Cold War Engineering:
Technical Infrastructure, Noise, and Geography in Radio Free Europe's Operation in the 1950s and the 1960s

By

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Abstract

The thesis focuses on the archives of the Engineering department at Radio Free Europe in the 1950s and the 1960s. The text explores the political nature of technical issues outlining specific technological policies and political terms embedded in the radio operation. Using as a departure point some main aspects from the paradigm of Science and Technology Studies, the text highlights key non-living objects, communication links, and external institutions, which shaped the radio's technical infrastructure described, throughout the Cold War, with the self-evident term "network." The text concentrates on noise as an object of scientific research and technical work which led to the development of a peculiar political mode of hearing and mobilization of computer analysis of data for the purposes of the Cold War. Registering concrete places, which acquired specific significance in engineers' everyday practice, the thesis traces the emergence of a technical geography in which geographical places became politically important because of their role in the radio operation.

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Introduction

LOCATION	Office of Director Engineering & Services Station Operations	MONTH	September 1966

RECEIVING STATIONS SCHLEISSHEIM AND MOOSBURG

2. Maintenance and Projects

h) Proposals were made to install power-factor correcting capacitors in the main powerline circuits to provide a substantial improvement in the power utilization at the Schleissheim plant.

i) The General Engineering section has started work to complete the installation of the four new Beverage antennas that were started last winter. Trenching work for the installation of gas-coaxial transmission line is in progress.

BIBLIS

1. Transmitters

Routine maintenance on all transmitters.

Work has begun on building a perforated enclosure for the tuning coils on top of Biblis 2.

2. Antennas

Routine inspection of all antennas, diplexers and transmission lines.

Corona trouble was experienced in the tuning box for antenna C1. Since the installation of corona rings on the vacuum capacitors there has been no further trouble.

NOTE: ALL MAJOR OPERATIONAL PROBLEMS ARE TO BE REPORTED ON THIS SHEET. SUCH AS CONSTRUCTION PROGRESS, MAJOR EQUIPMENT FAILURE, SPECIAL ITEMS, ETC.

"ETC." The last word precisely is the main problem of this history study. In the bottom of the sheet, this banal abbreviation was written casually, but copied on each page of Radio Free Europe's monthly technical reports. This "et cetera" both obscures and concentrates in itself billions of technical details which occurred in the process of propaganda transmission behind the Iron Curtain.

The monthly technical reports are documents stored in the archives of the Engineering and Services Department at Radio Free Europe. All routine problems and technical innovations are preserved on these pages. In the 1950s, they were short summaries of non-routine operations. Ten years later, the reports became more complex and standardized, including more routine processes and new "projects", as seen above.

In the technical reports we can observe many "events" hidden between phrases such as "routine maintenance". Gradually, this technical data merged into a system of knowledge that not just the engineers, but, to a certain extent, other members of the radio team share because all of them worked at a working propaganda machine. Another issue is that the entire machinery comprised many specific actions that only the technical experts were able to recognize, describe, and, eventually, master.

One of the most difficult tasks in Cold War historiography is to reach things that, among the participants, were considered clear and banal; objects that were briefly mentioned or concealed. The Cold War is a peculiar historiographical field. Although many of the documents from that time were stamped "top secret", yet tons of resources are available to researchers. We have boundless opportunities even to interview key participants in historic events before 1989. We can identify numerous important persons who can tell us their stories on everyday life, spaces of resistance, the vices of power...

But we have a sea of information on the conflict between the two superpowers. And here lies the biggest problem. All narratives from that period accumulate a shared space of

knowledge that, throughout the Cold War and beyond, established areas of common understanding which we approach without questions, as if we deal with solid historical facts. There is hardly a better example than Radio Free Europe (RFE). It is a commonplace that the radio was a key player in the propaganda war that constantly transmitted messages from the "free world" to the "communist world" and contributed to the resistance against the regimes in the Eastern Bloc. With its powerful transmission towers, RFE was fighting against the deafening sounds of communist jamming. All such stories formed solid knowledge that drew our understanding of the second half of the 20th century.

Can we afford to look more closely and accept a different starting point: if we examine not today's solid facts, but the moments when these same facts were still floating, unstable instances of trial and error? Historians should not be afraid, at least occasionally, to put under doubt the successful existence of the symbolic radio. How was it possible to mobilize a whole army of broadcasters, technical personnel, facilities, and places with the task to attack "enemies" behind the Iron Curtain with invisible waves, electric impulses that only scientists have "seen", but many have heard both of their dimensions: either as voices of RFE journalists or monotonous sounds of jamming?

Many interesting questions emerge, looking at the shared knowledge, specifically at technical and organizational issues, with the eyes of a foreigner. From their answers, we can learn about the way Cold War participants imagined successful propaganda.[1] What were the groups, on which the whole operation depended? How did they evaluate their success and failures in the fight against jamming? To what extent did the operation depend on global and local politics? How did the whims of the weather influence the whole process and what were the other obstacles in the path of the radio waves? What were the technological

[1] I use the term "propaganda" following the definition of propaganda by Peter Kenez: "an attempt to transmit social and political values in the hope of affecting people's thinking, emotions, and thereby behavior." Peter Kenez, *The Birth of the Propaganda State: Soviet Methods of Mass Mobilization, 1917-1929* (Cambridge: Cambridge University Press, 1985), 4.

innovations to overcome the Iron Curtain? Which were the communication technologies in the whole complex operation?

All these questions concerned mostly the radio engineers: the people who, night and day, were engaged in the maintenance of RFE. Besides being the technicians in charge of the radio towers, they were well known to all the radio departments. They responded to every small technical question asked by their colleagues behind the microphones in the studios where propaganda was verbalized. Why are engineers particularly interesting for Cold War history? These mysterious radio practitioners who made a living with their passion of radio amateurs? What can we still learn from the technicians when, in their speech, the name of Heinrich Hertz resonated much more often than Lenin, Stalin, Khrushchev, and Brezhnev put together?

I will approach the Cold War technical archive following Bruno Latour's methodological tool of "actor-network theory", a central concept in the field of Science and Technology Studies. In this paradigm, there are several aspects that I will constantly keep in mind in my history analysis of radio practice. Following Latour, I will consider the non-living objects as equally important actors or "actants"[*] in the Cold War practice. In other words, I will try to "bring objects back into the normal course of action," [2] to provide an extensive study of dynamic and durable associations between humans and non-humans in this historical context. Through extensive archival research, I endeavor to follow Latour's recommendation: "follow the actors in their weaving through things they have added to social skills so as to render more durable the constantly shifting interactions."[3] Engineers and their tools, humans and non-humans, will be part of this history study of the technical aspects of Cold War broadcasting. Thus, along with engineers, my study deals with analysis

[*] In Latour's terminology, they are "actants".
[2] Bruno Latour, *Reassembling the Social. An Introduction to Actor-Network-Theory* (Oxford-New York: Oxford University Press), 70.
[3] Ibid. 68.

of objects in all their charming specifics: electrons in radio waves reflected from the ionosphere, magnetic storms, towers, antennas, and all types of devices for recording, monitoring, and sending messages. I will also examine the seemingly auxiliary and well-know characteristics of the geographical areas from which the radio operated. A history analysis of often neglected objects will contribute to deeper understanding of the dynamics and complexity of specific groups and institutions, on which the whole propaganda practice directly depended.

Focusing both on engineers and "Cold War engineering", this thesis will examine the political nature of technological issues. The text will trace the pre-history of key policies and political terms, in which the entire broadcasting operation was embedded. My main aim is to examine the way engineers dealt with political problems in their daily technical work throughout the Cold War operation called Radio Free Europe. In my thesis I do not draw any sharp distinctions between technical work, technicians, and politics because, as scholars in the field of Science and Technology Studies observe: "the machinery of what is officially political is only the tip of the iceberg when compared to the many other activities generated by many more 'activists' than those who claim to do politics *per se*."[4] In this context, it is important even to trace to what extent seemingly "purely technical" tools became objects of political use. The thesis deals with politics, which is "not limited to humans and incorporates the many issues to which they are attached", in Latour's terms.[5] Examining engineers and their technical plants, the text will enrich our understanding of the social groups that shaped the rhetorical landscape of the Cold War. In this text, the technicians are not examined in isolation, but as an integral part of a complex amalgam of key administrative institutions and vocabulary in this historical period.

[4] Bruno Latour, "Turning around Politics - A Note on Gerard de Vries' Paper," *Social Studies of Science* (2007), 37(5): 103.
[5] Bruno Latour, "From Realpolitik to Dingpolitik or How to Make Things Public," in Bruno Latour and Peter Weibel (eds.), *Making Things Public: Atmospheres of Democracy* (Cambridge: MIT Press, 2005).

In this research, action and technical work are rather surprising and not reducible to any abstract sociological and historical categories. [6] This is a pledge of identifying unknown events in the history of the propaganda war and to enrich our understanding of well-known ones. My research examines a dynamic system of technological objects, places, individuals, professional groups, political organizations, and, most importantly, the (in)famous jamming noise, which also shaped the Cold War radio infrastructure. In this sense, the theoretical program of the researchers who founded the whole field, Science and Technology Studies, allows us, in the historical context of the Cold War, to explore what John Law and Michel Callon call "negotiation space": a space and a time within which a local network might be built that would in turn generate a range of intermediaries, the final result of which was the creation of a working Cold War radio.[7] Behind these perfectly working installations stood hundreds of circumstances and actors who have not been explored by Cold War historians and will hardly ever be completely known in all their integrity.

This is an obliging methodological approach: the Cold War student relies on texts containing what Harold Garfinkel called "shared agreement" or "common understanding." Following this type of archival traces the researcher must constantly revisit the historical background, the pre-history of the links that led to a brief technical report of few short sentences. If we apply Garfinkel's words to the technical documents, the researcher must "minimize or even eliminate the occasions in which "et cetera" and other such *ad hocing*

[6] In Latour's words: Action should remain a surprise, a mediation, an event. It is for this reason that we should begin, here again, not from the 'determination of action by society', the 'calculative abilities of individuals', or the 'power of the unconscious' as we would ordinarily do, but rather from the under-determination of action, from the uncertainties and controversies about who and what is acting when 'we' act—and there is of course no way to decide whether this source of uncertainty resides in the analyst or in the actor." Bruno Latour, *Reassembling the Social. An Introduction to Actor-Network-Theory* (Oxford-New York: Oxford University Press), 45.

[7] I am paraphrasing Callon and Law who write about the construction of an airplane see: John Law and Michel Callon, "The Life and Death of an Aircraft: A Network Analysis of Technical Change" in Wiebe E. Bijker, John Law (eds.) *Shaping Technology/Building Society: Studies in Sociotechnical Change* (Cambridge, Mass: MIT Press, 1992), 42.

practices would be used." [8] This means that we should find extensive archival data and stories which explain one single rule embedded in the radio infrastructure.

Ideally, my text will lead to detailed descriptions of technical issues, a "thick description" [9] of the practices before transmitting radio signals, to use Clifford Geertz' famous phrase. He, and every qualitative researcher, proposes to be attentive to the words and rules used by the real actors, the local people, in order to base our conclusions on a "thick", specific text. [10] In my case, I will try to understand propaganda rules explained by the engineers themselves, their view of propaganda, expert requirements for global and local policy, as well as their own choice of technological tools that would create a successful radio.

So far, everything sounds good, but the problem is that engineers are not the most talkative people and historians lack the tools of ethnographers who rely on field research in the comfortable context of a present and specific place and time. The painful question for a historian is when and where to find technological stories in the Cold War archive. One productive way, proposed by Bruno Latour, is to be sensitive to what he famously called a "shift from matters of fact into matters of concern." [11] The whole picture behind a solid historical fact or object is seen precisely through "concerns": when something in a system is wrong, an accident, a technical problem occurs, for instance, then we can see specific conditions and institutions which underpin and maintain the entire system.[12] Such crucial

[8] Harold Garfinkel, *Studies in Ethnomethodology* (Cambridge: Polity Press, 1967), 22.
[9] Clifford Geertz, "Thick Description: Toward an Interpretive Theory of Culture," in *The Interpretation of Cultures. Selected Essays by Clifford Geertz* (New York: Basic Books, 1973).
[10] Clifford Geertz, *Local Knowledge. Further Essays in Interpretive Anthropology* (New York: Basic Books, 1983).
[11] Bruno Latour, "Why Has Critique Run out of Steam? From Matters of Fact to Matters of Concern," Critical Inquiry 30 (Winter 2004): 225-248.
[12] Latour illustrates his notion of "matters of concern" and "deployment of networks" with the incident with the Columbia space shuttle in 2002: "You thought the Columbia shuttle was an object ready to fly in the sky, and then suddenly, after the dramatic 2002 explosion, you realize that it needed NASA and its complex organizational body to fly safely in the sky (…).The shuttle Columbia was not an object whose substance could be defined, but an array of conditions so unexpected that the lack of one of them (a bureaucratic routine) was enough to destroy the machine." On Latour's reflections on the term "network," its use, and the notion of "deployment of networks" see: Bruno Latour, "Networks, Societies, Spheres – Reflections of an Actor-

and often invisible (in their everyday mode) circumstances appear very often in new phenomena which include many technological innovations and technical work, which could be analyzed with Thomas Kuhn's notion of "paradigm shifts" and his analytical approach that opens up spaces for history of science as a social activity.[13]

Archival sources, through which we can identify Cold War "matters of concerns" and "paradigm shifts", are the Monthly technical reports of the Engineering and Services Department at Radio Free Europe. They keep all the obstacles to the successful propaganda operation and all innovations, thereby show numerous factors on which RFE depended. I will examine closely the files from the years 1966 and 1967, which are available in the Open Society Archive in Budapest. In approximately 30 pages, monthly, the radio technicians recorded all details of the operation, which, at that time, had already established its basic infrastructure and routine practices. With some exceptions, late 1960s demonstrate the technical facilities that operated until the end of the Cold War. These monthly technical reports thus are particularly valuable because they keep both things that were taken for granted and situations when these things precisely were considered problematic and discussed extensively.

Since my task is to look deeper into this daily operating radio infrastructure, I will concentrate mainly on older documents from inter-office correspondence between 1955 and 1960. Those were the years when engineers were excited by the newly established propaganda system aiming to beam news behind the Iron Curtain. In these years, the main technical outlines of RFE were still considered vague. Places for broadcasting were still negotiated during heated debates on propaganda techniques. In other words, I will

Network Theorist," *International Journal of Communication* 5 (2011): 796-810. http://www.bruno-latour.fr/node/139 (Access date: May 12, 2015).

[13] Thomas Kuhn, *The Structure of Scientific Revolutions* (Chicago: The University of Chicago Press, 1996). On the importance of Kuhn's theory in Science and Technology studies see: Sergio Sismondo, Science and Technology Studies and an Engaged Program in Edward Hackett, Olga Amsterdamska, Michael Lynch, Judy Wajcman (eds.) *The Handbook of Science and Technology Studies* (Cambridge: The MIT Press, 2008).

constantly refer to the roots of the concerns from the late 1960s. I will enrich the history analysis with publications from a specialized journal *Broadcast News*. In 1957, it published a comprehensive description and a map of RFE's technical facilities. As an indispensable document, I will use the book *Radio Free Europe* by Robert Holt published in 1958.[14] It is the first and one of the most detailed studies about the radio's departments. The book was initially written as a doctoral thesis including interesting informal accounts, specifically from the engineering department. Other additional archival sources include: photographs and propaganda messages from the Public Affairs department at RFE, declassified documents from the Central Intelligence Agency, and Annual reports from the Board for International Broadcasting.

The secondary literature on the problem constitutes a rich historiographical field. Books on Radio Free Europe's history are written by key authors such as Allan A. Michie,[15] Sig Mickelson,[16] Ross Johnson,[17] and Michael Nelson[18] who discuss important technical elements and issues in the broader history of Cold War broadcasting. Technical, political, and cultural aspects of jamming are explored by Istvan Rev[19] and George Woodard[20] in the richest collection of essays on the role of the radio entitled *Cold War Broadcasting*: *Impact on the Soviet Union and Eastern Europe*. In their works, authors such as Arch Puddington[21]

[14] Robert T. Holt, *Radio Free Europe* (Minneapolis: University of Minnesota Press, 1958).
[15] Allan A. Michie, *Voices through the Iron Curtain: The Radio Free Europe Story* (New York: Mead & Company, 1963).
[16] Sig Mickelson, *America's Other Voice: the Story of Radio Free Europe and Radio Liberty* (New York, NY: Praeger Publishers, 1983).
[17] A. Ross Johnson, *Radio Free Europe and Radio Liberty. The CIA Years and Beyond* (Stanford, California: Stanford University Press, 2010).
[18] Michael Nelson, *War of the Black Heavens: the Battles of Western Broadcasting in the Cold War* (London: Brassey's, 1997).
[19] István Rév, "Just Noise? Impact of Radio Free Europe in Hungary," in: A. Ross Johnson and R. Eugene Parta, eds., *Cold War Broadcasting: Impact on the Soviet Union and Eastern Europe: A Collection of Studies and Documents* (Budapest: Central European University Press, 2010).
[20] George W. Woodard, "Cold War Radio Jamming," in: A. Ross Johnson and R. Eugene Parta, eds., *Cold War Broadcasting: Impact on the Soviet Union and Eastern Europe: A Collection of Studies and Documents* (Budapest: Central European University Press, 2010).
[21] Arch Puddington, *Broadcasting Freedom: The Cold War Triumph of Radio Free Europe and Radio Liberty* (Lexington: University of Kentucky Press, 2000).

and Richard H. Cummings[22] also registered stories specifically related to the radio engineers. Rimantas Pleikys, in his book *Jamming*, wrote about technical aspects of jamming in Lithuania. [23] He includes information from the archives of the RFE's Engineering Department in order to introduce the broader context of his research. Primarily technical aspects of Cold War broadcasting are described in the books *History of International Broadcasting*[24] by James Wood and Jerome Berg's *Broadcasting on the Short Waves*.[25] In the last few years, in Cold War historiography, the names of Alexander Badenoch and Andreas Fickers stand out. They published two editorials *Airy Curtains in the European Ether*[26] and *Materializing Europe: Transnational Infrastructures and the Project of Europe*. [27] In their books Badenoch and Fickers put a special emphasis on the global aspects of transnational media infrastructure in postwar Europe.

