken as a given exogenous factor within international relations scholarship and has been mostly treated as a black box, indicating an unobservable process. This study attempts to open the black box and dismantle a given technology into parts. For example, while the telegraph has often been taken as a given singular 'technology' within the discussion of its role as a tool of statecraft during wartime, it actually

[50] According to Ilai Z. Saltzman (2012, 132), soft balancing refers to "a calculated, focused and nonmilitary strategy that may involve economic statecraft, institutional binding or exclusion, diplomatic entangling and political integration practiced in order to constrain and restrict an emerging power from pursuing its threatening policies."

incorporates not only cables (which can also be dismantled into copper wire and insulating material), but also specially-built steamships to lay and repair the cables, sufficient knowledge on the topology of ocean beds, and social practices such as negotiations for landing rights and building stations in each landing site. Likewise, as pointed out by Geoffrey L. Herrera, technologies are "much more than physical objects" and, therefore, should be regarded as "bundles of physical artifacts and social practices that together make up a given "technology" (Herrera 2006, 7)."[51] What should also be noted is that not all technologies should be treated as the same, as each technology offers different qualitative impacts on the international system. Among the significant technologies that have great relevance to international politics, this study puts a particular focus on network technologies—technoogies that creates and undergirds a network, generating its inherent feature of network effect within the network composed of the nodes connected. By acting as an enabler of the connection between the nodes, its intrinsic feature affects the strategies taken by the nodes, or the states in this study.

Going back to the definition of network balancing, it then can be more specified as *a type of balancing strategy adopted by great powers to*

[51] Aside from telegraphy, another example would be the railroad: as a technology, it includes "not just the wooden ties, steel track, locomotive, and rolling stock, but also the legislation that creates the funding, the timetables and schedules, the market and logistics of the procurement of supplies, coordination between state and civilian authorities, and so on (Herrera 2006, 35)."

counter external threats by establishing one's own network undergirded by a network technology to balance against the pre-existing network. What should be noted is that sufficient internal capabilities are required as a prerequisite to carry out network balancing strategy. In order to break free from the existing network, it is important for a state to have the ability to take the control of the technology undergirding the networks by aggregating its internal capacity which includes securing technical and material expert, getting access to vital resources, sufficient financial support, and so on. Once the state has sufficiently aggregated its capacity, the state can then take the network balancing measures by pursuing bilateral and/or multilateral cooperation with other states to expand its own network, and, at the same time, constrain further expansion of the pre-existing network. Because no single state can secure, or have its political authority over every node in a transnational network, it is indispensable for a state to cooperate with other states. In order to break free from the pre-existing dominant network, secondary states need to cooperate to constrain the monopoly either by building a network equivalent to, or even larger than, the pre-existing network to bypass the monopoly or by dislodging the monopoly through bilateral and/or multilateral agreements.

Telecommunication technologies and external threat

In order to classify an action taken by a state as network balancing according

to the aforementioned conceptualization—a type of balancing strategy taken by great powers to counter external threats via establishing one's own network undergirded by network technology to balance against the pre-existing network, it is crucial to first demonstrate that "the action taken was in response to a perceived threat, and then to argue that the action was taken in order to counter (Martin 2003)" the external threat. Then what constitutes an external threat to a state? While there are many variants to balance-of-power theory, as discussed in the preceding chapter, nearly all claim that "the highest goal of states, besides securing their own survival and autonomy, is to prevent the emergence of hegemony, "a situation in which one state amasses so much power that it is able to dominate the rest of the states in the system," and, therefore, states will form "a balancing coalition against any state that would attempt to gain a hegemonic position that would enable it to impose its will on other states (Fortmann et al. 2004)." (Waltz 1979; Schweller 1994; Papayoanou 1999; Snyder 2001; Levy 2004, 32, 35-6; Paul 2004, 2005).

As Levy puts it, "[w]hen the issue is hegemony, [even] the Waltz-Walt debate vanishes because hegemony over the system almost always constitutes the greatest threat to the interests of other states, or at least to the other great powers, and only the strongest power in the system can threaten to impose hegemony (Levy 2004, 35)." In this sense, a state's preponderance

upon a particular technology should pose a serious threat to other states, especially when it concerns their security and autonomy, hence their sovereignty.[52] In fact, the significance of technological capacity has been acknowledged by many scholars. Walt (1985, 9-13) factored "technological prowess" into measuring a state's resources that counted as its aggregate power, one of the four factors he suggested to measure the degree to which a state threatens others.[53] Christensen and Snyder (1990, 144) have also noted the importance of the technological component of power by arguing that the technological capacity of an attacker would increase the vulnerability of those being attacked. However most, if not all, studies in IR that point to the significance of technological factor treat technologies as no more than material capabilities without delving into exactly why they matter so much

[52] While state sovereignty is often distinguished between internal and external (Keohane 1993; Schrijver 1999; Ferreira-Snyman 2006), having the both constitutes complete sovereignty as the essence of sovereignty derives from the fact that the state "decides for itself how it will cope with its internal and external problems (Waltz 1979, 96)" (Bodley 1999, 419). In other words, sovereignty is about having not only the ability but also the recognition by internal and external actors, to make authoritative political decisions with regard to internal and external issues (Ashley 1984; Thomson 1995).

[53] Walt suggests four objective factors "to evaluate states' threat perceptions regarding their adversaries: its aggregate power, geographic proximity, offensive capabilities, and offensive intentions (He 2012)." In regards to 'aggregate power,' he claims that "the greater a state's total resources (i.e., population, industrial and military capability, and technological prowess, etc.), the greater a potential threat it can pose to others (Walt 1985, 9-13)." Kai He suggests that a state's threat perception can also be captured subjectively by relying on "policy makers' beliefs revealed by public statements and speeches to evaluate a state's threat perceptions (He 2012, 173)."

and how exactly they may pose threats to one's sovereignty by constraining one's authority to make its own political decisions on internal and external issues which include making decisions on developing one's own strategies and charting one's own courses (Waltz 1979, 96; Bodley 1993, 419; Gilpin 1981; Keohane 1993).

The reason why a state's dominance over network technology—telecommunication technologies in the case of this study—poses a particularly grave threat to other states is that having such dominance could allow the dominating state to wield its power over both the participants and non-participants of the network; the former can get locked in while the latter could either lose access to their vital interests or get no other option but to succumb to join the network under the terms in favor of the dominating state. Then, what are the conditions under which a state can wield its power of dominance over a network undergirded by network technologies? The central reason can be found in a distinctive feature of network technologies: the network effect. By generating a self-reinforcing logic that rewards early entrants as the network expands (Castells 2004; Grewal 2008; Balbi and John 2015), the network effect provides "established networks both inertial power and the power to exclude (Cowhey and Mueller 2009)," allowing a certain state, or states, to be in "a better position to create the critical mass required to get a viable network off the ground (Mueller et al. 2013)," which, in turn,

generates enduring power asymmetries. In such a way, the network effect can powerfully affect the likelihood of weaponizing the dominance being present and exploitable (Drezner et al. 2021). Farrell and Newman (2019) argue that such an asymmetric network structure creates and increases the potential for what they term "weaponized interdependence," in which certain states can leverage their connection with other states to coerce them.[54] In their later article, Farrell and Newman (2021, 310) described the term as "states' use of global networks to achieve geostrategic objectives." Due to the self-reinforcing logic of such networks, it becomes extremely difficult to redress or change the existing balance or to uproot the dominance once the network effect takes place (Bolisani et al. 1994, 41). Once networks become established with their network effect effectively in place, the participating individual actors, or states, will experience lock-in effects. Although some scholars claim that states are entrenched within the existing network "only up to the point where the costs of remaining in the network are lower than the benefits," in reality, the sunk costs of irrecoverable capital and intangible investments previously sustained, such as physical network and routines, and the switching costs of readjustments together generate exit or transit barriers which makes it difficult for a state to decouple itself from the locked-in network which is especially so if the fixed cost for the network is high

[54] Such an aspect of network has been discussed in the preceding chapter.

(Bolisani et al. 1994, 41).[55] Likewise, as Druzin (2021) noted, although states are 'technically' free to leave, these costs generated by the network effect pressure prevent states from doing so which makes such lock-in effects to be "open to strategic manipulation." Grewal refers to such a situation of making "free but involuntary" choices under the pressure of network effect as facing a "Hobson's Choice," in which states must either choose to remain within the network, or else choose to leave, suffering insurmountable costs (Grewal 2008, chap. 3). In this regard, the only opportunity for states to counterbalance the potential network hegemony opens with the emergence of a new generation of technology before its network effect takes place among the participants. Before getting trapped into a lock-in effect, states will most likely take preventive measures in order to limit the pace of development of the potential network hegemon, thereby preventing any state from taking a first-mover advantage that may even lead to a winner-takes-all situation (Sajduk 2019).

The Logic of Learning Model

As discussed in chapter two, not all states can take the opportunity given by

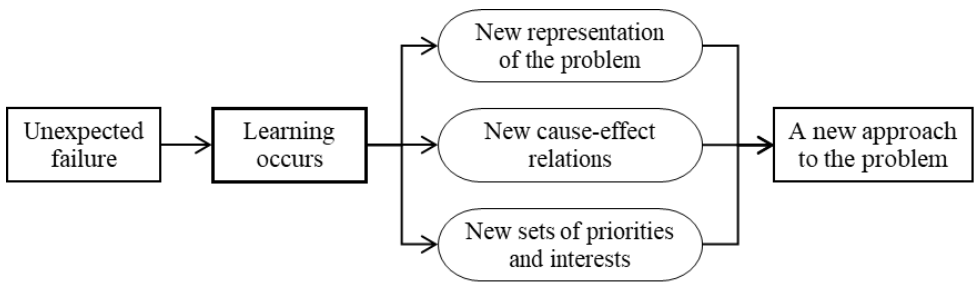
[55] Although the term switching cost is borrowed from the economics literature, it can be more than economic costs; other costs associated with switching costs include "search costs, transaction costs, learning costs, emotional cost, cognitive effort, etc. (as cited in Ayyilmaz 2018)."

the emergence of new technology; only those who have 'learned' the significance, as well as the mechanism of the network effect, can have the foresight to grasp the chance (Liebowitz and Margolis 1994, 1995). In other words, the distinctive feature of network technologies—the network effect—cannot be taken as a given exogenous factor that affects state behavior, but instead has to be endogenized through the process of 'learning' in order to be reflected in an actual change in state behavior. In this regard, because we cannot assume that states will automatically adapt their behavior to international changes quickly and accurately, employing the logic of learning theory can supplement the theories of state behavior for a better explanation. As Farkas (1998, chap.2) noted, "not all states perceive the constraints and opportunities that the international system presents with the same acuity."

A model of state learning posits a two-stage causal chain: 1) the observation and interpretation of experience provides new knowledge that leads to change in the beliefs of policy-makers regarding the cause-effect relations and then 2) the changed beliefs influence subsequent behavior (Levy 1994). To illustrate, learning is usually triggered by unexpected failures that challenge the existing way of approaching problems. So, when a state encounters such failures, its policy-makers, or a group of people in charge of making foreign policy, develop a new representation of the problem and a new cause-effect relationship, possibly with a new set of priorities and

interests, based on their observations and interpretation of new information acquired from past experience. Once the existing schema is restructured and modified into a new one based only the awareness of newly understood causal relations, it leads the state to take different, and often times more effective, approaches to attain one's end (See Figure 3.1).

Figure 3.1. The process of state learning



Source: Reorganized by author based on the works of Levy (2004), Hermann (1990), Stein (1994), and Haas (1980).

A model of state learning presumes that some states adequately adapt their behavior, or policy, to international changes while others do not. Such a framework provides a more realistic depiction of the environment in which states interact and also enables a better understanding of varied behaviors and outcomes in balance-of-power politics.

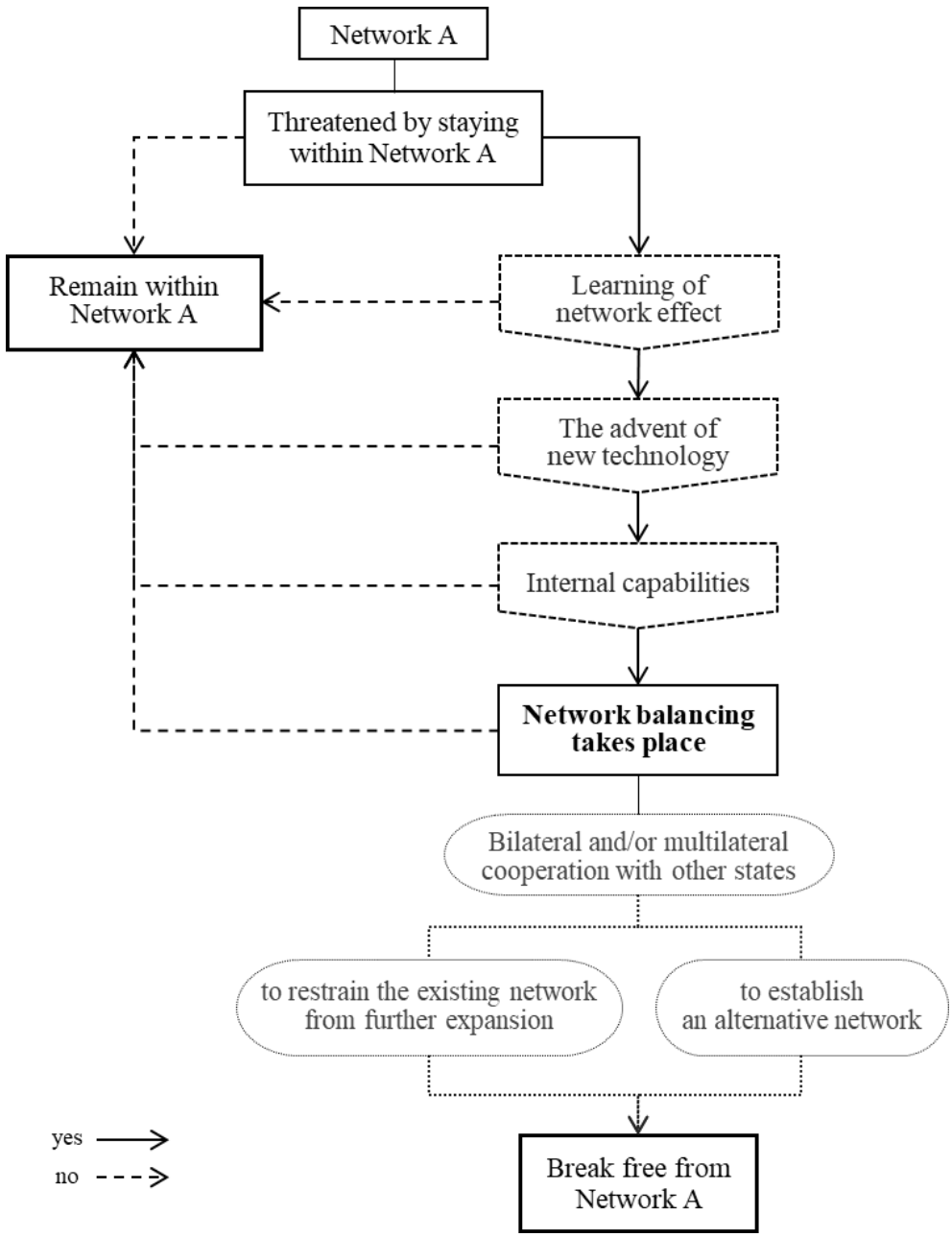
The Model Specified

I take the perception of a threat coming from the preponderance of a state as a given. The model then considers how the inherent feature of network technologies—the network effect—influences the strategies of great powers in balance-of-power politics. The explanatory variables are thus perceived threat and the network effect exhibited by network technologies, with the latter being the key causal variable. The stage or level of network effect is captured by the number of connections, but not particularly focusing on the number of connections per se but rather on the strategic importance of the nodes the network is connected to. In order to explain states' behavior of network balancing, the model also considers three intervening causal linkages: learning of the network effect, the advent of new technology, and internal capabilities.

The network balancing model specifies that when a state is faced with a threat to its sovereignty within Network A, the state will attempt to establish its own network to counterbalance Network A—which I define as "network balancing." However, in order to do so, the state first has to learn about the mechanism and significance of the network effect generated by the previous network. When learning occurs, the political actors of the state will have the foresight to attempt to decouple from the existing network when given an

opportunity with new technology. Moreover, having a better understanding of the mechanism of the network effect, they would usher in early enough to avoid the network effect of any preceding network. But, again, in order to carry out the network balancing strategy, the state has to be sufficiently equipped with internal capabilities; only then, the state can take the chance offered by new technology. When a state succeeds in network balancing, it will successfully break free from the pre-existing network (Network A) by either replacing the network with its own or establishing a duopoly. Figure 3.2 summarizes the process of network balancing taking place.

Figure 3.2. Dynamics of network balancing



Source: Author
Note: 'Network A' indicates a network undergirded by telecommunication technologies that embeds the feature of the strong network effect. The figure shows the ways in which a state's network balancing can take place against the threat of pre-existing network.

2. Propositions

Based on the foregoing discussions, following propositions can be suggested.

Proposition 1. The process of globalization, which involves increasing mobility of goods, services, labor, capital, technology, and information, has fundamentally depended on the development of technologies in telecommunications and in transportation (Bluma 2005). A rapid expansion of national and international networks of communication played a significant role in the first development of globalization in the nineteenth century characterized by an intensification in global trade and labor flows, by helping to overcome national and geographic barriers in telecommunications, thereby increasing connectivity and interdependence among states with reduced cost for all forms of economic transactions and information costs (Bluma 2005; Lampe and Ploeckl 2014). Such developments were reinforced by the intrinsic feature of these networks—the so-called network effect. However, there is also a downside that coexist with such developments especially when states are "literally" connected to each other with some sort of lines such as pipelines and cables where the addition of participants "ordinarily means connecting to subsequently more distant or otherwise more costly participants

(Liebowitz and Margolis 1994).” Unlike “metaphorical” networks,[56] these “literal” networks require an investment of capital, which naturally allows for having ownership or control of such networks. Such ownership embeds a great chance of making those networks heavily asymmetric so that they are effectively dominated by hubs, creating what Keohane and Nye (2001/1977) term ‘vulnerability interdependence’ among those connected within such networks (Liebowitz and Margolis 1994). Such vulnerability interdependence within the networks is reinforced by their innate feature of network effect, giving a monopolistic power to the owner of those networks which in turn arouses the political actors of attached states to increasingly question the network’s sovereignty implications as they experience constraints on their political decisions which become particularly egregious as the geopolitical situation deteriorates.

P1-1. Telecommunication technologies promote globalization and international cooperation by reducing transaction costs and increasing connectivity among states.

P1-2. Increased connectivity and interdependence reinforced by the intrinsic feature of telecommunication technologies—network

[56] The “metaphorical networks” refer to the networks that “provide interrelationships in which there are no physical connections” therefore less likely to be owned. A typical example would be the network of English speakers (Liebowitz and Margolis 1994). The are also referred to as ‘virtual’ networks (Puffert 2002).

effect—are likely to inflict sovereignty issues among the states, arousing the political actors within a network to increasingly question the network's sovereignty implications.

Proposition 2. As states come to realize the strategic significance of the network undergirded by network technologies, such as telecommunication technologies, which can be used as a tool of constraining their sovereignty, those who have learned to understand the mechanism of network effect will have the foresight into the self-perpetuating tendency toward vulnerability interdependence within such networks dominated by others. Hence, they will most likely attempt to decouple from the existing telecommunication network either by leaving the network for an alternative or by establishing one's own network. However, as I have discussed in the preceding chapter, once the participating states of the pre-existing network are locked in by the network effect, it becomes extremely difficult to break free from the network.

P2-1. By learning the significance of network effect feature embedded in telecommunication technologies upon their sovereignty, political actors attempt to decouple their country from the existing network.

P2-2. Depending upon the degree of network effect, it becomes extremely difficult for states to decouple from the existing network even for those who have learned the significance of network effect upon their sovereignty; the stronger the network effect is, the harder it is for

states to decouple.

Proposition 3. Likewise, when the network effect of the existing telecommunication network that is strong enough to lock-in its participants is already in place among the connected states, it is nearly impossible for the states, even for those with sufficient understanding of the mechanism, to find a way to decouple. However, a window of opportunity opens with the emergence of a new generation of telecommunication technologies to balance against the previous telecommunication network by establishing an alternative network—what I term "network balancing." With the network effect of the new technology yet to take place among states, a state wishing to delink itself from the existing network would have a chance to do so. Such an opportunity may not guarantee the success of decoupling, but it does allow states with sufficient internal capabilities to take network balancing measures to decouple from the previous network. Network balancing includes both establishing its own network and constraining further expansion of the existing network. In both cases, it is indispensable to cooperate with other states, especially in the case of transnational networks. In other words, a state attempting to take network balancing measures should muster support from secondary states through bilateral and/or multilateral agreements. As mentioned earlier, the reason why new technology can be an opportunity for network balancing is that states can act before the existing network can

effectively generate its network effect among the participating states, which increases the chance for states to break free from the network before it develops a stranglehold on those states. If a state manages to constrain the expansion of the existing network, it will most likely succeed in uprooting the network and building its own network.

P3-1. A new generation of telecommunication technologies opens a window of opportunity for states to decouple from the pre-existing network by establishing an alternative network.

P3-2. A state with sufficient internal capabilities is likely to grasp the opportunity given by a new technology to take network balancing measures against the state dominating the pre-existing network.

