

THE UNTOLD HISTORY OF “HARMFUL INTERFERENCE” IN THE REGULATION OF RADIO FREQUENCY COMMUNICATIONS

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A key, universal concept used in the international and domestic regulation of radio frequency communications is “harmful interference.” While “interference” was a recognized concern from the earliest days of wireless telegraphy, it took several decades—until the late 1940s—for regulators to adopt a formal definition of “harmful interference.” This definition, modified slightly in the 1950s and 1970s, is still in place today. Harmful interference and related terminology are often criticized as cryptic, vague, amorphous, and ambiguous, resulting in excessive regulatory uncertainty and delays. The general frustration with the definition’s qualitative nature has led to demands for more quantitative approaches to assessing when interference is “harmful” and when it is not. This article explores the previously untold history of these regulatory concepts and definitions. It details events from two eras: During the first era (from the early 1900s to the 1940s), interference concepts were not specifically defined in any way. The second era (from 1947 through the 1980s) was the period in which regulatory definitions were developed within small groups of technical experts at international radio conferences without much attention or controversy. Domestic regulators in the U.S. implemented these definitions without much, if any, deliberation. This comprehensive study of the original context, usage, and definitions of these regulatory terms of art sheds new light on the modern-day critiques of the longstanding vocabulary.

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INTRODUCTION

In the international and domestic regulations governing radio frequency communications, a universal concept and driving force has been “harmful interference” and the prevention thereof. The international regulation of radio and efforts to control interference began in the early 1900s, but “harmful interference” was not formally defined by regulators until the late 1940s. Later, in the 1970s, regulators officially defined the term “interference.” These regulatory terms and their definitions are often criticized as cryptic, vague, amorphous, and ambiguous, resulting in excessive uncertainty and delays for new wireless technologies and services.¹ Frustrated with the current definitions, technical experts have suggested alternative approaches to defining or quantifying interference.² Regulators, practitioners and other scholars have defended the “flexible” definition of “harmful interference” contained in the regulations, although some admit that the rules include several undefined terms and concepts that make them difficult to apply consistently.³

1. See, e.g., Michael J. Marcus, *Harmful Interference and Its Role in Spectrum Policy*, 102 PROC. IEEE 265, 266 (Mar. 2014) (“[U]ncertainties and ambiguities that result from the current definition [of ‘harmful interference’] . . . and delays in interpreting national and international regulations also have an effect on the introduction of innovative technologies.”); IEEE-USA, CLARIFYING HARMFUL INTERFERENCE WILL FACILITATE WIRELESS INNOVATION 17 (2012); J.P. de Vries, *Harm Claim Thresholds: Facilitating More Intensive Spectrum Use Through More Explicit Interference Protection Rights*, 12 COLO. TECH. L.J. 55, 61 (2014) (“The definitions . . . are very general and require case-by-case interpretation.”).

2. See, e.g., Charles Lee Jackson, *Defining Harmful Interference Efficiently* (TPRC 2016) at 17, <https://ssrn.com/abstract=2756144>; de Vries, *supra* note 1, at 65-70; Marcus, *supra* note 1, at 267-268. *But see* Thomas W. Hazlett & Sarah Oh, *Exactitude in Defining Rights: Radio Spectrum and the “Harmful Interference” Conundrum*, 28 BERKELEY TECH. L.J. 227, 336 (2012) (providing an economic, and contrary, perspective on the value of full, precise, unambiguous delineations of spectrum use rights and definitions).

3. See, e.g., Fed. Commun. Comm’n [FCC], SPECTRUM POLICY TASK FORCE REPORT, ET-Docket No. 02-135, at 26 (2002); R. Paul Margie, *Can You Hear Me Now: Getting Better Reception from the FCC’s Spectrum Policy*, 2003 STAN. TECH. L. REV. 5, 11-12 (2003); Mitchell Lazarus, *Finding the Harm in “Harmful Interference,”* COMMLAWBLOG (Jan. 30, 2009), <https://www.commlawblog.com/2009/01/articles/cellular/finding-the-harm-in-harmful-interference> [<https://perma.cc/QUY8-FJQF>] (last visited Oct. 9, 2024);

This article explores the untold history and original meaning of “harmful interference” and related regulatory concepts and definitions. It reviews the evolution of this terminology in the context of the international and domestic regulation of wireless communications from the early 1900s to the present day. This article examines the existing historical scholarship on radio regulation and several previously overlooked primary sources such as international treaty documents, their original translations from the official language at the time (French),⁴ and the deliberations (or lack thereof) of technical committees at international conferences and of regulators in the United States.

Section I starts with an introduction to the language of today’s interference terminology and regulatory definitions. Section II explores the etymology and usage of the term “interference” and summarizes how the term evolved from the earliest days of radio regulation through international treaties. In sections III and IV, we travel further down the evolutionary path from the 1940s to the 1980s, when international and domestic regulators developed and solidified the current official definitions. The last section concludes with observations on how understanding the original purposes, context, and usage of these definitions can shed light on modern-day critiques of the longstanding vocabulary. These observations suggest future research efforts that could explore the historical interpretations and implementations of these concepts over the decades with, for example, the century-old, principal *ex ante* approach to avoiding harmful interference: the international and domestic Tables of Frequency Allocations.

I. CURRENT REGULATORY DEFINITIONS OF “HARMFUL INTERFERENCE” AND “INTERFERENCE”

The definition of “harmful interference” contained in Article 1, Section VII (entitled “Frequency sharing”) of the Radio Regulations of the International Telecommunication Union (ITU) reads as follows:

Mitchell Lazarus, Fletcher, Heald & Hildreth, Presentation to Nat’l Spectrum Mgmt. Ass’n: Defining the Harm in Harmful Interference (May 20, 2009); Peter A. Tenhula, *Enforcement of Spectrum Usage Rights: Fair and Expedient Resolution of “Interference” Disputes* (TPRC 2012) at 8, <http://ssrn.com/abstract=2032312>; Michelle Hersh, *A Study on the Role of Spectrum Usage Rights within Disputes*, 12 COLO. TECH. L.J. 445, 469 (2014).

4. See generally, INT’L TELECOMM. UNION [ITU], INTERNATIONAL TELECOMMUNICATION CONVENTION, art. 21, § 1 (Madrid, 1932) (“The language used for drawing up the acts of Conferences and for all the documents of the Union is French.”) [hereinafter MADRID 1932 CONVENTION]; see also CONSTITUTION OF THE INTERNATIONAL TELECOMMUNICATION UNION, art. 29, §173 (Guadalajara, 2010).

Interference which endangers the functioning of a *radionavigation service* or of other *safety services* or seriously degrades, obstructs, or repeatedly interrupts a *radiocommunication service* operating in accordance with Radio Regulations (CS).⁵

The ITU's definition of "interference" is as follows:

The effect of unwanted energy due to one or a combination of *emissions, radiations*, or inductions upon reception in a *radiocommunication* system, manifested by any performance degradation, misinterpretation, or loss of information which could be extracted in the absence of such unwanted energy.⁶

These international regulations also include two closely related terms:

permissible interference: Observed or predicted *interference* which complies with quantitative *interference* and sharing criteria contained in these Regulations or in ITU-R Recommendations or in special agreements as provided for in these Regulations.

accepted interference: *Interference* at a higher level than that defined as *permissible interference* and which has been agreed upon between two or more *administrations* without prejudice to other *administrations*.⁷

These same definitions are written nearly verbatim in U.S. regulations promulgated by the Federal Communications Commission (FCC) and the National Telecommunications and Information Administration (NTIA).⁸

5. ITU, *Radio Regulations*, ch. 1, art. 1, § VII, 1.169 (2024) (italics in original). The italicized terms in the definition indicate that those terms have their own definitions in Article 1 of the ITU Radio Regulations. *Id.* at Introduction, 1.1 NOTE. The reference to "CS" at the end denotes that it is identical to the definition contained in the Annex to the *ITU Constitution*. See also ITU CONSTITUTION, *supra* note 4, *Annex* at 1003.

6. ITU, *Radio Regulations*, ch. 1, art. 1, § VII, No. 1.166 (2024) (italics in original).

7. *Id.* at Nos. 1.167 & 1.168 (italics in original, footnote omitted). The same footnote 3 in these two definitions says that these terms "are used in the coordination of frequency assignments between *administrations*;" See also *id.* § I, No. 1.2 (definition of "administration").