My work will contribute to this rich historiographical tradition with an analysis of unpublished documents which enclose interesting dynamics from the everyday practice of Cold War broadcasting. A detailed history synthesis, derived specifically from engineers' accounts, provides a thorough description of a communication infrastructure that is impossible to reconstruct and understood in small fragments dispersed in Cold War historiography. Archival data from the Engineering department highlights unexplored links from Cold War broadcasting and unregistered events from the everyday operation behind technological objects and innovations that shaped Cold War politics.

The first part of the thesis begins with a brief pre-history of the use of the notion of "network" as a self-evident description of RFE, examining "networks" as an indispensable

[22] Especially in Richard Cummings' blog *Cold War Broadcasting*, http://coldwarradios.blogspot.hu/ (Access date: May 1, 2015).
[23] Rimantas Pleikys, *Jamming* (Vilnius: R. Pleikys, 1998).
[24] James Wood, *History of International Broadcasting* (London: The Institution of Electrical Engineers, 2000).
[25] Jerome S. Berg, *Broadcasting on the Short Waves, 1945 to Today* (Jefferson, NC: McFarland & Company, 2008).
[26] Alexander, Badenoch, Andreas Fickers, Christian Henrich-Franke. *Airy Curtains in the European Ether. Broadcasting and the Cold War* (Baden-Baden: Nomos Verlagsgesellschaft, 2013).
[27] Alexander Badenoch, Andreas Fickers, *Materializing Europe: Transnational Infrastructures and the Project of Europe* (New York: Palgrave Macmillan, 2010).

part of Cold War rhetoric. This chapter includes detailed registration, and a map of the technical infrastructure of RFE as described by the Engineering department in the technical reports from the 1960s and publications in the late 1950s. Examining key functions of the radio installations, I will concentrate on the importance of geographical places, key links with external institutions, and technological objects in the RFE's operation.

The second chapter focuses on the heart of the Cold War technological policies: jamming behind the Iron Curtain. I will outline specific everyday practices behind the RFE's installations including closer look at practical problems related to propaganda. In particular, this was specific research of noises. I will explore technical and scientific observations of two main categories of noise: jamming and atmospherics from the ionosphere. The aim is to outline the prehistory of measuring the "effectiveness" of the radio signals. I will explore "effectiveness" as a complex political, propaganda, and technological category throughout the Cold War.[28] This category emerged in the shared knowledge about the radio operation through the work of trained technicians with their skills and tools.

The last part of the study will add a special dynamic to the analysis of the technical infrastructure and routine activities. The final third chapter concentrates on the Hungarian revolution in 1956. I will explore places and radio machines that had particular importance for gaining information in the exceptional circumstances of the revolution. The thesis concludes with a summary of the main findings related to technological objects, noise, and

[28] The problem of "effectiveness" in Radio Free Europe's history is an integral part of a broader research problem. Along with the engineers, this was a major concern for the Media and Opinion Research Department at RFE. While technical specialists focused on the quality of the transmitted signals, their colleagues, through public opinion research, tried to determine to what extend the audible sound influenced the radio *listeners*. Audience research was the second step in assessing effectiveness; a whole research process, which mobilized many other actors and intellectual currents. In this case, the "laboratory" was related to public opinion research institutes and sociological questionnaires designed for the context of the Cold war. My archival research includes only the Engineering Department, but audience research is another important problem for further history analysis that could outline other unexplored technological objects that were included in sociological interviews and public opinion polls. On the structure and the main tasks of the Public Opinion Research Department see: R. Eugene Parta, *Discovering the Hidden Listener: An Assessment of Radio Liberty and Western Broadcasting to the USSR during the Cold War* (Stanford, California: Hoover Institution Press, 2007).

geographical places as important elements in the history of the symbolic Radio Free Europe through which we can examine complex policies of technology during the Cold War.

Before undertaking my work, it is fair to say what my "professional" role and personal concerns in this study are. I must say that I am neither an engineer, nor a radio amateur. I have never delved into serious study of a machine. Concerning Radio Free Europe, my experience is even smaller. I never heard the radio in the first two years of my life, which coincided with the last years of the communist regime in Bulgaria before its end in 1989. Two generations ago, the closest people in my family had never listened to Radio Free Europe. My father was an Air Force officer who worked with the same technology, but in a completely different context, while my grandfather was among the party leaders in a small town in which you cannot even afford to mention the name of this radio. Like most Bulgarians, I associate RFE with Georgi Markov, but I also think that he was not just a radio broadcaster from the Cold War. He is a writer of genius, but few people have read all his works (even fewer know that he was a graduate engineer).

I have no professional qualifications or sentiments that tie me to Radio Free Europe, my main *personal* concern is different. I was born in the late 20th century and had too little time to be intrigued by the internal structure and the process of creating computers before they quickly concentrated in portable laptops and beautiful miniature phones with constant access to "networks". When the word "network" has already become part of our existence and our personality, we are less curious about the factors that determine our existence. Criticizing technology does not help. We still remain indifferent to people and objects behind certain innovations. From personal experience, I will shift to a collective speculation, which is my personal conviction: even the people who create new technologies are becoming less curious about the objects and subjects behind a computer chip.

I believe that one way to awaken personal curiosity is to get back to the stories from that 20th century when technological tools were still interesting, even miraculous, to go back to the age of "radio lovers" through the prism of the historian's craft, which, I believe is "pure curiosity about the specific"[29] in Paul Veyne's words. Although this craft requires a lot of work, one of the best places in the world to understand the confused and hidden traces from the second half of the 20th century is the Open Society Archive in Budapest. We need only curiosity and a method in order to understand all the problems from this important historical period such as politics, everyday life, public opinion, media, propaganda, Cold War philosophy and epistemology, families, technologies, antennas, radio crystals, transatlantic cables, headphones. In a word, everything that otherwise we could easily concentrate in three letters and one point: etc.

[29] Paul Veyne, *Writing History. Essay on Epistemology* (Middletown, Connecticut: Wesleyan University Press, 1984), 47-71.

1. Multiple Actors in the Radio "Network": Dependencies, Communication Links, and Objects

This chapter will trace the development of Radio Free Europe's technical infrastructure, its main facilities, and technical components. They were fundamental elements in Cold War broadcasting that allowed obtaining news and information from behind the Iron Curtain, following the world news flow, constant communication between numerous studios, and, finally, transmitting short waves at a great distance. Before proceeding with the study, I will first contemplate the importance of engineers' insight for radio history in the 1950s and 1960s.

In fact, I could legitimately speak about some technical details from the operation without referring to technical experts. I have a solid shared, and even worse, "professional" knowledge (inherent from social sciences) about the way RFE worked. My first intuition is that the radio used many powerful transmitters to fight the jamming towers in Eastern Europe. However, I have always felt that it was not that easy, that, in reality, it was more "complex". Using more sophisticated argumentation, I could confidently argue that the technical operation was not just a radio transmission, but a complex *network* of technical facilities. Then, I could legitimately proceed with my next intuitions about the most important components in the web, or even more legitimately, move to some more interesting and important aspect of Cold War history. Unfortunately, the notion of network is one of those magic tools that have the ability to close unwritten history chapters. To say that something was a complex network is intellectually prestigious, even somewhat innocent, and liberates us from further efforts to explain the way *it* actually worked.

At least in our case, dealing with the Cold War, the notion of network is not just a neutral methodological tool. The same term was used actively in Cold War political rhetoric

and propaganda along with the idea that RFE was armed with powerful transmitters. Thus, I feel obliged to start my work with a brief pre-history of my own intuitions that, interestingly/shamefully enough, coincided with the intuitions of Cold War propaganda experts.

1.1 The Term "Network" as a Self-evident Description of Radio Free Europe.

Radio towers attract the attention of participants and students of the Cold War propaganda. We tend to think that the high power short-wave transmitters were an important actor in broadcasting behind the Iron Curtain. In 1952, in the early years of Radio Free Europe's history, the radio's founding organization, The National Committee for Free Europe[30], registered in an annual report the number of the new transmission towers, adding technical details about their power. [31] The importance of "expanding the technical facilities" was a key part of this early report on the functioning of the radio.[32] Throughout the Cold War, the need for new transmitters became a major rhetorical figure in the proposals for funding from the US government budget, initially through the annual budget of the Central Intelligence Agency.[33] Allusions to the powerful transmitters appeared not only in some hidden or specialized administrative files. Starting from the 1950s, the Public Affairs department at Radio Free Europe collected photographs of radio towers with propaganda

[30] On the role of the National Committee for a Free Europe and its early activities that led to the creation of a radio see Walter A. Hixson, *Parting the Curtain. Propaganda, Culture, and the Cold War (1945 - 1961)* (New York: St. Martin's Press, 1996) and A. Ross Johnson, *Radio Free Europe and Radio Liberty. The CIA Years and Beyond* (Stanford, California: Stanford University Press, 2010).
[31] National Committee for a Free Europe, President's Report for 1952 in Whitney Shepardson, Letter to Allen Dulles, Central Intelligence Agency, Freedom of Information Act, Electronic Reading Room, Document Number (FOIA) /ESDN (CREST): 0000238877 http://www.foia.cia.gov/document/letter-mr-allen-w-dulles-whitney-h-shepardson-re-presidents-rep (Access date: May 5, 2015).
[32] Ibid.
[33] CIA, Executive Committee Meeting, Subject: Radio Liberty and Radio Free Europe - Proposed Expansion, 14 May 1962 in CIA, Freedom of Information Act, Electronic Reading Room, Document Number (FOIA) /ESDN (CREST): CIA-RDP80B01676R002400030013-1, http://www.foia.cia.gov/document/cia-rdp80b01676r002400030013-1 (Access date: May 5, 2015).

text for press releases, attached to the images, where we can read about the extraordinary power of these technological innovations.[34]

Fig.1.1. A photograph from the Public Affairs Department showing a high radio transmission tower behind barbed wire; the allusion is clear: a powerful transmitter and the Iron Curtain. Source: OSA Archive.

There was something obsessive in the figure of the powerful radio tower. However, strictly speaking, one radio tower was quite important, but only for a short period of time. In the very beginning of the operation, in the spring of 1950, a 7,5 kilowatt American mobile shortwave transmitter arrived in the former Luftwaffe Air Force base in the forests of Lampertheim near Frankfurt and beamed the first RFE signal through the air. [35] This single tower was installed on a heavy military truck which carried concentrated equipment for military radio operations. A photograph of this first military installation, with a propaganda description, is also preserved in the archive of the Public Affairs department.[36] In their reports, the RFE engineers called this transmitter Barbara, which proves "her" great sentimental value. Practically, it was only an auxiliary device at the opening of new stations,

[34] OSA Archive: Radio Free Europe Corporate Records, Department of Public Affairs, Photograph Collection.
[35] Some authors use the mobile transmitter later nicknamed "Barbara" as an interesting detail from RFE's early history: Allan A. Michie, *Voices through the Iron Curtain: The Radio Free Europe Story* (New York: Mead & Company, 1963), 14. Richard Cummings, "The Urgent Whisper from Barbara: Radio Free Europe Begins Broadcasting on July 4, 1950," in Cold War Broadcasting blog, http://coldwarradios.blogspot.hu/2012/07/urgent-whisper-from-barbara-radio-free.html (Access date: May 1, 2015).
[36] Ibid.

but quickly became redundant and replaced with more powerful 50, 100, and 250 KW transmitters forming a complex "network" which stretched to Portugal and Germany.

With the multiplication of the towers, we can observe a proliferation of expressions that describe the radio technical equipment as a powerful "network" of transmitters that send signals behind the Iron Curtain. The Public Affairs archive at RFE kept pictures of large tower plants with attached propaganda sentences praising their power. A propaganda specialist tried to explain the functioning of the radio with the following catchy phrases: „A Radio Free Europe broadcasting tower (…) is a part of a vast transmitter system that effectively beams RFE programs to the 80 million captive people (…) Each year, the communists spend more money in futile jamming attempts than RFE spends in its entire operation. In addition to RFE's powerful transmitters, the network outwits the Soviets' jamming attempts through the use of multiple frequencies for broadcasting each program."[37] Similar texts were multiplied in propaganda slogans and films.[38] The official CIA correspondence about the need for annual funding from the US budget gradually included more sophisticated descriptions of the radio, which "has grown from a tiny 7½ kilowatt mobile transmitter into a network of five stations, utilizing 29 transmitters located in West Germany and Portugal."[39]

The term network was also multiplied actively in the 1970s (after the public disclosure of the links with the CIA) when the budget of the radio had already been discussed in public reports. In annual reports, the newly established radio supervising commission, the Board for International Broadcasting (BIB), recommended allocation of funding directly from the US government budget. In a report from 1978, the board argues

[37] OSA Archive: Radio Free Europe Corporate Records, Department of Public Affairs, Photograph Collection.
[38] See *This is Radio Free Europe* (1964) https://www.youtube.com/watch?v=_jyqEB5Q6Xg, Hoover Institution Archive, (Access date Apr 20, 2015).
[39] Allan A. Dulles, Memorandum for Robert Murphy, May 2, 1957, in Central Intelligence Agency, Freedom of Information Act, Electronic Reading Room, Document Number (FOIA) /ESDN (CREST): CIA-RDP80B01676R002600100042-9 http://www.foia.cia.gov/document/cia-rdp80b01676r002600100042-9 (Access date: May 5, 2015).

that building "a new worldwide transmitter network" would mean too high costs, so the BIB proposed new investments of 22-25 million dollars[40] for 16 new 250 kW transmitters for the existing facilities. [41] As an illustration, the report includes a bird-eye-view photograph of an enormous transmission station, which, "obviously", required new resources.[42] Some late reports even include historical references explaining the development of the radio "network" of transmission towers that was established in the 1950s. [43]

But how can we, as historians, propose something different and trace the history of "the network" beyond the metaphor, propaganda phrases, and images? To a significant extent, my task is to look closely at such proverbial expressions because they are a result of what Bruno Latour calls "blackboxing" [44] of technology. We see only the final results of a technological phenomenon if we hear a signal behind the Iron Curtain and we live peacefully with the thought that the whole operation is "effective" without thinking about the millions of elements in the "vast transmitter system". We usually cease thinking about the history of the links that formed the so called "network." Even back in the 1950s, there was a confidence that an operation consisted in numerous interrelated networks is something completely natural and effective, indisputable as a photograph showing strong metal installations that surmounted the physical barrier called "The Iron Curtain".

Interestingly enough, the RFE engineers did not use the word "network" in their reports. Judging by the archive, they always tried to be very specific speaking about

[40] In this case this was a proposed investment for the three American radios, financed by the US budget: VOA, RFE, and Radio Liberty.
[41] The Board for International Broadcasting, *Annual Report - 1978*, page 42. Available at Hathi Trust Digital Library, Permanent link: http://babel.hathitrust.org/cgi/pt?id=mdp.39015066191662;view=1up;seq=18 (Access date: May 8, 2015).
[42] The report of 1978 includes pictures of antenna switching equipment for RFE/RL broadcasts at Lampertheim, West Germany and RFE/RL transmitter antennas at Playa de Pals, Spain.
[43] The Board for International Broadcasting, *Annual Report - 1980*, page 28. Available at Hathi Trust Digital Library, Permanent link: http://babel.hathitrust.org/cgi/pt?id=mdp.39015066191951;view=1up;seq=32 (Access date: May 8, 2015).
[44] "Blackboxing" is a process that makes the joint production of actors and artifacts entirely opaque. Each of the parts inside the black box is a black box full of parts." see Bruno Latour, "On Technical Mediation - Philosophy, Sociology, Genealogy." *Common Knowledge* (1994) 3(2): 36-37

technology. Certainly, they were not isolated from their own culture: they referred to the Voice of America as a "radio network" and used expressions such as "networks of Soviet jammers." However, they never used this word to describe RFE as a "network" because they worked there and their own "network" was composed of many specific circumstances and objects observed daily by the engineers. This detailed technical account is priceless for the history of technology in a period when technology and Cold War ideology were closely intertwined.

In May 1958, a press release that "29 powerful towers transmit radio behind the Iron Curtain" was sent to the print media. In an inter-office correspondence at Radio Free Europe, we can read a protest letter[45] that keeps the angry voice of George Graveson, assistant director of the Engineering department, who was indignant at the circulation of press releases that led to media publication with a wrong number of towers.[46] In 1958, one of the main Cold War radio engineers wrote a letter to the Public Affairs department, and, as we can see, he was concerned not only about the mistaken fact, but also about the lack of practical knowledge:

> This is an erroneous statement as you know. We have discussed this figure, and whenever there has been an opening I've sounded off on the absurdity of continuing to say 29 transmitters[47] when there are only 22 in Target Service. We do have 6 relay transmitters which feed program material to Lisbon. Even with them, the figure is 28. We do have 3 kw transmitters for our service between Munich and Lisbon and for substitution for target transmitters during breakdown. If we want to mention the total number of RFE transmitters installed in Europe, it would be 22 target plus 6 relay, plus 4 3 kw Collins (…) making 32 in all. BUT[*] only 22 carry programs "behind the Iron Curtain". (...) We look pretty foolish when our own press releases indicate we do not know how many transmitters we have. Can't we stop this nonsense?[48]

In this chapter, I will follow Graveson's angry voice and outline the practical functioning of the installations about which he was so strict. As we shall see later, the

[45] George L. Graveson, Memorandum, Radio Free Europe, Engineering Department, May 9, 1958 in HU OSA Archive, Funds 298, Subfunds 1, Series 3, RFE Correspondence: Engineering Reports and Other Materials
[46] Similar press releases are attached to the photographs discussed above and stored in the Cold War archive.
[47] As we have seen, the same wrong number is used not only in media publications, but also in the CIA official correspondence from 1957. See page: 17.
[*] I have kept the original spelling from the archival source.
[48] George L. Graveson, Memorandum, Radio Free Europe, May 9, 1958 in HU OSA Archive, Funds 298, Subfunds 1, Series 3, RFE Correspondence: Engineering Reports and Other Materials.

number of towers is not so important because it increased annually, and it became almost impossible to trace the exact number. Instead of counting towers in "the network", I will register the voices of engineers who created and mastered this radio system with thousands of efforts throughout the Cold War. The point is to overcome the self-evident vocabulary of the Cold War. In this effort, engineers, such as George Graveson, gave us invaluable help saying that the towers were not merely mushrooming transmitters that sent short waves into the ether. Before transmission, there were many interesting components that also shaped this Cold War operation.