3. Research Design

A heuristic single-case study

On the foundations laid in the previous section, the link between technology and balance-of-power politics will be illustrated through a single case study with a heuristic approach. The goal of the case study is to showcase through the analysis of a historical episode how a certain feature of network

technologies plays a role in changing a state's behavior, and thereby in changing the balance of power. Some critiques, like King, Keohane, and Verba (KKV), have raised skepticism on the value of single-case studies, or single-observation studies, arguing that in general, "the single observation is not a useful technique for testing hypotheses of theories (King et al. 1994, 211)" as those "studies involving only a single observation are at great risk of indeterminacy in the face of more than one possible explanation, and they can lead to incorrect inferences if there is measurement error (King et al. 1994, 108 and 208-211)." Despite such criticisms, many scholars, in fact, still appreciate its value for certain purposes (Robert Yin 2014; George and Bennett 2005). Yin (2014) suggests five rationales for single-case designs: "when the case represents the critical case in testing a well-formulated theory; where the case represents an extreme case or a unique case; when the case is the representative or typical case; when the case is revelatory; and when the case is the longitudinal case of studying the same single case at two or more different points in time." In the case of this study, it is revelatory in that it has a "heuristic purpose"[57] to identify a new theoretical variable and postulate a

[57] As noted by Clark E. Moustakas (1990), "the root meaning of *heuristic* comes from the Greek word *heuriskein*, meaning to discover or to find." In this vein, a heuristic study originally refers to "a process of internal search through which one discovers the nature and meaning of experience and develops methods and procedures for further investigation and analysis." Here, the emphasis is on latter—development of method and procedures for further investigation and analysis—when using the term 'heuristic.'

new causal mechanism in a way that has not been appreciated within the IR field (George and Bennett 2005, 81), thereby showing how investigations of the relationship between technology and IR could be done in a previously unappreciated way, thus stimulating much further research. This study also stands for the fifth rationale suggested by Yin (2014)—the longitudinal case—in that it specifies how certain conditions and their underlying process change under different technologies which develop over time.

One goal of this case study is to show that the link between technology and power politics matters, not only in theory but also in understanding significant events in international relations, especially with the recent development of international politics inextricably linked to network technologies. Without attention to how these technologies relate to power politics, it is difficult to understand the underlying dynamics of today's technological competition among great powers—like the one currently taking place between the United States and China. For this purpose, this study attempts to provide the instruments that are necessary to bring technology into the core discussions of IR scholarship and to show why doing so matters. Another goal of this case study is to make sense of the implications of the current technological developments for international politics by identifying the key technologies, especially the one that has the most impact on power politics, and by placing the technology in a broader historical context. Such a

historical approach is expected to allow us to better understand the complexity of the interactions caused by technological development and its profound consequences for international affairs (Shultz 1987, 1 as cited in Skolnikoff 1994; Rennstich 2008).

Case-selection

The case of Anglo-German rivalry over telecommunication networks in the late nineteenth and early twentieth centuries well serves the purpose of this study. In fact, the reasons why it makes a good case for this study is threefold. Firstly, the case was selected on its heuristic value; it allows for the observation of the first period of globalization undergirded by the very first telecommunication networks in which states involved were affected by the network effect for the first time Such an investigation is expected to demonstrate similar dynamics of technology, inter-state relationship, international cooperation and conflict, and sovereignty issues as we witness these days. And secondly, while a vast amount of literature exists on the rivalry between Britain and Germany, less academic attention was given to the technological aspect of the rivalry despite its importance in terms of balance-of-power politics at the time. Considering the fact that Great Britain and Germany were undoubtedly the pivotal actors in European balance-of power-politics before the First World War, it is important to understand the

sources and effects of the strategies taken by these countries in every aspect to come to grips with the bigger picture of balance-of-power politics at the time. Hence, an analysis of the case is expected to provide unique insights to better understand the logic of balance-of-power politics and complement the explanatory power of the existing theories. Lastly, as noted by Wenzlhuemer (2013), it is almost imperative to focus on Great Britain and Germany in the discussion of the development of a global telecommunication network as the companies or government departments of the former were undoubtedly the center of the worldwide telecommunication business before the outbreak of the Great War with by far the biggest share of international telegraph cables with the latter being the biggest competition to the former (Headrick 1991, 273; Finn and Yang 2009, chap.5)..

For these reasons, I undertake a close examination of a single case of Anglo-German rivalry over telecommunication networks in the period of the late nineteenth century to the early twentieth century. However, as an 'embedded' single case study,[58] I separate the case into two parts (chapters four and five) according to the two different technologies undergirding each telecommunication network. Chapter four explores the development of the

[58] A single-case study can take the two different compositional forms: the classic single-case study where a single text is used to describe and analyze the case and a variant form of single-case study adopting an embedded design in which attention is given to a subunit or subunits within a single case (Yin 2014, 53-55 and 184).

first telecommunication network—the submarine cable network, and examines how the nature of network technology constrained Germany from counterbalancing the British dominance of the network. Chapter five examines the development of another telecommunication network—the wireless telegraph network, and examines how the nature of network-driven technology helps account for Germany's success in breaking free from Britain's dominance of the network.

Methodology

The approach taken by this study to answer the research question is of qualitative nature. In particular, among the three explanatory approaches in case study research—co-variational analysis, process-tracing, and congruence (Blatter and Haverland 2012; Ulrksen and Dadalauri 2016), this study engages in process-tracing as its primary method. In fact, it may be even considered imperative for a single-case research to apply an in-depth process tracing to its analysis (George and Bennett 2005) as it is perhaps the best way to probe into and elucidate how variables are interrelated (Ulrksen and Dadalauri 2016). Papayoanou. As noted by Little (1991) and Keohane (2009), "causal mechanisms exist independently of directly measurable relationships between variables" and thus, process tracing can be considered as the most appropriate and effective way of illuminating those details hidden under the

surface. These causal mechanisms, as Keohane (2009) claims, are best elucidated with case studies and narratives, conducted in an analytically rigorous way. According to Vanhala (2017), "the detailed work required for process-tracing analyses can identify the scope conditions for causal relationships, can help develop an understanding of necessary and sufficient causation, can assist in unpacking recursive causation, and can contribute to the discovery of new variables." Likewise, the method is particularly useful for analyzing complex causal relationships as it "involves the identification of intervening causal pathways between causes and outcomes (George and Bennett 2005)." Papayoanou (1999) has also pointed out that the method also allows the author or analysts to "bring to bear evidence about the decisional process by which the outcome was produced."

This study follows the description of process tracing recently introduced by Bennett and Checkel: "the analysis of the evidence on processes, sequences, and conjunctures of events within a case for the purpose of either developing or testing hypotheses about causal mechanisms that might causally explain the case (2015, 7)." Here, the evidence would include the use of "histories, archival documents, interview transcripts, and other sources (George and Bennett 2005, 6)." The process tracing entails marshaling both primary and secondary sources as evidence to support or refute propositions. While the pitfall of bias exists in using secondary sources,

they not only "point to the current 'state of knowledge' or historical consensus among historians on a particular" (Gaddis 1997, 81), but also allow the researcher to cover "a greater array of primary sources than is possible (Davidson 2002, 113)." In this sense, both primary and secondary sources are utilized for research. Because much has been written by historians as well as scholars in international relations on the behaviors of the two countries in these periods, I am able to draw on and address debates in the extensive historiography that exists for the case. While it primarily relies on these secondary sources, this study also uses some of the important, and accessible, original documents (official documents, government documents, letters, and news articles) to provide the basis for my conclusions on the case and to strengthen the inferences made by and the credibility of the theoretical argument.

CHAPTER 4. ANGLO-GERMAN RIVALRY OVER THE SUBMARINE CABLE NETWORK

Telegraphy has been integral to the process of hegemonic maintenance, challenge, and response that has been ongoing among the polities at the core of the capitalist world economy throughout history (Hugill 2009, 258-9). As a typical network technology, telegraphy derived much of its value from its potential reach, which depended on the number of people in other, often far-flung, places that could be contacted via the network (Wenzlhuemer 2013). And these networks connected by worldwide cables and telegraph systems, along with steamships and railways, were "the sinews supporting huge flows of capital, technology, people, news, and ideas which, in turn, led to a high degree of convergence among markets, merchants, and bankers" (Winseck and Pike 2007; Rosenberg 2012, 96; Rosenberg 2014; Tworek 2019).[59] Starting with optical telegraphy in the early eighteenth century followed by electrical telegraphy that emerged in the 1830s, telegraph lines "enabled information to move exponentially faster than goods or people for the first

[59] Before the advent of the electric telegraph, the slow and unreliable nature of communications such as semaphores, naval flag, and public postal systems, acted as a restraint to such convergence (Headrick 1991, 6).

time (Tworek 2019)."[60] As governments of great powers grew more convinced of the power of telecommunication technologies, they became a core part of balance-of-power politics.[61] The great power competition between Great Britain and Germany on telecommunication technology networks, which will be examined here and in the following chapter, well illustrates how technologies, especially network technologies represented by telecommunication technologies, offer a great impact on state strategies in terms of balance-of-power politics. This chapter first examines the development of Anglo-German rivalry over the submarine cable network and the context in which Germany's attempts to take network balancing measures were frustrated by the British.

1. The British Monopoly

Birth of submarine cables

[60] In 1898, Charles Bright, a leading expert on submarine telegraphy, assessed the impact of undersea cables on international relations as following: "At first sight, the contrary result might have been anticipated; but, on the whole, experience distinctly pronounces in favor of the pacific effects of telegraphy (as cited in Headrick 1991, 75)."

[61] Communication historians such as Harold A. Innis have pointed out that "the geographical limits of empires were determined by the possibilities for effective communication, and that changes in the technology of transport and communications have permitted vast changes in the possibilities for the extension of empires (Innis 2007 as cited in Yang 2010)."

The very first telegraph network, "using towers, flags, and semaphores, was built across the European continent in the 1790s by Napoleon's armies (Headrick and Griset 2011)," which later spread across Europe and also appeared in the United States in the early nineteenth century. While electricity was applied to long-distance communication in the 1830s, the first submarine cable telegraph was not introduced until 1850 due to the difficulty in finding an appropriate and effective insulating material to lay a telegraph line underwater. While finding a proper insulator was by far the biggest challenge at the time, there were additional problems that had to be resolved: the wire, which was too thin to sink to the bottom of the ocean bed, simply floated in the water behind the laying boat, and once the cable was finally laid, the messages were being garbled because of the changes in cable's electrical properties by the surrounding water (Standage 1998, 71-73). The first undersea cable was finally laid across the English Channel—from Dover, England to Calais, France—in 1850, "primarily to fulfill military and colonial purposes of the French and British governments (Headrick and Griset 2011)." [62] In the mid-nineteenth century, the French government was desperate to communicate with its colony of Algeria, and the British

[62] The first cable, however, failed within a few hours after a French fisherman broke the cable thinking that it was a kind of seaweed. A new cable armored with gutta-percha was laid again successfully in 1851 by John Brett and his brother Jacob Brett from Dover to Calais, the narrowest point in the English Channel, which lasted for many more years (Burns 2010; Meyer 2020).

government was also eager to communicate with its biggest colony, India, where a major uprising, the "Sepoy Rebellion", threatened to overthrow British rule (Headrick and Griset 2011; Headrick 2009, 186). On a more global level, the first transatlantic submarine cable was completed in 1858 and became fully functional in 1866 (Hugill 1999, 28; Kurbalija 2013). Although the 1858 cable failed within just few weeks, the year 1858 is usually identified as “the beginning of transatlantic submarine cable (Finn and Yang 2009, 6).[63]

As William Preece (1905) noted, “installation of the undersea cables entailed extensive and difficult work” as design and construction were definitely not the only complex stages of submarine connection. It was also necessary “to transport the cables and lay them on an as-flat-as-possible deep-sea floor by submerging them with the utmost care using pulleys.” Likewise, manufacturing and laying submarine cables were definitely not a simple

[63] After the failure of 1858 cable, which lasted only for six weeks due to “a rudimentary understanding of how electric current behaved through thousands of miles of cables (Meyer 2010)”, the American and British cable-engineers could not manage to complete a new cable across the Atlantic until 1866 due to the technical problems caused by poor understanding of electrical theory and topography of the ocean floor. Such difficulties were aggravated by financial near-bankruptcy and the political turmoil of the American Civil war (Finn 2009, 12; Muller 2016, 4). However, in the end, the Anglo-American Telegraph Company, owned by an American, Cyrus Field, but heavily funded by British investors for its capital (the most prominent among them was John Pender), “succeeded in spanning the North Atlantic from Ireland to Nova Scotia in 1866, linking Britain with the United States, with which transoceanic cable construction entered a boom period, with the British at the forefront (Britton 2013).”

process; they were complicated and costly, and, therefore, involved many practical as well as political problems to be overcome; achieving the most out of the opportunities made possible by the new communication technology of submarine cables was definitely not without challenges (Godfrey 2018, 39). First of all, the copper wire carrying the electrical impulse had to be both insulated from the seawater and armored against sea creatures.[64] Rubber and tar were used to insulate the first, primitive cables in the 1840s, but as they turned out to be inadequate to hold up under deep sea waters, an alternative material had to be discovered. A material called 'gutta-percha' was later discovered as a well-suited substance for the purpose (Hugill 1999, 29; Burns 2010). According to Helen Godfrey (2018), gutta-percha was the most effective insulator for undersea cables because "it had better tensile strength and the ability to withstand cold, damp and saltwater when compared with other electrical insulators (Godfrey 2018, 1-2)."[65] And once these cables were insulated with adequate material, specially-built steamships, not to mention a thorough understanding of physics and the topography of the ocean floor,[66] were needed to carry miles of heavy cables and lay them underwater

[64] The 'armoring' refers to the outer, protective layers of cables such as hemp with the outer layers of wire wrapped in a spiral formation (Godfrey 2018, 42).

[65] Although it is now largely forgotten, gutta-percha was, in fact, a product of strategic and economic significance for decades since the mid-nineteenth century (Godfrey 2018, 1-2)

[66] It was important to survey the ocean so as to determine in advance the exact route the cable should take. Moreover, the depth and nature of the ocean bed, the strength and direction of currents, the temperature at the bottom, all had to be

or retrieve them for repair. (Finn 2009, 17-18; NYT, *Laying Submarine Cable*, 1877).[67] Edwin J. Houston and Arthur E. Kennelly provide a detailed description of the prerequisites for the cable-laying ship:

> "The ship which lays a submarine cable has to be specially fitted for the purpose, and, when the cable has considerable length, has also to be specially built. Such a vessel has to contain strong tanks firmly attached to its frame. These tanks are generally kept full of water after the cable has been coiled in them. The largest telegraph ships can hold an entire Atlantic cable stowed away in their tanks. The ship has also to be provided with powerful machinery for laying out the cable on its ocean bed, or for picking it up when so required. Moreover, lead wheels, or guide sheaves, must be constructed between the tanks and the gear, to facilitate the passage of the cable along the decks. Finally, large sheaves have to be placed at the bow and stern of the vessel to enable the cable to be paid out,

ascertained beforehand (NYT, *Laying Submarine Cable*, 1877).

[67] About 2,500 nautical miles of cables had to fit on a single ship. According to Anton Huurdeman (2003, 97), who used to work for Telefunken and also the author of *The Worldwide History of Telecommunications*, "the first transatlantic cable to be laid successfully, in 1866, was 4000km long and weighted 9000 tons. By then, the 19,000-ton British cargo ship *Leviathan*, built in 1858 by Sir Isambard Kingdom Brunel, later renamed as the *Great Eastern,* was the only ship in the world that was large enough to carry such large amount of load. It was obtained by the British cable manufacturers Glass Elliot & Company in 1864 for laying cable under the Atlantic to convert the ship "from a passenger ship to accommodate three large tanks in which the cable was coiled and submerged in water to prevent the gutta-percha from drying out. Special paying-out machinery had to be developed and installed on the ship to enable smooth cable laying, even in rough water and varying ocean depths (Huurdeman 2003)."

> or picked up, without injury. A telegraph ship can always be recognized, even at a considerable distance, by these large bows and stern sheaves (Houston and Kennelly 1906, 351-353)."

Moreover, because most cables were transnational, meaning that one end of the cable must land on the sovereign territory of another state (Zajacz 2005), laying these cables across the ocean was closely linked to political matters; "there were often complex political negotiations to be pursued as well as agreements to be made with" foreign countries and their local telegraph companies regarding the right to installation, landing rights, fees, and technical standards as well as protection and security of lines (Allain 1991, 270-271; Finn 2009, 11).

Great Britain's head start

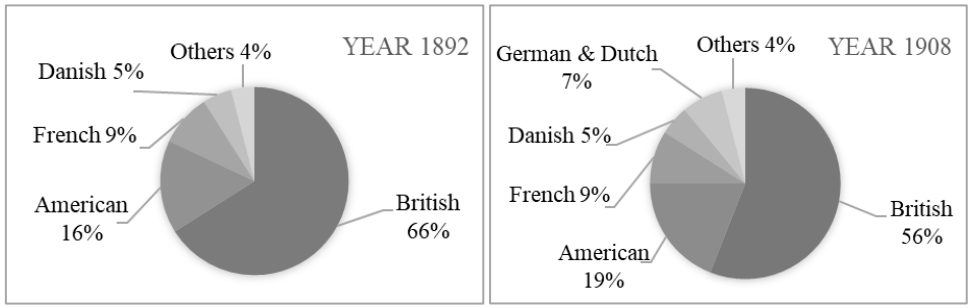
From the mid-1800s, British submarine telegraph cables first monopolized and later dominated the most important market, the North Atlantic Ocean. Elsewhere in the world, a British conglomerate, *the Eastern and Associated Telegraph Companies*, owned or controlled "most long-distance cables with little competition until the 1920s (Headrick and Griset 2011)." By the late-1800s to early-1900s, *the Eastern* and its associated companies, backed by the British government acting as investor and user, had the control of a

massive international communication network extending over 150,000 km of submarine cable (Houston and Kennelly 1906, 6; Headrick 2009; Muller and Tworek 2015; Allain 1991). David Murray, an engineer and the inventor of a telegraphic typewriter system, described in a journal article that the conglomerate practically owned

> "… all the cables from Land's End in England through the Mediterranean to Suez, on through the Red Sea to Aden, across the Indian Ocean to Bombay, thence linking into the system Madras, Singapore, Hong-Kong, Manila, Australia, and New Zealand … [Moreover,] practically all the cables which now surround Africa and many of those which cross the ocean and follow the coastline of South America (Murray 1902, 2299)."

As it is shown by Figure 4.1, British dominance in cables was overwhelming; its ownership of cables started with sixty-six percent of the total in the early 1890s and maintained its dominance well into early 1900s by occupying more than half of the entire ownership (Tworek 2019; Solymar 2021, 79). By 1913, the Eastern and Associated Companies owned more than 180,000 km of cables, representing "two-thirds of all British cables and two-fifths of all cables around the world (Headrick 1988, 105; Mueller 2010)."

Figure 4.1. Distribution of cables by ownership, 1892 and 1908



Source: figures taken from Solymar (2021, 79)

Its monopoly did not simply come from its ownership of the cables but even more from its manufacturing and laying of submarine cables; Great Britain was leading every crucial sector involved in submarine cables. The *Telegraph Construction and Maintenance Company* (TCM), one of the British cable manufacturing companies owned by John Pender, made two-thirds of the world's cables before 1900 with most of the other third being made by other British companies including *Siemens Brothers*, and *The India Rubber, Gutta Percha & Telegraph Works Company* (Hugill 1999, 33; Finn 2009, 19).[68] The control of cable-laying ships was also almost entirely in British hands. Until 1873, as mentioned earlier,[69] only the British-owned 19,000-ton *Great Eastern* was capable of holding enough cables "submerged

[68] As Zajacz (2005) explains, John Pender, the owner of the TCM, branched out to establish companies to lay cables to North Africa, the Mediterranean and India and merged these companies to form the Eastern telegraph Company. A first-mover advantage was given to the Eastern by involving in cable manufacturing and control over the most important commercial and strategic routes.

[69] Refer to supranote 67.

in water to prevent the gutta-percha from drying out, to cross an ocean (Hugill 1999, 33)," and out of thirty cable-laying ships in 1896, twenty-four were British (Solymar 2021, 79). Moreover, by 1892, the Eastern Telegraph Company owned about forty-five percent of world's cables (Zajacz 2005). The British dominance was acknowledged by others in general as we can find in William Siemens' presidential speech to the Society of Telegraph Engineers in 1873:

> "London . . . is the principal center of the Telegraphic enterprise in the world, and musters consequently the greatest number of Telegraph Engineers. It is a remarkable fact that the manufacture of insulated wire, and of submarine cables, is almost entirely confined to the banks of the Thames (cited in Solymar 2021, 78)."