8. See 47 C.F.R. § 2.1(c) (2023) (definitions of "harmful interference," "interference," "accepted interference," and "permissible interference"). See also NTIA, *Manual of Regulations and Procedures for Federal Radio Frequency Management*, ch. 6, § 6.1.1 (2023). "Harmful Interference" is also defined, sometimes with slight differences,

In 2002, a working group of the FCC’s Spectrum Policy Task Force described these definitions as “four levels of interference,” noting that they “are decades old.”⁹ The FCC’s Technological Advisory Council recognized in a 2014 White Paper “that interference is understood differently by the technical community [than] it is by the policy/regulatory community” and that, under the current regulatory framework, “determining whether interference is harmful or not is technically complex and highly subjective.”¹⁰ Similarly, in a 2022 report, a committee of technical experts convened by the National Academies of Sciences, Engineering, and Medicine attempted to distinguish the “legal” or “operational” definition of “Harmful Interference” from a “technical” definition that focused on broader “physics and engineering questions of harmful interference.”¹¹ Since this article focuses on the history of the four regulatory (or legal) definitions quoted above, we do not address various technical or alternative definitions of “interference” and related concepts that have been developed or proposed over the decades.¹² Nor do we address the implementation of these

in other FCC rules including 47 C.F.R. §§ 1.907, 5.5, 15.3(m), 18.107(b), 26.5, 76.613(a), 90.7, 95.303, 97.3(a)(23), and 101.3 (2023). The language in some of these definitions following “in accordance with” varies. For example, sections 15.3(m), 18.107(b), and 76.613(a) refer to “this chapter,” which is a reference to Chapter I of Title 47 of the Code of Federal Regulations. On the other hand, section 95.303 applies to any “radiocommunication service operating in accordance with applicable laws, treaties, and regulations.” (emphasis added); see also *Allocation of Spectrum for Non-Federal Space Launch Operations*, Final Rule, ET Docket 13-115, 89 Fed. Reg. 63296, 63322 (Aug. 5, 2024) (to be codified at 47 C.F.R. pts. 0, 1, 2, 26) (adopting the most recent addition to this collection of definitions in section 26.5, included in a new Part 26 governing Space Launch Services, which – like section 90.7 – reads: “For the purposes of resolving conflicts between stations operating under this part, any emission, radiation, or induction which specifically degrades, obstructs, or interrupts the service provided by such stations.”).

9. FCC, *Report of the Interference Protection Working Group of the Spectrum Policy Task Force*, 6, 7 (2002); see also Marcus, *supra* note 1, at 266 (“It is unclear when the present wording was adopted, as it has been the same for decades.”).

10. FCC Tech. Advisory Council, Spectrum/Receiver Perf. Working Group, *Introduction to Interference Resolution, Enforcement and Radio Noise* 5 (2014) (citing and quoting a definition of “interference” found in Federal Standard 1037C, Glossary of Telecommunication Terms (1996)); see also de Vries, *supra* note 1, at 56-57 (explaining that “[t]here are distinct connotations of the term ‘interference’ in legal and engineering parlance . . .”).

11. NAT’L ACAD. OF SCI., ENG’G & MED, *Analysis of Potential Interference Issues related to FCC Order 20-48* (2023) (“To ensure clarity, [the committee’s report] focuses on the broader meaning of ‘harmful interference’ [uncapitalized] and not the FCC-defined [and capitalized] term ‘Harmful Interference.’”).

12. For example, current FCC regulations include definitions and descriptions of “unacceptable interference” and “objectionable interference” in connection with particular radio services. See 47 C.F.R. §§ 22.970(a), 73.182, 73.525(f), 90.377(f), 90.672(a) (2023); see generally George H. Hagn, AGARD Conference Proceedings No. 159, *Definitions and Fundamentals of Electromagnetic Noise, Interference, and Compatibility*, SEE N76-16256 07-32 (Nov. 1975).

definitions through technical rules, studies, and recommendations by domestic and international regulators, but further research is encouraged.

As discussed in more detail below, the longstanding regulatory definition of “harmful interference” was originally adopted by the ITU in 1947, and the other three, including the definition of “interference,” became part of the ITU Radio Regulations in 1979. Without any apparent deliberation or analysis by the FCC (or NTIA), these international definitions were incorporated into domestic regulations. While the official regulatory definition of “interference” is relatively younger, the term has been used in the context of physics and telecommunications since the 1800s.

II. ETYMOLOGY OF “INTERFERENCE” AND “HARMFUL INTERFERENCE”

The noun “interference” derives from the verb “interfere,” which is derived from the Latin words *inter* (“between”) and *fere* “hit or strike.”¹³ English scientist Thomas Young used the word “interference” in physics as early as 1802 in reference to the “mutual action of two waves or systems of waves, in reinforcing or neutralizing each other, when their paths meet or cross.”¹⁴ The term was originally introduced in this context to designate phenomena observed in the mutual action of two rays of light and subsequently extended to sound waves and undulations on the surface of water.¹⁵ In the context of telecommunications, the Oxford English Dictionary defines “interference” as the “[d]isturbance of the transmission or reception of signals by the intrusion of extraneous signals; hence, signals collectively or radiation which causes such disturbance, or the effects by which it is perceived (e.g., unwanted sounds in radio reception),” tracing such usage to 1887.¹⁶

Chuck Jackson briefly delved into the early history of the term “interference” in the context of wireless telegraphy, tracing it back to the following description from a U.S. Navy report dated December 1, 1899:

13. See *Wave interference*, WIKIPEDIA, https://en.wikipedia.org/w/index.php?title=Wave_interference&oldid=1098192191 [<https://perma.cc/FAH2-N5SQ>] (last visited Oct. 10, 2024) (describing the etymology of the word “interference”).

14. *Interference*, OED.COM, https://www.oed.com/dictionary/interference_n#264881 [<https://perma.cc/3A5L-A9VH>] (last visited Mar. 25, 2025) (derived from Old French *s'entreféir*, to strike each other).

15. See *id.* (“The sound-waves proceeding from the prongs of the fork neutralizing each other – an effect known as interference.”).

16. *Id.*

“interference” . . . may be described as follows: When signals are being exchanged between two stations, if signals are made at a third station within the radius of effect then the signals at the receiving station of the first two mentioned become confused and unintelligible.¹⁷

In these early descriptions, and comparing them to the current definition of “interference” (quoted above in Section I), when wireless telegraphy signals became “confused and unintelligible” in 1899, it was the “effect” of the signals (*i.e.*, “unwanted energy”) from a third station. Similarly, a “disturbance” appeared to be the same as “misinterpretation” or “loss of information” in today’s terms. Indeed, as discussed below, the first international agreement on wireless telegraphy in 1903 used the term “interfere” but did not define it, while the English translation of the next conference three years later replaced “interfere” with “disturb.”¹⁸

Although undefined, various international treaties and domestic laws and regulations prominently used the English term “interference” over the following decades. Sometimes the term was preceded or followed by a modifier—but not “harmful”. For example, the regulations from the 1938 International Radiocommunication Conference in Cairo used the term “interference” over 75 times. They included the phrases “serious interference” and “interference detrimental” in four provisions.¹⁹ Nine years and a World War later, the International Radio Regulations were dominated by the phrase “harmful interference” (used 78 times) along with a new definition.

The first definition of “harmful interference” appeared in the 1947 International Radio Regulations:

Any radiation or any induction which endangers the functioning of a radionavigation service or of a safety service or obstructs or repeatedly interrupts a radio service operating in accordance with these Regulations.²⁰

In 1959, the international definition was revised to read:

17. Jackson, *supra* note 2, at 5.

18. See *infra* III.A.2; see also Jackson, *supra* note 2, at 5.

19. See ITU, *General Radiocommunication Regulations and Additional Radiocommunication Regulations*, art. 7, ¶80 § 2 and art. 24, ¶538 § 8 (“serious interference”) (Cairo, 1938); *id.* art. 7, ¶82 § 3 and art. 17, ¶374 § 2 (“interference detrimental”). The English word “disturb” appeared in three other places.

20. ITU, *Radio Regulations*, ch. 1, art. 1, § IV, ¶ 69 (1947) (annex to The International Radio Convention (Atlantic City, 1947)).