1.2. Reconstructing the Radio's Infrastructure Following the Engineers

In the late 1950s and the 1960s, RFE's installations gained their main shape which, with some modifications, was maintained until the end of the Cold War. Radio Free Europe's installations aroused considerable interest among its first observers. The political scientist Robert Holt, who in January 1956, as a PhD student at Princeton University, conducted the first research on the radio's structure, used valuable personal observations and informal conversations in order to reveal some practical details from Cold War broadcasting. In his dissertation (published as a book later)[49] he dedicated a special chapter to technical aspects of propaganda, which was proofread and approved by the RFE engineer, Russel Geiger.[50]

One year later, in April 1957, the managing editor of the specialized journal *Broadcast News*, Paul Greenmeyer, published an extensive report on the way Radio Free Europe operated and mapped the radio system. His article immediately resonated with radio practitioners, if we judge by an official letter by the Canadian Broadcasting Corporation,

[49] Robert T. Holt, *Radio Free Europe* (Minneapolis: University of Minnesota Press, 1958).
[50] Russel Geiger, Memorandum, September 12, 1956 in HU OSA Archive, Funds 298, Subfunds 1, Series 3, RFE Correspondence: Engineering Reports and Other Materials.

who kindly asked for more detailed technical information on the unusual system of radio antennas. [51] The report entitled *Radio Free Europe's Broadcast Operation* is based on the stories of radio engineers who described for Greenmeyer a precise technical geography of RFE's installations which he later called a "king-size operation."[52] I will trace the main components of the system, following its first analyzers: Robert Holt, Greenmeyer, and, most importantly, the staff of the Engineering Department who, by the late 1950s, had already mastered the complex system of transmitters and antennas: something which in the eyes of the close observers seemed extraordinary.

1.2.1 Monitoring

In the 1960s, RFE issued Monthly Technical Reports, which reflected the state of the entire operation and put under control all features on the path of the radio signal from the radio studios in Germany and the United States to the countries of the Eastern Bloc. All these reports began with a general technical summary from the directors of the central offices in Munich and New York. But the main body dealt with specific technical details; a precise descriptions of routine activities and problems, which started from the RFE monitoring stations. Monitoring was the initial operation, which, according to the engineers' logic, laid the foundation of the whole broadcasting practice. Technically speaking, without monitoring activity, Cold War news broadcasting was unthinkable. RFE's monitoring facilities kept key devices for capturing, recording, and transcribing radio station broadcasts from behind the Iron Curtain, as well as news from Western press agencies.

The monitoring devices were concentrated in Schleissheim and Moosburg. Schleissheim was 32 kilometers north of Munich - where the headquarters of Radio Free

[51] W.H.Moffat, General Information on RFE Antenna Facilities, May 31, 1957 in HU OSA Archive, Funds 298, Subfunds 1, Series 3, RFE Correspondence: Engineering Reports and Other Materials.
[52] Paul Greenmeyer, Radio Free Europe's Broadcast Operation, *Broadcast News* 94 (April, 1957).

Europe were. Moosburg was 58 km away from Munich (east of Schleissheim). Moosburg was chosen as an alternative place because it was more isolated and ensured better sound perception away from the communications of the main city. And clear sound was vital for the amount of work done in both stations. By the end of the 1960s, for instance, monitoring tasks included 45 Eastern radio stations. In some months, the installations reached over 10,000 monitoring hours per month. Information from 8 Western radio stations was gathered, with average of about 150 hours per month. Besides radio stations, 11 Eastern press agencies news flow was observed for around 2,000 hours monthly and 6 Western agencies reaching 1800 hours. [53] Official press information from behind the Iron Curtain included press agencies such as: TASS (Soviet), Tanjug (Yugoslav), Agerpress (Rumanian), PAP (Polish), CTK (Czechoslovak), MIT (Hungarian),BTA (Bulgarian), ATA (Albanian).[54]

The most difficult task for the engineers was to detect the signal from the radio station behind the Iron Curtain, which were intended for local use only. In order to deal with this constant problem, they design special antenna systems adjusting distant signals. Once the RFE's technical personnel successfully tuned into a radio station, monitoring was carried out by trained journalists armed with technological devices. Journalists' monitor booths in the 1950s "had a tape recorder and a typewriter equipped for typing his specific language."[55] After recording and transcribing the sound from behind the Iron Curtain, with averages between 45,000 and 48,000 words daily,[56] the content was sent to the central editorial office in Munich through Teletype and Hellschreiber. Both devices, which I will describe later, used a well known technology from the inter-war period and during World

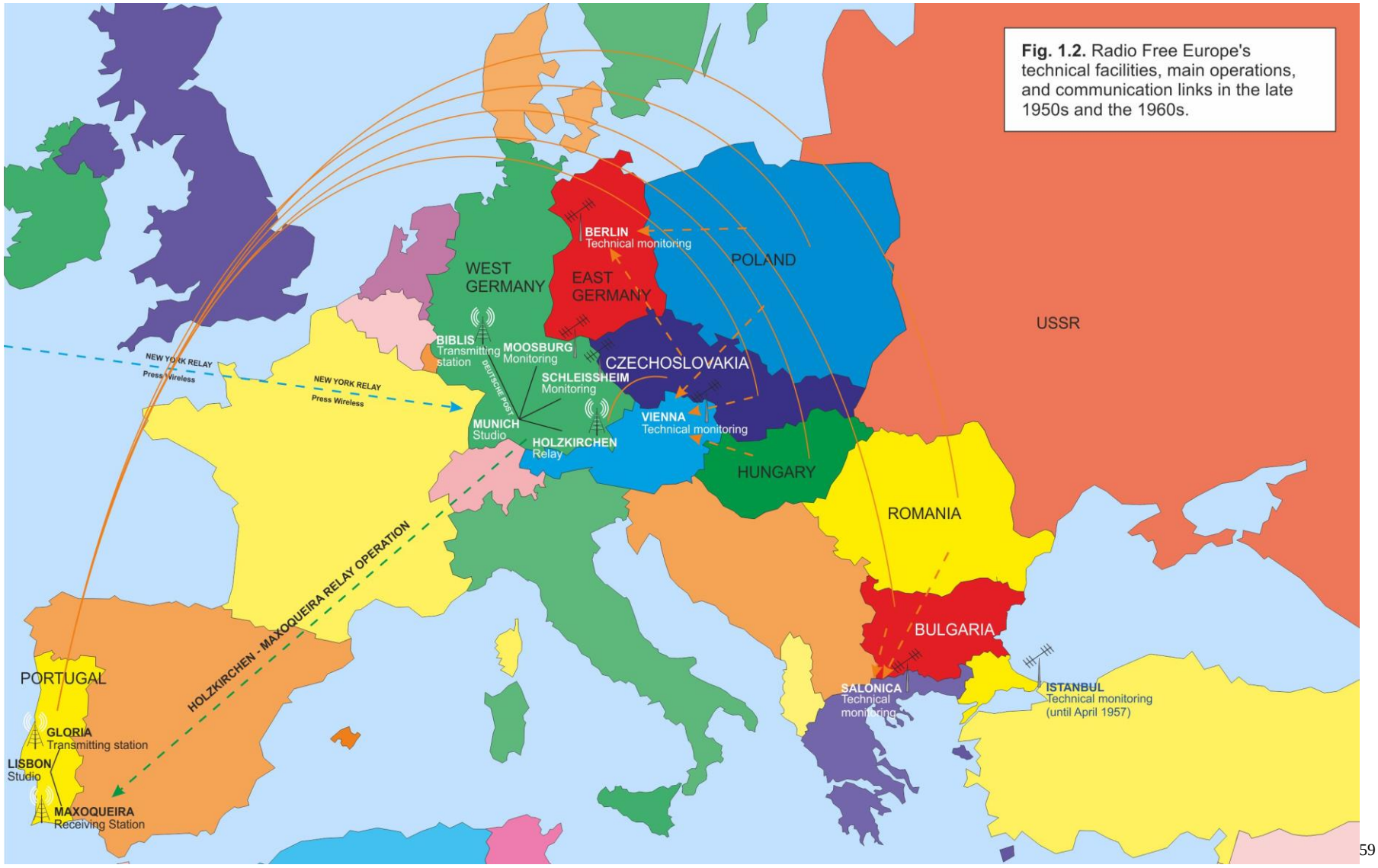
[53] Based on observations from the Monthly Technical Reports for the years 1966 and 1967 in HU OSA Archive, Funds 298, Subfunds 1, Series 3, RFE Correspondence: Engineering Reports and Other Materials
[54] Robert Holt, *Radio Free Europe* (Minneapolis: University of Minnesota Press, 1957), 107.
[55] Paul Greenmeyer, Radio Free Europe's Broadcast Operation, *Broadcast News* 94 (April, 1957), 17. http://www.americanradiohistory.com/Archive-RCA-Broadcast-News/RCA-95.pdf (Access date: May 11, 2015).
[56] Ibid, 99.

War II. The principle was again related to sending typewritten text via wired or radio connection, in this case, these were communications lines of the German Post.

Besides media monitoring, the facilities in Schleissheim performed another two key functions in the process of obtaining information for broadcasting. Schleissheim served as a receiving terminal for program transmissions sent from New York. Along with the editorial office in Munich, the radio had a studio in New York, which sent daily American news, official messages, and specific political requirements to coordinate the entire operation. By the end of the 1950s, before reaching Schleissheim, the signal traveled across the Atlantic Ocean through a short-wave circuit leased from Press Wireless Inc. [57] The company was one of the giants of the American telecommunications industry in the postwar years, which transmitted and received press information between the US and Europe, initially, by wireless links. [58]

There were four main operations addressed in the monthly technical reports from the receiver stations in Schleissheim and Moosburg. The first three, described above, were: Content Monitoring, Radio Teletype, and New York Relay. The last component of the monthly monitoring reports was called "Cue Circuit Holzkirchen-Lisbon." In practice, it was listening to RFE's own sound. I will return again to the importance of "Cue Circuit monitoring" after explaining the structure and functions of RFE's transmission facilities.

[57] Russel Geiger, Memorandum, September 23, 1957 in HU OSA Archive, Funds 298, Subfunds 1, Series 3, RFE Correspondence: Engineering Reports and Other Materials.
[58] Charles A. Siepmann, Propaganda and Information in International Affairs, *The Yale Law Journal* (August 1946) 55(5): 1263.



[59]

[59] Fig. 1.2. The map is designed using Paul Greenmeyer's map of RFE's Broadcast Operation and information based on Engineering Department's technical reports.

1.2.2. Relay, Transmitting, and Technical Monitoring

There were three key places, from which Radio Free Europe transmitted signals during the Cold War. The first transmission station was established in a small town, Biblis, near Frankfurt. This was the first radio broadcasting station, where the engineers began to build transmission towers in 1950, after moving their first mobile transmitter "Barbara" from Lampertheim, where they beamed the first sounds behind the Iron Curtain. Biblis was a short-wave station that served all five "target countries" (Poland, Hungary, Czechoslovakia, Romania, and Bulgaria) using eight medium and high power transmitters (3 of 50 kW, 1 of 20 kW, and 4 of 10 kW)[60]. The control room panel was designed and built by RFE engineers to accommodate five incoming voice lines from the studio in Munich to the eight transmitters. The link between the transmitting station at Biblis and the editorial office in Munich was a wired communication web of Deutsche Post. [61]

In Holzkirchen, 33 km south-east of Munich, was the other facility that transmitted radio programs. This was the only station that broadcast on medium wave only to Czechoslovakia because of the convenient location. [62] However, the facility at Holzkirchen had a more important, specialized task, crucial to the entire operation. They call it by a separate name "Relay operation", which had an autonomous status with specialized employees who were in charge of this special radio function. 36 technicians worked at Holzkirchen by 1966.[63] They were mainly concerned with carrying out a sound transfer from Germany to the largest short wave station, located in Portugal, which acted as a duplicate of Biblis and transmitted identical programs. With its distance, Portugal was

[60] Russel Geiger, Memorandum, September 23, 1957, page 2 in: HU OSA Archive, Funds 298, Subfunds 1, Series 3, RFE Correspondence: Engineering Reports and Other Materials.
[61] Paul Greenmeyer, Radio Free Europe's Broadcast Operation, 18.
[62] Russel Geiger, Memorandum, September 23, 1957 in HU OSA Archive, Funds 298, Subfunds 1, Series 3, RFE Correspondence: Engineering Reports and Other Materials. From this location the engineers had made also some successful attempts to transmit a decent sound to Poland and Hungary by skywave.
[63] Monthly Technical Report, December 1966 in HU OSA Archive, Funds 298, Subfunds 1, Series 3, RFE Correspondence: Engineering Reports and Other Materials

publicly described as a better strategic place for transmitting short waves. But the problem was that engineers had to ensure perfect synchronization and almost instantaneous communication transfer, so that the stations in Germany and Portugal could broadcast simultaneously.

In this case, it was impossible to connect the editorial studio and the transmitters with wired line (such as Munich-Biblis). Therefore, RFE established a high frequency radio relay system capable of transmitting the entire program output from Munich Studios to Portugal in all five "target languages." This system consisted of 10 kW transmitters, which maintained a so called "trunk channels" operation with three separate short wave frequencies. The RFE engineer, Russel Geiger, explained that "this duplication of facilities insured satisfactory reception of the program material at Lisbon even under extremely unfavorable conditions which frequently result from atmospheric, jamming, and interference from other services." [64] This was the reason why the receiving stations monitored the radio relay line between Germany and Portugal[65] with the same precision, with which they heard the signals from the stations behind the Iron Curtain.

Once passed across the relay line, the signal reached a special receiving station at Maxoqueira, Portugal (32 km east of Lisbon). The only function of this point was to check the quality of the signals arriving from Germany. This station revealed the sense of the radio jargon "trunk channels" of three frequencies: a receiver operator in Maxoqueira chose the best out of three signals. If he considered the sound as clear, it was transmitted by short wave broadcast towards Lisbon, the next point of the operation. If not, the team at Maxoqueira could ask their colleagues in Germany to set better frequencies and send back the same material for radio transmission (again multiplied by three relay lines between

[64] Ibid.
[65] Ibid.

Germany and Portugal). In some periods, such changes of frequencies reached 1000 per month.[66]

The transmission station in Gloria (Portugal) was the most powerful system in the whole radio operation and it was maintained by a local affiliate corporation called RARET (Sociedade Anonima de Radio Retransmissao). Between the receiving station in Maxoqueira and the towers in Gloria there was an intermediate unit - the studio in Lisbon, where the administrative headquarters of RARET were. 450 people worked in the building, most of them were Portuguese, but there were also Americans coordinating the process by 16-hours Teletype connection with the main offices in Munich. [67] The studios in Portugal were equipped with three types of rooms: editing-monitoring, recording studios, air-shift. The first type of activity was related to tuning up the sound from Maxoqueira and adding last-minute changes in the program content. The second step was sound recording on magnetic tape in case of any technical problems. Air-shift personnel at the studio, lastly, were in charge of the final forwarding of broadcast materials to the transmission site in Gloria. [68]

From Portugal, the first voices were sent into the ether on July 4, 1951 when the mobile transmitter "Barbara" laid the foundations of the station in Portugal taking its last trip before it was eventually shipped back to the US ten years later.[69] On December 24, 1951 the station already had a 50 kW short wave transmitter, and by February there were two others. [70] By 1957, Gloria already had a "vast web" of 13 transmitters for shortwave broadcasting. RARET maintained the most complex and fast growing devices in the entire

[66] Paul Greenmeyer, "Radio Free Europe's Broadcast Operation. Part Two: RFE Installations in Portugal," *Broadcast News* 95 (June 1957), 55. http://www.americanradiohistory.com/Archive-RCA-Broadcast-News/RCA-95.pdf (Access date: May 11, 2015).
[67] Ibid. 58
[68] Ibid.
[69] W.H. Moffat, Engineering Department Report for January 1960, February 5, 1960 in HU OSA Archive, Funds 298, Subfunds 1, Series 3, RFE Correspondence: Engineering Reports and Other Materials.
[70] Russel Geiger, Memorandum, January 1955 in: HU OSA Archive, Funds 298, Subfunds 1, Series 3, RFE Correspondence: Engineering Reports and Other Materials

system. To visualize this rapid development, it is enough to see the chronological inventory of the infrastructure within the first 3 years. The list, stored in the RFE archive, includes numerous details including buildings, where employees lived, and a monument commemorating the mission of the station in Portugal.

Date of Inception or Completion	**Description of Facility**
July 4, 1951	7 ½ kw short wave transmitter (Barbara) 2 rhombic antennas VHF radio relay equipment
August, 1951	2 Triple Diversity Exalted Carrier Single Sideband Receivers 3 Rhombic Receiving Antennas to receive from Germany and 3 to receive from New York
December 24, 1951	50 kw Short Wave Transmitter
Early 1952	Transmitter building Studio building - 1 master control, 4 control rooms, 12 studios 4 rhombic antennas
January 1952	50 kw Short Wave Transmitter
February 1952	50 kw Short Wave Transmitter
February 27, 1952	50 kw Short Wave Transmitter
July 1952	Housing project at transmitter site
November 11, 1952	Addition to transmitter building Two 50 kw Short Wave Transmitters Dedication of monument commemorating NCFE - Portuguese operation
December 12, 1952	1 Triple Diversity Exalted Carrier Single Sideband Receiver
December 15, 1952	2 Triple Diversity Exalted Carrier Single Sideband Receiver
December 20, 1952	50 kw Short Wave Transmitter
December 25, 1952	50 kw Short Wave Transmitter
April 1953	60 kv, 10,000 kva power line
June 1953	1 Rhombic Antenna for use with 3 kw Cue Transmitter
July 1953	3 kw Cue Transmitter
November 1953	Building at transmitter site
December 24, 1953	Addition to transmitter building
December 25, 1953	100 kw Short Wave Transmitter
February 24, 1954	2 - 100 kw Short Wave Transmitters
September 1954	3 kw Cue Transmitter

Fig. 1.2.2. The rapid development of the system of Radio Free Europe in Portugal between 1951 and 1954. Some of the dates are described as "approximate."[71]

The operation did not stop with sending sound into the ether. Once the signal was conveyed via short wave, the radio crew received the task to evaluate to what extent the

[71] Geiger, Memorandum, January 27, 1955 in: HU OSA Archive, Funds 298, Subfunds 1, Series 3, RFE Correspondence: Engineering Reports and Other Materials.

voice of broadcasters was really heard behind the Iron Curtain overcoming all obstacles in the infrastructure, the natural conditions, and most importantly, as I will explore later, jamming. In order to evaluate the final product of its own radio operation, RFE installed three stations for technical monitoring in Berlin, Vienna and Istanbul. (The station in Turkey operated until April 1957.)[72]

I will return to this last and crucial element of the technical infrastructure in the next chapter, where I will discuss the importance of noise for radio technician's daily practice. But before that, I will look more closely at the process, described above, in order to identify the external actors in the operation, as well as some of the most important objects from the equipment of RFE's monitoring, relay, and transmission stations.