There were, in fact, several factors that allowed Britain a head-start on the submarine cable network from a advantageous position. First of all, its head start in the industry came from a strong motive to communicate with its colonies—especially with India. At the time of laying the first cross-border submarine cable, the British government was in desperate need of communication with its colony, India, where the Sepoy Rebellion threatened to overthrow British rule,[70] which led the government to offer a contract to

[70] Also known as the Indian Mutiny in Britain and as the First War of Independence in India, the Sepoy Rebellion in 1857 was, according to Walden (2011),

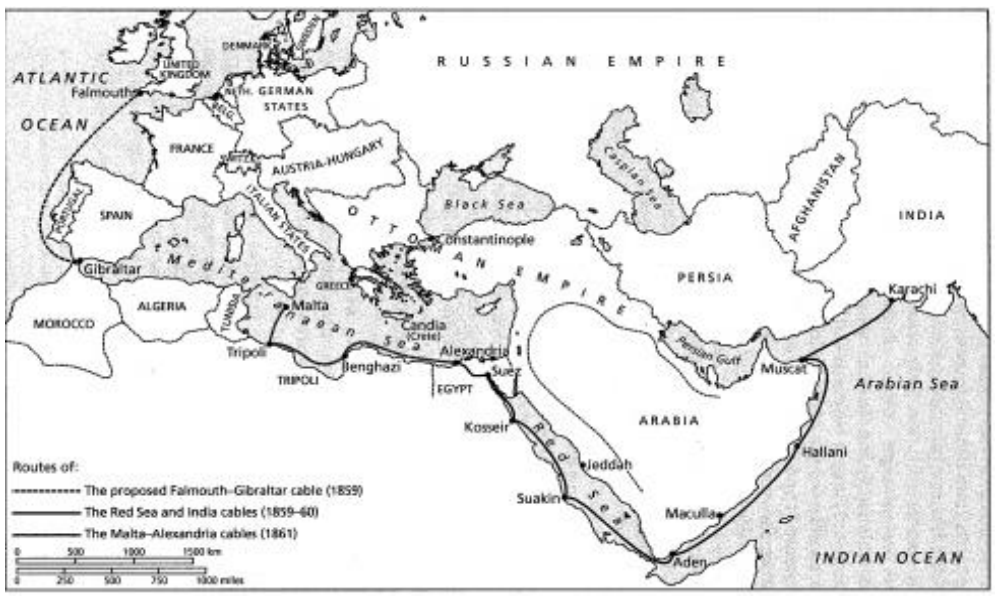
one of its companies to lay a cable from Egypt to India via the Red Sea. The Red Sea and India Telegraph Company was established in early 1858 to lay the cable and they asked for a government subsidy (Headrick and Griset 2011). By the time of the request, the India Mutiny was over but alerted by the new mood, the government was willing to guarantee a dividend of 4.5 percent on capital of 800,000 pounds for 50 years (Solymar 2021, 70). Unfortunately, the attempts to lay the Red Sea cables in 1859 and 1860 both failed (see Figure 4.2), but such failure along with its near-death experience in India led the British government to name a special commission of eminent engineers and experts to investigate all aspects of submarine telegraphy which greatly improved the general knowledge on cable-related matters, facilitating the entrepreneurs to lay a trans-Atlantic cable (Headrick 2009, 186).[71] As an article in *Electrician* stated, the result of the investigation became "the most valuable collection of facts, warnings, and evidence ever compiled concerning submarine cables (as cited in Winseck and Pike 2007, 23)." Likewise, the undersea cables became "a concrete definition of Imperial unity

undoubtedly the greatest challenge faced by the British during the nineteenth century. For more on the Sepoy Rebellion, see Walden, Harley Dereck. 2011. *Salib and Sepoy: The British Perspective on the Sepoy Rebellion of 1857*. MA Thesis. Marshall University.

[71] Four main recommendations were suggested by the British investigation: "improve the quality of cable technology; establish common technological standards; develop better cable laying techniques; and improve the ends of the network in terms of signaling and receiving (Harvey, *New Imperialism*, 29 as cited in Winseck and Pike 2007, 23)."

[and] the controlling instrument of national aggrandizement," with its connection becoming "a significant tool in colonial administration and a means of managing both diplomatic and military operations (Godfrey 2018, 29)."

Figure 4.2. The routes of the ill-fated chain of British cables



Source: Taken from a map in Frederic John Goldsmid, *Telegraph and Travel*, 1874 (cited in Hunt 2021, 115).

Another factor that gave the British an edge over others was its privileged access to, and later control of, gutta-percha, a rubber-like latex from a tree first introduced to Britain in 1843 by a British surgeon in Asia, William Montgomerie, which was discovered in the late 1840s by Werner Siemens and Michael Faraday as having excellent properties for insulating undersea cables; it retained its plasticity over time as well as under extreme

pressure and low temperatures that characterize the ocean floor (Hugill 1999; Burns 2010). Bernard S. Finn gives a clear description of gutta-percha as a well-suited substance for insulating submarine cables:

> "It is a natural plastic, firm at ordinary temperatures but becoming malleable when the temperature approaches 40 degrees centigrade. It can become brittle when exposed to air but is virtually inert underwater, especially in the temperature and pressure conditions at the bottoms of the world's oceans. Very little needed to be done to it, and techniques were quickly developed for processing the imported boules of gutta-percha so that it could be extruded around copper wire cores. (Finn 2009, 12)"[72]

The best gutta-percha "with a minimum of water, dirt, and resin and a maximum of pure dense gutta (Standage 1988, 70)" primarily came from the region under British control—Malaysia and the Indonesian archipelago, Borneo, Java, and Sumatra in particular[73]—which allowed Great Britain's

[72] The reason why so little had to be done to gutta-percha, unlike India rubber that had to be vulcanized to be useful as an insulator, was due to its thermoplastic property; it softens at elevated temperatures and returns to its solid form as it cools, which made it easy to be molded into any shape and retain its plasticity over time underwater, making it ideal for insulating cables. (Standage 1998, 70; Burns 2010). As mentioned in New York Times, it was "practically indestructible under water (NYT, *The Value of Gutta Percha*, 1902)."

[73] It is stated in a New York Times article that "Sumatra was once called the Island of the Percha Tree (NYT, *The Value of Gutta Percha,* 1902)."

imperial outreach to these places to guarantee easy access to vital resource at a relatively low cost. Moreover, British control over its trade through the port of Singapore served as a crucial factor for British dominance in manufacturing (Bright 1974, 258 in Hugill 1999, 29; Finn 2009, 19; Tully 2009).[74] As in Meyer (2020)'s words, gutta percha protected a worldwide network of communications, particularly that of the British Empire" for many decades. More than half of gutta-percha went to England followed by less than one-quarter to France, about an eighth to Germany, three percent to the U.S., and the rest to Asia, Italy, and Holland (NYT, *The Value of Gutta Percha,* 1902).

Some scholars also pointed to the British network's origin in the era of liberal globalism as a reason for its rapid expansion in the 1870s following the Great Atlantic Cable (Hugill 2009; Finn 2009; Mueller 2016). Before being first laid to serve geopolitical needs in the later period, most of Britain's cables were laid to make profits with which to sustain the substantial capital

[74] As the lengths of cables around the world soared up to over 200,000 miles, the demand for their insulating material, gutta percha, skyrocketed in the 1850s and 1860s "which soon outstripped the available supply (Meyer 2020)." For example, the supply of gutta trees in Singapore region was failed as early as 1850. The British alone imported over 1,000 tons per year. Considering the fact that "each fully grown felled tree produced two pounds of gutta percha at most," the amount imported by the British was excessive. As a way of overcoming the shortage of gutta perchas, 'the Dutch developed gutta plantations in the Dutch East Indies in the 1880s, and by the 1920s most gutta percha came from farmed trees. Only in the 1950s did gutta percha finally give way to a man-made insulator—polyethylene (Meyer 2020)."

investment needed for manufacturing and laying the cables. Most of the major investors came from the textile industry—"the first truly international industry"—in which the British played a central role. As Hugill (1999, 32) noted, "[b]y the mid-1800s most of the world cotton was being grown in the slave states of the American South, warehoused in the great British cotton port of Manchester, spun and woven in the textile towns of Lancashire and around Glasgow in Britain, and marketed worldwide." Therefore, it is not surprising to observe that John Pender, the former cotton merchant and cable financier, became the central figure by creating the TCM and *Eastern and Associated Telegraph Companies* (Mueller 2016, 233-234) with most of the major investors in Pender's companies coming from the textile industry (Headrick 1991, 36). He was behind almost every important submarine scheme of the British Empire (Mueller 2010).[75] By 1892, Pender's Eastern and Associated telegraph Companies owned more than forty-five percent of the world's total cable mileage and nearly seventy percent of Britain's, becoming "the largest multinational corporation of the nineteenth century (Hugill 1999, 32)." Alongside the rise of the cable business, Britain was also equipped with supporting infrastructure such as "commercial and banking organizations to finance the cable-manufacturing and -laying industry

[75] Andrea Giuntini (2020, 46), who focused on the development of telegraphic communications in Africa, describes John Pender as the "cable king."

(Headrick and Griset 2011)."

Lastly, as pointed out by Kennedy (1971) and Headrick (1991), Britain's geographical position and its scattered possessions, or colonies, all over the world gave the country a clear advantage. Because the longer the cable, the heavier and more expensive it was and the more easily it broke, cable companies would always search for ways to shorten the length of each section of a cable. So, having control over landing rights of strategic locations such as the British Isles and the Azores under the Portuguese flag was extremely advantageous to Britain (Zajacz 2005).[76] All these factors taken together, "Britain had the field to itself in the crucial formative years (Headrick and Griset 2011)," thereby gaining a technological lead based on the first-mover advantages. Anirudh Suri, in his recent book, has also attributed the British control of global submarine cable network to "[t]he potent combination of manufacturing expertise, ownership of physical infrastructure, strategic influence over cables routes, control of essential raw materials for manufacturing cables, unmatched cable-laying and cable-repair capabilities, and domination of international standards for telegraph technology (Suri 2022)."

[76] The British Isles and the Azores Islands often served as repeater stations for transatlantic cables to preserve the strength of the signal (Zajacz 2005).

The new imperialism and submarine cables

Until the 1880s, the improvement in communication among nations enabled by transnational cables was believed to be fostering mutual comprehension and respect which would ultimately eliminate the scourge of war (Finn and Yang 2009, chap. 10). In this sense, other European countries such as "France and Germany were content to use the British cables (Headrick and Griset 2011)."[77] For example, France depended all their communications outside Europe to some degree on the British network, and therefore on the political power exerted by London. So, if a conflict were to rise with Britain, its entire colonial empire in Africa and Eastern Asia were to be in a vulnerable position that can be exposed to the danger of cutting off from the home country, except for direct maritime contact (Allain 1991, 270). Other European countries were also dependent on the British network for their official and diplomatic communication.

As the century reached its last decade, however, mistrust and tensions were exacerbated between European powers which led the cables to become

[77] In fact, the French attempted to combat Britain's tightening control on "the first global telecommunications network in the period from the 1870s through the 1890s. However, these schemes invariably failed either to attract crucial government subsidies and guarantees or to make a profit (Headrick 1991, 42-43)" which were indispensable in maintaining the cable network.

a constituent part of imperial competition.[78] As Innis (2007) pointed out, "the geographical limits of empires [were] determined by the possibilities for effective communication, and that changes in the technology of transport and communications have permitted vast changes in the possibilities for the extension of empire." And, as Yang notes, "it is in this sense that communication technologies [became] the technology of empire (2010, 2-3)." However, as the reliance of nations on their communications intensified, so did their fears of losing them which were proved real when a series of irritations involving cable issues ensued. Consequently, the undersea cables, once symbolized as an indicator of national progress, have become a symbol of a national necessity and imperial defense (Muller 2016, 214). As Mueller noted, the years towards the end of the decade marked "the end of cable neutrality and cable protection in times of war, which had originally been secured under the 1884 International Telegraph Convention,"[79] with the Spanish-American war, the Fashoda Crisis, and the Second Boer war serving

[78] Scholars who contributed significantly to the studies of the relationship between empires and global communication include Paul Kennedy, Daniel Headrick, Peter Hugill, Jill Hills, Robert Boyce and Daqing Yang.

[79] The International Telecommunication Union (ITU) was found in Paris in 1865 when the first International Telegraph Convention was signed by twenty states amid the rapid expansion of international telegraphy which called for the need for uniformity (ITU website, *Pre-1865 International Telegraph Agreements*). However, as noted by Mueller (2015, 246), as it was proved by a series of conflicts involving cables in the later period, the Convention had only been an ostensible success as it had no power over the belligerents and the ocean cables in times of conflicts.

as the decisive dividers (Mueller 2016, 215). Likewise, as the neutrality of cables faded from view, European great powers woke up to the strategic importance of cables for their security and to their vulnerability to British dominance (Headrick in Finn and Yang 2009).

A series of conflicts involving cables

During the Spanish-American War, that took place in 1898, "the U.S. Navy cut several British-owned cables in Cuban waters, putting to rest the idea that belligerents would respect the cables of neutrals (Headrick and Griset 2011)." During the Franco-British confrontation at Fashoda in Sudan, the British expeditionary force communicated directly with London while refused to let the French use British lines to communicate with Paris which was crucial in defeating the French. "And in the South African War of 1899 to 1902, the British insisted France, Germany, and Portugal hand over their codebooks[80] if they wished to continue their communication with their colonies in southern Africa. (Headrick & Griset 2011)." These incidents revealed the critical vulnerability of lines of communication and how much actual risk the countries were taking by depending on the British telegraph cables (Headrick

[80] Telegraphic codebooks were developed to simplify and shorten the messages which in turn reduced costs of transmission and ensured secrecy of the users. These codebooks, first developed for overland telegraph users as early as 1845, became an important feature of the nineteenth century in terms of commerce as well as military which were used well into the twentieth century (Godfrey 2018, 29).

1991; Headrick and Griset 2011).

The first incident to bring communication conflicts out in the open was the Spanish-American War in 1898 which initiated "the shift from a discourse on submarine cables as symbols of national progress to a means of national security (Mueller 2016, 215)." By using a loophole in the International Telecommunication Union (ITU) convention of 1884 which stated that the convention would not "in any way restrict the freedom of belligerents," the United States attempted to cut all cables leading into and out of Cuba. Lieutenant Cameron McRae Winslow, who commanded one of the boats used to attack cables in the Battle at Punta de la Colorados, gives a first-person account in *The Century* magazine in November 1898:

> "To cut off General Blanco at Havana, Cuba from direct communication by ocean telegraph-cables with many of the islands of the West Indies, and thence with the home government at Madrid, cutting off those cables and thus destroyed the Spanish telegraphic lines of communication, preventing to authorities at Madrid and at Havana, and the ships of Admiral Cervera's fleet, from sending or receiving information, was of the utmost strategic importance to Americans (Winslow, 1898)."

Although it eventually failed to break Cuban contact with Spain due to the lack of charts on "cable positions and the specialized ships and

equipment needed to raise and cut cables (Meyer 2010)," such actions taken by the U.S. revealed that the previously cherished belief that cables would be neutral in times of war was obsolete (Meyer 2010). Consequently, as Hills (2002, 5) noted, the access to cables as well as the ability to cut them "became a military imperative and the avoidance of such action became a strategic necessity" (in Mueller 2016, 215). Another aspect of undersea cables revealed by the conflict was that even "[those] belonging to neutral power were just as likely to be seized or cut as the cables of an enemy (Headrick 2009, 189)," which proved that any kind of dependency on foreign states would come with political vulnerability. Before the outbreak of war, there were four cables connected between Spain and its colony of Cuba: two American cables between Key West and Havana, a British cable from Cuba to Jamaica, and a French cable to Haiti and then to North America. So, when the U.S. attempted to interfere with Spanish communications, the British and French lines were beyond their reach (Headrick 2009). When the US military accidentally cut the British Eastern and Extension Company's cable, in an attempt to cut cables in the Philippines connected to Cuba, the company refused the request by the US government to repair the broken cable, claiming their obligation to obey the terms of their license from the Spanish government that its cables shall not be used against Spain. However, when the military and political situation changed in favor of the U.S., the company abandoned the terms with Spain and reopened the line to Manila as requested by the Americans

(Ahvenainen 1981, 166; Bright 1911, 6 in Mueller 2016, 215).

The vulnerability of cable dependence on foreign states was revealed once again during the Franco-British confrontation at Fashoda in Sudan when the British expeditionary force enjoyed direct communications with London while rejecting the French military's request to use British lines to communicate with Paris (Headrick and Griset 2011).[81] When France planned to control Africa from Dakar (the west) to Djibouti (the east), it clashed with the British colonial ambitions to establish its control from Cairo (the north) to Cape Town (the south). Because the French military "had no direct communications with France (Tworek 2019)," the French government could only receive and rely on the British version of the news from Fashoda, and Major Marchand was unable to refer to Paris for instructions while the British General Kitchener was able to stay in regular contact with London (Squier 1901; Solymar 2021). The dependency on British cable made it impossible for the French military to pursue any kind of secrecy of information and decision-making, and the transmission of critical news and information was also delayed or sometimes intercepted. As Kurbalija (2013) notes, "[t]he British victory in this crisis was determined to a large extent because the

[81] The Fashoda crisis came about when the ambition of France and Great Britain in Africa clashed by simultaneously pushing forward the borders of their colonies with the British wanting to stretch from Cairo to Cap Town along the eastern coast of Africa and the French wanting its "continuous blue swath from Dakar on the Atlantic to Djibouti on the Red Sea (Solymar 2021, 88-89)."

British commander had a means of communicating, via the telegraph, with his headquarters." Such a means not only allowed London to be fully informed of what was going on in Fashoda, unlike the French government, but also to deliver false information about the French troops to Paris (Kurbalija 2013; Allain 1991, 271), putting the British government representatives in a superior position during negotiations with their French counterparts (Kennedy 1971, 728; Headrick 2009, 191; Mueller 2016, 516).

In southern Africa, "the British fought two wars against the Dutch Afrikaner, or the Boer, settlers of two independent republics—the Orange Free State and the Republic of the Transvaal." The Second Boer War which lasted from 1899 to 1902 spurred the fear France and Germany already had against the British dominance over submarine cables. It started with the British imposing censorship at Zanzibar and Aden by prohibiting all telegrams in code or cipher except those between foreign governments and their consuls in Africa which took place on October 14, two days before the start of the war (Headrick 2009, 190; Finn and Yang 2009). When the war "took place against a backdrop of growing new imperial rivalry (Headrick 1991)" in the region, the British extended the ban to include government telegrams out of a concern that the Boer republics and their European friends would develop an alliance against the British.[82] The French, German and

[82] According to the agreement of the St. Petersburg Conference—the

Portuguese, of course, protested complaining that such a ban would harm their legitimate commercial interests in the region. As a response to their pressure, the British lifted the ban on commercial codes provided that copies of relevant codebooks were submitted to them (Headrick 1991, 88; Headrick and Griset 2011, 563). The British demand made it clear that "all other countries' vital communications were at risk as long as Britain ruled (Headrick and Griset 2011)" the cable network. For Germany, the British action made it abundantly clear that they would "use its control over undersea cables to censor and even block German and French communications in Africa when necessary (Meyer 2010)." As Jill Hills (2002, 71) noted, the Second Boer War "marked the beginning of British surveillance of cable communications."

fourth International Telegraph Conference, which took place in 1875, it was legal to impose such a ban as the agreement clearly states that all states have the right to suspend any message going through their territory, "subject to notification … to the other contracting governments (as cited in Headrick 1991, 88)."

Table 4.1. A series of conflicts involving cable issues in late-1890s

Conflict	Year	Issues involving the use of cables
The Spanish -American war	1898	• The U.S. attempted to cut all cables leading into and out of Cuba – to break Cuman contact with Spain
The Fashoda Incident (The Franco-British confrontation)	1898	• France's dependency on British cables put French military in an inferior position
The Second Boer War	1899	• France's dependency on British cables put French military in an inferior position

Source: Author

The underlying cause of those conflicts (see Table 4.1.) and the shift in the discourse on submarine cables was that states started to embrace both an aggressive nationalism and the new imperialism in the aftermath of the Berlin Conference of 1884 (Hugill 2009, 263-264). With their imperial ambitions, states, the latecomers like the U.S. and Germany in particular, began to rethink their role as continental to aspiring global powers (Tworek 2016); they increasingly thought of themselves as a global power rather than just a regional power. As imperial rivalry started to grow and mass migration to foreign states increased with imperial powers scrambling for colonies in Asia and Africa, the matters of ocean telegraphy increasingly became an integral part of their foreign policy which led the undersea cables to be conceived as something more than national progress—a "national necessity"

(Letter of Abram Hewitt to John Pender 1895 in Mueller 2016, 246), especially in the face of Britain's role at the center of controlling the world's telecommunication network.

The states that had been content with using British cables for their communications started to realize the risk of having the political, commercial, or military information to land first on British soil and, therefore, increasingly sought to influence their ocean cable companies while attempting to break free from the British monopoly (Mueller 2016). The French government brought its attention to submarine cables when faced with a confrontation with Britain at Fashoda. The French were particularly concerned about the fact that they can only communicate with Indochina, their richest possession, via the British network. In order to avoid British interference with cables in the event of a war, the French attempted to develop their own colonial cable network by laying a cable that would link up with the land-based network in Russia, a friendly ally, or by diversifying its connection through convoluted routes that could avoid *the Eastern*. While these attempts did put an end to total dependence on London, the French could never achieve complete independence from the British and failed to attract any commercial business due to the increased cost of telegraphic service which eventually limited its use and, in the end, were not replaced after breaking down in 1913 (Headrick 2009, 191; Allain 1991, 273). In the case of Germany, a great consternation

was created when the British disproved the German request for "landing rights to a German-American cable in the late 1890s despite years of negotiations (Huurdeman 2003, 308)." So, mirroring the attempts undertaken by the French government (Mueller 2016, 216), Germany also took measures to diversify its connection with other countries or to push for its own transatlantic telegraphic link to bypass the British cable network (Tworek 2016). More details of Germany's strategies will be discussed in detail in the later section of this chapter.