Any emission, radiation or induction which endangers the functioning of a radionavigation service or of other safety services or seriously degrades, obstructs or repeatedly interrupts a radiocommunication service operating in accordance with these Regulations.²¹

Along the lines of one of the most puzzling mysteries of life involving chickens and eggs, it is not obvious which came first: “interference” or “harmful interference.” Although the term “interference” preceded the predominant use of “harmful interference” beginning in 1947, the official regulatory definition of “interference” was not adopted until the 1979 World Administrative Radio Conference (WARC). The conference delegates also modified the definition of “harmful interference” from the 1959 Radio Regulations to replace “Any emission, radiation or induction” with the new term “Interference,” resulting in the current definition quoted above.

In the early decades of the FCC’s existence, its regulations were also void of specific definitions of interference until it obediently implemented the results of the various international radio conferences.²² On December 10, 1948, the Commission adopted its first definition of “harmful interference” in Part 2 of its rules to make them “consistent with existing treaties, conventions and the Final Acts of the International Telecommunication and Radio Conferences, Atlantic City, 1947, ratified by the United States on June 18, 1948.”²³ On November 8, 1983, the FCC adopted its new definitions of “Interference,” “Accepted Interference,” and “Permissible Interference” and a revised definition of “Harmful interference” “to be consistent with the international definitions approved at the 1979 WARC.”²⁴ Below we discuss in more detail how the international definitions, and their domestic implementations, developed and evolved.

Early U.S. radio laws and regulations in the 1920s and 1930s similarly utilized the term “interference,” with “harmful interference” not appearing until decades later. For example, a core

21. ITU, *Radio Regulations*, ch. 1, art. 1, § III, ¶ 93, (1959) (emphasis added to show additional language compared to the 1947 definition).

22. See generally LIBR. OF CONG., <https://www.loc.gov/collections/federal-register> [<https://perma.cc/2TPV-CNK5>]. Searching the Federal Register archives prior to 1948 revealed very few instances of the phrase “harmful interference,” providing only five results, while a search for the phrase between 1948 and 1999 provides over 1,300 results.

23. *Part 2 – Frequency Allocations and Radio Treaty Matters*, Final Rule, Docket Nos. 8977, 9022, 13 Fed. Reg. 8130-8131 (Dec. 21, 1948).

24. *Implementation of the Final Acts of the World Administrative Radio Conference, Geneva, 1979*, Final Rule, Gen. Docket No. 80-739, 49 Fed. Reg. 2358, 2359, 2368-2371 (Jan. 19, 1984).

statutory responsibility of the Federal Radio Commission established in 1927—and then the FCC formed in 1934—was, and is now, to “[m]ake such regulations not inconsistent with law as it may deem necessary *to prevent interference*.”²⁵

The Communications Act of 1934 and its predecessor statutes did not contain the phrase “harmful interference,” but several subsequent amendments to the 1934 statute and other laws used the phrase, while other amendments simply used “interference” or “interfere.”²⁶ “Willful or malicious interference” was a related concept dating back to the Radio Act of 1912 and is used twice in current law.²⁷

The first U.S. radio law that used the phrase “harmful interference” was a 1965 amendment to Section 355 of the 1934 Communications Act (now Section 354) to require radiotelegraph stations on ships “be so located that no harmful interference from extraneous mechanical or other noise will be caused to the proper reception of radio signals.”²⁸ The second use of “harmful interference” in enacted legislation was in the 1968 addition of a new Section 302 of the Communications Act, which gave the FCC authority to prescribe regulations governing the manufacture, import, sale, shipment, or use of devices that are capable of causing “harmful interference to radio communications.”²⁹ At the time, Congress did not define “interference” or “harmful interference.” The legislative history of Section 302 provides some evidence of the “acute interference problems arising from the expanding usage of electrical and electronic electric devices which are capable of causing harmful interference to radio reception.”³⁰ Although there was no reference to the ITU or FCC definitions or the terms used therein, the Senate committee report referenced specific examples of “excessive” and “undesired radiation” causing a “serious amount of interference” that was making, according to the Federal Aviation

25. Pub. L. No. 69-632, § 4(f), 44 Stat. 1162, 1163 (1927); *see also* Pub. L. No. 73-416, § 303(f), 48 Stat. 1064, 1082 (1934).

26. The IEEE-USA Committee on Communications noted in 2012 that “The term [‘harmful interference’] is mentioned eight times in the Communications Act and with four more new references added in the recently enacted amendments to the Act . . . yet it is never defined in legislation.” IEEE-USA, *supra* note 1, at 4-5 (footnote omitted, *citing* 47 U.S.C. §§ 302(a), 303(y)(2), 337, 354, 922, 923, 1100, and 2511).

27. *See* Pub. L. No. 62-264, 37 Stat. 204 §§ 2, 5 (1912); *see also* 47 U.S.C. §§ 303(m)(1)(E), 333.

28. Pub. L. No. 89-121, § 6, 79 Stat. 514 (1965).

29. Pub. L. No. 90-379, 82 Stat. 290 (1968) (*codified at* 47 U.S.C. § 302a(b)).

30. S. REP. NO. 90-1276, at 1 (1968). A bill introduced in January 1950 would have defined “harmful interference” the same way as the definition quoted above from the 1947 International Radio Regulations. *See* H.R. 6949, 81st Cong., 2d Sess. § 2 (1950).

Administration, navigation aids “unreliable” and “not usable in particular quadrants,” posing a “genuine threat to safety of life.”³¹

More recent legislation used the phrase “harmful interference” but, again, did not provide a definition, leaving it to the FCC—and the Secretary of Defense—to interpret the phrase using the existing regulatory definition noted above. In the Rural Local Broadcast Signal Act of 1999, Congress directed the FCC to “ensure that no facility licensed or authorized under [the Act] cause[] harmful interference to the primary users of that spectrum or to public safety spectrum use.”³² In implementing this law, the FCC relied on the definition of “harmful interference” in Section 2.1(c) of its rules, the application of which the D.C. Circuit Court of Appeals found to be permissible and reasonable.³³ Another recent example was a specific provision in the National Defense Authorization Act for Fiscal Year 2021 that required the Secretary of Defense to certify whether certain commercial wireless operations “do not cause harmful interference to a Global Positioning System device of the Department of Defense.”³⁴ Finally, on September 26, 2024, the President signed the Launch Communications Act, which required the FCC to adopt regulations for commercial space launches and reentries using designated radio frequencies at private launch sites that “would not cause harmful interference with Federal systems.”³⁵ The U.S. Congress was apparently comfortable with the FCC relying on its own regulatory definition of “harmful interference.”

Next, we turn back to the pre-World War II era of radio frequency regulation.

III. HISTORY OF “INTERFERENCE” IN EARLY RADIO REGULATION

Writing in a 1955 law journal article on *The International Law of Radio*, George A. Coddington, Jr., a longtime member of the University of Colorado faculty, stated succinctly that the primary purpose of international cooperation in the field of radio

31. S. Rep. No. 90-1276, at 3-4 (1968); *see also* H.R. Rep. No. 90-1108, at 3-4 (1968). Other examples in the House and Senate committee reports included interference to radios used by police and fire departments that cause “error or delays” affecting the preservation of life and property and “excessive radiation” resulting in “radio listeners and television viewers who are the victims of static, garbled signals, and fluttering images.” *Id.*

32. Pub. L. No. 106-113, div. B, App. I, tit. II, § 2002(b)(2), 113 Stat. 1501, 1501A-544 (1999).

33. *See Northpoint Technology, Ltd. v. FCC*, 414 F.3d 61, 69-70 (D.C. Cir. 2005).

34. Pub. L. No. 116-283, § 1662, 134 Stat. 4047 (2021); *see also* NAT'L ACAD. OF SCI., ENG'G & MED, *supra* note 11, mandated by section 1663 of this legislation.

35. Pub. L. No. 118-85, § 2(b)(2), 138 Stat. 1546-1547 (2024).

communication “is to eliminate ‘harmful interference.’”³⁶ However, the regulatory concepts of “harmful interference” and “interference” and their meaning were far from clear at the dawn of the radio age through the 1950s. Indeed, it took decades for regulators and scholars alike to understand radio interference, much less to appreciate the need for definitional precision.