1.3. Objects and External Companies as *Internal* Components in the System

We have already reconstructed the main geographical sites, technical objects, and links in the technical infrastructure of Radio Free Europe. We can thus see the main places and material components of the formation which in the 1950s was called a "network" or a "system." One of the main points in the engineers' accounts is that the transmission of radio signal was only one of numerous elements in Cold War radio broadcasting.

Engineers paid special attention to the monitoring stations, which contributed to the accumulation of information.[73] Key actors, across the entire system of communication between different locations, include: sound recording machines, magnetic tape, and teletype machines, without which recording, transcribing, and circulating of information would have been impossible. Sending information between different points of the radio system

[72] Engineering Department, Annual Report, May 8, 1957 in: HU OSA Archive, Funds 298, Subfunds 1, Series 3, RFE Correspondence: Engineering Reports and Other Materials.
[73] Media information was used not only for propaganda messages, but also in intelligence analyses. Concerning the monitoring and research capability of RFE/RL Ross Johnson writes that "the CIA early became a consumer of rather than the source for this information". A. Ross Johnson, *Radio Free Europe and Radio Liberty*. The CIA Years and Beyond (Stanford, California: Stanford University Press, 2010), 43.

depended on telephone wires, radio micro waves, transatlantic wireless connections between the United States and Europe. I will explore some of these components, their pre-history and role in the Cold War, thought it is impossible to cover all heterogeneous elements. Using concrete examples from technicians practice, I will examine the role of external institutions and specific technological objects as key elements in the radio machinery.

1.3.1. Communication links

An example from the engineering records shows the radio infrastructure in action. Engineers observed and controlled all the communication links, not only in abstract categories, but also as a physical, tangible part of the entire operation. Though invisible for outside observers, for the engineers, each wired or wireless connection between different radio locations was a matter of concern, scientific interest, observations, and calculations.

On February 13 1964, the engineering department observed closely the path of a signal sent from America to Eastern Europe. They were asked to publish their practical experience for propaganda purposes during the campaign Crusade for Freedom. On this particular occasion, a new 250 kW transmitter was inaugurated and celebrated with a special event. The RFE decided to do an experimental transmission from Los Angeles to Budapest to see the complexity of the entire operation and to impress the audience.

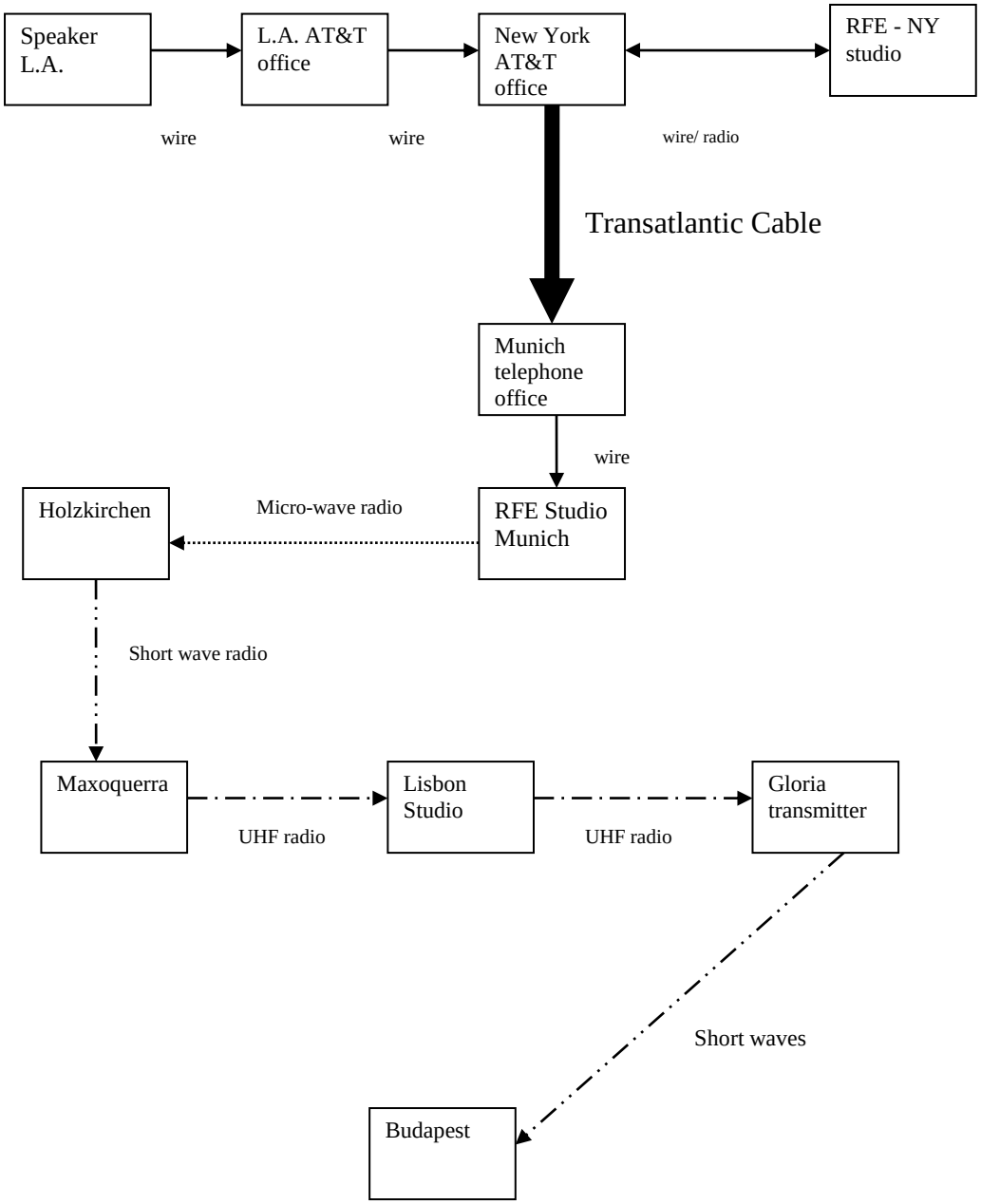


Fig.1.3.1. The Engineering Department observed the signal from LA to Budapest on February 13, 1964.

In this case, radio engineers were asked to calculate the path of the radio signal from a distant point, Los Angeles: "since the Atlantic cable was used, the total length of wire and cable circuits probably amounted to more that seventy - five hundred miles. Total radio-

circuit distances was in excess of twenty - seven hundred miles. It was controlled and monitored at at least seven different points within the RFE system, alone, and was supervised additionally by AT&T engineers in the United States and Deutsche - Post personnel in Germany." [74] In this case, radio waves passed through external radio institutions. The signal was also transformed into several different modalities before reaching the Eastern bloc: telephone wires, transatlantic cable, short waves with different frequencies.

Detailed knowledge of all communication links was essential for the engineers, because if, for instance, there was a breakdown in the German Posts, the whole operation might collapse. Such "surprises" were expected daily by the engineers who kept strict statistics on the times when an interruption of internal communication was caused by external actors. Each month, in a column called "Outages" engineers entered the total time with technical interruptions in Germany. The issues were reported monthly to the German Post, whose task was to maintain the main communication lines: Munich - Holzkirchen (relay line) and Munich - Biblis (transmitting line), because there was a direct link from the studio to the transmitters and each problem could cause severe damage to the broadcasting program. In January 1967, for instance, there were five interruptions lasting 51:39:00 hours in the former line and 8 interruptions lasting 1:10:00 hours in the latter. Certainly, this did not mean that at this time the radio was not heard by the listeners behind the Iron Curtain because another main radio component was sound recording.

[74] John Patterson, Thumbnail Description of the Program Circuit, Los-Angeles - Hungary on the occasion of the inauguration of new 250 kw transmitter in Portugal (13 February 1964), 24 February 1964. in: HU OSA Archive, Funds 298, Subfunds 1, Series 3, RFE Correspondence: Engineering Reports and Other Materials The person behind this idea is John Patterson, Crusade for Freedom's executive president. On his role in the campaign see: Richard H. Cummings, *Radio Free Europe's "Crusade for Freedom": Rallying Americans Behind Cold War Broadcasting, 1950-1960* (Jefferson, N.C.: McFarland & Company, Inc., 2010)., At that time, RFE's audience received advertising messages that the radio was funded by charitable funds and ordinary people could contribute to its mission

1.3.2. Magnetic tapes

First, not all radio programs were broadcast "on air" like in the propaganda campaign, described above. Most of the programs were recorded in the studio and put on "stand-by" on magnetic tape, ready to be played; therefore, they were not "transported" every time through the postal and wireless lines. Even in live broadcasting, in case of technical problems that directly affected the transmission, there was a backup plan. The studios in Lisbon had tape-recorded music at hand. Thus music was aired immediately until all technical noises were removed. While these small failures in the system were repaired, radio listeners heard music which was not intended to sound at that particular time.

RFE staff used an impressive amount of magnetic tapes. Thousands of blank tapes were issued every month. In July 1966, the radio received 3840 blank tapes, and 4120 in August the same year.[75] This is a random example that illustrates the approximate range of used empty reels. So far, we have seen two of the main functions of magnetic tapes: recording radio broadcasts and monitoring of foreign radio stations.

But there was a third feature that makes them even more significant for the political context of the Cold War. In the late 1960s, the radio had 9 field offices,[76] from which the RFE team received information from different parts of Europe. Robert Holt called the field offices "micro-RFE-Munich for collecting news and information": "Each is headed by a correspondent, usually an American. They ranged in size from the small organization in Istanbul, where there was an interviewer and a typist in addition to the correspondent, to the large offices in Vienna, London, and Athens, where there were nine to twelve full-time employees."[77] One of these units' key tasks was to record and send full-length interviews

[75] Monthly Technical Reports, July 1966 and August 1966 in HU OSA Archive, Funds 298, Subfunds 1, Series 3, RFE Correspondence: Engineering Reports and Other Materials
[76] Monthly Technical Report, December 1966, HU OSA Archive, Funds 298, Subfunds 1, Series 3, RFE Correspondence: Engineering Reports and Other Materials.
[77] Robert Holt, *Radio Free Europe*, 104.

with refugees and travelers from the Eastern Bloc. Therefore, strategic points of Europe were selected: "Istanbul was the major source for Bulgarians; in Athens (and its branch office in Salonika), Bulgarians and Rumanians were available (...) Graz, Salzburg, Vienna, and Munich were congregating points for newly arrived Hungarians and Czechs, and refugee camps."[78]

In order to maintain information gathering and communication between so many points of Europe, they needed a special, reliable solution. In this case, magnetic tapes, sent by mail were essential. In December 1966, for instance, the radio received 200 magnetic tapes from London and 102 tapes from Paris. In smaller offices, the number was lower: 17 tapes were sent from the Stockholm head office in Munich, while 21 arrived in Munich from Vienna.[79] These tapes stored a vast amount of information that was transcribed with typewriters and, eventually, archived in documents. Every month, hundreds of reels were also shipped from the main office in New York to Munich. In this case, magnetic band always provided clear sound.

1.3.3. Teletype

Communication between New York and Munich depended mainly on wireless technology called teletype or teleprinter. This crucial wireless link was leased by an American company called Press Wireless. The engineering archive keeps the tariffs of the contract with the company from 1960, when the radio used two sending and receiving radio teletype channels between New York and Munich, for a minimum of six hours per day, six days per week. [80] Every hour was paid: $ 10,50 per hour for two transmitting channels (twinplexed) and $ 1,50 per receiving channel, per hour. After the six minimum hours daily,

[78] Ibid, 104.
[79] Monthly Technical Report, December 1966. HU OSA Archive, Funds 298, Subfunds 1, Series 3, RFE Correspondence: Engineering Reports and Other Materials.
[80] Georgi L. Graveson, Memorandum, 29 March 1961 in HU OSA Archive, Funds 298, Subfunds 1, Series 3, RFE Correspondence: Engineering Reports and Other Materials.

the radio might continue to use this communication channel for $ 6,00 per hour for one transmitting channel and $ 4,50 for a second channel.

Accessible communication tariffs were directly related to the establishment of Press Wireless Inc. The company was founded in 1929 when several newspapers invested in a new wireless technology for international news exchange in order to reduce their expenditure for the same service provided by transatlantic cable telegraph companies. New York Times, New York Herald Tribune, and Chicago Tribune were among the main investors in this company for transatlantic wireless exchange of information. [81]

Radio Free Europe signed a contract with them not only for financial considerations. There was another aim that coincided with an older American military strategy. Press Wireless precisely was among the communication companies which were "mobilized" during World War II when cutting transatlantic telegraph cables was a well-known military strategy.[82] The alternative wireless line was thus used for international communication between the US and the military fronts in Europe. The army used the Press Wireless' pioneering service of combining simultaneously transmission of text (400 words per minute) and telephone, called in the pre-war years "moduplex." [83] The crucial aspect in this wireless form of communication was the possibility of installing cipher machines for transmitted secret military text information.[84]

Even before the implementation of wireless military cryptography, the technical dream of private communication was embedded in the teletype history. This was the dream

[81] Press Wireless history is discussed in two reports on the problems of international communications published by UNESCO in the 1950s: Francis Williams, *Transmitting World News: A Study of Telecommunications and the Press* (Paris: UNESCO, 1953) and *The Problems of Transmitting Press Messages* (Paris: UNESCO, 1956).
[82] Daniel R. Headrick, "Strategic and Military Aspects of Submarine Telegraph Cables, 1951-1945," in Bernard Finn and Daqing Yang (eds.) Communications under the Seas. The Evolving Cable Network and Its Implications (Cambridge, MA: The MIT Press, 2009), 200.
[83] Press Wireless, *Chicago Daily Tribune*, January 30, 1945. Source: Chicago Daily Tribune digital archive. Permanent link: http://archives.chicagotribune.com/1945/01/30/page/8/article/press-wireless (Access date: May 11, 2015).
[84] One type of cipher machines for wireless communication was the famous Enigma used by the German army. See Daniel R. Headrick, Strategic and Military Aspects of Submarine Telegraph Cables, page 199.

of eliminating the intermediaries and possible interferences between two separate persons. Until the late 1920s, telegraph and telephone lines had operators who provided contact in the lines and practically knew what the message was. After the introduction of automatic switches, there was no need for telephone operators, but the telegraph lines still used important "personal" links in the communication chain. In the 1920s, the telegraph's mechanical alternative was envisioned in technical projects for "start-stop telegraph printer, provided with a typewriter keyboard and requiring only momentary synchronism." [85] In 1925, *The Journal of Electrical Engineering* published an account that reviews the teleprinters' high expectations:

> In the course of years this new development will have a revolutionary effect on telegraph offices, which will become automatic switching exchanges, very like an automatic telephone exchange, and the telegraph operators, like the telephone girls, are doomed to disappear, and their places will be taken by a few engineers and mechanics wandering about in the deserted operating rooms, looking after the telegraph-switching apparatus.[86]

The idea of private and instantaneous personal correspondence was gradually fulfilled through laboratory experiments in the 1930s, when Bell Labs invented the first device for direct communication between two points, which combined the functions of telegraph and telephone without intermediate units, later called teletype of telex. It was based on the older invention of automatic switches which eliminated the human telephone operators in the 1920s. The second level of innovation was the theoretical assumption (developed again at Bell Labs), which showed that "text, speech, and images could be treated as equivalent when transmitting them down a wire." [87] In the early 1930s AT&T introduced teletypewriter service, which for the first time fit different types of signals in one

[85] Alvin F. Harlow, *Old Wires and New Waves: The History of the Telegraph, Telephone, and Wireless* (New York, London: D. Appleton Century Company Incorporated, 1936), 505.
[86] Don Murray, *Journal of Electrical Engineering*, 1925 quoted in Alvin F. Harlow, *Old Wires and New Waves*, 505.
[87] David A. Mindell, *Between Human and Machine. Feedback, Control, and Computing before Cybernetics* (Baltimore: John Hopkins University Press, 2002), 131

"converging communication system." [88] Though the principle of signal transmission changed throughout the years, some infrastructural elements of teletype were embedded in the infrastructure of the early computers, specifically in keyboards.[89]

Teletype, this peculiar technological "fossil" in the history of communication, which combined the old technology of the telegraph and telephone, replaced by sophisticated fax machines and computers later, was particularly important for radio communication during the Cold War: to transmit ciphered written signals over long distances without intermediaries meant first and foremost - secret communication, at least, at that specific historical period. Furthermore, the printed text had the status of a document.

Fig. 1.3.3. The teletype machine is in the center of this picture showing the workflow at RFE. Source: OSA Archive.

There were two main reasons for using teletype service: press information from the global news flow and secret interpersonal communication.* Teletype perfectly fit RFE as a

[88] Ibid, 136.

[89] Teletype keyboards standards were implemented in the first computers. An example was ASR-33 Teletype, a device which had a keyboard standard "QWERTY" and some keys such as ''Control'' (CTRL) and ''Escape'' (ESC) keys, which later became standard for desktop computer keyboards. The ''@'' symbol (Shift - P) was later adopted for indicating addresses on the Internet. Paul E. Ceruzzi, *A History of Modern Computing*, (Cambridge: The MIT Press, 2003), 134.