The British Side: All-red line route

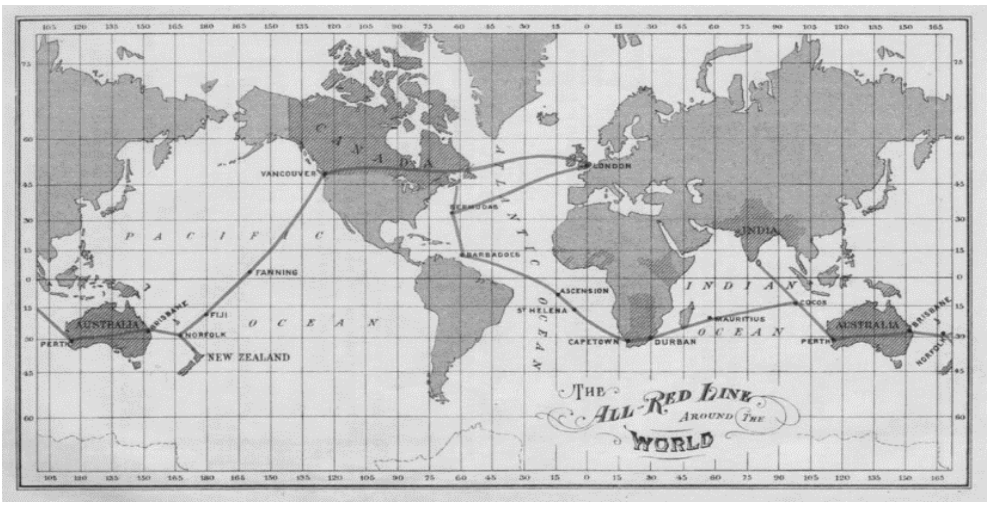
During the first three decades of undersea cable technology, Britain faced no serious rival in submarine telegraphy with practically all intercontinental telegraphic communications, regardless of origin or destination, traveling over British lines (Hugill 1999, 38), which led the British policymakers to defend the cables by simply advocating their international neutralization (Kennedy 1971, 732). However, in the 1890s, notwithstanding their overwhelming superiority in cables, cable ships, and naval power, the British started to worry about the security of their communications, especially with India. The ensuing outbreak of conflicts not only spurred fear among other great powers but also served as an impetus or a wake-up call for Britain to recognize the military significance of telegraphy (Nebeker 2009). A series of

conflicts that involved the issue of undersea cables, especially the nightmare Britain experienced in the second Boer war,[83] led Britain to realize that no existing international agreements or a commonly cherished belief of the cables' neutrality in times of war could prevent strategic uses of cables in times of conflict (Mueller 2016, 188-189; Headrick 2009, 194-195). In order to avoid a repeat of communication isolation that could come from a mixing of lines and stations in foreign territories (Allain 1991, 274), the British government appointed a special committee to come up with detailed measures on "what should be done to stock supplies, station cable ships, lay new cables, defend landing site, and otherwise prepare for war. (Headrick 2009, 190)." Although the committee was originally appointed to consider telegraphic communication with "India" in times of war, the report issued by the committee recommended "a network scheme" of laying strategic cables that would touch only upon British territory and avoid "passing near the naval stations of a possible enemy," arguing that it is "impossible to deal with the question of telegraph communication with India, without taking into consideration the requirements of the Empire as a whole (1891 committee report cited in Cain 1970, 217)." When another interdepartmental committee

[83] During the second Boer war, the British suffered from the cable cutting and line tapping by the Boers. The Boers not only interrupted British communications by cutting the cables but also used it to ambush British lines parties. For instance, when line parties were sent out to repair the telegraph wire between Witklip and Badfontein on May 3, 1901, they were ambushed by 50 armed Boers (Harris 1998).

reinforced the idea that the security of Empire could only be assured by all-British cable routes, it led the British government to press for the formation of an all-British or all-Red cable system (Headrick 1988).[84] As it shows the willingness to use its domination of the world cable industry to interfere with the communications of even neutral powers in time of war, the report can therefore be seen as "a drastic departure from the defensive approach of the past (Headrick 2009, 190; Cain 1970, 222)."[85]

Figure 4.3. A Map of the British All-Red Line completed in1902



Source: Johnson's *The All Red Line – The Annals and Aims of the Pacific Cable Project (1903).* Image available in the public domain

[84] All-Red lines, "named after the red color used on maps to define British colonies and dominions," also had a side-effect of avoiding "untrained telegraph clerks with little knowledge of the English language relaying progressively more garbled message (Meyer 2010)."

[85] The report bluntly stated that "the Committee … have come to the conclusion that we ought to cut an enemy's cables wherever necessary for strategic reasons" and also included contingency plans in the event of a war with Russia, Japan, the U.S., and France. What is interesting to note is that, as Headrick (2009), pointed out, the possibility of war with Germany was not even mentioned in the report.

As a first step to round out the British network, the Pacific Cable Board was created to lay a cable across the Pacific Ocean in 1901.[86] In addition to that, new cables were also laid in the South Atlantic and Indian oceans, duplicating existing lines to provide alternative routes to India in case Britain loses control of the Mediterranean Sea (Headrick 2009). By 1902, with the completion of "All-Red line" route, the British owned not only most of the world's commercial cables but also strategic cables that enabled its communication with major colonies and naval bases practically invulnerable (see Figure 4.2). By 1913, Britain owned over half of all undersea cabling, and the gap between the British holding and that of the nearest competitor remained large: out of 539,000km, Britain had 330,000 km; the U.S., in second place, had 7,000 km and France, in third position, 46,000 km (Allain 1991, 268-269). As Great Britain became convinced of its invincible security in global communications not only in terms of invulnerability toward attack, interference, or espionage but also in regards to having the ability to cut enemies off from the rest of the world and censor the messages, its attention was turned to offensive operations (Bruton 2014b; Headrick 2009, 194-195).

[86] In fact, such a plan met considerable resistance from a number of different parties for many reasons among which the biggest concern was that the Pacific cable saw considerably less lucrative (Wenzlhuemer 2013, 117).

2. Network Balancing by Germany

Up to the late nineteenth century, German officials were unaware of the importance of communications infrastructure, which partly explains why Germany's involvement "in global communications networks had been comparatively limited (Tworek 2019)" in the formative years of submarine cable network. The German government did not even consider supporting the Siemens Brothers when they attempted to compete with the Anglo-American Eastern and Associated Companies in the 1870s (Tworek 2019). However, as Germany increasingly gained its strength in the late nineteenth century, it started to pay more attention to the strategic importance of the telecommunication network.

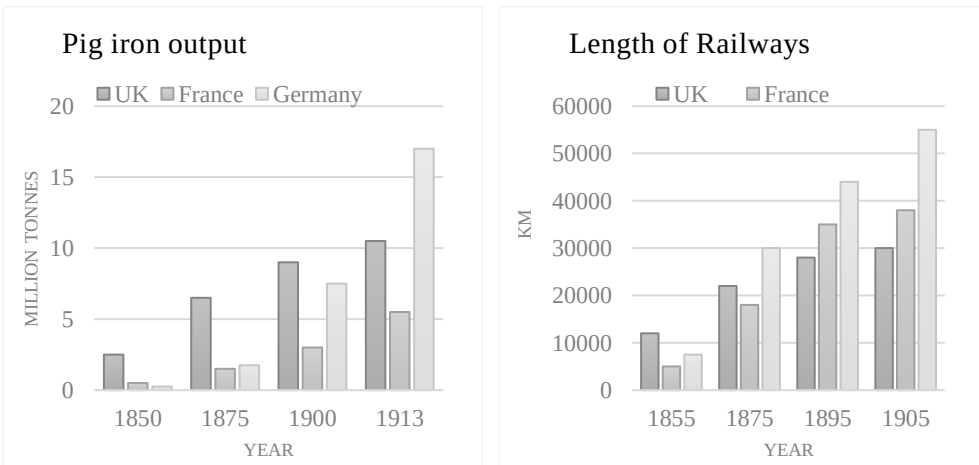
The Strategic Situation

The rise of Germany

According to Paul Bairoch's documentations, Germany, by all accounts, remained as an 'industrial backwater' until the mid-1800s, lagging behind not only Great Britain, France, and the United States, but also China, India, and Russia (Bairoch 1982, 284; Naude and Nagler 2017). However, by the last decades of the nineteenth century, many indicators showed Germany's great leap forward. After the period of the Long Depression between 1873 and 1879,

the world economy started to grow rapidly with the economic power of Germany and the U.S., in particular, bypassing Great Britain (Hobsbawm 1996, 46-51 as cited in Mueller 2016, 191). Germany also achieved dramatic industrial progress as it is shown by the two typical measures of industrial progress: the output of pig iron and the length of railways, relative to Britain and France (see Figure 4.3). In the middle of the nineteenth century, Britain was the major supplier of iron to the world market and had the longest length of railways. However, the length of railways in Germany surpassed that of Britain's railways towards the end of the century, and, by 1913, German's iron exports had also exceeded British exports, becoming the biggest supplier of pig iron (Allen 1979, 911; Solymar 2021). Germany also showed a spectacular increase in the output of steel, becoming larger than that of Britain, France, and Russia combined (Kennedy 1989, 210).

Figure 4.4. The progress of Germany in pig iron output and the length of railways built



Source: rearranged from Solymar (2021, 141)

In regards to submarine cables, by the late nineteenth century, Germany had enough "mechanical and electric industries capable of manufacturing cables at a competitive price (Headrick and Griset 2011, 557)," becoming sufficiently competitive against Britain. By the eve of the First World War, Germany became the economic powerhouse of Europe by reaching close to Britain as the leading world exporter with its share of world manufacturing production overtaking Britain's (Kennedy 1989, 210-211).[87]

Strong motive

Although some scholars including Solymar (2021) claim that Germany had no interest whatsoever in the manufacturing and laying of undersea cables, the German government actually had, in addition to its capability, strong motives to be interested in the cable industry, especially towards the end of the nineteenth century. First, there was a sharp increase in demand for German-American communications. When the revolutions of 1848 to establish democracy failed, thousands left Germany to settle in America which resulted in nearly one million Germans immigrating to America in 1850s (Library of Congress, *The Germans in America*). As the journey across the Atlantic became more accessible and more tolerable with steamships

[87] Between 1890 and 1913, Germany's share of world manufacturing production (14.8%) outpaced Britain's (13.6%) (Kennedy 1989, 211).

replacing sailing ships, the number of German immigrants reached more than 5 million in total by the end of the century (Library of Congress, *German: A New Surge of Growth*). Fueled in part by a large number of German immigrants to America, Germany's trade with America also increased exponentially, with the U.S. becoming the second-largest market for German goods in 1890 as it can be noted in Table 4.1 (Buchheim 1986, 44; Headrick and Griset 2011).

Table 4.2. Exports to the six most important countries purchasing German goods in 1890

(in million marks)

	Great Britain	USA	Austria-Hungary	Netherlands	France	Russia
Total	689	417	332	258	231	184

Source: rearranged from the table in Buchheim (1986, 44)

Another motive came from Germany's imperial aspiration and its increased need and desire to secure its communication with the colonies. In the last decade of the nineteenth century, Germany started "to see the world beyond Europe as a vital battleground for their national interests (Tworek 2019)" and increasingly thought of itself as a global power (*Weltmacht*) rather than just a regional power, becoming deeply invested in *Weltpolitik* (world politics). Such reconfiguration of its role as Weltmacht dovetailed with its increasing investment in building a colonial empire, which made

communications critical in carrying out such plans (Tworek 2019). For Germany to assert itself as a world power, the country had to have a world communications network as "communications and power were tautologically and inextricably intertwined."

Threats to sovereignty

By going through a series of conflicts involving cable issues, Germans became increasingly convinced that Great Britain was using the global submarine cable system to serve their strategic goals and to project their will upon others. On top of those conflicts, the incident that had particularly spurred Germany's suspicion and fear of the British control over cables was when the British refused to approve the "landing rights to a German-American cable in the late 1890s despite ten years of negotiation (Tworek 2019, chap.2)," creating great consternation in Germany.

Until the first few years of the 1890s, Germany continued to rely on the Anglo-American transatlantic cables to communicate with North America that were connected to the German Cable Company (a Felten and Guilleaume affiliate) interconnecting cables in the European continent. "As the company expanded, it increasingly collided with the dominant Anglo-American companies and the British government (Winseck and Pike 2007)." So, in

order to avoid unnecessary collision, the German Cable Company asked the British government for landing rights in Waterville, Ireland to establish a new route "connecting Emden, Waterville, and the United States." The Anglo-American Company and British government continued to obstruct German's proposal, worrying that such a route would not only "divert business from the Anglo-American Company (Winseck and Pike 2007, 89-91)" but also would bypass London which would undermine Britain's strategic position (Tworek 2019). Although the British government eventually approved the landing rights on January 1900, it was only under the condition that the German Cable Company would comply with the "British" firms, "routed its traffic through London, and avoided competing with existing companies on the basis of rates (Winseck and Pike 2007)." However, right before the British approval was issued, the German Cable Company signed a deal with Commercial Cable Company to bypass London and instead lay the cable via the Portuguese Azores archipelago, situated in a geographically strategic location in the mid-Atlantic.[88] It was the longest submarine cable in the world at the time of its opening in 1900 (Huurdeman 2003, 308). On 4 August 1914, however, when the war broke out, the British government immediately ordered to cut the two German cables that linked Emden to New York via the Azores, and the

[88] The route was Greetsiel - Borkum - Vigo - Azores - New York. (Glover 2013); The Azores archipelago was placed at a strategically important location for the future international radiotelegraphy network (Queiroz 2010).

Portuguese authorities under the pressure from the British sealed the German station a month later, effectively ending the traffic between Azores and America, thus Emden to America (Silva 2018). As Silva mentioned in her article, it was "quite clear that the Portuguese policy concerning telegraph cables was always determined by British interests," and depending the technical resources—concerning "not only the apparatuses, but also in terms of expertise in engineering—provided by the British telegraph networks of cables to manage and control its empire" was one of the main reasons (Silva 2018; Giuntini 2020, 48). The German's fear of British dominance over the cable network elevated when the British government completed their "All Red Route," or what Germans called the British 'world cable network (*Weltkabelnetz*),' "that only landed on British imperial soil by laying the final link across the Pacific Ocean to connect Vancouver with New Zealand and Australia in 1902 (Tworek 2016; 2019)."

Network Balancing Measures

Internal capabilities as a prerequisite

It was not until the mid-1890s the German Cable Company started to get involved with Germany's international communication services which had been mostly managed by the Anglo-American Company. Such a change did not occur out of a sudden but was premised on Germany's undertaking of a

process of "forced industrialization at home and a stronger projection of its interests abroad. Among those involved in both activities (Winkseck and Pike 2007)," the German cable manufacturer *Felten and Guilleaume Carlswerk A. G.* (hereafter Felten & Guilleaume) played a central role. When the German faced with Britain's rejection on its request for landing rights, the German government encouraged Felten & Guilleaume with substantial subsidies, which led to "a sixteen-fold increase in cable exports between 1891 and 1908 (Clapham 1961, 306-309 as cited in Zajacz 2005, 61)." When Felten & Guilleaume found a new cable operating company, *Deutch-Atlantische Telegraphengesellschaft* (DAT), which was established to compete with the Anglo-American Company to operate cables across the Atlantic, it received "a subsidy of 1.4 million Reichsmarks a year from the government (Headrick 1991, 106; Headrick and Griset 2011, 558)." Moving from being a simple manufacturer of communication technology and electronic apparatus for internal markets to becoming a developer and an operator of the global telecommunication system, it promoted four regional networks: "one for transatlantic communication *(Deutsch-Atlantische Telegraphenges);* another for communications between cities along the European coast of the Atlantic *(Deutsche-See Telegraphenges);* another affiliate for South America *(Deutsch-Sudamerikanische Telegraphenges);* and finally, in collaboration with the government of the Netherlands, another network between Indonesia and China *(Deutsch-Niederlandische Telegraphen Ges.)* (Winseck and Pike

2007)."

Network balancing attempts

Based on its augmented technological capabilities, Germany now had to cooperate with other secondary states to balance against British dominance in submarine cable network either by building its own network or by at least bypassing British soil to avoid any disadvantages. Its first attempt was to ask for Portugal's cooperation to approve the landing rights to build its own network connecting Germany to the U.S. via the Azores to secure a direct connection between Germany and North America that would avoid a landing in British soil. (Headrick 2009, 192). Azores islands, together with Lisbon and Cape Verde, were one of the central nodes of the international submarine cable network in Portuguese territories, channeling the telegraphic traffic between European states as well as between European countries and states in other continents (Silva 2018). Because the Azores were situated in such a geo-strategically important location for landing the cables and establishing relay stations, Britain strongly appealed to use Portuguese territories as the central location of building its telegraph empire—the all-Red line routes "by calling upon the old alliance between the two countries and its strong financial power" (Silva 2018).[89] However, when the Portuguese government received a

[89] The Portuguese ambassador in London wrote in a report that a British

proposal from the German company, *Felten & Guilleaum*, to build a connection between the Azores and the U.S. for a more effective channel to communicate with the U.S., the Portuguese felt that they were being despoiled of their African colonies by other European states, especially by Britain. For instance, the British "ultimatum of January 1890 to retreat Portuguese troops from the region between Angola and Mozambique, claimed by both countries" directly affected the Portuguese government to reconsider the proposals of both the *Felten & Guilleaum* and the British *Telcon* (the Construction and Maintenance) Company (Silva 2018). In search of ways to build their own cable network free from British influence and scrutiny, Germany was eager to get the landing rights approval and Britain losing its "unchallenged ascendancy over the Portuguese government" seemed to provide them an opportunity. The landing rights were approved to lay cables to New York, to Canada (Canso), and to Emden (Germany), enabling Germany to reach New York via Azores, without using the British lines. The result turned out ostensibly as Germany planned, but because the landing rights contract was signed with the British-based *Europe & Azores Telegraph Company (E&A)* in December 1899, it should be interpreted as Germany's ultimate failure in

official stated that "Portugal was, still is and will always be the best support for Great Britain in continental Europe" (Historical Archive of the Ministry of Foreign Affairs, 16 August 1860 as cited in Silva 2018).

decoupling itself from the existing British network (Silva 2018).[90]

After the North Atlantic, the next target of Germany's network balancing attempt to bypass the British network was the Ottoman empire**,** where Germany had growing interests. Before 1899, communications with Turkey went either by landline across Russia or by British cables in the Mediterranean, neither one politically acceptable. In 1899 a German firm obtained the right to construct a landline across Hungary and Romania but was blocked until 1905 from laying a cable to Constantinople due to the refusal of landing rights by the Ottoman government (Headrick 2009, 192). Although it was the Ottoman Empire (Basra) and Portugal (Goa) that notified the official refusal of landing rights for the cable, the actual opponent of such plans was the British with a strong influence on both the Ottoman Empire and Portugal (Kurbalija 2013).[91] The British actually had a reason to have such a strong influence over Ottoman Empire. In 1857, the Ottoman government announced its plan to build its own national telegraph network, "but the project proceeded haphazardly, taking nearly eight years (Winseck and Pike 2007)" to finish which was only possible due to "the injection of fresh capital

[90] The E&A, a Portuguese nationalistic enterprise, was in fact a subsidiary of the British Eastern Telegraph Group (De Cogan 2013).

[91] Britain's primary goal of protecting the Rimland (Gibraltar-Malta-Suez-Aden-India) was obviously to block German plans to establish its own telegraph cable between Basra (the Persian Gulf / Ottoman empire) and Goa (India) (Kurbalija 2013).

and expertise from Britain (Winseck and Pike 2007).” However, because “such injections of capital and expertise came with strings attached (Winseck and Pike 2007),” the Ottoman’s original goal of establishing “a symbol of a modernizing nation-state” ended up largely financed and built by British and European interests. “These difficulties were further compounded in the early 1860s when decisions were made to back up the Ottoman telegraph lines between Baghdad and Basra with additional links to the Persian government’s nascent telegraph system (Winseck and Pike 2007).” Such moves reflected Britain’s concern regarding “network security in the frontier zones of the Ottoman Empire and Persia, and separate negotiations between Britain on one side and Turkey and Persia on the other were conducted between September 1861 and December 1862 with the aim of creating a regional telegraph system linking both countries.” The British proposal demanded the “new line to be built with British funds and operated under British supervision between the Persian Gulf cables and from there to the Persian capital of Tehran and to Kahanakin, the closest city to Baghdad near the border of the Persian and Ottoman Empires (Winseck and Pike 2007, 31-32).”

In order to communicate with its Pacific colonies—the Carolinas, Marianas, Palau, and part of Samoa—Germany, this time, looked for assistance from the Netherlands and France. In 1900, when a German cable entrepreneur approached the Dutch Telegraph Administration about a joint

cable connecting the Netherlands East Indies with the German colonies in the Pacific and eventually with an American Pacific cable, he found a warm reception. In 1903, when the American cable reached the Philippines, "the Germans established a joint cable company, DAT, with the Dutch Telegraph Administration (Tworek 2019)" to lay cables linking the German island of Yap with American Guam, Kiaochow Bay and the Netherland East Indies in 1904. Until then, German and Dutch colonies could not communicate with their metropoles without the British lines (Meyer 1977, 77; Ahvenainen 1981, 175-184 as cited in Tworek 2019). Although the new German-Dutch lines did not meet any requirement of business, the true purpose of laying those cables was much more a strategic move against British policy.

In the South Atlantic, the Germans faced the same dilemmas as in the Pacific, namely the impossibility of building their own cable network. Spain[92] and Liberia were willing to grant concessions, but on the Brazilian side, if they wished to avoid the British, they had no choice but to turn to the *South American Telegraph Company*, owned by the French government. In exchange for a share in this company's concession, Germany helped France complete its West African network (Headrick 2009, 192-3). The German government worked with "the French to lay a cable to South America, in

[92] The Germans were permitted in 1907 "to land cables at the Spanish island of Tenerife and also at Monrovia, on the west coast of Africa, thereby bypassing the Azores altogether (Winseck and Pike 2007, 212)."

return for German help with France's network in West Africa (Headrick and Griset 2011, 567 as cited in Tworek 2019)." Likewise, Germany, by collaborating with France and Holland, did build its regional network "between Indonesia and Qingdao, but it still relied on the *Eastern Associated Company* for the long-haul transportation of all their diplomatic, military, and commercial communications back to Berlin (Winseck and Pike 2007, 111)." Although John Pender "received subsidies from all the European powers during the new imperialism era of 1890-1900, the British government had priority access to Pender's cables over all others which was clearly indicated by Pender's position on the British Colonial Defense Committee (Winseck and Pike 2007)."