Professor Coddling’s effort to describe this concept—based on his detailed study of the history of the ITU—provided the following technical explanation:

Many things can happen between the transmission and the reception of a signal to harm or distort it. The term “interference” is used to describe such occurrences. . . . Interference is relative. In most types of radio communication there exists a certain amount of background noise resulting from atmospheric conditions, electrical machines, and the emissions of radio transmitters other than that to which a receiver is tuned. As long as contact can be maintained in the desired manner, the interference is not classed as harmful. However, when any of these noises reach such an intensity that it completely disrupts communication, as in radio-telegraphy, or the listeners complain, as in standard broadcasting, the interference is classed as harmful.³⁷

Professor Coddling’s article quoted and cited in a footnote the “technical definition of ‘harmful interference’” but did not attempt to explain how his descriptions of “interference” and “harmful interference” in the quoted passages aligned with the actual regulatory definitions adopted by the ITU.³⁸

36. George A. Coddling, Jr., *The International Law of Radio*, 14 FED. COMM. B.J. 85, 87 (1955) (footnote omitted) [hereinafter Coddling 1955]. At the time he published this article, Coddling was a Lecturer on Political Science at the Wharton School, University of Pennsylvania. He came to Colorado in 1961 and, along with Frank S. Barnes, co-founded CU’s Interdisciplinary Telecommunications Program. *Interdisciplinary Telecommunications Program*, WIKIPEDIA, https://en.wikipedia.org/wiki/Interdisciplinary_Telecommunications_Program [https://perma.cc/2E5U-LMNR] (last visited Feb. 23, 2025).

37. Coddling 1955, *supra* note 36, at 88 (footnotes omitted). Coddling’s more comprehensive and well-known history of the ITU was published three years earlier. GEORGE A. CODDING JR., *THE INTERNATIONAL TELECOMMUNICATION UNION: AN EXPERIMENT IN INTERNATIONAL COOPERATION* (E. J. Brill 1952) [hereinafter CODDING 1952].

38. See Coddling 1955, *supra* note 36, at 88 n.13 (*citing and misquoting* the definitions of “harmful interference” and “safety device” [sic] from the INTERNATIONAL TELECOMMUNICATION CONVENTION (Buenos Aires, 1952) art. 49 & annex 3). In another footnote in his 1955 article, Coddling explained further how “Interference varies to a great extent, therefore, depending upon the service being performed” or whether the

They did not align. Yet, even without any exactness with the defined terminology, Coddling comprehensively chronicled the historical context in which “[t]he importance of harmful interference is reflected in the space in the Conventions and Radio Regulations devoted to its elimination.”³⁹ International agreements began in the early 1900s by establishing regulations to prevent interference, but did so without explicitly defining what interference *was* or *was not*.

When the concept of interference initially arose in the context of international telecommunications regulation and institutions, it was in connection with new radiotelegraphy technologies and well after the first international agreements concerning wired telegraphy systems.⁴⁰ An 1865 Conference created the International Telegraph Union: “the first supranational government organization to come into existence and at the same time the first organization to oversee and regulate an international public service.”⁴¹ The 1865 Treaty was revised several times in the 19th century,⁴² the most important being the 1875 St. Petersburg International Telegraph Plenipotentiary Conference.⁴³ That meeting split the prior Conventions into “articles of a general nature” that could be reviewed and revised only in future

listener is a “novice” or an “expert” (presumably in the Amateur Service). *Id.* at 88-89 n. 14. In another example: “A local broadcasting station, however, would be subject to ‘harmful interference’ if outside emissions merely distorted musical tones.” *Id.*

39. *Id.* at 88. Coddling, along with FCC staffer Anthony Rutkowski, published another book in 1982 analyzing the history of the ITU. See GEORGE CODDING & ANTHONY RUTKOWSKI, *THE INTERNATIONAL TELECOMMUNICATION UNION IN A CHANGING WORLD* 208 (Artech House 1982). See also Gary D. Rosch, *Book Reviews – The International Telecommunication Union in a Changing World*, 36 FED. COMM. L.J. 95 (1984) (“Through a historical review of ITU policy and structure the reader is provided with a perspective that is often not treated in works of this type.”).

40. The first such agreements were signed in the 1840s between Prussia and 15 other German states, and within the boundaries of the Austrian Empire (Vienna-Bрно-Prague). Telegraph agreements were confined to interconnection and charging, but did not have to address radio interference issues. See G. Balbi *et al.*, *Bringing together the two large electric currents that divide Europe: Switzerland’s Role in Promoting the Creation of a Common European Telegraph Space (1849-1865)*, 15 INT’L COM’TE HISTORY OF TECH 60, 61 (2009); see also Simone Fari, *Telegraphic Diplomacy from the Origins to the Formative Years of the ITU, 1849-1875*, in *HISTORY OF THE INTERNATIONAL TELECOMMUNICATION UNION*, § 7.2 (Gabriele Balbi & Andreas Fickers eds., 2020) [hereinafter ITU HISTORY].

41. Simone Fari *et al.*, *THE FORMATIVE YEARS OF THE TELEGRAPH UNION* 5 (P. Kennan trans. 2015).

42. An intermediate step was taken at the International Telegraph Conference (Rome 1871-1872), where – for the first time – the rights of non-governmental parties (at that time, submarine cable constructors and operators) were recognized by a change in article 14 from “*Etats*” to “*Administrations*.” See CODDING 1952, *supra* note 37, at 13.

43. See ITU, *Plenipotentiary Conferences: St. Petersburg 1875* (French only), <http://handle.itu.int/11.1004/020.1000/4.4> [https://perma.cc/HFB9-B44T] (last visited Oct. 10, 2024).

Plenipotentiary Conferences of the Union⁴⁴ and regulations that could be revised at “Administrative Conferences.”⁴⁵ This set the institutional structure for the later separation of periodic radio and plenipotentiary conferences.⁴⁶

Well before the first international radiotelegraph conferences, several well-known inventions (and their famous inventors) demonstrated how radio waves could be “oscillated” (varied by amplitude, frequency, or time) to convey information without wires. While Heinrich Hertz made the first decisive experiment in 1888 proving electromagnetic waves existed and could be altered by an electric current, Italian inventor Guglielmo Marconi first put theory into practice, developing and marketing the first radio that could transmit and receive Morse code.⁴⁷ Because Italy had relatively weak patent rights, he left for London, filing his first patent there in 1896 and organizing spectacular demonstrations.⁴⁸ Thus, by the time of the first international radiotelegraph conference in 1903, Great Britain and Italy were fully aligned, using the Marconi wireless telegraphy system, while the U.S. and other countries were initially relying on incompatible systems or codes. By the turn of the century, however, Marconi’s “apparatus” dominated the — mostly maritime— market via exclusivity provisions in its contracts that prohibited operators of its equipment from communicating with non-Marconi equipment, even in the event of an emergency.⁴⁹ The two Berlin conferences were the initial international efforts to harmonize a system of rules to govern radiotelegraphy.

44. ANTHONY MICHAELIS, *FROM SEMAPHORE TO SATELLITE* 30, 67 (ITU 1965) (“It consisted of 21 articles, in four major divisions: the relations of the contracting parties to the users of international telegraphy, the relations of the Members of the Union to each other, the composition of the Union itself, and finally the way in which the Convention and the Telegraph Regulations were to be applied.”).

45. CODDING 1952, *supra* note 37, at 87.

46. See Audrey L. Allison, *Meeting the Challenges of Change: The Reform of the International Telecommunication Union*, 45 FED. COMM. L.J. 491, 497 (1993).

47. ANTON HUURDEMAN, *THE WORLDWIDE HISTORY OF TELECOMMUNICATIONS* 201-04 (Wiley 2003).

48. ANDREAS FICKERS & PASCAL GRISET, *COMMUNICATING EUROPE: TECHNOLOGIES, INFORMATION, EVENTS* 39-41 (Springer 2019).

49. See DAVID LEIVE, *INTERNATIONAL TELECOMMUNICATIONS AND INTERNATIONAL LAW: THE REGULATION OF THE RADIO SPECTRUM* 40 (Sijthoff 1971) [hereinafter LEIVE 1971]; see also Allison, *supra* note 46, at 498 n.17. This prohibition led to embarrassment on the high seas: In 1902, Prince Heinrich of Prussia (1869-1929), brother of Wilhelm II (1859-1941), the king of Prussia and emperor of the German empire, while crossing the Atlantic on his way back from the United States, wanted to send a courtesy telegram to President Theodore Roosevelt (1858-1919), but the Prince was refused service because the radio on his ship was not made by Marconi. HUURDEMAN, *supra* note 47, at 357.

A. *The Berlin International Wireless Telegraphy Conferences*

1. Berlin 1903 “Preliminary” Conference

The 1903 “Preliminary Conference on Wireless Telegraphy” in Berlin was not an official Union conference but rather a preparatory conference convened by the Government of Germany and involving representatives from Austria, France, Germany, Great Britain, Hungary, Italy, Russia, Spain, and the United States.⁵⁰ At this stage in the development of radio, radiotelegraphy was primarily used for ship-to-shore communications, especially aboard naval vessels.