*Most of the teletype printers, used by RFE, were produced in the United States. However, in 1950s, in Germany, some offices were equipped with similar machines produced in Germany called Hellschreiber. They

professional Cold War media, financed by the CIA. Thousands of teletype messages were exchanged between various points of the RFE system, reaching over 4000 monthly in the late 1960s. According to the monthly technical reports, the largest amount of messages was exchanged between the central offices in New York and Munich. In November 1966, for instance, 1945 messages were sent between the two offices. The reports keep strict statistics for each message, which were divided into two types: non-classified and classified. The classified correspondence for November 1966 consisted of 215 messages.[90]

Teletype service was used not only between the two main offices, but also to forward news from the central monitoring station into the newsrooms in Germany (in this case Teletype service was provided by the German Post, again for a monthly fee). The RFE engineers installed teletype machines in separate rooms. They used separate machines for each specific type of messages. Otherwise, it was impossible to control the huge flow of information. There was a separate teletype for each of the key Western news agencies such as Associated Press[91] and DPA[92] (Deutsche Presse-Agentur). Every installation required specific settings, because the information flow needed similar settings for the sending and the receiving printer, which must be synchronized according to a specific frequency and a certain speed of sending and receiving text. Otherwise, the flow of information could be interrupted.[93]

were used in German military communication during the Second World War. Robert Holt, the first RFE researcher, published a precise technical description in his book on RFE: "It is a long-distance, slow-speed transmitting and receiving system that can be used on short, medium, and long wave. In use, the Hellschreiber is connected connected in place of the loud-speaker to the output of a communications receiver. Special signals activate the reproducing head located in the recorder unit. Narrow paper tape passes between the head and a rotating inked drum. Various combinations of pulses produce printed letters on the moving tape. Thus, complete words are spelled out along the length of the paper strip."

[90] Based on Monthly Technical Report, November 1966 in HU OSA Archive, Funds 298, Subfunds 1, Series 3, RFE Correspondence: Engineering Reports and Other Materials.

[91] Monthly Technical Report, July, 1966 in HU OSA Archive, Funds 298, Subfunds 1, Series 3, RFE Correspondence: Engineering Reports and Other Materials

[92] Monthly Technical Report, May, 1967 in HU OSA Archive, Funds 298, Subfunds 1, Series 3, RFE Correspondence: Engineering Reports and Other Materials.

[93] Monthly Technical Report, July, 1966.

1.3.4. Antennas

The last example in this chapter will explore the amalgam between objects, engineers, and external companies, using one of the most popular objects in broadcasting - the antenna. The construction of a precise antenna system was crucial in the process of obtaining information from behind the Iron Curtain. Antennas were not merely installed, but required technical research and a constant practical work of trial and error.

One example was the use of an antenna system for better reception of stations from Czechoslovakia, Hungary, Poland, and Romania from June 1966. The RFE technicians called it 2-Bay-Yagi antenna for high-frequency reception. Yagi type antennas are a classical device in radio electronics. They were invented in 1926 by H. Yagi and Shintaro Uda. [94] Since them, this antenna's image became archetypal (see the illustration of monitoring facilities on Fig.2.1.). In its most basic form, the antenna looks like a metal base supporting structure with parallel metallic elements. The inventors, Yagi and Uda, had found that, in this way, antennas capture radio signals much better because the numerous elements serve as directors and reflectors, which enhance radiation from a particular direction.

Although the appearance may look simple, in practice, it offers endless possibilities for improvement because it consists of multiple variables: parasitic element diameter, element length, spacing between elements, supporting booms of different cross sectional area, various reflectors, and overall length.[95] Any shift, even one millimeter, affects signal reception. Over the years, the structure of these early 20th century antennas, was constantly being improved with numerous experiments. Many modifications were introduced both by

[94] National Bureau of Standards, Technical Note 688, Peter P. Viezbicke, Yagi *Antenna Design*, December, 1967, Time and Frequency Division, Institute for Basic Standards. U.S. Department of Commerce, http://tf.nist.gov/general/pdf/451.pdf (Access date: May 9, 2015).
[95] Ibid.

radio amateurs and high level technicians. An example of the latter is a report by NASA, from 1965, which specifically deals with the arrangement of a Yagi-type antenna with parallel disc elements that could receive signals from space. [96] For the engineers at the radio, such type of research activities was a part of their daily routine which determined the quality of the signal received from behind the Iron Curtain.

But this does not mean that monitoring devices were left only to RFE's own efforts. Calculation for the most efficient transmitter signals and new antennas were delegated to external companies, one of which was Motorola. Stations at Schleissheim and Moosburg had special antenna rooms supplied with Motorola equipment. [97] Motorola was one of the main suppliers of military radios in the US and it was not a coincidence that it was actively used in Cold War monitoring. This was a company with extensive experience in military sponsored research during WWII. One of the most famous inventions of the company was the mobile and portable two-way radio communication used by soldiers on the front lines. [98] In the postwar years, Motorola continued its production of precise radio elements. Among its clients was Radio Free Europe.

[96] Fred B. Beck, *A Method for Arraying, Yagi-Disk Antennas* (Washington, D.C.: National Aeronautics and Space Administration, 1965).
[97] Monthly Technical Report, January 1967 in: HU OSA Archive, Funds 298, Subfunds 1, Series 3, RFE Correspondence: Engineering Reports and Other Materials
[98] On Motorola's history, see: Daniel Holbrook, Wesley M. Cohen, David A. Hounshell and Steven Klepper, "The Nature, Sources, and Consequences of Firm Differences in the Early History of the Semiconductor Industry," *Strategic Management Journal, Special Issue: The Evolution of Firm Capabilities* (Oct. - Nov., 2000), 21 (10-11): 1023

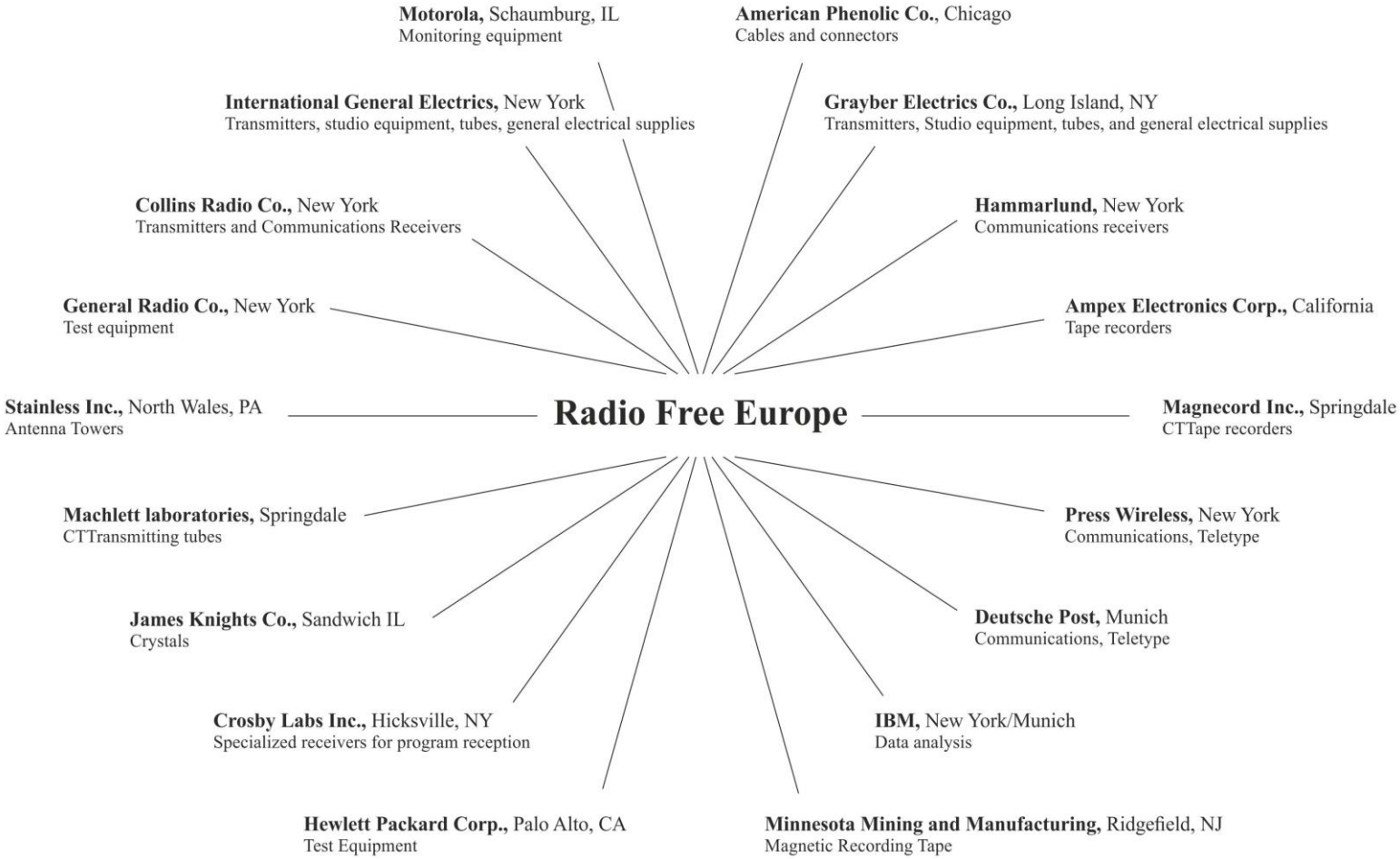


Fig. 1.3.4. These are some of the companies which worked closely with RFE.[99]

[99] This diagram is based mainly on Geiger, Memorandum, April 4, 1955 in HU OSA Archive, Funds 298, Subfunds 1, Series 3, RFE Correspondence: Engineering Reports and Other Materials. Some of the companies are based on Monthly technical reports.

Conclusion

In its everyday technical operation, Radio Free Europe included multiple institutions and specific key technological objects that determined the whole Cold War broadcasting practice. But there were no other professionals, besides engineers, that were interested in registering as precisely as possible the whole propaganda operation. They learned from experience that a technical error in one unit can affect the entire system.

I began this chapter with the problems in my own intuitions about the technical aspects of the RFE, which included the term "network". I was not alone: as a self-evident term, the same metaphor appeared in propaganda messages and official administrative documents from the CIA and The Board for International Broadcasting. From the archives of the Engineering Department, we can see the practical dimensions of a phenomenon that was described as a "network" throughout the Cold War era.

From the engineers' accounts, we have seen that he propaganda war generated its own technical geography of specific key geographical places which gained political importance because of their role in the radio infrastructure. The engineering practice combined strategic points such as Lisbon, Biblis, Holzkirchen, Maxoqueira, and Moosburg. Technology, geography, and politics of the Cold War were interrelated in a complex constellation, in which even seemingly peripheral places gained crucial importance. Moosburg ensured clearer sound for receiving information behind the Iron Curtain. Holzkirchen and Maxoqueira were seemingly auxiliary plants, but without them it was practically impossible for the signal to reach "the powerful transmitters in Lisbon." These detailed accounts of concrete places contribute to our understanding of the practical dimensions of the process of global communication and technology in general. Authors such as Alexander Badenoch and Andreas Fickers write about the political significance of

"broadcasting geographies", in which "new technologies constantly emerged during the Cold War, permanently and perpetually changing the broadcasting geographies of Europe. The notion that there were two self-contained blocs that were sharply demarcated by the material borderline of the Iron Curtain is insupportable when considering the field of broadcasting. Even within the blocs, broadcasting spaces were not homogeneous."[100]

Concerning the problem of geography in the process of radio broadcasting, engineering practice gives us a valuable insight into the significance of places. The work of the radio technicians, who were "inside" transmission technology, required areas that were directly related to very specific, seemingly "too technical" aspects before the final act of radio transmission behind the Iron Curtain. Engineering reports thus enrich our understanding of global technology. In the technical operation seemingly marginal places gained crucial importance. Such places could be very easily omitted because technology, especially when it is new, seems emancipated from space or concentrated in a small space.[101] But the technical work of the engineers generated stable connections between significant and not so easily replaceable locations with too specific functions, which gave a key role in the Cold War context even to seemingly marginal places.

Another important technical issue emerging from the engineering archive is that the heavy technical infrastructure was developed around various technological policies, starting with gathering information from behind the Iron Curtain, maintaining secret internal communication, and sound transmission to "target countries". Each of these elements, in turn, depended on communication links and technological equipment provided by external institutions, which were indirectly "mobilized" in the propaganda war. The radio worked

[100] Alexander, Badenoch, Andreas Fickers, Christian Henrich-Franke, *Airy Curtains in the European Ether. Broadcasting and the Cold War* (Baden-Baden: Nomos Verlagsgesellschaft, 2013), 362.
[101] The importance of geographical places is one of the problems that could be easily missed in analysis of science and technology. An important contribution to the debate about the importance of the places in technology and science give authors such as Christopher Henke and Thomas Gieryn see: Christopher Henke and Thomas Gieryn, "Sites of Scientific Practice: The Enduring Importance of Place," in Edward Hackett (ed.) *The Handbook of Science and Technology Studies* (Cambridge: The MIT Press, 2008).

with companies such as RARET, Press Wireless, Deutsche Post, and Motorola. Many key functions were delegated. In specific daily practice, RFE was primarily a collective player, composed of a whole amalgam of foreign companies.

Looking closely at this complex technical infrastructure, we have seen that, at a micro level, the propaganda operation involved specific technological objects that also became integral parts of the Cold War visions, discussed above. Special antenna equipment contributed to better signal from isolated radio stations from the Eastern Bloc, while teletypes ensured vital secret communication. International exchange of magnetic tapes synchronized the information from the field offices whose task was not only to provide interesting news, but also to conduct interviews with refugees and travelers from Eastern Europe.

Dealing with thousands of objects required specialized practical knowledge used by a specific group of people - the engineers. The Cold War was usually associated with secrecy, but even the routine work of the engineers was to a significant extent hidden to the other participants in the operation. Not so much because it was difficult to understand, but because all these elements were taken for granted. For the engineers, the most routine activity was only the final goal. Before a routine transmission of sound, they investigated, monitored and mastered a global communication system. Keeping in mind all these technical efforts, we can proceed to the heart of the technical problems of the Cold War: jamming. In other words, we can move from the specificities of the infrastructure to specificities of action. Cold War action was both routine and surprisingly unpredictable and involved other crucial components.

2. Observing Disturbing Sounds: Noise as an Object of Research

Jamming was one of the most tangible aspects of the propaganda war.[102] Behind Cold War transmission towers and jammers, hundreds of technicians constantly observed the actions of their "enemies" - colleagues behind the Iron Curtain. This chapter examines the activities of the engineering team at Radio Free Europe amid constant noise. Concerned about signal quality, the technicians differentiated many modalities of interference that became an object of constant observation and research.

Along with jamming sounds, they paid special attention to natural factors causing sound disruptions. The solar activity and dynamic changes in the ionosphere were tested in order to predict unavoidable atmospherics. As we have seen in the previous chapter, even unforeseen circumstances in their own radio infrastructure, which relied on many external actors, also "produced" unwanted noise. Interferences, caused by clashes of two Western radio stations also caused unclear signals in the increasingly crowded radio spectrum of 20th century Europe.[103]

Following engineering reports, we can acquire specific sensitivity to all these aural modalities. The main task of this chapter is to trace the role of noise in everyday broadcasting practice. And in the context of the Cold War this was not just noise, to

[102] Jamming is also a well-known military technique: "International radio jamming is extensively used during periods of armed conflict. It began in World War I and has continued, as techniques and counter-techniques improve, after every war thereafter." George Woodard, "Cold War Radio Jamming," in A. Ross Johnson and R. Eugene Parta, eds., *Cold War Broadcasting: Impact on the Soviet Union and Eastern Europe: A Collection of Studies and Documents* (Budapest: Central European University Press, 2010), 52.

[103] One of the main tasks of the Engineering Department was to maintain a strict schedule for the adjacent frequencies in the European radio spectrum. Special schedules and licenses were provided by the International Frequencies and Registration Board (IFRB) at the International Telecommunication Union (ITU). Since RFE had licenses to transmit using many different frequencies, they often interfered with radio channels from Western Europe. The archive keeps such examples of frequencies "clashes" between RFE and Radio Nacional (Spain), Deutschland Funk (Germany), Radio Limoges (Marseilles, France). On the problems with the radio spectrum in Cold War broadcasting see: Robert S. Fortner, *International Communication. History, Conflict, and Control of the Global Metropolis* (Belmont, California: Wadsworth Publishing Company, 1993) 151-173. George A. Codding, *The International Telecommunication Union: an Experiment in International Cooperation* (Leiden: E. J. Brill, 1952).

paraphrase Istvan Rev, who argues that noise does create meaning[104] because the presence of jammers in the ether was a powerful message: "The sound that the East European jammers generated did not simply aim to make the enemy broadcast inaudible. The noise also established and confirmed the presence of the communist authorities in the air, and thus in the private sphere of the secret listener." [105]

Radio sounds had a peculiar ideological and propaganda dimension in the socialist context after mid-1960s, explored by Rossitza Guentcheva who writes about "anti-noise concerns"[106] in Bulgaria. One of the recommendations of medical specialists, used for propaganda purposes, was to reduce the loud noise which "affected workers' reproduction* outside of the workplace."[107] Thus, the loud playing of radio at home was considered among the negative activities according to the ideological "notion of the socialist way of life."[108]

On the other side of the Iron Curtain, ideological dimensions of noise were embedded in laboratory work, which constantly reminded the RFE's team that they were involved in a propaganda "war", that they should constantly improve their technical skills and practical knowledge in order to achieve political purposes. Using the archive of the technical department, we can trace the way noise affected RFE's employees and contributed to the development of the whole radio infrastructure.

I will explore the work of the engineers related to the scientific research of the quality of their own radio, as heard from behind the Iron Curtain, aiming to understand why

[104] István Rév, "Just Noise? Impact of Radio Free Europe in Hungary," in: A. Ross Johnson and R. Eugene Parta, eds., *Cold War Broadcasting: Impact on the Soviet Union and Eastern Europe: A Collection of Studies and Documents* (Budapest: Central European University Press, 2010), 244 Jacques Attali's notion of noise is significant in understanding the role of noise in Cold War broadcasting: "A network can be destroyed by noises that attack and transform it, if the codes of the place are unable to normalize and repress them." (The quote is from Jacques Attali, Noise: The Political Economy of Music (Minneapolis: University of Minneapolis Press, 1985), 33. quoted in Istvan Rev, "Just Noise? Impact of Radio Free Europe in Hungary.")
[105] Ibid.
[106] Rossitza Guentcheva, "Sounds and Noise in Socialist Bulgaria," in John Lampe and Mark Mazower (eds.), *Ideologies and National Identities. The Case of Twentieth-Century Southeastern Europe* (Budapest: Central European University Press, 2006), 222.
*The author uses the Marxist notion of reproduction which means restoration of the capacity for work.
[107] Ibid.
[108] Ibid, 217.

and how engineers evaluated and predicted, with precise accuracy in percentages, RFE's "effectiveness." What did they understand by using the term "effectiveness" in their everyday work? In this case, my interest is related to the pre-history of the creation[109] of certain numbers and charts, which summarized the quality of the radio signal.