3. Findings and Analysis

As I have discussed in this chapter, every network balancing measure taken by Germany against the existing submarine cable network was frustrated by the British. The biggest reason why Germany eventually failed in network balancing, despite its many attempts, was because the network effect of the British submarine cable network that had expanded among the participating states was already strong enough to trap them into the British network by the time Germany ushered in to establish its own network or find an alternative

way to bypass the British. Only if the Germans had realized the significance of the network effect upon their sovereignty in the incipient period of the network, there may have been a chance for Berlin to take the lead or at least to hold back Britain's dominance. It is more regretful for Germany because there was indeed a window of opportunity slightly open for the Germans in the early period of submarine cables.

A missed opportunity

The Prussian and later German governments had shown relatively little interest and marginal involvement in subsidizing or laying cables, let alone establishing its own network, when submarine telegraphy had first emerged in the mid-nineteenth century primarily for the reason that Bismarck, going through an internal reshuffling, was preoccupied with the political fabrication of the German State (Showalter 1973, 50).[93] Whereas, the British were engaged in their peaceful pursuit of establishing trans-Atlantic communication under the benign Victoria. Consequently, as Muller (2016) noted, the German government did not even intervene to support *the Siemens*

[93] According to Dennis Showalter (1973, 51), the Prussian army's neglect of the telegraph as a means of exercising command in the mid-1860s came from "technical shortcomings, organizational weaknesses, and unexpectedly fierce partisan warfare" combined, which later contributed to the army's failure to develop efficiency in its use.

Brothers[94] when they attempted to compete with the *Anglo-American Eastern & Associated Telegraph Company* in the 1870s which was, in hindsight, a window opened for Germany to counterbalance, what was then potential, British monopoly over submarine cables (Muller 2016, chap.2; Tworek 2016).

As mentioned previously in chapter four, John Pender, the former cotton merchant and cable financier and the founder of TCM and *the Eastern and Associated Telegraph Companies*, was the prime mover of the Class of 1866, a mostly Anglo-American group of cable pioneers including engineers, entrepreneurs, financiers, and journalists who ruled the global communication system in the 1870s when a cable boom and rapid network expansion followed the Great Atlantic Cable. As Mueller (2016, 233-234) puts it, these actors had built up a monopoly, which had "like a huge octopus, fastened its tentacles upon almost every part of the eastern and southern world (Holland 1914, 6 as cited in Mueller 206)." However, the 1870s also witnessed the rise of an important rival to this group of people led by Pender; it was William Siemens and the Siemens family's cable manufacturer Siemens Brothers. They actually understood the exact logic of the network

[94] The Siemens Brothers was an electrical engineering design and manufacturing business based in London which was a branch of the German electrical engineering firm, *Siemens & Halske*.

undergirded by the network-driven technology this study is attempting to demonstrate. Observing that the Class of 1866's main market advantage was based on their control over a vertical business network, the Siemens figured that the only way to beat the established players was to offer not an alternative provider of communication using the cables laid by them, but a new alternative network with its own capabilities to manufacture, lay, operate, and finance an undersea cable. Constructing their own cable ship, *the Faraday*,[95] equipped for the purpose of cable laying was the most conspicuous one of his strategies to achieve his goal. Although the Siemens' attempt to establish a rival network by establishing the *Direct United States Cable Company* eventually failed,[96] the cable war between John Pender and William Siemens was viewed as representing a "drama of progress" between a system of monopoly aiming at capital accumulation, as pushed by John Pender, and a system of competition allowing for technological progress, as proposed by William Siemens (Hobsbawm 1996, 4 as cited in Mueller 2016, 235).

To go back to the reason why Siemens failed to move beyond its planning stage, when Siemens launched the company and put its cable into

[95] The 5,000-ton Faraday was "the first ship constructed as a cable ship in 1873-1874 to the design of William Siemens which served until 1923 and laid 60,000 km of submarine cables (Huurdeman 2003, 97)."

[96] According to Mueller (2010), the National Archives in London holds some of last proofs of its existence, which never got beyond the planning stage.

service in 1874 and began taking customers, Pender began buying up shares and promoting what he called a 'Friendly Alliance,' which eventually enabled him to prevail and *the Direct* came under his control. So, if the German government had intervened to provide financial support for the Siemens, that may have prevented Pender from taking the shares of the company, which, in turn, may have given Germany 'a window of opportunity' to take network balancing measures against the British submarine cable network (Cattaneo 1994, 77).

Network balancing frustrated

By missing out on the opportunity in the early period of the cable network, without even realizing the significance of the chance, Germany was faced with difficulties in taking network balancing measures by the time they decided to counterbalance the pre-existing network led by Great Britain. Although Germany was only indirectly affected by the Spanish-American war and the Fashoda crisis which highlighted the strategic importance of submarine cables, their experiences in the Second Boer war, when the British forced both France and Germany to hand in their codebooks, against their will, in exchange for their communication with the colonies in Africa, made the Germans realize how telecommunication network can be used as a strategic tool in times of conflict in the form of censorship or blockage. The incident

that decisively spurred the already-present fear was when Berlin requested for landing rights in Waterville, Ireland to build an alternative route to North America to simply avoid unnecessary collision coming from the congestion on the existing line by contracting for another cable (Clapham 1961, 306-309 as cited in Zajacz 2005). Having a concern of losing its strategic position by letting Germany bypass London, the British refused to approve, which only confirmed Germany's burgeoning, yet doubtful, fear of staying connected to the British communication network.

Increased fear against the British network led Germany to take counterbalancing measures (see Table 4.2). Its first attempt was to ask Portugal for its approval on the landing rights on the Azores to secure direct communication with the U.S. that would avoid a landing in British territory. Portugal eventually gave its approval which ostensibly turned out as Germany planned. However, as the landing rights contract was signed with a British-based Portuguese company, Germany, in reality, failed to break free from the British network. Another attempt was made when Germany requested the Ottoman empire for landing rights approval in order to construct a landline across Hungary and Romania to avoid using British cables in the Mediterranean. Such a request was rejected by the Ottoman empire, but really by the British which at the time had a strong influence over the Empire with its injection of capital and expertise in the empire's national telegraph system

that was linked to the cables linked to other countries. Germany also made attempts to build its own connection with its Pacific colonies by asking for assistance from the Dutch that also had colonies there. To avoid having to use the British lines to communicate with their colonies, a new German-Dutch line was established, though it was eventually stalled by failing to meet any requirement for the business to continue as the British line was much shorter and thus cheaper. The Germans were again faced with failure when they tried to establish their own line in the South Atlantic. Having no other choice but to turn to the French for assistance to lay a cable to South America. This time, although Germany did manage to build its own regional network, it still had to rely on the British Company "for the long-haul transportation of all their diplomatic, military, and commercial communications" back to Berlin (Winseck and Pike 2007).

Table 4.3. The ill-fated network balancing attempts by Germany against the British submarine cable network and the cause(s) of their failure.

Targeted location (Country in control)	Germany's proposed destination for cable communications	Cause(s) of the failure in network balancing
The Azores Islands (Portugal)	The United States	Refusal of landing rights due to the British pressure
Constantinople (The Ottoman Empire)	Turkey	Refusal of landing rights due to the British pressure
Celebes/Sulawesi (The Netherlands)	Its Pacific colonies: the Carolinas, Marianas, Palau, and part of Samoa	The cable line stalled by the lack of business
Brazil (France)	South America	The cable line limited to the short-distance communications

Source: Author

Likewise, whenever Germany attempted to take measures to decouple itself from the British network by getting the assistance of other states, most of them were already entrapped into the network to decide otherwise. In other words, the British had already secured its supremacy over the submarine cable network by increasing the number of connections, especially with the places of strategic importance. Once those connections were set, the states participating in the network were locked in mainly due to the reasons of high fixed costs, switching costs, and other political reasons. No matter how hard she tried, Germany's attempts to take network balancing

measures were eventually doomed to failure by British dominance of global telecommunications through the fixed-route global submarine telegraph network laid with its capital centered on London. Faced with the strong network effect generated by the existing British network, Germany, despite its partial creation of a regional network, eventually failed to break free from the British global network.

CHAPTER 5. ANGLO-GERMAN RIVALRY OVER THE WIRELESS TELEGRAPH NETWORK

The British monopoly in intercontinental submarine telegraphy enjoyed extraordinary longevity and they, again, managed to take the lead in the development of wireless telegraphy. However, things unfolded quite differently with the new technology as its rivals rushed in to counter Britain's dominance of the global telecommunication network (Aitken 1985; Hong, Sungook 2001 in Muller 2016, 248; Headrick 1991).

1. Great Britain's Embryonic Dominance

Birth of new technology: wireless telegraphy

The new technology of wireless was offered to Britain by Guglielmo Marconi, a young Italian who was the first to put "together pieces attributed to other men—Hertz's spark, Branly's coherer, Popov's antenna, Lodge's tuning circuit—and to see a practical application of radio waves," thereby creating a device that not only sent and received electromagnetic waves, but used them to transmit information in the Morse code (Headrick 1991, 117; Hugill 2009).

While Hertz and Lodge were satisfied with proving Maxwell's theory by signaling from one room to another, Marconi took such theory further to create a technology that would allow sending signals to ships at sea or across the great ocean masses (Headrick and Griset 2011). In his interview with the New York Times in 1912, Professor Michael I. Pupin of Columbia University described Marconi as a genius who "gave the idea to the world, and taught the world how to build a telegraphic practice upon the basis of [his] idea (NYT, *New discoveries will help wireless to defy water*, 1912)."

Starting with the first test across the English Channel in 1897, the contracts with the Admiralty—the Royal Navy—and the U.S. Navy Department in that year promised some needed financial basis and prestige which allowed him to conduct a series of experiments of wireless communication (Aitken 1985; Headrick 1991, 117; Yang 2010, 56-7).[97] "A contract signed with the Admiralty in July 1900 was more significant as it provided for the installation of Marconi equipment in 26 ships and 6 coast stations, and their maintenance for a period of 14 years (Aitken 1985, 232)." Contracts with the U.S. Navy was with less result, having three sets were installed on the flagship New York, the Massachusetts, and at the Navesink

[97] By the time Marconi arrived in London, "the Navy relied on fast torpedo boats for long-distance communication supplemented by flashing light signals similar to the Morse code (Pocock 1988 as cited in Zajacz 2005)." Recognizing the necessity for a new system of signaling, the British Admiralty "made Marconi's its sole supplier of wireless equipment" for over a decade (Headrick 1991, 118).

Highlands Light Station (The U.S. Naval Institute Proceedings 1899). Likewise, the navies showed great interests in wireless telegraphy because the new technology was particularly appealing to the high commands of all navies as it allowed headquarters to have control of the fleet at sea (Blish 1899). In advocating the wireless station, the U.S. Navy stated that,

> "[t]he great advantage of such an installation is difficult to overestimate, for with the fleet in reach of the national capital in all parts of the Atlantic Ocean and Caribbean Sea, a much closer and more perfect surveillance may be maintained over matters of international import than has heretofore been possible (as quoted in Blish 1899)."

After setting up "Poldhu and the Lizard stations in Cornwall, England, Marconi successfully transmitted his first transatlantic wireless signal from Cornwall to Newfoundland," located 3,500 km away, on December 12, 1901 when he received the three-dot Morse signal sent by John Ambrose Fleming, who assisted Marconi's experiment, from Poldhu, Cornwall, at Cabot Tower on Signal Hill, St. John's, Newfoundland (Huurdeman 2003, 269; Papacostas 2002). On December 1902, Marconi bridged for the first time in history the great distance between Canada and Britain, and, in the following year, he also carried out syntonic experiments at Poldhu station, proving "the possibility of rendering the installation on a ship in the neighborhood entirely independent

up to a distance of 10 kilometers (ITU, *[Documents of the] Preliminary Conference on Wireless Telegraphy* 1904, 29-30)."[98]

The British-based Marconi's head start

Due to the concern that the customers would develop equipment of their own and the market imperative for stable access to communication system rather than its ownership, Marconi ceased selling his equipment and instead instituted "a leasing arrangement consisting of an initial payment and an annual fee (Solymar 2021)," which turned out to be a "stroke of genius (Solymar 2021)." In April 1900, Marconi set up the *Marconi International Marine Communications Company* (hereafter, Marconi Company) "to establish and operate a chain of its own shore stations, provide each subscribing ship (Tworek 2019)" with Marconi equipment and employees, and collect payments from passengers and steamship lines for delivery of their messages (Zajacz 2005, 110; Satia 2010; Solymar 2021).[99] Marconi company also demanded dispatching their own staff to set up their apparatus

[98] According to the proceedings of the Preliminary Conference on Wireless Telegraphy in 1903, Lieutenant Marquis Luigi Solari, an Italian delegate, vehemently advocated Marconi's contributions to the progress of wireless telegraphy.

[99] However, as Zajacz pointed out, due to the Telegraph Acts that made it illegal to charge for individual messages, collecting payments more likely resembled "a subscription service where the line paid a monthly or annual sum for the company's services (Zajacz 2005 110)."

at the customers' expense (Aitken 1985; Satia 2010; Raboy 2016: chap.5). In other words, customers had to lease both the equipment and trained operators to gain access to shore stations of Marconi Company (Zajacz 2005). The shipowners wishing for radio facilities now had to lease the equipment to gain access to a communication system that used standardized apparatus and operating methods (Aitken 1985, 233).

Another stroke of genius was its non-intercommunications policy which demanded strict instruction to all Marconi operators "not to communicate with the wireless operators of any other company" (which were mostly German ones—the Slaby-Arco apparatus) except in the case of emergency (Solymar 2021). In order to discourage later entrants from connecting to the network it established, the Marconi company insisted that their "sets would work best if they worked with other Marconi sets, but that they would not work at all if they had to exchange messages with different systems (Zajacz 2005)." It was perhaps reasonable for Marconi to discourage others' access to their network considering the fact that it was intolerable for a business company to risk its enormous investment of capital in building shore stations in letting its competitors to make a profit without contributing anything to those costs (Baker 2002/1970, 95 in Zajacz 2005). However, such an argument about technical incompatibility was not persuasive as all systems, whether Marconi or Slaby-Arco, "used spark transmitters and some kind of

coherer (Aitken 1985, 236).” When its claim of technical impossibility of intercommunication turned out to be deceitful (Howeth 1963, 78), the company advanced the point, which was “equally manipulative, that the operation of many different systems would result in chaos and that its restriction would prevent such chaos by maintaining the service under one authority” (Douglas 1989, 71; Burns 2003; Zajacz 2005). In this regard, the policy of non-intercommunication effectively forced shipping lines to adopt Marconi’s system.

Although the policy of prohibiting communications with non-Marconi apparatus was, in fact, well calculated to give it an effective monopoly by “putting together a completely integrated and exclusive system and one that could refuse intercommunication with any other (Aitken 1985),” the keystone of his monopolistic scheme was the signing of a contract with Lloyd’s, the world’s leading maritime insurance conglomerate serving the most important shipping lines of all the industrialized states, on September 26, 1901, only two years after Marconi had found possible to transmit messages 30 to 40 miles (Hearings before U.S. Congress (hereafter Hearings) 1908, 111; Aitken 1985, 233-234; Satia 2010).[100] Supplementing the non-

[100] Having Lloyd’s as the most important customer, other crucial customers included the Cunard, P&O, White Star, Hamburg-Amerika, Compagnie Transatlantique, and Canadian Beaver lines (Headrick 1991, 119).

intercommunication policy with the contract with Lloyd's brought an enormous victory to the Marconi Company as the contract obliged the insurance company to enforce the policy with its shore stations (Zajacz 2005). At this time, Lloyd's had a network of more than 1,300 agents and subagents who, in addition to other duties relating to marine insurance, "were especially charged with transmitting to London from their districts the latest news of ship arrivals and ship movements (Hearings 1908, 111)." As "a global information network (Aitken 1985, 235)," Lloyd's was leading an industry with "an immense need for accurate information (Zajacz 2005)" by providing marine intelligence to shipping companies and maintaining "a network of look-out stations throughout the world which enabled ships to pass messages by semaphore or lamp to the shore stations (Burns 2003, 354)." Therefore, when wireless telegraphy emerged as a new telecommunication technology, it "held out significant prospects for a vast improvement in the efficiency of this global information network (Aitken 1985)" and Lloyd's was the first major company "to recognize the commercial potential of Marconi's invention (Raboy 2016, 88)." While it was, therefore, understandable for Lloyd's to be interested in closing the contract with Marconi, "the 1901 agreement was much more than a simple contract for the hiring of Marconi equipment and operators (Aitken 1985)"; it demanded exclusive privileges including the establishment of a series of Lloyd's wireless stations equipped with Marconi apparatus on the coast of England with the request not to use

other equipment or "communicate with ships using other systems, and also not to permit the use of any other system at, or in connection with, their signal stations (Satia 2010)." What this meant in practice was that any major shipping line wishing to take advantage of the worldwide network of marine intelligence had no other choice but to have its vessels equipped with Marconi apparatus. As mentioned earlier, this requirement had nothing to do with any technical incompatibility between Marconi and non-Marconi equipment regardless of what Marconi spokesmen suggested since "all systems used spark transmitters and some kind of coherer."[101] The reasons for stipulating Lloyd's to use only Marconi apparatus and to communicate only with those equipped with Marconi apparatus were not technological but economic (which later turned out to be also strategic); it was a typical corporate strategy of Marconi to exert "far-reaching control over the use of its patents and equipment (Winseck and Pike 2007)." Such arrangement forced ships to agree to Marconi's terms if they wished to communicate with Lloyd's worldwide marine intelligence network or with a Marconi-equipped ship or shore station (Satia 2010, 848; Solymar 2021) which ensured a steady stream of orders for the Marconi Company (Zajacz 2005). Until it ended in 1908, "the contract

[101] The Marconi spokesmen first argued that "intercommunication was technically impossible because the transmitting and receiving equipment of different systems were supposedly incompatible" and then later changed their argument by claiming that "the fundamental patent of wireless telegraphy belonged to Marconi (Raboy 2016, 272)."

with Lloyd's was the very cornerstone of Marconi expansion (Aitken 1985)" and the keystone of his monopolistic scheme (Headrick 1991; Satia 2010).[102]

Anglo-German rivalry begins

The years 1900-1907 saw the emergence of serious rivals to Marconi's dominance (Headrick 1991, 122). The first of these were the Germans, who had nationalistic as well as commercial reasons to challenge anything British (Headrick 1991, 122-3). In early 1902, the Germans experienced the effects of the Marconi monopoly when Prince Heinrich (Henry), brother of the Kaiser Wilhelm II, returning back to Germany from New York, attempted to send a wireless telegram to American President Theodore Roosevelt but could not communicate with any Marconi station in the English Channel because the ship he was on board, *the Hamburg-American Line steamer Deutschland*, "was equipped with the German Slaby-Arco apparatus, and ships and stations using Marconi's system were contractually forbidden from communicating

[102] The fourteen-year agreement with Marconi International Marine Communications Company was supposed to run until 1915. However, it became null and void in 1908 when the International Convention on Wireless Communication at Sea, signed by Britain the year before, became effective. This Convention, largely at the insistence of Germany and the US, called for unrestricted interchange of communications between all stations, regardless of the maker of equipment, and thereby destroyed, as it was intended to, the virtual monopoly of ship-to-ship and ship-to-shore traffic that the Marconi Company had built up in the intervening years (Aitken 1985; Winseck and Pike 2007).

with other systems except in case of emergency (Raboy 2016)" (NYT, *To Call A Telegraph Congress,* 1902). For Kaiser, the incident demonstrated "the power of Marconi's to choose its correspondents (Headrick 1991, 120)," which is also referred to as "Marconism" (Born 2016). In other words, it reflected "how the new communication technologies were being governed at the beginning of the twentieth century (Raboy 2016; Headrick 1991, 199)."

Although some scholars describe the incident as a trigger that prompted frenzied action of the German government (Zajacz 2005), it was more like "the Germans" seizing "the pretext of the Prince Henry incident," a mundane refusal of a Marconi station at Nantucket to accept a diplomatic message, "to broach an issue that had been concerning them for some time (Raboy 2016)": Britain's control of communication system (Raboy 2016; Born 2016; Solymar 2021). Wilhelm II was determined not to let this situation—facing British monopoly on telecommunication network—repeat itself with wireless on his watch, "especially when the Marconi company was perceived, accurately, to be a British company (Raboy 2016)" (Headrick 1991). Wireless telegraphy has then increasingly become "a strategic piece of the German effort to build a navy capable of challenging British supremacy (Raboy 2016: 199)" in the face of the naval race between the two. Complaints also came from France and the United States. The French claimed "that Marconi stations rendered some of their coastal radio stations ineffective due

to the Marconi Company's policy of non-intercommunication with other competing systems. The Americans, too, grumbled with Marconi-equipped ship refusing to answer queries about the position of a derelict ship in the shipping lanes."