In calling the 1903 Conference, the German Government aimed to ensure the development of new radio technology would not be unduly hampered by any attempt to monopolize facilities and to, therefore, develop rules to block any attempt to impose one system (*i.e.*, the Marconi system) upon others.⁵¹ Specifically, Germany proposed, among other provisions, that the following language of a suggested protocol be considered to combat potential abuses of monopoly power:

Radiotelegrams coming from and sent to ships shall be received and transmitted without regard to the system employed.⁵²

Great Britain and Italy led the opposition to this interoperability requirement.⁵³ The Italian Delegate argued that this provision would lead to, among others, “Military Difficulties” because

the use of several international systems would greatly interfere with communication between ships of war and commercial coast stations on account of technical and

50. See ITU, *Preliminary Conference on Wireless Telegraphy* (Berlin, 1903), <http://handle.itu.int/11.1004/020.1000/4.35> [<https://perma.cc/6ACR-PWLR>] (last visited Oct. 10, 2024). Marconi’s attempted monopoly, as much as anything, brought the United States to the bargaining table. J. Henry Glazer, *The Law-Making Treaties of the International Telecommunication Union Through Time and in Space*, 60 MICH. L. REV. 269, 274 (1962).

51. See CODDING 1952, *supra* note 37, at 84.

52. See ITU, *Documents of the Preliminary Conference on Wireless Telegraphy* (Berlin, 1903) at 1 (translation of the *Procès-Verbaux and Protocole Final* by Geo. R. Neilson, of the Eastern Telegraph Company and Officially Accepted by H.M. Postmaster-General) [hereinafter Berlin English 1903 Minutes]; see also CODDING 1952, *supra* note 37, at 85.

53. See CODDING 1952, *supra* note 37, at 85.

administrative difficulties, while the adoption of a single international system, which all vessels of war would use in the same way as the international system of signals, would facilitate the radio-telegraph service.”⁵⁴

The British Delegate “observed that the preventing of interference was a technical question as to which it was not known if science were sufficiently advanced.”⁵⁵

Two days later, Germany proposed to add a new paragraph to Article I, reading:

The service of radio-telegraph stations must be organized, as far as possible, in such a way as not to interfere with the service of other radio-telegraph stations.⁵⁶

The German Delegate explained that this provision “only lays down a general rule for the organisation of the service” and:

Looking to the nature of wireless telegraphy, and to the fact that the Hertzian waves spread in all directions, and that consequently the simultaneous undisturbed working of several neighbouring stations is still a problem not fully solved, it is necessary to lay down the principle that the Administrations should undertake to adopt every precaution to limit reciprocal interference as much as possible. The details of these precautions form part of the executive regulations . . .⁵⁷

On the other hand, the Italian Delegate was of the opinion that

it would be hazardous to give at present the details of the stipulations which should form part of working regulations for a service which has not yet been tested by any Government on commercial lines. But it would be necessary to submit the matter to a practical examination in the various countries by special commissions which would study the questions to be formulated by this Conference.⁵⁸

54. Berlin English 1903 Minutes, *supra* note 52, at 11 (emphasis added).

55. *Id.* at 13.

56. *Id.* at 26 (emphasis added).

57. *Id.* at 27 (emphasis added).

58. *Id.*

The British delegate noted that “[i]n the propositions formulated by the German Government before the meeting of this Conference no mention is made of the question of preventing disturbances, and we do not think it possible to agree on definitive measures on this subject at the present Conference.”⁵⁹

The Final Protocol of the 1903 Berlin conference contained eight articles in barely four pages.⁶⁰ The language proposed by Germany to combat potential abuses of monopoly power was modified and became Paragraph 2 of Article I, which read:

Coast stations are bound to receive and transmit telegrams originating from or destined for ships at sea without distinction as to the systems of wireless telegraphy used by the latter.

This was still insufficient for Italy (on behalf of Marconi, still desiring a global monopoly), which made a Declaration at the end of the Final Protocol that it would only accept the proposed text on the condition “that all these systems give a satisfactory guarantee for mutual working as to range, perfection of organisation, and certainty of communication.”⁶¹

The 1903 Conference minutes and Final Protocol were produced officially in French and subsequently translated into English for the British Postmaster-General. The Conference proceedings and results settled on a single French phrase, *ne pas troubler*, the official British translation of which was “not to interfere.” As noted above in Part II, the English verb “interfere” was derived from Old French “*s’entreféir*,” meaning to strike each other, whereas the modern translation of the French verb “*troubler*” is to “confuse,” “disturb,” or “disrupt.”⁶² Other French terms were later translated to mean “interference,” “interfere,” or “disturb.”

When comparing provisions and the discussions of interference in the French version (and the English translation) of the 1903 Conference Minutes, the French text used several words or phrases: *perturbation*, *troubler*, *non interrompu*, *rendrait très malaise*,⁶³ and

59. *Id.* at 34 (emphasis added).

60. *Id.* at 57.

61. *Id.* at 61.

62. *Troubler*, COLLINS FRENCH TO ENGLISH DICTIONARY, <https://www.collinsdictionary.com/dictionary/french-english/troubler> [https://perma.cc/PD8K-7JPN] (last visited Apr. 12, 2025).

63. This phrase was used by the Italian delegate, who (according to the English translation) argued “the use of several international systems would greatly interfere with communication between ships of war and commercial coast stations on account of

des troubles sérieux. Each expressed the concept of “interference” but was translated variously into English. For example, sometimes the French “*perturbation*” in the minutes was translated both as “disturbance” and as “interference” in the English version – sometimes on the same page.⁶⁴ In one instance, “*perturbation*” was translated as a third English verb: “dislocate.”⁶⁵ Despite the elementary state of radio in 1903, the concepts and other principles laid down in the Protocol of the first Berlin Conference became the basis for the regulation of radio communication for the next several decades.⁶⁶

2. Berlin 1906 Conference

The second international radio conference included substantially more countries but, according to Professor Codding, did not significantly build upon the 1903 Conference results.⁶⁷ Although it embodied the principles of the 1903 Protocol, the 1906 Final Protocol elaborated upon the details and included the first set of International Radio Regulations. It “came no closer to changing the monopolistic practices of the Marconi Company.”⁶⁸ To reduce interference between types of transmissions, these regulations specified certain frequencies (at the time, expressed in terms of two wavelengths at 300 and 600 meters) for particular stations.⁶⁹

Interoperability among ship stations was another hot issue. The United States introduced a last-minute proposal requiring all ship stations to receive communications from all other ship stations, regardless of the type of apparatus employed. Italy and Great Britain opposed this.⁷⁰ Rather than craft new treaty

technical and administrative difficulties, while the adoption of a single international system, which all vessels of war would use in the same way as the international system of signals, would facilitate the radio-telegraph service.” Berlin English 1903 Minutes, *supra* note 52, at 11; *see also* ITU, *Documents de la Conférence préliminaire concernant la télégraphie sans fil* (Berlin, 1903) at 21 [hereinafter Berlin French 1903 Minutes].

64. Compare Berlin French 1903 Minutes, *supra* note 63, at 24 (discussion of Herr von Stibral: “*perturbations*”) and Berlin English 1903 Minutes, *supra* note 52, at 13 (“interference”) with Berlin French 1903 Minutes, *supra* note 63, at 24 (discussion of the Conference President: “*perturbations*”) and Berlin English 1903 Minutes, *supra* note 52, at 13 (“disturbances”).