Through research and distribution of large amounts of data, numerous dimensions of sound were carefully analyzed and archived. Sound became one of the most tangible matters for the Cold War engineers. Clashes between two fragile sound waves and sound absorption in the atmosphere became visible phenomena. Microscopic developments of these phenomena mobilized external laboratories, specialized technicians, and powerful computers. During the Cold War, the radio engineers became experts of noise, they "observed" it with practical interest that often remain hidden behind precise numbers, facts and figures.

2.1. Technical Monitoring: From Political Mode of Hearing to Accumulation of Data

> Jamming is deliberate interference with a radio transmission in order to prevent its reaching all or part of the intended audience. Generally, jamming transmitters broadcast signals that sound like intense atmospheric static or interference similar to that cause by electric razors, motors, etc. At times, however, jamming is accomplished more subtly by broadcasting music or other apparently legitimate material on the same frequency as the desired broadcast.[110]

Russell Geiger, the Assistant Director of Engineering at RFE, sent this definition of jamming to other radio departments in order to explain the technical team's contribution to the main political task of the Cold War: "reaching the *intended* audience." Jamming counter-measures" were also used, the most important one of which was "the utilization of optimum frequencies of transmission at all times." [111] RFE transmitted signal on several

[109] Using the term "create", I am not saying that these statistics was fabricated. I am using this word envisioning a whole scholarly, laboratorial, and technical system behind the operation called "Radio Free Europe".
[110] Russel Geiger, Memorandum, August 24, 1955in HU OSA Archive, Funds 298, Subfunds 1, Series 3, RFE Correspondence: Engineering Reports and Other Materials.
[111] Ibid.

frequencies simultaneously in order to overcome jamming in a certain frequency. I will examine jamming as an object of complex calculations during the Cold War. These calculations were part of the official professional characteristics of the Engineering department which was in charge of "special studies concerning jamming."[112] Their professional role was defined not only in technical, but also in political terms because the RFE's engineers had to produce "compilation of data concerning jamming and other counter-measures undertaken by the opposition." [113]

Every technical action, undertaken by "the opposition" was observed closely and registered during a complex research process. The final results of such research were published at the beginning of every monthly technical report under the notion of "average effectiveness." After the first three weeks of September 1966, for instance, there was an average effectiveness of 58.1 % of the operation against 65.4% during the same period of 1965. There were two main reasons for this "loss of effectiveness": the increased interference and a discrepancy in the solar activity. [114] It is important to understand how such a precise figure as 58.1% was formed. Such measurements were collected and processed by technicians and made accessible to numerous radio units.

But such data went beyond purely professional and internal discussions. One example was the propaganda film *This is Radio Free Europe* from 1964. Propaganda experts mobilized the authoritative facts and figures, synthesized by the RFE jamming specialist, claiming that "jamming does interfere with some broadcast, but over 90% of our programs get through to listeners." [115] The problem of quality of sound and transmission

[112] Russel Geiger, Memorandum, August 23, 1957. in HU OSA Archive, Funds 298, Subfunds 1, Series 3, RFE Correspondence: Engineering Reports and Other Materials.
[113] Russel Geiger, Memorandum, Summary of activities of the Radio Free Europe Engineering Department (New York), August 15, 1957in HU OSA Archive, Funds 298, Subfunds 1, Series 3, RFE Correspondence: Engineering Reports and Other Materials.
[114] Monthly Technical Report, September 1966 in HU OSA Archive, Funds 298, Subfunds 1, Series 3, RFE Correspondence: Engineering Reports and Other Materials.
[115] *This is Radio Free Europe* (1964), Hoover Institution, youtube channel, https://www.youtube.com/watch?v=_jyqEB5Q6Xg, (Access date: May 16, 2015).

effectiveness emerged also in the political discussions which directly determined the annual radio budget initially planned by the CIA and, after 1973, by The Board for International Broadcasting (BIB) (see: Chapter 1.1). The link between the radio technicians and the politicized quality of sound became public in 1977 when the BIB engaged, among its members, a director of engineering in order to "address a variety of problems concerning technical quality - ranging from audibility in conditions of jamming to voice quality as affected by various transmission and relay lines."[116] The decision to include a technical expert in the commission was presented as a part of the Board's "primary mission" to assess "the quality, effectiveness and professional integrity of RFE/RL* broadcasting within the context of the broad foreign policy objectives of the United States"[117]

What was the pre-history of sound effectiveness measured with precise rates, which were part of the shared knowledge of the radio team, Cold War politics, and propaganda? Hundreds of pages with precise outcomes from studies of noise are preserved in the radio archives. Noise was evaluated in strict percentages. The task of the historian is not simply to calculate whether these percentages were correct, but to trace the actions of technicians as researchers.

The Cold War specialists in jamming sounds worked in facilities for technical radio monitoring. The main activity of these stations, equipped with antenna systems, was to listen only to Radio Free Europe and to evaluate the extent to which the radio signal was delivered clearly behind the Iron Curtain. These were the people who knew who was prevailing - whether their colleagues from Germany and Portugal or the "opposition" of jammers from Eastern Europe. By 1957, the stations for technical monitoring, financed by

[116] Board for International Broadcasting. Final Annual Report, 1979 (Covering the period from October 1, 1977 to September 30, 1978), page 17. Available at Hathi Trust Digital Library, Permanent Link: http://babel.hathitrust.org/cgi/pt?id=mdp.39015066191662;view=1up;seq=216 (Access Date: May 30, 2015). Copies of these reports were sent to the President of the United States and the Congress of the United States. On the role of the BIB in RFE's history see Chapter 1 and the discussions around the effectiveness of the radio "network".

*Radio Free Europe and Radio Liberty had a common technical staff in 1977.

[117] Ibid.

the budget of RFE, were located in Vienna, Berlin, and Istanbul.* The geographical place was chosen in order to provide a location as close as possible to the five "target countries": Poland, Czechoslovakia, Hungary, Romania and Bulgaria. (See figure 1.2) The program in Polish and Czech was monitored simultaneously from two points: Berlin and Vienna. Hungarian program was checked from Vienna, whereas the quality of Bulgarian and Romanian broadcasting was evaluated in Istanbul. [118] After 1957, the station in Istanbul cease functioning and its tasks were assigned to a new station in Salonica (Thessaloniki, Greece). By the end of the 1960s, in Berlin and Vienna, three persons worked as "technical monitors", whereas two employees were hired at the station in Salonica. [119]

From the documents, available in the engineering archives, we cannot determine whether they worked always together or in shifts, but, judging from the duration of the observing periods and the number of authorized personnel, it is possible that, they worked in shifts and, during one working day, either one or two persons monitored the radio from a specific location. The archive of the engineering department preserves documents from monthly intelligibility reports from the 1960s. The work took place under strict standards in each of the stations. Engineers registered noise in the radio sound using two main types of documents.

The first one was entitled "Intelligibility evaluation." [120] At the beginning of the working day, engineers received sheets with empty tables with two main axes. The first axis depicted 24 hours, starting from 4:00 AM until the next day.* The second axis shows a percentage of intelligibility with six options: 0, 20, 40, 60, 80, and 100%. That table was

*There was also a technical monitoring unit in Munich which was in charge of all technical noises generated by the radio installations during the broadcasting day. 11 technicians worked as technical monitors in Munich.
[118] Radio Free Europe. Intelligibility Evaluation, 1966-1967. in HU OSA Archive, Funds 298, Subfunds 1, Series 3, RFE Correspondence: Engineering Reports and Other Materials.
[119] Monthly Technical Reports, 1966-1967in HU OSA Archive, Funds 298, Subfunds 1, Series 3, RFE Correspondence: Engineering Reports and Other Materials.
[120] The following observations are based on Radio Free Europe. Intelligibility Evaluation, 1966 in HU OSA Archive, Funds 298, Subfunds 1, Series 3, RFE Correspondence: Engineering Reports and Other Materials
* Although the table had space for 24 hours, the technical monitors had specific limited schedule which could not be inferred only from their observations.

multiplied 10 times on each page because the radio broadcast on different frequencies; at the same time thus the program could be heard with different quality on different radio bands. The task of the technicians was to evaluate the percentage of intelligibility for each of the corresponding frequencies. They used pen or pencil inserting small dashes in "percentages" for each hour they listened. It was their responsibility to decide whether to indicate higher or lower percentage of noise. These peculiar skills were important for the whole operation, because at the end of the monitoring shift all these dashes merge into a final curve. Similar curves were formed for different languages and frequencies for radio transmission. At the end of the month, all the data was collected in order to form a single curve for the percentage of radio intelligibility for every "target country."

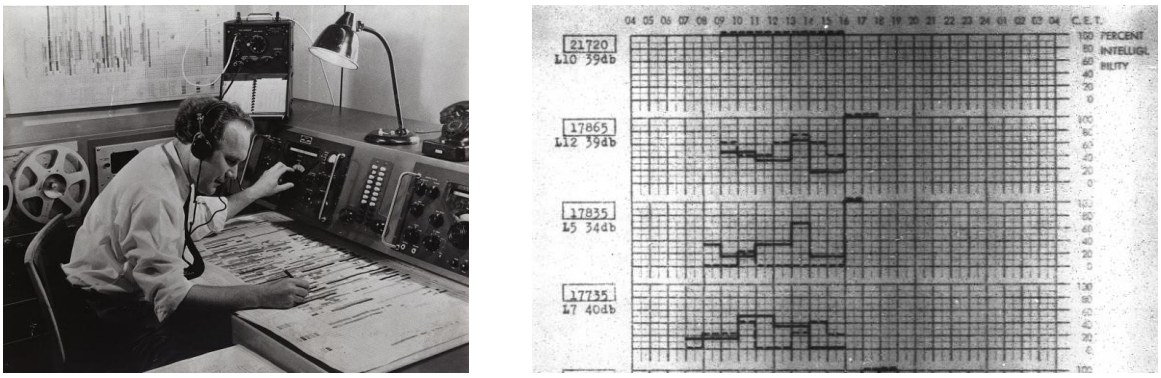


Fig 2.1. Technical monitoring at Radio Free Europe included constant evaluation of percentage of intelligibility which was recorded in graphics. In this archival graphic we can see an intelligibility report for the Polish program transmitted in 4 different frequencies between 19 and 25 February 1967. Source: OSA Archive

The second type of documented study included more information. [121] In a separate document, the so called technical monitors registered specific causes for unclear signals. In this case, the possibilities were not limited to jamming. The study differentiated between 8 types of unwanted noise: jamming, voice, code, heterodyne[122], local man-made noise, low

[121] The following observations are based on Radio Free Europe Reception Reports, 1966 in HU OSA Archive, Funds 298, Subfunds 1, Series 3, RFE Correspondence: Engineering Reports and Other Materials.
[122] This type of noise is part of the everyday selection and adjustment to new frequency for the radio. It is a standard operation in radio frequency electronics called "frequency translation, whereby all the signals in a

or nil signal, atmospherics, other interference. Such a document was typed, using a typewriter.[123] The final result was a detailed list of predominant noises throughout the day. One such list was created after a numerous micro political decisions and statements because, at the end of each month, "it mattered" whether the technicians indicated "jamming" and directly revealed the actions of the machines "from the opposition" behind the Iron Curtain, or typed "local man-made noise" instead, or simply "other interference" or "low or nil signal" which were the most politically neutral terms.

Through these documents, technicians also demonstrated their experience with listening and analyzing types of sounds that an ordinary listener could hardly recognize. Because the listener of the secret radio station was interested in the content of the broadcast, whereas the technical monitors were concentrated only on additional noises. From this peculiar profession, we can learn how many different noises were heard from the secret audience of RFE that imagined Western broadcasting as constantly embedded in a background of jamming sounds throughout the Cold War. These nuances of poor sound quality were constantly in the ether even after jamming stopped, which was the case in Hungary after 1964.[124]

Before proceeding toward the final percentage of intelligibility, the radio team made one final step in their research. They did not rely only on subjective hearing of their colleagues. RFE received "second opinion" from external experts. Similar technical monitoring stations operated in Helsinki and Belgrade sponsored by the US Information

given frequency band are shifted to a higher frequency band or to a lower frequency band. Every spectral component is shifted by the same amount." See: Jon B. Hagen, *Radio-Frequency Electronics: Circuits and Applications* (Cambridge: Cambridge University Press, 2009), 46.

[123] There was one abbreviation for each type of noise. For instance, "J" meant "jamming", "V" - voice.

[124] István Rév, "Just Noise? Impact of Radio Free Europe in Hungary", 245.

Agency, Frequency Division. These technicians did identical calculations for the signal quality of the VOA[125] and sent monthly reports for some of the RFE's programs.

As a result of this activity, the radio accumulated a huge amount of data because information from five stations was collected according to different days, time, languages, place of transmission, multiple frequencies, and type of noise. All this information was sent monthly to the offices in Munich and New York, where the engineering experts were supported by computers for calculating and analyzing large data. The archive keeps a comprehensive document of an IBM analysis for the period of October and November 1954 when, according to the IBM Computer Systems, Radio Free Europe reached over 90% efficiency for each of its languages. [126] Percentages are based on a huge amount of variables. For these two months, for instance, only the station in Berlin observed a total of 2,815 radio frequencies, a number that could not be processed manually. Before examining the role of the so called IBM analysis in Radio Free Europe, I will look more closely at the ionosphere forecasts, the second source of information that, in the 1960s, was impossible to be obtained without a huge calculation machine.

2.2. The Emergence of Precise Ionosphere Predictions through Computer Analysis

In April 1957, Stanley Leinwoll took the position of Radio Frequency and Propagation Manager at Radio Free Europe. In the Engineering department, Leinwoll was in charge of radio propagation analysis and analysis of effectiveness and jamming reports. [127] He worked at the radio office in New York, where he examined all the documents sent by

[125] In one archival letter, technicians from RFE and VOA exchanged instructions about the way certain specific noises should be indicated. See: Stanley Leinwoll, Letter to Martin Cebbecks, February, 1962 in HU OSA Archive, Funds 298, Subfunds 1, Series 3, RFE Correspondence: Engineering Reports and Other Materials.
[126] Ann Case, Reception of RFE, October and November 1954, February 23, 1955 in HU OSA Archive, Funds 298, Subfunds 1, Series 3, RFE Correspondence: Engineering Reports and Other Materials.
[127] Memorandum, June 19, 1957 in HU OSA Archive, Funds 298, Subfunds 1, Series 3, RFE Correspondence: Engineering Reports and Other Materials.

the stations for technical monitoring. He was also entrusted with the task of evaluating the impact of weather conditions in the process of radio transmission.

Applying his solid practical experience, after the end of his career at the radio, Leinwoll published a book called *From Spark to Satellite. A History of Radio Communication*. The book examines the history of wireless communication starting with Guglielmo Marconi to the early American satellites. I will use his book to explain why radio waves are influenced by atmospheric conditions; a phenomenon in which Leinwoll was professionally interested. Certainly, a definition of the relationship between ionosphere and radio waves may be found in many textbooks in physics, but, for the history of Radio Free Europe, it is important to perceive the scientific acumen of a man who worked for many years as a radio propagation analyst and knew the problems of sound in details. Leinwoll defined the importance of the ionosphere with a micro analysis of matter:

> Like all matter, gases are composed of atoms. The atom is a fundamental unit of matter, made up of a positively charged nucleus surrounded by units of negative electricity, or electrons. When each atom has its normal number of electrons, it is said to be neutral. The ionosphere is formed when photons of ultraviolet light and X-rays from the sun bombard these various gas atoms high in the upper atmosphere. (...) The free electrons within the layers can move independently of the surrounding ions, so each layer of ionized gas acts as a metallic conductor and can therefore reflect radio waves to Earth. If the strength of the ultraviolet and X-radiation decreases, the free electrons begin to recombine with the ions in the various ionospheric layers. This process of recombination occurs primarily during hours of darkness, when the ionosphere has been cut off from solar radiation.[128]

To his micro description of matter, Leinwoll adds a drawing of atoms and goes on by describing how the ionosphere varies according to the seasons and parts of the day, depending on solar energy. The engineer pays special attention to the lowest ionospheric layer, the "D layer", with an average altitude of 64 km: "this layer appears during daylight hours only, disappearing during the hours of darkness."[129] The goal of the engineers was to overcome this layer and move to higher ionosphere segments called "F1 and F2 layers",

[128] Stanley Leinwoll, From Spark to Satellite. A History of Radio Communication (New York: Charles Scribner's Sons, 1979), 119-120.
[129] Ibid, 121.

which are at about 100 to 300 miles above the Earth's surface. The problem is that there are negative weather conditions restricting the access to the most effective and high atmospheric layers: "During solar storms, when solar radiation increases tremendously, the D layer absorbs radio waves in the shortwave region of the spectrum, preventing the reflection of the radio waves and thereby causing signal failure on long-range radio circuits."[130] This explains why radio technicians constantly monitored the weather forecasts; in particular, prognoses for solar radiation were important for them to predict days in which bad radio signal was inevitable.

Leinwoll's book was not just an abstract theoretical reflection of a talented engineer: similar discussions about the importance of solar activity were part of the professional correspondence related to financial and political aspects of the whole operation. On April 30 1957, Claude Harris, who was a director of the Engineering department, sent a letter to RFE's director, Conerey Egan. The title of the letter is: *What are sunspots and why are they important to RFE?* [131] The aim was to explain, using serious scientific arguments, but in plain language, why it was important to monitor constant changes in solar radiation and to invest in this activity.

Starting with the fact that the ionosphere undergoes marked variations from hour to hour and even from minute to minute, the engineer explains that "solar radiations are responsible for the presence of the electrons in the various reflecting layers. Variations in solar radiation disturb the characteristic of the ionospheric layers and thereby affect communication."[132] The engineer also includes a picturesque description of the sun in order to introduce a phenomenon called "sunspot": "The sun appears to be in the constant state of eruption with enormous geysers of luminous gas shot from the interior like fire from a flame

[130] Ibid.
[131] Claude Harris, „What are sunspots and why are they important to RFE?", April 30, 1957. in HU OSA Archive, Funds 298, Subfunds 1, Series 3, RFE Correspondence: Engineering Reports and Other Materials.
[132] Ibid.

thrower." [133] A historical argument follows: "The highest sunspot maximum so far recorded is that of 1778 when the average sunspot number was about 189. It is expected that during 1957 the solar activity may thus reach the highest level it has had for at least 200 years", which was a prime matter of concern among the radio engineers in 1957.