2. Network Balancing by Germany

Threats to sovereignty and learning from the past

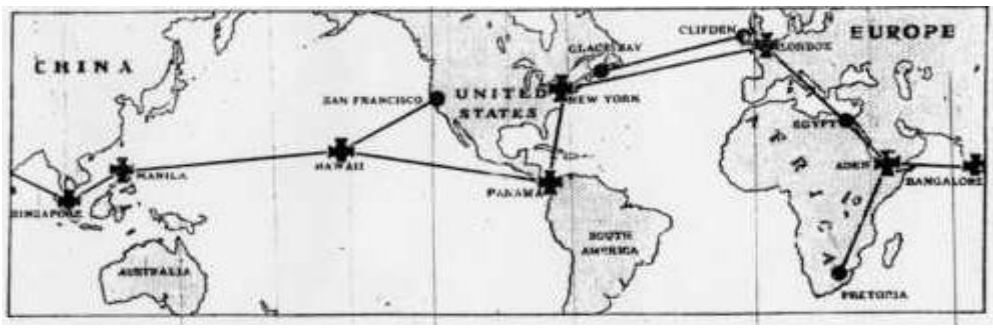
As mentioned earlier, the Germans were already carefully observing how things were developing around the wireless telegraph network even before the incident of Prince Henry. The activities of the Marconi Company such as its non-intercommunication policy and its contract with Lloyd's brought back the fear Germany had experienced with facing the British monopoly on the submarine cable network (Friedewald 2001, 34) and increased its anxiety about Marconi securing a worldwide monopoly over the wireless telegraph, "which would be, for Germany, tantamount to the British having a monopoly (Born 2016)." The Germans definitely wanted to avoid the situation that would parallel that of the very extensive, worldwide, British cable network (Burns 2003, 355). In fact, German admirals like Alfred von Tirpitz were

particularly attentive to international developments in wireless technology with its focus on the British Navy which the German Navy saw as its main rival at the time (Tworek 2016). The German General Staff observed the situation with great consternation from the view that "the development and interaction of all possible communication means were a prerequisite for the constant and reliable intelligence service that was considered a crucial factor for the operation of large armies (Friedewald 2000, 456)." Moreover, the multiple memoranda and committee meetings held by General Helmuth von Moltke the Younger, the chief of the general staff, to discuss the expansion of the British-based Marconi Company shows just how much concern the German officials had about the potential British monopoly on wireless telegraphy (Tworek 2016, 184 and 2019, 45-6; McNeil 1984, 248-9). Such a concern among military officials became increasingly convincing when "multiple sources reported that Marconi was working with the British postmaster general" to establish a British-controlled "All-Red line of wireless towers (Tworek 2019)," just like they did with the submarine cables.[103] The existence of the plan later turned out to be true as Frederick Minturn Sammis, Marconi's Chief Engineer in America, described Marconi's vision of a Worldwide Wireless network (see Figure 5.1) in his article "Around-the-

[103] Multiple sources include "Report from German consulate in Sydney, July 26, 1911, and report from German Foreign Office, October 31, 1911 (as cited in Tworek 2019)."

World Wireless" in 1912.

Figure 5.1. A Map of Marconi's Worldwide Wireless Network



Source: Takem from Sammis (1912)

As noted by Tworek (2016, 184), it was clear, for Moltke, "that the first state with global wireless would garner significant military and political advantages." His letter to War Ministry in 1908 shows that he "believed that Marconi was planning a global network to create a monopoly over wireless" and strongly argued for preventing his country "from relying on foreign communications networks in case of unrest (cited in Tworek 2019, 184)." As Bachmann (2018, 53-4) stated, the Herero uprising of 1904-1907, which represented the most serious threat to German sovereign in the colony, stimulated Germany to react swiftly to connect its colonies to each other. While the superiority of the German communication infrastructure gave them leverage over the Herero, allowing them to reach the mainland in just a few hours, the German authorities were still at the mercy of the British Empire, which had full control over communication with the cable running over their

territory and using their connections between Africa and Europe (Bachmann 2018, 53-54).[104] Having memory of its failure to break free from the British submarine cable network, Marconi's purported plan to establish a British network seemed more alarming for Germany, particularly in political and military aspects. Such a fear spurred German's decision to take network balancing measures with "the new technology of wireless to bypass the apparent British stronghold on global communications (Tworek 2016)."

Network Balancing measures

Internal capabilities as a prerequisite

Germany's investment in technical experts in wireless telegraphy started early on. "Adolf K. H. Slaby (1849-1913), encouraged by Kaiser Wilhelm II and with the assistance of Count George Wilhelm Alexander Hans von Arco (1869-1940) (Huurdeman 2003)," developed the Slaby-Arco radio system in 1897. Its official demonstration, attended by Wilhelm II, took place in Berlin over a distance of 1.3 km on August 27, 1897. Production of this radio system started in 1898 in the Radio Telegraphy Department, established by *Slaby-*

[104] The German cables were inevitably dependent on the British line between Africa and Europe which the British had installed decades earlier as a "part of the system that included more than 320,000 km of cable and constitute almost two-thirds of all countries' cable connection (Bachmann 2018, 53-4).

Arco within the *Allgemeine Elektrizitäts-Gesellschaft* (AEG), the General electricity company founded in 1887 by the *Deutsche Edison Gesellschaft*, which was founded in 1883.[105] In the following year, the German physicist Ferdinand Braun (1850-1918) made "an important improvement in wireless telegraphy. Instead of connecting the antenna directly to a spark oscillator, he developed a spark oscillator circuit that was connected to the antenna inductively instead of galvanically (Huurdeman 2003)." Simply put, this increased the range of the transmitter by at least three times over that of the open spark oscillator circuit of Marconi. In 1901, Braun founded an electrical engineering company, *Braun-Siemens-Halske* (Huurdeman 2003, 214-215; Friedewald 2001, 28).

As Germany increasingly felt threatened by Marconi's growing dominance in wireless telegraph, which would be tantamount to Great Britain having a monopoly, Kaiser Wilhelm II provided considerable support to encourage the two rival German firms, the AEG-Slaby-Arco and Braun-Siemens-Halske, to merge their radio departments into a joint subsidiary, *Gesellschaft für drahtlose Telegraphie m.b.H.* (Telefunken) in May 27, 1903 to perform research and developments as well as to manufacture wireless

[105] By 1902, Slaby-Arco system was used to successfully communicate between the American naval Academy and its auxiliary cruiser, *Prairie*, which gave an entire satisfaction to the naval experts (NYT, *Wireless Telegraph Tests* 1902.)

devices and erect wireless towers (Huurdeman 2003; Mueller and Tworek 2015; Tworek 2019).[106] Telefunken was specifically arranged to concentrate on the solution of technical problems and the professional invention of components for wireless telegraphy by its parent companies (Friedewald 2000). The German government gave it every sort of encouragement from subsidies and military orders to patent protection (Hearings 1908; Aitken 1985, 234; Headrick 1991, 123). In the early years of its existence, almost seventy to eighty percent of Telefunken's revenue came from government contracts, among which "the navy was particularly vital, outfitting all ninety of its warships with Telefunken wireless receivers in 1909," making Telefunken the most crucial driver of innovation in German wireless technology before 1918 (Mueller and Tworek 2015; Friedewald 2000, 459). So, as a typical German quasi-monopoly of the period, backed by an efficient higher education system that was particularly strong in science and engineering (Naude and Nagler 2017) and having the Imperial German Army as a major client with practically all rivalry ceased to have all interests amalgamated into the company (Preece 1905), Telefunken prospered, becoming "the main driving force in the development of wireless technology in Germany (Friedewald 2000, 459)."[107] Tworek (2000, 184) noted that

[106] The official name of the new company was Gesellschaft für drahtlose Telegraphie M.b.H. Berlin, but it quickly became better known as Telefunken, which translates into 'the Company for Wireless Telegraphy' (Aitken 1985).

[107] The nineteenth century saw a remarkable rise of poly-technical and

government contracts counted up to seventy to eighty percent of the company's revenue in the early years. In addition to that, Berlin also intensified German industrial policy to contest the British standard and pursued protectionism by banning the Marconi systems while ordering German stations to use only the Telefunken system (Headrick 1991). In fact, these kinds of support from the government were indispensable to constructing transnational wireless stations as it costs a huge amount of installation expenses.[108] According to Frederick M. Sammis, Marconi's Chief Engineer in America,

> "[these transnational stations cover] tracts of land over a mile on length upon which are erected a large number of huge steel masts which, in some instances, are 400 ft. high. The masts support a network of copper wires. These wires perform a dual function. When they are connected with the transmitting apparatus or spark gap they shake, with a mighty electrical force, the ether surrounding them and cause electromagnetic waves to become detached and travel away into space. When connected to the receiving apparatus they become the ear

technical universities in Germany, where engineering and applied sciences were paramount. And the scientific breakthroughs at these universities were quickly taken up and applied for commercial purposes by German entrepreneurs (Naude and Nagler 2017, 2021).

[108] Although some would argue that the installation costs were much lower than those of submarine cables, that only applies to the stations located on their own territory; transnational wireless stations required a huge amount of expenses (Friedewald 2000, 456; Hearings 1908; Sammis 1912).

> instead of the voice of the system and collect the vibrations that have been hurled into space at lightning speed by the distant station and lead them down to the sensitive receiving apparatus which corresponds to the drum of the human ear (Sammis 1912)."

In addition to constructing stations, a huge quantity of material including masts, engines, and apparatus, as well as experienced operators also had to be prepared for each station which cost around $300,000 (Sammis 1912; Headrick 1991, 5),[109] not to mention the considerable expenses needed in carrying out the experiments (Telefunken-Zeitung, *Radio Telegraphic World Project*, 134). By 1905 Telefunken completed installations in thirteen countries—Argentina, Austria-Hungary, Denmark, Sweden, Norway, Holland, Russia, Spain, Portugal, Turkey, Mexico, Siam, and Tonking (Preece 1905), and the number increased to thirty-nine countries by the start of the First World War (Born 2016). With the founding of Telefunken on June 15, 1903, Germany was able to take on a full-fledged effort to advance its technological capability. Telefunken began building a giant station at Nauen, only 40 km west of Berlin, in 1906 as an attempt to overcome its weak position in the field of long-distance radiotelegraphy and directly

[109] The amount of cost appears to have varied rather greatly depending on the distance between the stations. In 1908, at the hearings before the U.S. Senate, John W. Griggs, representing Marconi Company, claimed that the cost of an average coastal station varied from $5,000 to $150,000 depending on the distances (Hearings 1908, 59).

"communicate both with Togo, a German colony in Africa, and with the United States (Tworek 2019)." (Headrick 1991, 123-129; Solymar 2021). Germany was, in fact, in a weak position in terms of long-distance radiotelegraphy with its nearest colony located five thousand kilometers away from the mainland, in Togo, West Africa, and its other colonial possessions located on the other side of the globe, in Asia and the Pacific (Headrick 1991, 129). Due to the vulnerability of its overseas cable connections to both its African colonies and the U.S. against British interference in the event of war, it was more than important for Germany to successfully build its own long-distance station. Therefore, when Nauen station was built as "a German high-power long-distance station, [it] became a concrete sign of German determination and Telefunken power (Raboy 2016, chap. 20)." The German government spent considerable expenses to carry out systematic range tests between Nauen and Togo (5,500km) in order to establish direct radio telegraphic traffic with its colonies in West Africa (Telefunken-Zeitung, *Radio Telegraphic World Project*, 134 as cited in Born 2016). In 1909, Telefunken also "produced an innovation called the quenched spark system which reduced atmospheric disturbances and enabled communications across thousands of kilometers (Tworek 2019)." By making the tone of frequency clearly discernible from cracking noises of atmospheric disturbances, the new quenched spark system avoided the loss of energy and doubled the efficiency of the transmitter by increasing the amount of power the antennas could

transmit which led the military users to abandon the Morse writer and turn to audio reception (Hugill 1999, 89-90; Friedewald 2000), which allowed "Telefunken to expand wireless to commercial and fishing vessels (Tworek 2019)." Compared to the spark transmitters that were used until then, which were extremely loud due to the strongly damped waves they produced, "the new Telefunken transmitter produced a decent tone between 500 and 2000 Hz (Huurdeman 2003, 271-2)." This technological improvement, together with its extremely sound engineering and politically guaranteed sales, ensured Telefunken's ability to survive in a market otherwise would have been dominated by Marconi (Hugill 1999, 90).

When a new technology, the continuous wave, was invented in the following year, it permitted Telefunken to erect antennas covering as much as two square kilometers at Nauen in 1911-1912 and to install a 100-kilowatt von Arco alternator, soon replaced by a 200-kilowatt, allowing the Nauen Transmitter Station, with it 812.5 ft in height, to become the most powerful station in the world (Headrick 1991, 129-130). The reconstruction of the station allowed "communication between Germany and the United States … to be one of the earliest achievements possible with the new station (NYT, *Highest Wireless Station*, 1912)." The station was able "to send messages a distance of between 3,125 and 3,750 miles," allowing the Germans to communicate with the U.S. at any time (NYT, *Germany Joined by Wireless*

to U.S., 1912). It also succeeded in transmitting single characters to a provisional station in Togo, West Africa (Friedewald 2000). As it became possible for Germany to bridge the distance of 3,500 miles to the African colonies, the Germans began building stations for long-distance signaling throughout their colonies in Africa (Bigelow 1951; Roscher 1920 as cited in Friedewald 2000). By the outbreak of the first World War, Germany was in direct communication with America and Africa with functioning wireless towers erected in all Germany's major African colonies along with Qingdao and several Pacific islands as well as "two towers on the East Coast of the U.S. at Sayville and Tuckerton (Tworek 2019)." (Headrick 1991, 130; Tworek 2016, 2019). The wireless station with three 180 ft towers in Sayville on Long Island represented the latest word in high-power wireless telegraphy and it was built and equipped entirely under the Telefunken system, owned and controlled by the Atlantic Communication Company, the American operating subsidiary of Telefunken (Preece 1905; NYT, *The Sayville Wireless Station*, 1912). An article in the *New York Times* also noted Telefunken's work of establishing wireless communication between Lima and Para, describing the work as "the most noteworthy overland achievement of wireless, the distance being 3,400 km over the primeval forest and the Andes, which are there 6,000m high (NYT, *Wireless over the Andes,* 1912)." Likewise, fears about a British-subsidized and Marconi-constructed wireless chain had spurred rapid construction of wireless towers which seemed to have secured German

colonial communications from British interference (Tworek 2016, 185-6). As it can be seen in the Table 5.1, the difference between Marconi and Telefunken in the market share of naval station reduced to only 6 percent by 1914 from over 50 percent in 1909.

Table 5.1. Market Share of the Main Suppliers of Naval Stations, 1909-1914

Year	**Marconi**		**Telefunken**		Others		Total
	Number	Share	Number	Share	Number	Share	
1909	161	67%	24	10%	55	23%	240
1910	203	63%	53	16%	66	20%	320
1912	900	37%	798	33%	752	32%	2450
1913	1047	37%	871	31%	879	31%	2797
1914	1521	39%	1281	33%	1100	28%	3902

Sources: taken from Thurn, 1910a, 1910b, 1912; Roscher 1913a in Friedwald 2000, 451.

Network balancing attempts

While Germany took an early start in preparing itself with sufficient technological capabilities regarding wireless telegraphy, cooperation with other secondary states was indispensable in order to counterbalance Britain's embryonic dominance over the wireless telegraph network. In the same year the Telefunken was established, Kaiser also invited the big powers to the first International Radiotelegraph Conference, held in Berlin on August 4-13,

1903.[110] It was attended by delegates of nine states—Great Britain, Germany, France, Italy, Austria-Hungary, Russia, Spain, and the United States (Baker 2002/1970; Burns 2003). Their discussions focused on the German draft protocol[111] which primarily proposed the international acceptance of the principle of free intercommunication that would allow any "radio-telegrams coming from and sent to ships [to] be received and transmitted without regard to the system employed (NYT, *Wireless Telegraph Conference*, 1902)" (Zajacz 2005); that is, as Burns (2003) describes, a ship equipped with German Slaby-Arco set should be able to send messages to, and receive signals from, a Marconi shore station. Although the conference was convened in the name of defending "the great principle of free intercommunication," arguing that unlimited competition is "the surest foundation both for the development of radio-telegraphic traffic all over the world and for the progress of science (Hearings 1908, 153)," it was clear that the proposal was directed at stopping Marconi's rising dominance (Raboy 2016, 226). In the opening speech of the conference, Herr Kraetke, Secretary of State for the Postal Department of Germany, himself clearly stated that the object of their

[110] It was indeed the "first" international conference for states to gather and discuss on the radiotelegraphy, but the conference is referred to as "preliminary" conference as it was "not an official Union conference, but rather a preparatory conference" convened by delegates from nine states "to establish a general basis for wireless telegraphy regulations (ITU, *History of ITU*)." Here, the 1903 conference will be referred to as both 'the first' and 'preliminary' conference interchangeably.

[111] See "Suggestions submitted by the German government for discussion" in ITU Archive, *The Preliminary Conference on Wireless Telegraphy 1903*, 1-2.

suggestions is “to prevent the creation of a monopoly in favor of a single system, and … to avoid disturbances of the different systems between themselves,” and he mentions Marconi’s contract with the Lloyds as an example of “a provision [that] limits in a material degree the utility of radiographic telegraphy” (Proceedings in ITU Archive, *The Preliminary Conference on Wireless Telegraphy*, 7).

Although Germany’s proposal appeared reasonable and fair to other states, it was commercially inequitable to Marconi Company as the company had to bear the burden and great costs of setting up the network of coastal stations (Burns 2003; Hearings 1908, 57). Therefore, allowing participation in their ship-to-shore service was “to provide rival Companies with shore facilities to the upkeep of which they did not contribute (Baker 2002/1970, 95)” without any adequate means of compensation for such service. Such concern and discontent are well illustrated in the statement of John W. Griggs, representing the Marconi Company, at the hearings before the Committee on Foreign Relations, U.S. Senate on January 15, 1908:

> “Our objection amounts to this: We have our own shore stations, [but] no other company has any. We built them, we established them. We invented the apparatus to put in, and we have our companies operating them. Now having all this, the theory of this treaty is that anybody who sails the ocean with

> any kind of apparatus, without any arrangement with us, can make use of our stations to do their business. Any vessel having a wireless apparatus on board, and having a passenger who wants to send a message, under this treaty, they can call up our land station and require us to do their business. In other words, they can make use of the necessary part of our system to carry on their business (Hearings 1908, 53)."

The Marconi Company responded with a press campaign depicting the conference as an attack by Germany on a British industry (Hearings 1908, 67; Raboy 2016). Marconi further claimed that "the technical specifications of his company's products prevented "intercommunication" between his equipment and that of rival companies (Raboy 2016, chap. 10)." All the participants, with the exception of Britain and Italy, favored "free competition based on the regulated obligation for all systems to communicate with one another (Raboy 2016)" and signed a protocol that endorsed the principle of free intercommunication (Douglas 1989, 122; Zajacz 2005).[112] The second paragraph in Article 1 of the final protocol specifically provides that "[c]oast stations are bound to receive and transmit telegrams originating from or destined for ships at sea without distinction as to the systems of wireless

[112] Both the British and the Italian delegation voiced reservations regarding Article I para. 2 of the final protocol; a British delegate Mr. Lamb explained that "it would be difficult for the British delegation to adhere to Article 1, without at the same time protecting the interests of the companies." By "companies," he meant Marconi Company (*[Documents of the] Preliminary Conference on Wireless Telegraphy* 1904, 16*;* Raboy 2016)."

telegraphy used by the latter (ITU, *[Documents of the] Preliminary Conference on Wireless Telegraphy* 1904, 57)." However, in the end, the participants decided that the technology was too new to be regulated, and the conference only settled on passing resolutions, not a draft treaty, which remained unofficial and was never strictly enforced;[113] the delegates agreed nothing except to ask their governments to examine these matters and, of course, it was simply ignored by Britain and Marconi (Manton 1930; Tomlinson 1938, 14-17 and Tribolet, 1929 as cited in Headrick 1991; Raboy 2016; Solymar 2021).[114] However, it was still troublesome for Marconi and a setback to his company in that the world's most leading powers "were in [an] agreement that wireless communication should not be left in the hands

[113] In a report written by the U.S. representatives after the preliminary conference, it is stated that it was "considered that the incomplete condition of wireless telegraphy demanded, for its proper development and utilization, free competition between the various systems, and that the full interchange of messages was in the interest of the general public (Hearings 1908, 112)."

[114] The British "viewed the Berlin conference as being intentionally designed more to advance the interests of the flagship of German wireless, Telefunken, than to secure a global public good (Winseck and Pike 2007)." At the hearings before U.S. Congress in 1908 after the second conference, John W. Griggs asserted that "the entire underlying motive of this movement for international regulation is a desire on the part of the German manufacturers of apparatus for equipping vessels which we claim is an infringement on the Marconi patents, a desire on their part to allow that kind of piratical apparatus to have the benefit of the established system which the Marconi company has effected and sustained and carried on at large expense for the development of their patents (Hearings 1908, 52)." The Italians also made specific reservations on the basis that they "could not make technical radio information public on account of their obligations to Marconi nor could they control stations in their territory operated by private enterprise unless they could induce Marconi to modify the agreements he held (Manton 1930, 350)" (ITU, Documents of the Preliminary Conference 1904).

of a single privately-owned company (Raboy 2016)" and that it should be obligatory for all coastal wireless stations to transmit and receive telegrams to and from all shipping (Baker 2002, 96; Raboy 2016, chap.11). Nevertheless, the outcome of the preliminary conference did not have a significant impact on the orders of Marconi equipment which had continued to come in (Baker 2002, 98-99).

In October 1906, Germany called the second International Radiotelegraph Conference at Berlin with the same agenda as the first; the focal point of discussions was the principle of free intercommunication. It was attended by representatives of thirty countries—Argentina, Austria-Hungary, Belgium, Brazil, Bulgaria, Chile, Denmark, Egypt, France, Germany, Greece, Great Britain, Italy, Japan, Mexico, Monaco, Montenegro, the Netherlands, Norway, Persia, Portugal, Romania, Russia, Siam, Spain, Sweden, the United States, Turkey and Uruguay (ITU 1906). Again, the British and the Italian delegations made reservations on the principle of free intercommunication while it was strongly advocated and defended by Germany and the U.S. (Hearings 1908, 153-4). Delegations from Great Britain and Italy were both in sympathy with the broad proposition itself,[115]

[115] The Italian delegation, despite opposing to the requirement of compulsory intercommunication, nevertheless acknowledged the justness of the principle by stating that they recognize "the importance to international relations of the principle of free radiotelegraph intercommunication between different systems of radiotelegraphy (Hearings 1908, 117)."

but nevertheless opposed to the enforcement of a full interchange of messages for their own reasons. The United States, however, was strongly on board in supporting the proposals made by Germany in 1903 (the 1903 Berlin Proposal) in regards to the unrestricted interchange of communication between all stations. John W. Griggs, the spokesman of Marconi Company, at the Hearings, confirmed that Germany and the U.S. "were the two imperial forces that were behind" the treaty (Hearings 1908, 56). In fact, the U.S. was already giving them pressure on the ground by requesting the Marconi company to remove its apparatus from the lightship Nantucket off the coast upon its refusal to accept messages from other companies, after receiving an official German complaint (Raboy 2016, 277; NYT, *Wireless Telegraphy Troubles the Nations*, 1906; Howeth 1963, 79) about the conduct of the Marconi station. In a letter to the American State Department, the German Ambassador in Washington wrote:

> "The efforts of the English Marconi Company to secure for its system of wireless telegraphy a world monopoly becomes apparent, it that signal stations equipped with Marconi apparatus will hold communication with no other vessels than those provided with apparatus of the same system, and the British Lloyd has already subscribed by contract to these conditions for a term of fourteen years. German vessels that have German wireless telegraph systems on board are thus precluded from communication with the English shore stations

> and with the Marconi station placed at the entrance of New York Harbor on the Nantucket Light Vessel. This proceeding of the Marconi Company works most serious injury to the interests of general intercourse as well as to the interests of the German shipping and commerce (NYT, *Wireless Telegraphy Troubles the Nations*, 1906)."