65. Compare Berlin French 1903 Minutes, *supra* note 63, at 72 with Berlin English 1903 Minutes, *supra* note 52, at 49.

66. See Codding 1955, *supra* note 36, at 87.

67. See *id.* at 85-86.

68. CODDING & RUTKOWSKI, *supra* note 39, at 13.

69. See LEIVE 1971, *supra* note 49, at 41.

70. See L.S. HOWETH, HISTORY OF COMMUNICATIONS-ELECTRONICS IN THE UNITED STATES NAVY 122 (U.S. Gov’t Printing Office 1963) (“The Italian delegation was frank enough to announce that its sentiments were in favor of the American proposition, but,

language, the U.S. delegation agreed to withdraw the point but persuaded a majority of other nations – nineteen in total – to enter into an *Engagement Additional* “which extended the obligation of compulsory intercommunications without regard to system, to ship-to-ship communications.”⁷¹

International documentation of this conference – the Final Protocol, regulations, and minutes – was (and still is) published solely in French.⁷² Three key provisions were in Article 8 of the Convention and Articles V and XL of the regulations annexed to the Convention, which read (in French):

*L'exploitation des stations radiotélégraphiques est organisée, autant que possible, de manière à ne pas troubler le service d'autres stations de l'espèce.*⁷³

*Des essais et des exercices ne sont tolérés dans ces stations qu'autant qu'ils ne troubleront point le service d'autres stations.*⁷⁴

*Les transmissions échangées entre les stations de bord visées à l'article 1^{er} de la Convention doivent s'effectuer de manière à ne pas troubler le service des stations côtières, celles-ci devant avoir, en règle générale, le droit de priorité pour la correspondance publique.*⁷⁵

The two similar French phrases turned on the same phrase used in the 1903 and 1906 Final Protocols: *ne pas troubler*, which, in 1903, was translated as “not to interfere.”⁷⁶ Despite that previous interpretation, the U.S. Department of State (and the U.S. Senate)

owing to the nature of the contracts between the Marconi Company and the Italian Government, it could not support the proposal.”)

71. Glazer, *supra* note 50, at 275.

72. See ITU, *International Radiotelegraph Conference (Berlin, 1906)*, <http://handle.itu.int/11.1004/020.1000/4.36> [<https://perma.cc/9K78-JFAK>] (last visited Apr. 13, 2025).

73. *CONVENTION RADIOTELEGRAPHIQUE INTERNATIONALE DE BERLIN, LE DEPARTEMENT DES POSTES DE L'EMPIRE D'ALLEMAGNE* (1906), art. 8 (emphasis added).

74. *Id.* Règlement de Service, art. V (emphasis added).

75. *Id.* art. XL (emphasis added).

76. The French *troubleront* is the gerund of *troubler*. In English, the difference is between “interfering” (or “interfere”) and the infinitive “to interfere.” *Troubler*, *Collins French-English Dictionary*, <https://www.collinsdictionary.com/dictionary/french-english/troubler> [<https://perma.cc/PD8K-7JPN>] (last visited Apr. 4, 2025).

relied on a slightly different translation of the 1906 provisions but understood the purpose as avoiding “interference.”⁷⁷

Notwithstanding the 1903 translation of the French *troubler* as “interfere” in Great Britain’s English translation of the Berlin 1903 Protocol, the U.S. State Department and Senate used a more literal meaning of *troubler* in its translation of Article 8 of the 1906 convention:

The working of the wireless telegraph stations shall be organized as far as possible in such manner as not to disturb the service of other wireless stations.⁷⁸

When it was seeking ratification of the 1906 Final Protocol and Regulations, the State Department translated the second clause of Article V of the regulations to read:

Experiments and practice will be permitted in such stations in so far as they do not interfere with the service of other stations.⁷⁹

Article XL of the regulations was translated to read:

The exchange of correspondence between shipboard stations . . . shall be carried on in such a manner as not to interfere with the service of the coastal stations, the latter, as a general rule, being accorded the right of priority for the public service.⁸⁰

Notwithstanding the success of the U.S. delegation at the Berlin 1906 Convention, U.S. ratification proved unattainable until 1912, and a common understanding of the meaning of “interference” seemed elusive but solvable. Testifying in support of ratification, one of the U.S. Delegates to the 1903 and 1906

77. See U.S. Senate, *Wireless Telegraph Convention*, 37 Stat. 1565, 1567 (1912) (translation used by the Senate) (expressing in the margin that this Article provided that “Interference [was] to be avoided”).

78. *Id.* (emphasis added); For a list of the various terms, definitions, and translations that came out of International Radio Conferences from 1903 to the present, see Peter A. Tenhula & Carl R. Frank, *Regulation of Radio Frequency Communications: The Untold History of “Harmful Interference”* (TPRC 2022), Working Paper v3.1, Appendix (Sept. 7, 2022), <https://papers.ssrn.com/abstract=4181043>.

79. See “*Wireless Treaty*” *Negotiated at the Berlin Conference of 1906: Hearings Before the S. Comm. on Foreign Relations*, 60th Cong. 24 (1908) [hereinafter *Senate Hearings on 1906 Wireless Treaty*]; see also 37 Stat. 1565, 1583 (1912).

80. *Senate Hearings on 1906 Wireless Treaty*, supra note 79, at 24; see also 37 Stat. 1565, 1598 (1912).

conferences described the interference problem that the treaty aimed to address as follows:

As it is, wireless telegraphy is simply chaos. . . . The wireless telegraph stations in use interfere with each other, the one having the greater power overcoming the other. The station having the lesser power can not [sic] send messages at all when its more powerful neighbor near at hand is sending unless wave lengths used differ largely. The wavelength is one matter for regulation.⁸¹

A joint memorandum submitted for the hearing record by the Departments of War, Navy, and Commerce and Labor summarized the treaty's "[p]rovisions for preventing interference and confusion, whether caused by accident or design."⁸² Among the numerous provisions cited and summarized, the joint memorandum described Article 8 of the Convention as follows:

The working of every station is required to be organized as far as possible in such a manner as not to interfere with the working of other stations.⁸³

The joint memorandum described Articles 6 and 28 of the regulations:

To limit the range of possible disturbance, it is provided that "all stations are bound to exchange traffic with the minimum expenditure of energy required for obtaining effective communication."⁸⁴

The Marconi Company representatives testified against ratification at the Senate hearings, mainly targeting the provisions requiring compulsory intercommunication.⁸⁵ Most American

81. *Senate Hearings on 1906 Wireless Treaty*, supra note 79, at 43-44 (Statement of Rear Admiral H.N. Manney).

82. *Id.* at 115 (Memorandum Concerning the Int'l Wireless Tel. Convention, concluded at Berlin, Nov. 3, 1906, by Messrs. Allen, Davis, Chamberlain, and Earl) (emphasis added).

83. *Id.* (emphasis added). A select committee of the British House of Commons similarly described Article 8 (and other provisions "required to meet the circumstances peculiar to radiotelegraphy to prevent interference and confusion") as a "General obligation not to interfere": "article 8 of the convention requires that the working of radiotelegraph stations shall be organized, as far as possible, in such a manner as not to interfere with the working of other stations of the kind." SELECT COMMITTEE ON RADIOTELEGRAPHIC CONVENTION, 1907, HC xii-xiii.

84. *Senate Hearings on 1906 Wireless Treaty*, supra note 79, at 115 (emphasis added).

85. *Id.* at 50-75 (Statement of John W. Griggs, Representing the Marconi Company).

radiotelegraph companies testified for it.⁸⁶ One representative letter in the record from the President of a small U.S. wireless telegraph company who opposed ratification stated:

The principal question is that of “interference.” Stations at several miles distance cause serious trouble in this respect, but wireless inventors are endeavoring to overcome the obstacle and believe it will be accomplished before long. The wireless treaty is dealing with the situation as it now is, and should it be ratified there will be no object for inventors to perfect this or other features of the system.⁸⁷

After two years, the Senate temporarily shelved the ratification efforts: “This conclusion is in spite of the fact that a dozen or more great powers [had] already approved the treaty and [were] waiting for the co-operation of the United States.”⁸⁸

At this point in the early history of radio communications, internationally and domestically, the English term “interfere” could mean “disturb” or “confuse.” It would remain misaligned with the French versions until 1947. However, the earliest practical attempt to describe the meaning of “interference” preceded the Berlin 1906 conference.

B. U.S. Development of Regulatory Recommendations in Early 1900s

Before the turn of the century, the U.S. Navy investigated radio techniques and reported on the interference “defect” shown in early demonstrations of the Marconi system. In the December 1899 Navy report quoted in Part II above, officers who witnessed the use of the system during America’s Cup yacht races in New York Harbor indicated that “this system is successful and well adapted for Navy use.”⁸⁹ The report continued:

86. See HOWETH, *supra* note 70, at 125-26.

87. *Senate Hearings on 1906 Wireless Treaty*, *supra* note 79, at 134 (Letter of Massie Wireless Telegraph Company, in Opposition to the Ratification (Jan. 30, 1908)) (emphasis added). This appears to be the only English-speakers’ use of “trouble” as a synonym for “interference.”

88. *Hearing Before the Committee on Foreign Relations, International Wireless Telegraphy*, X ELECTRICAL WORLD 292 (Feb. 8, 1908). Consideration of the ratification of the 1906 Berlin Convention by the U.S. Senate resumed in February 1912. See HOWETH, *supra* note 70, at 159.