Studying atmospheric phenomena in detail, the engineers' task was to predict days with poor signal quality and to adapt the radio propaganda to the best days of broadcast signal. In this activity, the radio depended on forecasts provided by external institutions. In the 1950s, RFE relied on the so called Long Range Forecasts from RCA Communications.[134] A separate forecast for each day of the month was given for daytime and nighttime propagation. Each day was evaluated with: poor, fair to poor, fair, fair to good, and good. In the mid-1960s weather forecasts already become more sophisticated and included the most precise daily factor "sunspot number", heatedly debated among the engineers in 1957. Sunspot numbers, a precise physical quantity, described the intensity of ionospheric storms much better than the vague "fair to poor".

Thus, after 1963, the radio changed its main supplier of weather forecasts using data from The Central Radio Propagation Laboratory (CRPL) at The National Bureau of Standards. The history of the first global ionosphere forecasts from the CRPL can be traced back to World War II. In 1944, the Allied Forces already had 44 stations to monitor atmospheric phenomenon in various parts of the world for the purposes of military radio communication.[135] The CRPL was the American unit in charge of wartime ionosphere analyses. In the postwar years, the laboratory continued to issue information about maximum usable frequencies in megacycles according to the different hours of the day and geographical latitudes. In the postwar years, laboratory instruments to study ionosphere

[133] Ibid.
[134] Radio Free Europe, Memorandum, Long range forecasts, January-December 1956 in HU OSA Archive, Funds 298, Subfunds 1, Series 3, RFE Correspondence: Engineering Reports and Other Materials.
[135] J. H. Dellinger, "The Ionosphere," *The Scientific Monthly* (August, 1947) 65 (2): 117

storms included: laboratory radio waves, recordings of geomagnetism and aurora, meteors analysis, and scientific rockets. [136] Enormous amount of data was accumulated in the laboratory from these different laboratory instruments.

In the 1960s, the laboratory provided the first forecasts designed specifically for external clients, among which was RFE. The possibility of processing large amount of information about commercial radios was the introduction of computers that "allow" such operations. The Engineering department discussed, for the first time, detailed ionosphere predictions based on IBM analysis in 1963. On May 28, Stanley Leinwoll, the radio frequency and propagation manager, distributed a handbook by the National Bureau of Standards. [137] The document shows how to use new ionospheric predictions based on much more information using an electronic computer.[138] Through this technology, the Engineering department was able to obtain more accurate results from the CRPL predictions. Leinwoll emphasized that their colleagues from The Voice of America (VOA) were already using this type of computing in 1963. As he explained: "it took about 4 seconds for the machine to draw a curve for the VOA." [139] This was the first opportunity to obtain precise data on

[136] Ibid, 126.
[137] Stanley Leinwoll, Letter to Russel Geiger, 28 May 1963 in HU OSA Archive, Funds 298, Subfunds 1, Series 3, RFE Correspondence: Engineering Reports and Other Materials.
[138] S. M. Ostrow, an expert from the National Bureau of Standards describes the role of the computers in the ionosphere forecasts: "The basic form of the F2-layer predictions in the new series is a table of numerical coefficients defining a function which represents the world - wide and diurnal variations of an ionospheric characteristic. This function, referred to as the "numerical map" of the characteristic, has the form of finite series of simple terms consisting of elementary functions of latitude, longitude and time, each multiplied by the appropriate coefficient given in the table. Employing these numerical maps, an electronic computer may be used for all computations for a particular problem, the computer performing all the necessary calculations. Additional factors in propagation may be added to the computer program as required. The computer, therefore, makes possible the most efficient and effective application of these predictions. Computer methods are particularly useful for more complicated propagation problems and for quantity production of detailed predictions for large number of circuits. Given the numerical maps, a medium or small size electronic computer is adequate for many propagation problems." See: S.M. Ostrow, Handbook for CRPL Ionosphere Predictions Based on Numerical Methods of Mapping (Washington: National Bureau of Standards, 1962), 1. http://babel.hathitrust.org/cgi/pt?id=mdp.39015003404434;view=1up;seq=2 (Access Date: May 25, 2015).
[139] Stanley Leinwoll, Letter to Russel Geiger, 28 May 1963

"sunspot numbers monthly over any propagation path planned for the five target countries"[140] behind the Iron Curtain.

Computers became a key component in the ionosphere predictions because the prognosis of The Central Radio Propagation Laboratory was based on huge amounts of data from various stations in the world and it was even more difficult to individualize this data to particular "clients" such as RFE. A new element in computers' infrastructure ensured this development. In the late 1950s, storage of data in punch cards gradually became redundant with the implementation of new type of machines.

Fig. 2.2. This picture shows the data processing center at RFE-Munich in the 1970s when the radio technical team installed a new computer for data analyses. The machine was Digital Equipment, model PDP-11, which replaced the older models (with IBM punch cards) used until the 1960s when the radio relied mainly on external institutions for processing large amounts of data.

Their main characteristic was that "instructions and data were stored in the same memory device, from which any datum can be retrieved as quickly as any other.[141] In terms of technical objects, this meant "the use of tape in place of punched cards." "The "Automatic" nature of the machine lay in its ability to scan through a reel of tape, find the correct record or set of records, perform some process in it, and return the results again to

[140] Ibid.
[141] Paul E. Ceruzzi, *A History of Modern Computing* (Cambridge: The MIT Press, 2003), 23.

tape. In a punched card installation, these tasks were performed by people who had to carry large decks of cards from one punched card machine to another. That made punched card processing labor-intensive."[142] Magnetic tapes did not completely eliminate problems in data reading and processing until, in the 1960s, the first disc storages offered rapid and direct access to large amounts of data.[143] These multiple shifts in computers' infrastructure directly affected Radio Free Europe whose engineers were impressed by the new accurate monthly forecasts issued for "4 seconds." Along with the developments of the first mass-produced electronic computers, in the monthly technical reports emerged precise percentages of "effectiveness" of radio broadcast based on accurate analysis of noise and ionosphere forecasts.

Conclusion

Starting from one particular example of percentage of "effectiveness", I traced the pre-history of numbers considering the engineers' practice before publishing such facts and figures that were actively used in Cold War political rhetoric and propaganda. Such technical figures found their place in the shared knowledge of the radio operation through a complex practice and perception - political mode of hearing through which technicians evaluated levels and types of noise. Throughout the propaganda war, engineers developed skills that allowed them to differentiate between numerous modalities of politically nuanced noise: from "Soviet" jamming generated by "the opposition" through natural atmospherics, which were also politicized in percentages of final propaganda "effectiveness", to various other more neutral nuances of human-generated sounds.

[142] Ibid, 30.
[143] Ibid. 200.

This specific type of work accumulated a huge amount of data that was processed by seemingly neutral computer analysis and infrastructure mobilized for the purposes of the Cold War. In his book *Science in Action,* Bruno Latour focuses on the practical work of engineers, introducing his famous concept of a "centres of calculation" proposing sensitivity to the process of "gaining knowledge," [144] to scientific work in a specific historical context and place. Latour pays special attention to the scientific tools and technological objects used in the technical and scientific work. In other words, this means following "the engineers in action." [145] Following the engineers from RFE, we can see how the first electronic computers became an indispensable part of the Cold War laboratory[146] where personnel and machines explored fragile sounds, attacked by many noises. Such scientific observations aimed to achieve irrefutable scientific evidence about the movement of propaganda radio waves behind the Iron Curtain. This laboratory aspect of the Cold War remained hidden behind at least three cultural layers - one is that such calculations of effectiveness were used in discussions about political and financial aspects of the radio operation. Another issue was that propaganda narratives presented the work of engineers on its surface using statistics in propaganda footage. The third problem was that the very engineering activity produced events that remained hidden even for the other participants in radio broadcasts, who, again, had access only to the final monthly rates of effectiveness.

The problem of the Cold War technical geography related to the radio transmission infrastructure, discussed in the first chapter, became more complex with radio sound research. In addition to the radio machines in Germany and Portugal, the radio operation

[144] Bruno Latour, Science in Action. How to Follow Scientists and Engineers through Society (Cambridge: Harvard University Press, 1987), 220.
[145] Ibid, 232.
[146] I use the term "laboratory" in the tradition of the Science and technology studies from the late 1970s and 1980s which approached the laboratory settings not as a place where something "natural" is revealed, in my case this is sound and noise, but as a place of specific scientific or technological work. Among the key publications in this paradigm are Bruno Latour and Steve Woolgar, *Laboratory Life: The Social Construction of Scientific Facts* (London: Sage, 1979) and Ian Hacking, *Representing and Intervening: Introductory Topics in the Philosophy of Natural Science* (Cambridge: Cambridge University Press, 1983)

included geographical locations for studying noise: Vienna, Berlin, Istanbul, Salonika, Belgrade, and Helsinki. All these geographical areas gained importance because from there it was possible to perceive sound from behind the Iron Curtain. Although it sounds obvious, it was otherwise impossible to assess the effectiveness and justify the investment of resources in the entire operation called RFE. In this sense, "legitimate knowledge required legitimizing places"[147] in the complex geopolitical context of the Cold War. Interestingly enough, the sophisticated systems with powerful transmitters simply needed places for better feedback, closer to the Iron Curtain in order to establish a "laboratory environment where it became possible to see things not visible elsewhere."[148]

All these important elements of the propaganda war remained hidden behind everyday actions at the Engineering department, which accumulated facts locked in engineering documents and jargon. However, not everything in the Cold War took place in "centers of calculation" or laboratories. This was an important dimension of the propaganda machinery, but there were moments when the engineers abandoned all graphics and rates, described so far, and switched into a different mode of action which I will examine in the third chapter.

[147] Christopher Henke and Thomas Gieryn, "Sites of Scientific Practice: The Enduring Importance of Place," in Edward Hackett (ed.) The Handbook of Science and Technology Studies (Cambridge: The MIT Press, 2008).
[148] Karin Knorr Cetina, *Epistemic Cultures: How the Science Make Knowledge* (Cambridge, MA: Harvard University Press), quoted in Christopher Henke and Thomas Gieryn, "Sites of Scientific Practice".

3. “Non-routine” Actions in Cold War Broadcasting: Technical Details from the Hungarian Revolution in 1956

I have examined routine scientific research of two well-known modalities of noise: jamming and atmospherics caused by solar activity. But the archive of the Engineering department at Radio Free Europe also keeps information on “non-routine” actions. These were the events that surprised the engineers themselves and altered the rhythm of their daily work sealed behind large amount of technical data. It is important to observe unusual dynamics of the problems of the technical infrastructure and geography, discussed so far, in order to understand Cold War politics and technology in their complexity. There is hardly a better example than the Hungarian revolution in 1956.

In the historical context of the revolution, I will examine strictly technical events, communication maneuvers with radio transmitters, jammers, and mobile antenna systems installed on heavy trucks. In other words, I will endeavor to reach an unusual technical insight into the revolution; to explore the pre-history of some important mediated representations of 1956. Without analyzing media text, I will discuss some important objective prerequisites for the creation of media messages and information.

In the autumn of 1956, the employees of the Engineering department were entrusted with the mission to provide clear radio sound to the revolutionaries. Technically speaking, such efforts were unnecessary. Surprisingly, at the height of the revolution in Hungary, RFE’s greatest concern, the deafening sounds of the communist jammers … disappeared. The radio sounded better than ever before. Meanwhile, the broadcasters in the studios did not know what exactly happened in the chaos of the revolt. They needed “non-routine” technical measures.

In the first days of the New Year, on January 3, 1957, Russell Geiger, assistant director of Engineering, typed a special report summarizing the last 90 days of "non-routine operating activities of RFE Engineering Department centered about the developments in Hungary and the special production and broadcasting requirements which arose therefrom."[149] The engineer summarized the technical steps taken by the radio in the Hungarian revolution of 1956. What did the radio team understand by the term "non-routine"? 1956 transformed and redefined all daily broadcast activities. All heavy elements of the technical infrastructure, described so far, gained new, unexpected meanings in the context of the mass rebellion. However, four months before the revolutionary crowd heard exploding tank shells on the streets of Budapest, the radio broadcasters had already switched to a different working mode.

The first signs that 1956 would change the course of the propaganda machine came in the summer. Radio Free Europe was among the Western media which were most excited by the so-called Secret speech, in which Khrushchev denounced "Stalin's autocratic rule, his terror, his falsification of history, and blamed him for the reverses the country had suffered at the outset of the World War II."[150] Khrushchev's words, central to the political history of the Soviet Union, were uttered in February 1956, but ceased to be "secret" for the Western media on June 4 when the speech was published in New York Times.[151] Radio Free Europe's reaction was instantaneous. Immediately after the key publication appeared, the newspaper text was translated, recorded by radio speakers on magnetic tape, and broadcast for three days. This was possible because the engineering department provided "separate channels for broadcasting the Khrushchev speech simultaneously with the normal

[149] Geiger, Situation Report, Memorandum, January 3, 1957 in HU OSA Archive, Funds 298, Subfunds 1, Series 3, RFE Correspondence: Engineering Reports and Other Materials.
[150] Peter Kenez, A History of the Soviet Union from the Beginning to the End (New York: Cambridge University Press, 2006 [1999]), 192.
[151] On the pre-history of the publication see: John Rettie, "How Khrushchev Leaked His Secret Speech to the World," History Workshop Journal, (Autumn, 2006) 62: 187-193.

Czechoslovakian, Hungarian, and Polish programs."[152] This was only the first among many technical steps that would change the radio's regular technical schedule later.

On June 28, early in the morning, the workers from the "Zispo" Stalin Enterprises (a railway factory, better known in the city by its former name Cegielski) went out to protest. They moved towards the central square, Mickiewicz, another emblematic place, which, in the postwar years, received a new name, Stalin. The Polish broadcasters at Radio Free Europe knew that Poznan is located in the famous Polish region, Wielkopolska (Greater Poland), with factories built in the 19th century; but gradually, by the mid-1950s, Poznan became peripheral town in the Polish economy. Government investment per capita there was three time lower compared with Warsaw and Krakow. [153] At the same time, within 10 years, the population of Poznan increased threefold reaching 380,000 people in 1956; 13,000 of them worked at "Zispo."[154]

Workers from Poznan's key factory went out to protest with a banner Zadamu CHLEBA ("We demand bread"). The demonstration grew into a mass revolt. Polish People's Army intervened. Meanwhile, Radio Free Europe received instructions to prepare "a special one hour program in Polish reporting in detail on the riots" starting at 01:35 CET.[155] The radio engineers decided to direct to Poland the medium wave transmitters in Holzkirchen, the facility which usually broadcast on medium waves to Czechoslovakia.[156] The technical team immediately checked the quality of the sound after the experiment. The

[152] Geiger, Situation Report (June 1 - June 30 1956), July 5, 1956

[153] In his book on Poznan 1956, Pawel Machcewicz writes that "in 1955, the average salary of an industrial worker in Poznan was 100 zlotys lower per month than the average for all state industry nationally, a significant difference, given that workers in Poland at that time rarely earned more than 1,000 zlotys. Investment was also lower than elsewhere; in 1956, per capita investment was 1,276 zlotys in Warsaw, 1,147 zlotys in Krakow, 572 zlotys in Lodz, 505 zlotys in Wroclaw, and 368 zlotys in Poznan." According to Machcewicz this handicap may have stemmed from the government's belief that the Wielkopolska (Greater Poland) region and Poznan itself were already among the most prosperous areas of Poland. See: Pawel Machcewicz, *Rebellious Satellite. Poland 1956* (Stanford, California: Stanford University Press, 2009), 87-125.

[154] Pawel Machcewicz, *Rebellious Satellite. Poland 1956*, 87-92.

[155] Geiger, Memorandum, July 5, 1956. in HU OSA Archive, Funds 298, Subfunds 1, Series 3, RFE Correspondence: Engineering Reports and Other Materials.

[156] Ibid.

RFE technical monitor was surprised that the first 30 minutes of the special broadcast passed unjammed. "Probably through oversight rather than design", concluded the assistant director, Russell Geiger, in his report.[157]

The engineers did not make any other technical changes in the radio broadcast. They did not have much time to react. On June 30, the Poznan protests had already been suppressed by the Polish People's army. In its internal correspondence, the Engineering department noted that date as the busiest in terms of communication with the RFE's studio in New York. The main political advisors, in charge of the main propaganda guidelines and the secret communication with the CIA, worked at the New York headquarters.[158] A comparison between June 30 and July 1 with the previous weekend was indicative for the new communication rhythm: regular teletype messages nearly doubled (87 against 46) while cipher traffic was almost five times as great (3,425 words compared to 715). Press traffic filed by the New York Newsroom was likewise five times as great as the previous weekend reaching 16,000 words as compared to 3,000 a week earlier.[159]

The secret messages precisely increased five times. It was impossible for the engineers to remain indifferent to such an inflow of secret information from New York to Munich. Even though they did not know the content of these messages, the whole radio team already knew that the operation had shifted to a different mode of action. By the end of July, even the load in the communication equipment increased because the employees from Munich sent long interviews with observers of the Poznan incident to New York. [160] In the last week of July, the teletype system also blocked: "the total cipher traffic count was almost

[157] Ibid.
[158] On the political relationships between the political advisers at the headquarters in New York and Munich see Robert T. Holt, *Radio Free Europe* (Minneapolis: University of Minnesota Press, 1958), 38.
[159] Ibid.
[160] Russell Geiger, Memorandum, Teletype Traffic Load, August 9, 1956. in HU OSA Archive, Funds 298, Subfunds 1, Series 3, RFE Correspondence: Engineering Reports and Other Materials.

three times its usual level because of a lengthy document by the Political Advisor's office in Munich which occupied that circuit to capacity for two days."[161]

From the workload in the summer of 1956, we can safely conclude that Radio Free Europe had already departed from the routine by the outbreak of the revolutionary situation in Hungary. The special technical report on the Hungarian revolution thus does not discuss "unexpected" overload with secret communication. The radio staff knew what the engineers had in mind starting with the phrase "non-routine operating activities." But this did not mean that they acted according to a pre-coordinated plan. Unexpected factors only increased.