In addition to the complaints from the Germans, there was also an incident that directly affected the Americans which gave the U.S. its own reasons to support the principle of free intercommunication.[116] Admiral Henry M. Manney, one of the delegates to the 1906 conference, cited the incident in explaining how important it is for the U.S. to be a party to the treaty at the hearings before the Committee on Foreign Relations, U.S. Senate, in reference to the "Wireless Treaty":

> "It is important … [b]ecause international questions involving radio-telegraph work in our own possessions may arise, as these stations may affect wireless telegraph stations in adjacent foreign countries. Just before this conference there had happened certain incidents of an extremely unpleasant nature connected with the wireless telegraph systems on this coast … One of the incidents was that of the steamer St. Paul, an

[116] Pleased by such a strong support by the U.S., regardless of their motive, Kaiser Wilhelm II commented to the U.S. Ambassador Charlemagne Tower, at an audience in Potsdam after the final adjournment, that it was the U.S. that had saved the conference from failure and he expressed his appreciation for the efforts of the American delegates to that end (Hearings 1908, 146).

> American vessel on her way to New York. When passing Nantucket, she was asked by the light-ship to communicate to the authorities on shore the fact that she had been damaged and suffered some loss during a gale. The Marconi station on the island of Nantucket immediately interfered and "drummed"[117] to prevent the United States vessel (the light-ship) from communicating with an American merchant vessel. The St. Paul carried a Marconi telegraph apparatus and the lightship carried instruments of another system, for which reason the Marconi shore station would not allow the Government vessel to communicate with the St. Paul. That the Navy Department regarded as an outrage (Hearings 1908, 45)."[118]

Meanwhile, there was another important issue discussed during the conference: the allocation of the spectrum, which was becoming crowded, especially in Europe. By then, there were so many transmitters operating at once that, despite tuning circuits, they were interfering with one another, and international cooperation was urgently required to prevent chaos in the air. Germany, supported by the US, proposed reserving the longer waves (600-

[117] "Drumming" refers to filling the atmosphere with a series of powerful electrical waves thrown out at short intervals (Hearings 1908, 126), which was often used as a means to interfere with the transmission of signals.

[118] Although John W. Grigg, a representative of the Marconi Company, claimed, in his supplemental brief submitted to the Committee on Foreign Relations, that they could not find any record of the incident and that their operators at all ship and shore stations have strict injunctions not to "drum" under any conditions (Hearings 1908, 72), John I. Waterbury, who has also attended the preliminary conference in 1903 as a U.S. delegate, also confirms on the occurrence of such incident in his memorandum submitted to the U.S. Senate (Hearings 1908, 126)

1600m) for government and military uses, relegating companies like Marconi's to the shorter 300-600m waves where long distances were impossible.[119] The requirements of technology and international trade forced compromises on all the participants. Therefore, it turned out, that in exchange for giving up the right of non-intercommunication, the British preserved the longer waves for commercial uses.

Likewise, the participants ultimately reached an agreement to sign the Convention for the Regulation of Wireless Telegraphy on November 3, 1906, to come into force on July 1, 1908, which is stipulated in Article 22 of the Convention (Headrick 1991, chap.7). The provisions for compulsory intercommunication were Article 3 of the Convention and the first article in the Supplementary Agreement attached to the Convention. Article 3 of the Convention provides that "[t]he coastal stations and the stations on shipboard shall be bound to exchange radiograms without distinction of the radio system adopted by such stations (ITU, *The International Radiotelegraph Convention 1906*)." Article 1 in the Supplementary Agreement, the equally distinct enunciation and concurrence in the principle of obligatory intercommunication between stations on ships at sea (Hearings 1908, 145)

[119] Refer to Article 2 and 3 in Service Regulations Affixed to the International Radiotelegraph Convention (ITU Archive, *The Radiotelegraph Convention 1906*).

provides that “[e]ach station on shipboard referred to in Article 1 of the Convention shall be bound to correspond with any other station on shipboard without distinction of the wireless telegraph system adopted by such stations respectively.” In other words, by these provisions, coastal "stations and ship stations were bound to exchange wireless telegrams reciprocally regardless of the system used to transmit them in each station (Burns 2003, 357-8). The convention thereby provided for full intercommunication between all wireless stations, whether onshore or shipboard, irrespective of the systems in use (Hearings 1908, 127). What should be noted is that while the Convention was signed by the representatives of twenty-seven states, the Supplementary Agreement was signed by only twenty-one with the refusal of Great Britain and its ally Japan, Italy, Mexico, Persia, and Portugal (Manton 1930, 351; Hearings 1908, 145). Among these five states, Britain and Italy were both strongly committed to Marconi contracts which compelled them not to sign the ship-to-ship agreement. When the conference ended with the resulting Convention as a whole signed by the majority of participants, Marconi vehemently raised objections against compulsory intercommunication, arguing that the convention “is unlawful and unconstitutional” (Hearings 1908, 50-75). “Marconi had used contracts and patents to establish a monopolistic position in Italy and Britain (and the British Dominions like Canada and Australia), but the rest of the world was wide open (Raboy 2016 chap.15).”

While Marconi vehemently opposed the convention, especially in regards to the mandatory provisions of articles 3 and 14,[120] Raboy claims that Marconi in fact had already started to think about making a deal with Telefunken even before the convention came into force, pointing to the fact that various schemes and discussions related to dealing with its German rival "scattered throughout the company archives between 1908 and 1910 (Raboy 2016, 342)." In January 1911, there was the announcement of the establishment of a new firm jointly owned by Marconi's Brussels-based subsidiary, *la Compagnie de telegraphie sans fil*, and Telefunken. Marconi and von Arco were among the directors of the new company known as *Deutsche Betriebsgesellschaft für drahtlose Telegrafie* (DEBEG) which took over the entire forty-one Telefunken stations on German ships and the thirty-eight Marconi stations (Friedwald 2012). Marconi and its Belgian subsidiary held a forty-five percent interest and Telefunken had the remaining fifty-five percent share in DEBEG. (Friedwald 2000) While the deal was "initially limited to the German mercantile shipping industry, it was the first of a series between Marconi and Telefunken aimed at eliminating direct competition between

[120] It is well presented in the memorandum of objections, written by John W. Griggs, submitted to the committee on foreign relations of the U.S. Senate in regards to the confirmation of the international wireless telegraph (p.61-72) and the supplemental brief submitted after his visit on January 15, 1908 (Hearings 1908).

them (Raboy 2016)" by concluding "a worldwide agreement with the Marconi Company that guaranteed the communication among each other (Friedwlad 2012)." There indeed exist documents showing that Marconi Company continued to be "in active competition with" its German rival, "Telefunken for a contract to supply portable field stations to the Ottoman army as late as May 1911 (Raboy 2016, 329)." A report on comparative experiments shows that after weeks of experiments, the competition ended in favor of Marconi as his system was not only revealed as faster to set up but also had clearer and stronger signals.[121] However, as mentioned earlier, in light of the Berlin proposals, Marconi, in fact, shifted its position and ceased to insist on a technical assertion against inter-communication between equipment based on different systems.[122]

The issue was officially resolved at the third conference, held in London on June 4, 1912, in the wake of the Titanic disaster which brought attention to the absolute necessity of intercommunication for marine safety, allowing the conference far less controversial than its predecessor (Tworek 2019, 50; Solymar 2021). The main agenda was to update the 1906

[121] As noted by Raboy, the "summary of a report regarding comparative experiments executed between Marconi and Telefunken Transportable Stations (as cited in Raboy 2016, 329)."

[122] As Winseck and Pike (2007) noted, Hugh Aitken (1984a) provides a detailed description on "the overall corporate strategy behind the Marconi rise to preeminence."

Convention by formalizing the practicalities of intercommunication through mandating that "all ships with over fifty passengers install wireless receivers (Tworek 2019)" with all ships "legally obliged to be able to communicate with each other regardless of their apparatuses (Tworek 2019, 50)." Article 3 of the Convention was updated as:

> "Coast stations and ship stations are bound to exchange radio-telegrams reciprocally without distinction as to the radiotelegraph system adopted by such stations. Each ship station is bound to exchange radiotelegrams with any other ship station without distinction as to the radiotelegraph system adopted by such stations. Nevertheless, in order not to impede scientific progress, the provisions of the present article do not prevent the contingent employment of a radiotelegraph system incapable of communicating with other systems, provided that such incapacity be due to the specific nature of such system and that it be not the effect of devices adopted solely with the object of preventing intercommunication (ITU, *Final Protocol of International Radiotelegraph Convention*, *1912*)."[123]

In light of the Titanic disaster, the British, and also Italy and Japan, accepted the decision which had not hitherto been accepted by these countries (NYT, *Titanic compels wireless action*, 1912). Although Marconi had already

[123] The Radiograph Convention in 1912 is described as "an absolute recognition of the principle of freedom of intercommunication (ITU, International Radiotelegraph Conference, 1912)."

accepted the intercommunication, now it has become official; the convention was an “absolute recognition of the principle of freedom of intercommunication.” (ITU, *The International Radiotelegraph Convention 1912*; Raboy 2016, 363-364). By November 1912, four months after the conference, the two companies, Marconi and Telefunken, were also able to announce “the withdrawal of all pending patent proceedings, effectively burying their ongoing disputes. In countries where there were still other competitors, like the United States and France, they agreed to work together to respect their patents (Raboy 2016).” The agreement basically divided the world between the two great powers—"Marconi reserved the United Kingdom and Italy, and Telefunken kept Germany and Austria-Hungary (Raboy 2016)” based on a consensus that “there would be no competition in those countries. The companies agreed to disagree in the United States and France; in those major markets, they would continue to compete, primarily with the strong US and French national champions (Headrick 1988, 128; Raboy 2016, 342-343).” As the cable expert Richard Hennig had predicted in 1912, Germany, by the time the war broke out, had “every right to say that the British cable monopoly is not a thing of the past (as cited in Headrick 1991, 130).”

3. Findings and Analysis

Network balancing succeeded

When Marconi presented embryonic dominance over the wireless telegraph network, three factors were combined to let that happen: its institution of leasing arrangement, its non-intercommunication policy, and its contract with the leading maritime insurance company, the Lloyd's. If instituting the first two policies allowed Marconi to have full control of those using his equipment by locking them into its network, signing a contract with Lloyd's was the cornerstone of its expansion. Including its distinctive policies within the contract, provided Marconi with an exclusive privilege to have the power to coerce any major shipping line that wish to utilize Lloyd's network to not only equip its vessels with Marconi apparatus but also agree with Marconi's term that strictly prohibited any communication with non-Marconi apparatus. Considering the fact that it had nothing to do with technical compatibility, the prohibition was purely for economic and strategic reasons. The British-based Marconi Company's lead definitely made Germany nervous, especially because Kaiser Wilhelm II as well as his key military officials were well aware of the threat they would encounter if they were to let the British lead the telecommunication network. Having to depend on British cable for their connection between Africa and Europe during the Herero uprising conjured

up Germany's bad memory of relying on the British submarine cable network, which stimulated the Germans to swiftly connect its colonies to one another. Given that the British controlled 56 percent of the world's total submarine cable and that the Royal Navy "ruled the waves (Solymar 2021, 82)" by 1908, the growth and development of wireless were vital for Germany as it would provide an invaluable means of communication with its colonies, especially in times of conflict (Baker 2002/1970, 94 as cited in Hall 2012). In this respect, Germany moved quickly to prepare itself to take network balancing measures against the wireless telegraph network led by the British-based Marconi Company.

Germany first invested heavily in technical experts in wireless telegraphy, and Kaiser strongly encouraged the two competing national companies to merge and create a joint company, Telefunken, solely for the purpose of wireless telegraphy. As Telefunken prospered based on all sorts of support from the government, it produced an innovation of quenched spark system which enhanced the quality of wireless signals and also established the world's most powerful station, Nauen, which opened direct communication with North America and Africa. However, having a strong technological capability alone could not dislodge Marconi from its dominating position; cooperation with other secondary states was indispensable. In order to decouple itself from the pre-existing network by

carrying out network balancing against the British network, however, Germany first had to constrain the British-based Marconi network from further expansion. To accomplish such a goal, Kaiser utilized multilateral settings to muster support from secondary states. At the first and second International Radiotelegraph Conferences, held in 1903 and 1906 respectively, the German government proposed for the free intercommunication regardless of the system employed which was directly aimed at stopping Marconi's further dominance. While Britain and Italy remained in opposition to such a proposal presented by Germany by refusing to sign the final protocol of the preliminary conference in 1903 that endorsed the principle of free intercommunication, all states including Britain and Italy were eventually able to draft an official treaty for free marine intercommunication by the second conference, effectively constraining Marconi's burgeoning power in the wireless telegraph network. Table 5.2. summarizes the key outcomes of the two conferences held in Berlin. In light of the Berlin proposals, Marconi shifted its position and ceased to insist on its policy of non-intercommunication among the participants of its network. By formalizing the practical realities of "intercommunication" at the third conference held in June 1912, the issue was officially resolved. Moreover, "the formation of a new company, [DEBEG,] jointly owned by Marconi's subsidiary (Raboy 2016)" and Telefunken established an effective Anglo-German duopoly.

Table 5.2. Germany's network balancing attempts against the British Wireless Telegraph Network: The two international conferences convened by Germany

Conference	Countries participated	Key elements of the conference
Preliminary Conference on Wireless Telegraphy (1903)	Austria-Hungary, France, Germany, Italy, Russia, the United States (9)	The Final Protocol ◦ Discussions based on the German suggestions ◦ The protocol was endorsed by All, *except for Britain and Italy* ◦ Main agenda: the principle of free intercommunication ◦ Relevant provisions: – Article 1, para. 2 of the Protocol (ship-to-shore intercommunication) – Article 2 of the Protocol
International Radiotelegraph Conference (1906)	Argentina, Austria-Hungary, Belgium, Brazil, Bulgaria, Chile, Denmark, Egypt, France, Germany, Greece, Great Britain, Italy, Japan, Mexico, Monaco, Norway, Montenegro, the Netherlands, Persia, Portugal, Romania, Russia, Siam, Spain, Sweden, the United States, Turkey and Uruguay (30)	The first International Radiotelegraph Convention ◦ Signed by 27 countries, *including Great Britain and Italy* ◦ Main agenda: the principle of free intercommunication ◦ The provisions for compulsory intercommunication: – Article 3 of the Convention (ship-to-shore intercommunication) – Article 1 in the Supplementary Agreement of the Convention (ship-to-ship intercommunication)

Sources: Compiled by the author from the document on Hearings before the U.S. Congress, 1908 as well as the official documents of conferences posted on ITU Archives website: *[Documents of] The Preliminary Conference on Wireless Telegraphy* 1903; *The International Radiotelegraph Convention* 1906; and *The International Radiotelegraph Convention* 1912

Likewise, when Germany was once again encountered with British dominance in telecommunication network with wireless telegraphy, as it did with the submarine cable telegraphy, it was in a better position to take network balancing measures against the British for three reasons. First, by the time they faced the embryonic dominance of Great Britain in the wireless telegraph network, Kaiser Wilhelm II and his key officials were well aware of the significance of having control of such a telecommunication network by having learned about its network effect feature upon their sovereignty. Second, the advent of wireless telegraphy itself was an opportunity for Germany to establish its own network before the network effect of the British network could lock in its participating states, which allowed the states to make choices for their own interest without having strong pressure from the British. The four countries—Portugal, Turkey, France, and the Netherlands, that failed to assist Germany's network balancing against the British submarine cable network due to the unavoidable pressure of the British based on their control over the network, all ended up supporting Germany's network balancing by signing the Convention of the second International Radiotelegraph Conference; they were free to choose for their own interests in regards to wireless telegraph network without, or only a little, pressure from the British. Lastly, the reason Germany could grasp the chance given by the advent of wireless telegraphy was that it was equipped with sufficient capabilities. All these factors taken together allowed Germany to decouple itself from the pre-

existing British wireless telegraph network through successful network balancing.

CHAPTER 6. CONCLUSION

The use of the term "information and communication technologies (ICTs)" suggests recent developments in computers, artificial intelligence, and the fifth-generation (5G) technology that allow the connectivity, movement, storage, and analysis of large quantities of data and information. However, the focus of this study was not on the first two decades of the twenty-first century, but rather on the last decades of the nineteenth century onto the early decades of the twentieth century. From the mid-1800s through the early-1900s, a network of submarine cables, and later a network of wireless telegraphy, tied the world together across the ocean through a new means of communication. These nineteenth-century ICTs did not accommodate the storage and analysis of information in the manner of those in the twenty-first century, but they did increase the speed and reach of telegraphic messages to unprecedented degrees. This system brought about extensive changes to the ways in which governments, businesses, media, and societies carried out their routine tasks (Britton 2013), which makes it a crucial element to explore political and economic international relationships in the first period of globalization. Without the international network of telegraph communications, such developments could not have taken place. In this light,

this study examined the ways in which telecommunication technologies, a subset of ICTs, have affected balance-of-power politics in the late nineteenth and early twentieth centuries based on a historical analysis of Anglo-German rivalry over dominance in telecommunication networks.

1. Findings and Evaluation

The analysis began with the first global laying of undersea cables across the Atlantic Ocean in 1858 followed by Great Britain's monopoly, and later dominance, over the submarine cable network, which allowed the British to take privileged leverage over others. Germany, preoccupied with its own internal issues until the early 1870s, was late to come to realize the significance of the telecommunication network undergirded by undersea cables. From the late 1870s, Germany started to take various measures to counterbalance the dominance of the British network by establishing its own network in order to break free from the pre-existing British network which I term 'network balancing.' However, as I have examined in chapter four, every measure taken by Germany was frustrated by the pre-existing British network which led to an eventual failure to fully execute its network balancing measures against Great Britain. When Britain once again started to present its embryonic dominance over an emerging network undergirded a new

technology, the wireless telegraph, the Germans took counterbalancing measures toward the British monopoly, as it did toward Britain's dominance of the submarine cable network, and this time, the Germans were able to fully execute its balancing strategies which eventually succeeded in bypassing the British network and effectively breaking the monopoly through the establishment of Anglo-German duopoly over wireless telegraph network.

The historical analysis of the case has shown how Germany reacted in different ways when dealing with the external threat posed by Britain's dominance over the telecommunication networks. It was puzzling to see how and why the Germans adopted different measures, resulting in different outcomes, to deal with a similar kind of threat posed by practically the same situation in terms of facing British dominance in telecommunication networks. In order to find an explanation for the puzzle, this study introduced a new analytical framework of 'network balancing model' to incorporate the network effect—an intrinsic feature of network technologies—as a key explanatory variable with the three additional factors as intervening causal linkages: learning of the significance of network effect upon sovereignty, the advent of new technology, and internal capabilities. By using the model of network balancing, this study attempted to show that, theoretically and empirically, network-driven technologies affect the balance of power politics in ways that have not been appreciated by the preceding discussions in

international relations scholarship.

The case of the submarine cable network in chapter four shows how the perception of the British threat and the level of network effect generated by the pre-existing network account for Germany's failure in breaking free from the British-led network through network balancing. In the early days of submarine cable telegraphy, it was viewed as a technological miracle that led to the "annihilation of time and space" which enabled sending a message over thousands of kilometers only in a matter of hours (Headrick 1991, 73; Godfrey 2018). As cables reached every continent in just twenty years, telegraphy became not just a miracle but an indispensable necessity of business and governments (Headrick 1991, 46) as the trade and prosperity of the world depended on a constant flow of information and communication across the borders. And Great Britain had been at the center of a global cable network ever since it installed the first transnational subsea cable across the English Channel. In order to open the black box of submarine cable technology, the chapter devoted a large part to providing a detailed examination on how the British had come to dominate the cable network by breaking the technology into its composing parts. As the century reached its last decade with growing international tensions, some of the states participating in the British-led cable network, no matter how much they had benefited from staying within the network, started to realize the magnitude of

political power given to the British by having control of the telecommunication network and the consequential threat upon their sovereignty. The ensuing conflicts in the late nineteenth century proved that the British were not only capable of interfering with communication among states but also were willing to use their control over the telecommunication network whenever its interests were threatened, which stimulated other states to consider creating their own network of telecommunication. The chapter's historical analysis revealed that there were indeed several network balancing attempts made by Germany to counterbalance the British monopoly over the undersea cable network. However, every attempt made by the Germans to find ways to bypass, or to decouple from, the British network was frustrated by the latter's control over the states connected to its network. As I have discussed in chapters two and three, such control originated from the reinforcing effect of the network effect generated by the British network that reached upon the sovereignty of participating states. Having its every effort ultimately thwarted by the British—as shown in the cases of its attempt to bypass the British through the assistance of Portugal, the Ottoman Empire, the Dutch, and France, Germany was left with no other choice but to remain within the British network despite having constraints on its sovereignty.