89. *Id.* at 34 (quoting from a Letter from Chief of Bureau of Equipment, U.S. Navy, to Secretary of the Navy (Dec. 1, 1899)).

The chief objection to it is known as “interference,” which may be described as follows: When signals are being exchanged between two stations, if signals are made at a third station within the radius of effect then the signals at the receiving station of the first two mentioned become confused and unintelligible.

Notwithstanding this fact, the [Navy] Bureau [of Equipment] is of the opinion that the system promises to be very useful in the future for the naval service.⁹⁰

Later, the Secretary of the Navy reported:

When signals are being transmitted from one station to another . . . and another vessel comes within signaling distance and attempts communication with [a land station], then the signals from the two ships become confused, and the receiving station on shore is unable to distinguish between them.⁹¹

In the early 1900s, the Navy, Army Signal Corps, and the Department of Agriculture experimented heavily with radio but “with little coordination between the various departments.”⁹² The two main types of radio facilities in the early 1900s were maritime (ship-to-shore, ship-to-ship) and amateur. At the time, the latter service was mainly used within the United States and Great Britain. Driven by interference concerns, the proposed regulation of radio in the U.S. did not wait for the development and ratification of international agreements.

In June 1904, President Theodore Roosevelt created a board of radio experts, representing four government agencies, to prepare recommendations for regulating wireless telegraphy and to ensure unfettered government use.⁹³ In less than a month, the Board reported to the President on July 12, 1904, proposing to assign oversight of government radio to the Navy and Army Departments

90. *Id.* (emphasis added).

91. SEC’Y OF THE NAVY ANN. REP. at 319-20 (1900), *quoted in* HOWETH, *supra* note 70, at 32.

92. THOMAS H. WHITE, *Early Government Regulation (1903-1041)*, UNITED STATES EARLY RADIO HISTORY: A WIRELESS MESSAGE, (2003), <https://earlyradiohistory.us/sec023.htm> [<https://perma.cc/US88-DRGX>].

93. The Department of Commerce and Labor was represented by Robley D. Evans, Rear-Admiral, U. S. Navy. Rear-Admiral Henry N. Manney and Lieutenant-Commander Joseph L. Jayne represented the Navy Department. Brigadier-General A. W. Greely (U.S. Army) represented the War Department. Professor Willis L. Moore represented the Department of Agriculture. *See* HOWETH, *supra* note 70, at 76.

and to place significant restrictions on commercial radio installations.⁹⁴ Among the Board's findings regarding the status of Government wireless telegraph stations:

The Navy Department has at times been very seriously interfered with in the vicinity of New York and Boston, and there are already so many stations in the vicinity of Newport that an effort has been made by the officer in charge of the torpedo station to establish a tentative arrangement whereby the various stations will interfere as little as possible with each other.⁹⁵

Among its conclusions: "When interference seems probable between stations of the Navy and War Departments, the question involved shall be mutually settled by representatives of the two Departments."⁹⁶ The Board's recommendations included:

That the Signal Corps of the Army be authorized under its chief to establish from time to time such wireless stations as he may deem necessary, and that they do not interfere with the coastwise wireless-telegraph system of the Government under control of the Navy Department . . .

[T]hat there may be special cases where private stations can serve a useful purpose, and the Board believes that the Department of Commerce and Labor should have the duty of issuing licenses in such cases under such regulations as will prevent interference with stations necessary to the national defense.⁹⁷

On July 29, 1904, President Roosevelt approved the Board's recommendations and directed that such recommendations become effective immediately to the extent that they applied to executive branch agencies.⁹⁸

In January 1905, the Departments of Navy, Commerce and Labor, and War considered draft legislation for the national supervision of radio.⁹⁹ The proposed bill included four provisions

94. INTER-DEPARTMENTAL BOARD APPOINTED BY THE PRESIDENT TO CONSIDER THE ENTIRE QUESTION OF WIRELESS TELEGRAPHY IN THE SERVICE OF THE NAT'L GOV'T, WIRELESS TELEGRAPHY (Jul. 29, 1904).

95. *Id.* (emphasis added).

96. *Id.* (emphasis added).

97. *Id.* (emphasis added).

98. HOWETH, *supra*, note 70 at 78.

99. *Id.* at 82.

referencing “interference,” such as a licensing requirement for any person or corporation operating wireless telegraphy apparatus “where interference would be caused thereby.”¹⁰⁰ Another provision would have authorized the President to establish regulations governing private or commercial stations “[f]or the purpose of preventing or minimizing interference” to naval and military stations.¹⁰¹

In September 1906 (before the delegates convened in Berlin), President Roosevelt became a victim of interference when amateur and commercial radio interference in the Boston area “prevented transmission of messages” to the President while on the U.S.S. *Mayflower* off Cape Cod.¹⁰² Infuriated, the President directed the Navy to prepare a memorandum regarding the control of radiotelegraphy. The Navy memorandum described the interference caused by commercial stations along the coast that “have approximately the same wave lengths as [the Navy’s]” that “interfere to such an extent as to prevent completely the sending or receiving of official messages.”¹⁰³ Although the Navy’s description of interference was formulated in a similar vein as the two Berlin conferences, it was vastly more specific: “interference” occurred when unwanted signals completely prevented the reception of the wanted signal.

According to Howeth, the Senate’s initial failure to consent to ratification of the 1906 Berlin treaty reflected President Roosevelt’s irritation with “big business” via his antitrust policies, which antagonized the British-dominated Marconi Wireless Telegraph Company of America.¹⁰⁴ In the absence of international controls, one Senate and two House bills proposing to regulate wireless telegraphy were introduced in 1908 during the 60th Congress. The Senate bill, introduced by Senator Hale on March 6, 1908, was nearly identical to the comprehensive legislation drafted by the executive branch agencies in early 1905.¹⁰⁵ The House bills would have prescribed “penalties for interference with official wireless messages.”¹⁰⁶ Although President Roosevelt supported the regulation of new radio communications services, the fledgling

100. *Id.* at 552-53 (Appendix D. Proposed Legislation for National Control of Radio, 1905, § 1).

101. *Id.* at 552 (§ 3).

102. *Id.* at 117, 521.

103. *Id.* at 117 (quoting Memorandum for the President from Rear Adm. Robley D. Evans (Sept. 29, 1906)) (emphasis added).

104. *Id.* at 129.

105. S. 5949, 60th Cong., 1st Sess. (1908).

106. H.R. 17719, 60th Cong., 1st Sess. (1908); H.R. 18979, 60th Cong., 1st Sess. (1908).

radio industry opposed the proposed legislation, and the 60th Congress “adjourned without voting on any of the three bills.”¹⁰⁷

Still, without ratifying the 1906 Berlin Convention, the U.S. Congress passed its first radio regulatory law on June 24, 1910. A modest bill, it did not mention “interference” (or any synonyms), but it required large vessels of all nationalities to carry a radio apparatus and radio operators to take effect by July 1, 1911.¹⁰⁸ The Bureau of Navigation in the Department of Commerce and Labor was assigned to enforce these provisions and was responsible for regulating radio until the 1927 formation of the Federal Radio Commission.

On April 15, 1912, the *Titanic* sank in the mid-Atlantic. Four ships that could have rescued its passengers were within sixty miles, and one ship was less than ten miles away – and had previously exchanged messages with the *Titanic* – but its radio operator was not listening for ship-to-ship traffic at the time.¹⁰⁹ The Senate had coincidentally provided advice and consent to ratify the 1906 Berlin Convention nearly two weeks before the *Titanic* sank so that the United States would be invited to attend the next International Radio Telegraphic Conference to be held in London.¹¹⁰

C. 1912 International Radio Conference (London)

After the *Titanic* had settled at the bottom of the Atlantic, forty-five countries met in London in June 1912 to revise the Berlin 1906 International Radiotelegraph Convention.¹¹¹ The official outcomes of the London conference were provided in both French

107. HOWETH, *supra* note 70, at 131-32. (“With the ether as a common medium of transmission, which medium can be preempted at pleasure by a youth for amateur play, or at any moment rendered unavailable for serious purposes by malicious disturbances from stations of competing wireless companies, the need of some regulation of its use cannot be gainsaid. The Hale bill, however, would in effect make the ether an instrument of warfare and in time of peace an appendage of the military establishment.” *Id.* at 130 (quoting *Government Regulation of Wireless Telegraphy*, 51 *ELECTRICAL WORLD*, no. 12, Mar. 21, 1908, at 589, 589-90).