One special step[162], taken during the revolution, was the already tested (during the Poznan revolt) measure to mobilize technicians in night shifts (when the radio did not have usual problems with the solar activity and had "natural" advantages over the jamming machines). Engineers decided that "the Hungarian portion of the saturation broadcast regularly scheduled for the period 00:40 - 01:10 CET was extended to 02:00 CET." In the Cold War technical jargon, "saturation" meant to turn off the signal to some or all of the other four "target communist countries" and to concentrate large number of transmitters to carry the same program at a given time only to Hungary. Since the radio always broadcast on several different frequencies simultaneously, jamming efforts were considerably lessened. [163] In theory, this night "saturation" would provide clear sound for special programs that the listeners needed to hear during the nights of the revolution.

But on the second day of the revolution the signal was clear even without this special measure. The engineers in Munich did not expect that, "on October 24, 1956, Gusztav

[161] Ibid.
[162] The second unconventional task in transmission was that, in mid-December, the medium wave transmitter at Holzkirchen, which usually broadcast only to Czechoslovakia, was set to the Hungarian service after 15:00 CET. It was provoked by "reports of power shortages within Hungary when the radio could reach only potential listeners equipped with battery - powered medium wave sets."
[163] Memorandum, August 24, 1955 in HU OSA Archive, Funds 298, Subfunds 1, Series 3, RFE Correspondence: Engineering Reports and Other Materials.

Gogolyak, head of Post Office No. 118, the covert site of the technical headquarters of the jamming operation in Budapest, ordered radio technicians all over the country to close down immediately all jamming facilities, shred the documents, and lock the doors of the jamming stations." [164] The technical monitoring of Radio Free Europe immediately reported the absence of jamming sounds in Hungary. [165] Such an event happened for the first time in the technical history of the radio. Strategic changes in the heavy transmission infrastructure and special broadcasts on the revolution were not necessary. Every sentence was a special message because the voices behind the microphone reached the listeners in Hungary.

In the context of the radio's daily routine, this news was shocking. Broadcasters had to obtain actual information on the revolutionary events and to understand what exactly was happening in the tense hours of the revolution. The "routine" answer was to mobilize all monitoring resources in Munich. But the only source of actual information that could be detected by the radio monitors in Munich was Radio Budapest, which constantly transmitted propaganda messages against "the reactionary elements" on the streets. In this case, this was completely inadequate information about the growing unrest across the country. Other possible sources were the other Western radio stations which broadcast in Hungarian such as VOA, BBC, Vatican Radio, Radio Madrid, Radio Rome, and Radio France.[166] However, RFE was among the few which had such strong technological potential and strategic geographical location.

Thus the radio crew made one of the key strategic moves in the Cold War - sending machines with portable monitoring equipment to the Hungarian border in Eastern Austria.[167]

[164] István Rév, "Just Noise? Impact of Radio Free Europe in Hungary," in: A. Ross Johnson and R. Eugene Parta, eds., *Cold War Broadcasting: Impact on the Soviet Union and Eastern Europe: A Collection of Studies and Documents* (Budapest: Central European University Press, 2010), 244-245.
[165] Harris, Annual Report, Engineering Department, May 8, 1957 in HU OSA Archive, Funds 298, Subfunds 1, Series 3, RFE Correspondence: Engineering Reports and Other Materials.
[166] Radio Stations Broadcasting in Hungarian in HU OSA Archive, Funds 298, Subfunds 1, Series 3, RFE Correspondence: Engineering Reports and Other Materials.
[167] Geiger, Situation Report, Memorandum, January 3, 1957. in HU OSA Archive, Funds 298, Subfunds 1, Series 3, RFE Correspondence: Engineering Reports and Other Materials.

Russel Geiger reported that from this point it was possible "to monitor and record relatively week signals from several of the freedom stations." [168] On October 25, Radio Free Europe received the first sounds from the so called "freedom stations" [169], which were ordinary Hungarian regional radio stations. Occupied by the revolutionaries, they broadcast cries for support to surrounding smaller towns and villages. Their radio facilities were weak. Signal from such small stations could be detected only by the closest possible distance with special monitoring equipment. Among the major key sources of information, therefore, were the cities which the monitoring trucks with portable antennas were able to detect from their strategic point at the Austrian border.

The engineers used the following monitoring standard: once captured, the sound from the mobile antenna at the Austrian border was recorded on magnetic tape, transcribed, and sent to the radio offices in Munich. Then the words from the radio stations became official documents called radio monitoring "items". These information sheets were used both as background information for broadcasting news, but were also transferred via teletype line to the Foreign Broadcast Information Division (FBID), a department of the CIA which supplied the agency with media information from abroad for detailed analysis made by intelligence experts.[170]

During the first days of the revolution, the monitoring operation had limited success. In the period from 23 to 25 October radio recorded only official information from Radio

[168] Geiger, Situation Report, Memorandum, January 3, 1957. in HU OSA Archive, Funds 298, Subfunds 1, Series 3, RFE Correspondence: Engineering Reports and Other Materials.
[169] Among the authors who emphasize the role of the freedom stations in the revolution are: Arch Puddington, Broadcasting Freedom, 102
[170] The Foreign Broadcast Monitoring Service was established in the Federal Communications Commission (FCC) by Presidential directive on February 26, 1941 with the main task to record, translate, and analyze foreign radio broadcasts. On September 25 1947, this service was transferred to CIA and assigned to Directorate of Intelligence. In 1950, it was redesigned as Foreign Broadcast Information Division (FBID). On the institutional history of FBID see The National Archives, Records of the Central Intelligence Agency, Records of the Foreign Broadcast Information Service and its Predecessors 1941-74, http://www.archives.gov/research/guide-fed-records/groups/263.html (Access date: June 3, 2015).

Budapest, which was obtained by RFE's monitoring stations in Germany. [171] The strategic maneuver was done on October 26 when the monitoring machine received information from the regional radio station in Miskolc in Norteastern Hungary. The largest amount of information came later from one of the cities closest to the Hungarian border - Gyor, located in Northwestern Hungary. Between October 28 and November 4, every day, the mobile monitoring station sent transcribed sounds from Gyor to the editorial office and the CIA. The second largest source of regional information was radio signals from Miskolc. On October 28, for instance, the information on the revolution was based on 19 monitoring reports from Radio Budapest, 7 documents from Gyor, and 2 from Miskolc. Two days later, on October 30, from the same sources, RFE and CIA received 32 items from radio Budapest, 3 from Miscolc, and 2 from Gyor.

But on 4 and 5 November, during the second invasion of the Soviet troops, the main informants disappeared from the ether. RFE relied instead on different regional radio stations from exactly the same trajectory, Northwest - Northeast, receiving sounds (for the first time) from Szombathely, Szabolcs, and Nyiregyhaza. Desperately trying to understand what was happening during the Soviet invasion, the radio receiver even recorded information from an "Unidentified" regional radio station.

The final results of the engineering efforts could be traced from an official CIA document entitled *Chronology of Principal Events during the Hungarian Revolution*. [172] The "Principal" events, through which the CIA intelligence experts were orienting themselves,

[171] At the end of the revolution, the engineering received a document with the total number of information items processed by FBID. From this document we can see the dynamics of the information flow to the editorial office in Munich and to the CIA. My observations are based on Hungarian Language Items, Published in IBID Daily Reports 23 Oct. - 10 Nov. 1956. in HU OSA Archive, Funds 298, Subfunds 1, Series 3, RFE Correspondence: Engineering Reports and Other Materials.

[172] Central Intelligence Agency, Chronology of Principal Events during the Hungarian Revolution: 23 October to 4 November 1956 in CIA, Freedom of Information Act, Electronic Reading Room, Document Number (FOIA)/ESDN (CREST): CIA-RDP80B01676R001000010034-5. Permanent link: http://www.foia.cia.gov/document/cia-rdp80b01676r001000010034-5 (Access Date: May 21, 2015).

were a collage of over 100 pieces of transcribed radio signals sent from the mobile receiver at the Austrian border.

The official information flow began on October 23 with the party's first secretary Erno Gero's speech over radio Budapest from which the CIA analyzers selected the phrase: "the party condemned chauvinist excitement, slanders against the USSR and the exploitation of youth for demonstrations." On the next day, October 24, they once again selected information from the only possible source at that moment, the communist propaganda, recording that "fascist reactionary elements have attacked public buildings and the police" and that "Soviet aid had been invoked on the basis of the Warsaw Treaty for the restoration of order in Budapest against counterrevolutionary elements."

The first message based on a regional radio station, recorded in the CIA archives, came from Miskolc radio on October 26 when the radio monitors, close to the Austrian border, transcribed the following lines: "an announcement for the Workers' Council of Greater Miskolc and Borsod Country (apparently a new organization) declaring they will maintain their demands as long as they are not fulfilled 'in essence." On October 28, Radio Free Europe recorded the first calls for mobilization: "Miskolc radio called on workers councils in various parts of the country Debrecen, Szeged, Hatvan, Szekesfehervar, Pecs, Szombathely, Gyor, Mosonmagyarovar, Szolnok, Nyiregyhaza 'and all the country' to support a program calling for creation of a provisional government under Premier Nagy to be followed by the holding of free elections."

On October 30, calls for mobilization continued, this time from Northeastern Hungary: "Radio Free Gyor reported national councils have been formed in near-by villages"; "Order reigns and food supplies are being collected; "Young people of Vas Country have resolved not to resume productive work before our oppressor, the Soviet troops, actually begins withdrawing from the territory of our country." On October 31, in

the morning, Radio Free Petofi - Gyor announced that the Varpalota transmitter was being jammed. On November 4, early in the morning, Radio Free Petofi - Gyor went off the air. Seven minutes later, Budapest radio went off the air "suddenly." Later on the same day, 15 minutes before midnight, the radio monitors registered with one short sentence: "Radio Budapest came on the air again with a defense of the Kadar government." Revolutionary stations from the border areas disappeared; the radio "picture" of the revolution blurred again. Yet again, the only source of information was the communist propaganda machinery set in motion by Janos Kadar.

During the second Soviet military intervention, on November 4 1956, the radio did not know what exactly was happening in Hungary, but the Engineering department discussed possibilities of psychological intervention in the Soviet tanks, which involved transmission of messages to the soldiers in the military machines. The radio technicians received a secret letter, signed by J. S. Walsh.[173] His suggested the radio transmit on the frequencies of the Soviet military communication in Budapest. The engineers knew that this fantasy went far beyond the capabilities of an ordinary radio and they refused to perform such a "psychological operation." On November 14, Claude M. Harris, Director of Engineering explained extensively to W. J. Convery Egan, the director of RFE, why engineers did not act on 4 November: "since the subject of this letter is primarily a first-line psychological warfare matter, I can not prepare a reply," wrote the engineer. [174]

First, the radio needed to know the precise frequency channel of the Soviet tanks, which was secret military information spread among the soldiers only in encrypted form.

[173] It is impossible to infer the whole content of the letter based on the correspondence from the Engineering Department. One hypothesis is that the author of the letter had access to secret military information. The Library of Congress archive stores the documents of John Walsh, an FBI agent, who participated in Venona project, a secret program of the U.S. Army Signal Intelligence Service examining encrypted Soviet diplomatic communications. But the initial of his second name is J., whereas the Engineering department typed "John S. Walsh". By 1956, 9000 experts were employed in National Security Agency's cryptographic agencies and the CIA was interested in this secret activities. See: Christopher Andrew, "Intelligence and International Relations in the Early Cold War," *Review of International Studies*, (July, 1998), 24(3): 322.

[174] Claude M. Harris, Memorandum, November 14, 1956 in HU OSA Archive, Funds 298, Subfunds 1, Series 3, RFE Correspondence: Engineering Reports and Other Materials.

Even if they could get deciphered frequencies list, it was not enough because "the tank groups operate on frequencies which can be changed at the will of the unit commander."[175] Even if RFE had direct access to all military communication, the idea remained in the field of the Cold War fantasies because "tank communications were carried on in the very high frequencies which had very limited range and tanks were also under local command, using receiving equipment with limited sensitivity."[176]

The only alternatives were to use a mobile transmitter near the tanks or to try an extremely powerful signal from all radio plants in Germany and Portugal. In this case, these were completely illusory alternatives. The engineer summarized it with three sharp refusals: mobile transmitter in Hungary was "surely impossible", in Austria it was "politically impossible"[177] to install a transmitter, whereas a too powerful signal from Germany "would violate the contract with the German Government."[178] The only possibility for the radio to contribute to the psychological operation was from a "non-technical" nature. In particular, to provide a Russian speaking person: "I suppose that pure Russian would probably be understood by most of the soldiers."[179] The engineer, Claude Harris, concludes with a suggestion to redirect the request to a more competent unit: the Psychological Warfare Branch of the US Army.[180]

[175] Ibid.
[176] Ibid.
[177] One possibility is that the Engineering department had problems with the Austrian authorities concerning their operation at the Austrian border. On the tensions between RFE and the Austrian Interior Ministry see: Andreas Gemes, *Austria and the 1956 Hungarian Revolution: Between Solidarity and Neutrality* (Pisa: Pisa University Press, 2008) 124-125.
[178] A broadcast license agreement between the Free Europe Committee and the German government was signed in 1955. The agreement "licensed the transmission of RFE and RL broadcasts from Germany for a term of five years, stipulated that they not contain material contradicting German national interests, required the Radios to retain recording of all broadcasts for one month and make them available to the German government for review on demand, and stated that the German government reserved its right to demand immediate cessation of any transmissions that, in its judgment, violated German policies." see A. Ross Johnson, *Radio Free Europe and Radio Liberty. The CIA Years and Beyond* (Stanford, California: Stanford University Press, 2010), 68.
[179] Ibid.
[180] Ibid.

After the revolution, the engineering department received an order to collect all records of radio broadcasts from October 23 to November 10, stored on magnetic tapes as physical evidence. One set of records was sent, for an investigation, to the CIA, and another one to The German Foreign Office. The main question was: what was the role of the radio in the Hungarian revolution?

On January 14 1957, after hearing 247 reels of tape, the CIA librarian and other Hungarian speakers answered a special questionnaire aiming to propose objective evaluation of the radio content to Allen Dulles, the director of the CIA:[181]

Question: Is there any evidence that RFE broadcasts directly inspired or provoked the uprising?
Comment: None.
Question: Did RFE make recommendations for action short of armed rebellion which should have incited the revolution?
Comment: No. The primary role of RFE was that of a transmitter of news.[182]

On December 20 1956, in Bonn, after hearing the magnetic records, the German Foreign Office typed an official telegram. The final conclusion was that "NO BROADCAST STATING WEST WOULD FURNISH CONCRETE MILITARY HELP. (THIS HAS BEEN PRINCIPAL ACCUSATION AGAINST RFE.)" [183]

In one of their observations, however, the German investigators could not afford to skip 5 critical remarks, because they heard, repeatedly, advice for revolutionary action:

[181] "CIA Post-Mortem on Radio Free Europe Hungarian Broadcasts," January 14, 1957, History and Public Policy Program Digital Archive, Obtained and contributed to CWIHP by A. Ross Johnson. Cited Ch3 n82 in his book *Radio Free Europe and Radio Liberty*, CIA mandatory declassification review document number MORI 1426219, 1426220. http://digitalarchive.wilsoncenter.org/document/115004 (Access Date: May 21, 2015).
[182] Ibid.
[183] "German Government Review of Radio Free Europe Broadcasts," December 20, 1956, History and Public Policy Program Digital Archive, Obtained and contributed to CWIHP by A. Ross Johnson. Cited in his book Radio Free Europe and Radio Liberty, Ch1 p13, CIA mandatory declassification review document number MORI 1376058 http://digitalarchive.wilsoncenter.org/document/115002 (Access date: May 21, 2015).

WORKERS WERE URGED TO STRIKE (OCTOBER 30)
HUNGARIAN SOLDIERS ASKED TO PARTICIPATE RESISTANCE (OCTOBER 30)
ADVICE GIVEN TO USE MOLOTOV COCKTAILS (OCTOBER 30)
HUNGARIAN ARMY CALLED STRONGER THAN SOVIET ARMY (OCTOBER 30)
STATEMENT MADE FIGHT HAD BEEN WON (OCTOBER 30)[184]

Calls for revolutionary action did not appear so often in the records. There was not enough evidence for the German authorities to accuse the radio, but these voices were "visible" enough to be noted because they were concentrated in one single day, October 30. These words were delivered clearly, unjammed behind the Iron Curtain. It was one of the days with a successful "non-routine" operation. A mobile machine with an antenna received and recorded information transmitted by radio waves from Gyor and Miskolc. Few days before the revolutionary voices disappeared in the ether and never returned.

[184] Ibid.

Conclusion

This text has examined an unusual archive filled with technical terms. However, along with the data on radio transmission, numerous political expressions emerged in the records of the Engineering department. The radio infrastructure was embedded in Cold War ideology. Technology and technical work were politicized. The very logical sequence of the technical operations involved key issues in this historical period: collecting, recording, and encrypting information from isolated societies behind the Iron Curtain and a subsequent transmission of sounds amid noises from jamming machines. Rhetorical figures and technical problems merged in a common amalgam of engineering activities.

The radio technical infrastructure was developed around Cold War technical geography which united places such as Holzkirchen, Biblis, Moosburg, Maxoqueira, Vienna, Salonica. The weak radio towers in Gyor and Miscolc became strategic points in the Hungarian revolution. Their location, in the specific historical context, was used in complex technological and political visions.

Non-living objects in the radio operation were only seemingly neutral elements in everyday radio practice. Key information and propaganda messages from the Cold War were shaped by magnetic tapes, teletype machines, antennas, mobile antennas in the context of the revolution in 1956, and computer analysis of vast amounts of information. Engineers' experience, stored in their archives, is invaluable for our understanding of these otherwise invisible, too banal elements from the everyday broadcasting practice. But in their banality, precisely, technological equipment became crucial to the whole radio operation.

Certain technological objects were also tools in a huge amount of technical work in radio installations and laboratories. Scientific research of noises and solar activity was not isolated from the context in which they occur. Thus, noise, which the average radio listener

may perceive just as a disturbing sound, became a key aspect from the professional characteristics and skills of the Cold War engineers. Throughout the propaganda conflict, perception of jamming sounds became "a sensitive issue" because categorization of noise and sound quality become important factors in the measurement of the effectiveness of the whole propaganda operation.

All these elements from the technical infrastructure, noise, and geography in the Cold War period were closely examined by the Engineering Department at Radio Free Europe. Observations and concerns of these technical specialists gave us a valuable insight into the historical context of the 1950s and the 1960s. The years of the radio lovers who were inspired by the movement of invisible radio waves and the development of a technical infrastructure for global communication, which only an engineer could observe with such sensitivity.

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