An ostensibly similar story is told in the beginning part of the subsequent chapter, but with a network undergirded by a different

technology—the wireless telegraphy. The point where the story bifurcates off from the story in the previous chapter on the submarine cable network is when Germany, having learned about the mechanism of the network effect, its significance upon sovereignty, and its self-reinforcing power on the network, did not wait long to take network balancing measures against the embryonic dominance of Britain. When the British, or more precisely the British-based Marconi Company, once again took the lead in expanding its wireless telegraph network, Germany not only moved quickly to enhance its internal capabilities in terms of technology but also cooperated with other secondary states to constrain further expansion of Marconi Company, which was indispensable for creating its own network. The three decisive factors that led to Britain's head start were Marconi Company's institution of a leasing system and the non-intercommunication policy, and, most importantly, its contract with the maritime insurance company, Lloyd's. The reason why the contract played the most crucial part in Marconi's initial dominance is that it served as the very foundation to effectively deter Marconi's potential competitors. The scholars who have emphasized the significance of the contract in terms of Marconi's expansion may have not used the term 'network effect' but some of them appear to have understood its basic mechanism. In explaining how Marconi took the lead in the wireless telegraph network, Hugh G. J. Aitken says, "[i]t was not fear of being sued for patent infringement that deterred the potential competitors but rather the near

impossibility of finding a toehold in the commercial marine radio market [where the British were holding the dominance]. And for this state of affairs, the agreement with Lloyd's was primarily responsible (Aitken 1985, 238)" as the contract made the worldwide network of marine intelligence provided by Lloyds available only to those equipped with Marconi equipment; in other words, the contract generated indirect network effect that reinforced the expansion of Marconi network. Rita Zajacz (2005, 111) noted that the company itself may even have realized in advance that the value of a network increased with every new user connected to it—which is exactly the definition of the network effect. Whether or not the Marconi company had the understanding of such a mechanism, that was the result of the contract with Lloyd's combined with their policies of leasing and non-intercommunication; as Aitken (1985, 239) describes, the more Marconi sets were installed on ships, the less sense it made to buy from another manufacturer (Zajacz 2005). Such a self-perpetuating arrangement lasted until the ratification of the 1906 Convention signed at the second International Radiotelegraph Conference. Determined not to repeat the situation of facing Britain's dominance in another telecommunication network, Germany hastened to take network balancing measures. In order to build its own network, the Germans not only had to increase its technological capabilities but also had to hold back Marconi's rapid and extensive expansion to constrain the British from consolidating the dominance in the wireless telegraph network. By utilizing

multilateral settings, Germany effectively mustered support from other countries in constraining the British-based Marconi's burgeoning power in the global wireless telegraph network which later served as the cornerstone of successfully breaking free from the British network and establishing its own network that expanded large enough to formulate an Anglo-German duopoly.

The reason Germany could take network balancing measures and ultimately succeeded in decoupling from the British network and establishing its own was that the expansion of Marconi was effectively constrained before the British could get their grip on the states connected to Marconi's wireless telegraph network. In other words, despite Britain's initial dominance in the field, the network effect of Marconi's network was not strong enough to generate a lock-in effect among those states connected to the network, leaving them with a possibility to consider other choices. For example, both Portugal and Turkey—the two countries that frustrated Germany's network balancing attempts by hesitating or rejecting the approval of landing rights to their territories under the pressure of the British, supported Germany's proposal of free intercommunication and signed the convention at the second International Radiotelegraph Conference in 1906. France and the Netherlands which eventually failed to assist Germany in establishing an alternative network due to the preponderance of the British network were also able to set

forth their opinion on supporting the German proposal. In particular, the proceedings of 1903 Conference show that the French delegation was, in fact the strongest in opposing the non-intercommunication policy of the British-Marconi Company. Unlike in the case of the submarine cable network, the British had no sufficient leverage over these countries to exert any kind of pressure to coerce them to remain with their network.

Perhaps one might ask if Germany's success in carrying out network balancing against the British wireless telegraph network, as opposed to the submarine cable network, is attributed to the technical difference between the two technologies, which may have caused differences in sunk costs, resulting in different levels of network effect generated by each network. There was definitely a difference between the sunk costs of the submarine cable network and the wireless network in which the latter was clearly lower, particularly in regards to the installation costs,[124] but the expenses necessary to have a transnational wireless connection as a whole were by no means easy to afford,[125] and therefore, once invested, they were sufficient to generate a

[124] According to Frederick M. Sammis, the chief engineer of Marconi Company in America, the cost of a submarine cable to cover a distance of 3,000 miles arranges from $7,000,000 to $10,000,000, while the total cost of a pair of wireless stations to do the same work is but $600,000 (Sammis 1912).

[125] As John W. Griggs, representing the Marconi Company, stated at the Hearings before the U.S. Senate in 1908, De Forest, an American wireless company, could not undertake the establishment of shore stations due to the shortage in the capital (Hearings 1908).

Table 6.1. Germany's network balancing against the British dominance in global telecommunication networks

	Submarine Cable Network	Wireless Telegraph Network
	The British dominance in telecommunication networks	
Perceived Threat	• A series of conflicts involving undersea cables • Britain's network scheme: All-Red Line route • Britain's refusal of landing rights	• Marconi's purported plan: the British wireless telegraph network • The Herero uprising
Learning of Network Effect	• The first transnational telecommunication network • Germany had no preceding experience	• Based on its experience with the British cable network, Germany learned about the mechanism of network effect and its sovereignty implications
Internal Capabilities	• The German cable company, *Felten & Guilleaume* competed with the British cable company - Capable of manufacturing cables at a competitive price - Ownership of, *the Faraday*, a cable-laying ship - Supported by substantial government subsidies	• The German radio system, *Slaby-Arco*, was developed • A German wireless company, *Telefunken*, established with substantial government subsidies to compete against Marconi - An innovation of the quenched spark system - The world's most powerful Nauen station erected for direct communication with Africa and the U.S.
The Level of Network Effect	• The states connected to the British cable network were already locked in by the strong network effect	• The network effect of Marconi's network was yet fully in place that was strong enough to trap those states connected to the network, leaving them with the possibility to consider other choices
Network Balancing Strategy	• Bilateral approach: Requested assistance of secondary states to bypass the British network - Portugal, the Ottoman Empire, the Netherlands, France	• Unilateral approach: Ban on the use of Marconi apparatus in German ships and stations • Multilateral approach: International conferences - 1903 Preliminary radiotelegraph conference - 1906 The first international wireless conference
The outcome of Network Balancing	• *Failed*: By the time Germany ushered in to establish its own cable network, the locked-in participants of the British network were unable to make any other choices but to remain within the existing network.	• *Succeeded*: Further expansion of the British-Marconi wireless telegraph network was constrained by multilateral actions; Germany's network expanded large and strong enough to vie with the British by establishing an effective Anglo-German duopoly.

Note: Shaded cells show the factors that have led to different outcomes of Germany's network balancing against the British dominance in submarine cable network and wireless telegraph network.

lock-in effect—which explains why the governmental investment and subsidies were indispensable to establish a network (Hearings 1908; Sammis 1912; Friedewald 2000, 456). In addition to constructing stations, a huge quantity of material including masts, engines, and apparatus as well as experienced operators had to be prepared for each station which costed around $300,000, according to the chief engineer of Marconi Company, Frederick M. Sammis (Headrick 1991, 5; Sammis 1912). Moreover, while the cost of repairs and upkeep on the cable was much higher than that of the wireless, the actual cost of operation of the wireless system was higher than that of the cable as the system was much more complicated (Sammis 1912). Moreover, as in the case of submarine cables, erecting overseas wireless stations also involved complex political negotiations with foreign countries and their local telegraph companies.

All in all, this single-case study reveals a pattern to a broad range of behavior that is generally consistent with my propositions, and the process tracing exercises of the empirical work show a great deal of support for proposed causal relationships. The theory and historical record together thus provide strong reasons to believe that network-driven technologies play a central role in balance-of-power politics, at least since the late nineteenth century when a series of technological developments started to bring the world together in terms of time and space. The case study has shown that

technology is indeed not simply a given exogenous factor but rather an integral part of international relations.

2. Implications for International Relations Theory

The relationship between technology and international relations has long been discussed as an important source for both power competition and cooperation by both realist and liberal scholars in the IR field. However, this study finds both schools of thought to be inadequate in the way they treat technology as a black box as well as an exogenous factor in the international system. The strategies great powers have pursued in balance-of-power politics have been influenced in crucial ways by technologies, network technologies in particular, since the late nineteenth century, in ways that differ from the discussions of both realists and liberals. Nevertheless, despite inadequacies in the realist and liberal perspectives, they should not simply be discarded as incompatible schools of thought. Realists are right to emphasize the importance of technology as one of the material resources that define power, and liberals are also right to claim that the progress of technology has been an important push for transformations of the international system. Yet neither school of thought has adequately specified the role of technology as a core component of

balance-of-power politics. The theoretical contribution of this study, therefore, lies in that it attempted to do so by providing a conceptual and analytical instrument—the model of network balancing—to bring in 'technology' within the core discussion of IR scholarship. However, it should be noted that while it is crucial, the model introduced by this study is by no means the only way to approach the link between technology and power but rather should be regarded as representing a step towards the building of the link.

This study also pursued and advanced an agenda for which many have called in security studies—a more serious combined use of history and theory (Gaddis 1987, Levy 1988, Nye and Lynn-Jones 1988). This synthesis should entail a strong appreciation of the historiography to make proper use of the historical record in empirically informed theoretical research (Lustick 1996), which is something this study attempted to do. As a result, I devote greater attention than political scientists in security studies typically do to the technology factor that historians, especially communication and technology historians such as Harold A. Innis and Daniel R. Headrick, often emphasize (Levy 1988). The prominent explanations in political science are typically in the realist tradition, which focuses on how security considerations, such as the distribution of military power and perceptions of threats, determine balancing behavior. By contrast, my theory leads to the consideration not just of security motivations but also of how certain technologies and their intrinsic

feature influence states' policies in balance-of-power politics. As Bijker (2006) rightly noted, 'it is important to actively render such influences of technology visible, because the more successful [and complicated] technologies are, the more they get black-boxed and entrenched in society."

3. Implications for the U.S.-China Rivalry over ICT Networks

What does this study of the past say about the future? Will the recent technological competition between the U.S. and China lead to the decoupling of the world? Will the U.S. continue to maintain its dominance over science and technology? These questions are currently the central concerns of scholars and policymakers alike. The United States and China are indeed at an inflection point where the development of new technology will bring a transformative change to the world and both are, therefore, striving to take the lead in defining a new phase of international architecture. The recent conflict "over the role of Chinese tech companies' participation in the rollout of the fifth-generation (5G) mobile infrastructure is only the most visible expression of the rising technology confrontation." The overall development of China's balancing measures and its confrontation with the U.S. presents an

uncanny resemblance to the case of this study: a century-old contest between Great Britain and Germany in the late nineteenth to early twentieth centuries. A brief tracing of the present Sino-American contest over ICTs confirms the network balancing model introduced by this study.

Since the Second World War, global telecommunication, or more broadly ICTs, network has expanded exponentially both in coverage and in bandwidth under the leadership of the United States which has come to generate strong network effect throughout the world (Headrick and Griset 2011). China has in fact strived for decades to create its own ICT network within its borders by denying foreign products and services equal access to its market and pursuing "a policy of technological independence (Lighthizer 2022)" or "internet sovereignty to restrict the free flow of information [from western society] to its citizens (Rudd 2019)." However, beyond its border, it had no other choice but to join the U.S.-led global ICT network ever since its accession to WTO, as it was obligated to harmonize its system with the U.S.-led international network (Hyun 2022). Nevertheless, as technology increasingly became a rallying point for all fields with manufacturing, communication, finance, education, and transportation all ushering in significant changes under the role of technology, China started to realize the importance of having the lead in the technological arena. In fact, China's determination to take network balancing measures started years before the

trade war and the Trump administration's restrictions on Huawei as is shown in the remarks of Xi Jinping in several speeches: it goes back to 2014 when Xi declared that "China must have its own technology," arguing that "the control of core technology by others is our biggest hidden danger" (Xinhua, 2014. 2. 27. as cited in Doshi et al. 2021). By 2016, it was evident that Chinese policymakers had a sufficient understanding of the mechanism of the network effect as there were already related papers being published in public journals. [126] Once China learned about the significance of network technologies upon sovereignty, China systematically took network balancing measures to decouple from the U.S.-led global network. However, as this study suggests, it was not easy for China to break free from the existing network as its network effect was already pervasive among the participants of the network. Then a window of opportunity finally opened for China with the development of 5G technology, a new generation of technology that allowed "its market leaders like Huawei to establish their footholds in the purchasing countries (Bateman 2020)." Based on its internal capabilities it has aggregated for decades, China took aggressive steps to take network balancing measures to build a network of its own to turn against its rival—the U.S. China has not only supported its domestic tech companies with

[126] Qin An, director of the China Institute of Cyberspace Strategy wrote an article on "Awareness, Understanding, and Consensus of a Network Power (as cited on Doshi et al. 2021)."

massive subsidies and preferential loans combined with extensive economic espionage (Allen-Ebrahimian 2020) but also gathered other secondary states through its ambitious Belt and Road Initiative.[127] For example, Huawei, although its initial dominance has been strangled by restrictions in the US and Europe, is still expanding its footprint to build an alternative network of its own in other continents (Farrell and Newman 2020). China have outpaced the U.S. dominance in neither the global ICT network nor the field of 5G technology, but it appears reasonable to say that its network balancing strategy has, at least partially, succeeded in taking a step toward breaking free from the U.S. network.

The United States has indeed enjoyed a significant first-mover advantage in the technology sector for decades and most Americans believed that U.S. leadership in the technological sector is so entrenched that it is unassailable (Allison 2019). However, by waking up to the magnitude of China's rise in the sector and increasingly perceiving the technological interdependence with China as a major threat to U.S. security, prosperity, and values in the last few years (Bateman 2020), especially in the domain of ICTs, the U.S. has been taking provocative measures to constrain further expansion of the Chinese network and frustrate its ambitions. In other words, the U.S. is

[127] The initiative seeks to link economies across Asia, Africa, and parts of Europe to Beijing (Hyun 2022; Johnson and Gramer 2020).

now taking network balancing measures against the Chinese network. Aggressive network balancing against China's progression started in the Trump administration and the Biden administration has been taking a similar path. In addition to amassing significant leverage over China by increasing its internal capabilities, the U.S. had to simultaneously come up with measures to constrain China from further extending its network. As early as May 2021, just four months after Biden's inauguration, the Strategic Competition Act was approved by the Senate which blatantly labeled China as "a strategic 'competitor' in a number of areas including trade, technology, and security," which was followed by ensuing sanctions thereafter. Among the series of restrictions, the most recent measure taken by the U.S. was banning "approvals of new telecommunications equipment from China's Huawei Technologies and ZTE" on national security grounds (Bartz and Alper 2022). Likewise, the Biden Administration has largely "embraced and extended its predecessor's recognition of China as a military and economic threat," which is intricately related to its technological advance (Fried 2022), and is adopting a series of measures including bilateral and multilateral approaches to crack down on the Chinese tech companies.

Although the result of this study does not give answers to the questions asked at the beginning of this section, it nevertheless put forth some implications for the ongoing U.S.-China technological competition. First, as

demonstrated by this study, the ICT network naturally leads to the emergence of positive loops that create increasingly important, highly connected hubs; these hubs have narrowed down to the U.S. and China in the recent decade. And whichever state harnesses the network will have a decisive advantage in maintaining control for many years which naturally leads to perpetuating asymmetric interdependence among the participants of the network. Considering the fact that having China's CCP dictate the terms is in no one's interest but a few authoritarian states as the CCP does not hesitate to use the ICTs as a tool for their autocratic control, it is important for democratic states to concentrate their efforts to forestall China's further breakthroughs. And this leads to the second implication of this study: it is important for democratic states to act in concert to bolster or extend their network as well as to constrain further expansion of the Chinese network before it is too late. The case study of Anglo-German rivalry over telecommunication networks in the late nineteenth century showed that the decisive network balancing measure taken by Germany to constrain Britain's embryonic dominance was by utilizing multilateral settings to muster support from other countries thereby preventing others from locking into the British network. However, democratic states have yet to act in concert and still remain relatively uncoordinated and reactive despite the fact that the U.S. has been rallying its allies and partners. Unilateral and bilateral restrictive measures by themselves may frustrate Chinese dominance in the short run but they are not sufficient to ensure the

technological preeminence of the U.S.-led democratic network over the long haul, especially in the midst of the extraordinarily complex process of 'decoupling,' between the U.S. and China.[128] Lastly, broad categories like AI and Big Data are too generic to meaningfully assess for security impact of the ICT network. As the ICT system becomes complex and develops faster than ever, it is necessary to break these broad categories into more specific parts of each technology.

4. Closing Thoughts

The starting point of this study was to observe the link between technology and international relations. Based on a case analysis of the very first occurrence of network effect taking place among the states connected within transnational telecommunication networks and the consequent great power rivalry over the dominance of those networks in the first period of globalization, this study took a heuristic approach to show the link between network technology and the balancing strategies taken by great powers. Such

[128] Here, 'decoupling' refers to the weaker form of definition: the kind of marginal reduction of technological interdependence (Bateman 2020). The stronger form would entail a total technological segregation between the U.S. and China which is nearly impossible considering the fact that they are both inextricably enmeshed with each other.

an approach is meaningful in itself, especially considering the fact that technology has received scant attention within the field of international relations despite its crucial role in reconfiguring "the entirety of global politics" since the nineteenth century (Buzan and Lawson 2015). By providing an instrument—the network balancing model—necessary to bring technology into the IR discourse and applying the model to the case, this study has not only illuminated an important yet under-researched aspect of Anglo-German rivalry in the first period of globalization but also allows for a better understanding of significant events happening today in international relations. In other words, by showing the significance of the link between network technology and states' balancing behavior, the findings have both theoretical and practical significance.

Despite its contributions, this study comes with a number of limitations that are expected to be complemented by further studies. The most conspicuous limitation of this study lies in its insufficient access to primary sources, especially the German sources. Considering the fact that the case study put more focus on the German side of the story, more access to German documents could have enriched the analysis. While the English-written secondary sources provided by German-speaking scholars such as Michael Friedwald and Heidi Tworek have offered inside stories of Germany that were meaningful for the study, there is no doubt that direct access to primary

German sources would add more details on every step of the network balancing process taken by Berlin. In addition to the need for more primary sources, the arguments here could be also complemented by adding the French side of the story. In fact, France was one of the key countries that actively took part in laying undersea cables in the late nineteenth century. However, when wireless telegraphy emerged, they supported Germany in constraining further expansion of the British network yet did not attempt to establish its own network as Germany did. Therefore, a comparison of the case of Germany's network balancing against the British with the French case would provide a fuller picture for further development of this study.

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Abstract (Korean)

“네트워크 균형” 전략을 통한 국가 간 디커플링:
전기통신네트워크를 둘러싼 영국과 독일 간 경쟁, 1858-1912

그동안 과학기술의 발전은 국제체제의 중요한 변화마다 크게 기여해왔다. 과학기술 분야에서의 우열은 한 국가의 성장과 국제체제 내 위상을 결정하는 주요 요인으로, 국제정치의 주요 개념이라 할 수 있는 권력(power)과 안보(security)에 밀접하게 연계되어 작용해왔다. 그 중에서도 국가 간 연결성에 깊이 관여하는 기술일수록 국제정치적으로 전략적 가치가 크기 때문에 이를 주도하고자 하는 강대국간 경쟁이 심화되는 경향이 있는데 정보통신기술 분야가 대표적이라고 할 수 있다. 따라서 국제정치학계에서도 해당기술의 권력의 도구로서의 중요성이 중점적으로 논의되어왔고, 특히 첨단 과학기술의 발전과 최근 미중간 기술패권경쟁의 격화로 인해 이에 대한 관심이 증대되고 있다. 그럼에도 불구하고 그동안 국제정치학에서 정보통신기술은 주로 외재적인 요인으로 간주되어 도구적인 시각에서 논의되어 왔으며, 이를 국제정치의 주요 변수로 다룬 연구는 많지 않았다. 이에 본 연구는 국제정치에서 단순히 권력의 구성요소로 기술에 접근하는 시각에서 나아가, 국제정치에 직접적인 영향력을 미치는 주요 변수로서의 기술에 주목한다.

본 연구는 네트워크 기술이 국가 간 관계와 국가의 외교정책에 영향을 미치기 시작한 첫번째 시기인 19세기 후반과 20세기 초 통신기술 (해저케이블과 무선전신) 네트워크 구축 및 독점을 둘러싼 영국과 독일 간의 경쟁구도에 대한 사례연구를 진행한다. 이 시기 영국과 독일의 경쟁구도에 대한 기존의 논의는 기술을 주요 요소로 고려하는 접근이 결여되어 있었기 때문에 그 설명에 한계를 노정하고 있다. 따라서 본 연구는 국제정치학의 주요이론인 세

력균형이론을 토대로 네트워크 기술의 내재적인 특성인 네트워크 효과를 주요 설명변수로 도입하여 새로운 분석틀인 '네트워크 균형' 모델을 제시하고 이를 해당사례 분석에 도입하였다. 이를 통해 네트워크 효과가 내재된 기술이 갖는 국제정치적 중요성을 강조하고, 해당기술로 형성된 네트워크 내에서 국가간 네트워크 효과가 발생했을 때 초래되는 지속적인 비대칭적 관계형성 및 주권 제약과 이에 대처하기 위한 국가전략에 대한 설명을 제시한다.

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주요어: 네트워크 균형(Network balancing), 세력균형, 전기통신기술, 영독관계, 해저케이블, 무선전신

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