108. Pub. L. No. 36-262, 36 Stat. 629 (1910).

109. For a full account of the tragedy, see MARVIN R. BENSMAN, *THE BEGINNING OF BROADCAST REGULATION IN THE TWENTIETH CENTURY* 8 (2000).

110. See HOWETH, *supra* note 70, at 159. Senate advice and consent to ratification was provided April 3, 1912, and the treaty was ratified by President Taft on April 22, 1912. *Wireless Telegraph Convention*, Nov. 3, 1906, 37 Stat. 1565, T.S. No. 568.

111. See CODDING 1952, *supra* note 37, at 97-107; see also ITU, *International Radiotelegraph Conference (London, 1912), Quick Facts*, <http://handle.itu.int/11.1004/020.1000/4.37> [<https://perma.cc/64D3-GZS4>] (last visited Oct. 10, 2024).

and English, but the United States and Great Britain developed slightly different translations of interference terminology.¹¹²

Article 3 of the 1912 Convention adopted the U.S. position from Berlin 1906 on mandatory reception of “ship-to-ship” messages “without distinction as to the radiotelegraph system adopted by such stations.”¹¹³ The British and U.S. translations of Article 8 retained the Berlin 1906 Convention’s provision on interference:

The working of radiotelegraph stations shall be organised, as far as possible, in such a manner as not to disturb the service of other stations of the kind.¹¹⁴

However, the official U.S. ratified version of the London Convention and regulations included several translations of the French term *troubler*. For example, Article VI of the regulations used the French phrase *ne troublent*, but the British translated this as “do not disturb,” while the American translation was “do not interfere.”¹¹⁵ Article VII of the regulations brought back the French term *perturbations*, translated by the U.K. as “disturbance” and by the U.S. as “interference.”¹¹⁶ In Article XLVI of the regulations, the U.K. and U.S. translated *ne pas troubler* as “not to interfere.”¹¹⁷ Whether called “disturb” or “interfere,” the 1912 London

112. Compare INTERNATIONAL RADIOTELEGRAPH CONVENTION JULY 5, 1912, Gr. Brit. TS No. 10 (1913) (Cd. 6873) [hereinafter LONDON CONVENTION], with Philip C. Knox, Report of American Delegates (Oct. 30, 1912), and P. C. Knox, Report of Delegates Representing the Department of Commerce and Labor (Jul. 10, 1912) (contained in INTERNATIONAL RADIOTELEGRAPHIC CONVENTION, and the Resolution of Ratification, *Message from the President of the United States*, S. Exec. Doc. No. A, 62nd Cong., 3rd Sess. at 40 & 61 (1913)) [hereinafter S. Exec. Doc. No. A]. The Conference Minutes were French-only. See ITU, *Documents de la Conférence Radiotélégraphique Internationale de Londres* (Berne, 1913).

113. LONDON CONVENTION, *supra* note 112, art. 3.

114. *Id.* art. 8 (emphasis added); see also RADIOTELEGRAPHIC CONVENTION, 38 Stat. 1672, 1708 (1912) (translation used by the Senate) (like the 1906 provision, expressing in the margin that this Article provided that “Interference to be avoided”) [hereinafter U.S. Senate 1912].

115. Compare LONDON CONVENTION, *supra* note 112, Regulations art. 6, with U.S. Senate 1912, *supra* note 114, Regulations art. VI, 38 Stat. 1719. The British and American versions of the Regulations also translated “trouble” differently in the Annex/Supplement of Article 22/XXII of the Regulations. Compare LONDON CONVENTION, *supra* note 112, Regulations, Annex to art. 22, with U.S. Senate 1912, *supra* note 114, Regulations, Supplement to art. XXII, 38 Stat. 1739 (Abbreviations to be used in Radio Communications; “Q R M”).

116. Compare *id.* art. VII.2(c) of the Regulations, 38 Stat. 1686 (French) and 1720 (U.S. English translation), with LONDON CONVENTION, *supra* note 112, Regulations art. 7.2(c).

117. *Id.* Regulations art. 46; U.S. Senate 1912, *supra* note 114, Regulations art. XLVI, 38 Stat. 1734.

Conference did not attempt to define these concepts, but they appeared to be synonymous at the time.¹¹⁸

The U.S. Senate consented to ratifying the 1912 London Convention on January 22, 1913.¹¹⁹ In urging this consent, the American Delegates reported on the technical discussions at the conference and ways to “minimize interference” among stations by reducing power, using alternative “wave-lengths,” improving the “sharpness of tuning,” and requiring the geographic separation and “classification of stations.”¹²⁰ They had also provided copies (or translations) of then-pending legislation in the U.S. Congress that was ultimately enacted in August 1912 to their international colleagues at the conference.¹²¹

For the next international radio conference, the U.S. Secretary of State extended an invitation to the other countries to host it in Washington, D.C. in 1917, which was accepted unanimously.¹²² Little did they know that an intervening war would lead to a ten-year gap before the Washington conference was convened. World War I brought “an end to this series of [international] conferences, and while it lasted international telegraphy was subject to the complete and arbitrary control of each national Government.”¹²³

118. Chuck Jackson pointed to the failure of these early international conferences and the Radio Act of 1912 to define “interfere.” Jackson, *supra* note 2, at 5. Great Britain, in its 1913 edition of the Postmaster General’s “Handbook for Wireless Telegraph Operators,” used the terms “interfere” and “interference” (13 times) more than “disturb” (5 times) and included a provision (entitled “Avoidance of Interference”) that read: Another general obligation which is imposed on all stations alike, and which is regarded as of the highest importance, is that they shall interfere as little as possible with the working of other stations. The rules of working are largely designed to prevent such interference. Great Britain Post Office, HANDBOOK FOR WIRELESS TELEGRAPH OPERATORS WORKING INSTALLATIONS LICENSED BY HIS MAJESTY’S POSTMASTER-GENERAL § 9 (H.M. Stationery Office 1913).

119. See S. Exec. Doc. No. A, *supra* note 112; see also U.S. Senate 1912, *supra* note 114. President Wilson ratified the treaty on February 5, 1913. *Id.* at 1706.

120. See Knox, *supra* note 112, at 50-51 & 65-66.

121. *Id.* at 44. (expressing views of the American Delegation that the value of ideas they advanced would be “demonstrated in the near future, and that the trend of advance [of radiotelegraph] will be along the general lines contained in the United States Radio Act”).

122. *Id.* at 55, 67.

123. MICHAELIS, *supra* note 44, at 72; see also International Radiotelegraph Union, § 8.4, reprinted in ITU HISTORY, *supra* note 40, at 198 (“For the duration of WWI, international collaboration was put on hold, and many international conferences were deferred or even cancelled. . . The International Telegraph Conference which had been due to take place in Paris in 1915 [was] postponed at the French government’s request. The International Radiotelegraph Conference slated to take place in Washington in 1917 never occurred.”). Government control led to government contracts, and rapid improvement “in the state of the art,” resulting in “better equipment being produced” CODDING & RUTKOWSKI, *supra* note 39, at 15.

D. U.S. Radio Act of 1912, World War I, and Herbert Hoover

The Radio Act of 1912 was the first comprehensive attempt to regulate the U.S. radio communications industry. The Act “grew out of widespread recognition of the increasing importance of radio and the need for the United States to carry out its obligations under the [1906] Berlin Convention . . .”¹²⁴ The new law required prior licenses for all amateur and commercial interstate or international radio transmissions.¹²⁵ Licenses were not required for government stations.

The 1912 Act included a set of nineteen exceptionally specific provisions (labeled “Regulations”) “for the purpose of preventing or minimizing interference with communication between stations.”¹²⁶ For all that specificity, the statute used “interference” or “interfere” fourteen times without defining these terms. It said, like the legislation proposed in 1905, a radio license was required “where interference would be caused” by the operation of radio apparatus.¹²⁷ Licenses issued by the Secretary of Commerce and Labor were to “state the wave length or the wave lengths authorized for use by the station for the prevention of interference” and were to explicitly provide that a station operator “shall not willfully or maliciously interfere with any other radio communication.”¹²⁸ It also authorized the Secretary to grant special temporary licenses to stations “under such conditions as will insure the least interference” to other stations.¹²⁹

Among the principal purposes of the legislation was the promotion of “the most general use of these means of communication without interruption (or ‘interference,’ as it is technically called).”¹³⁰ Congress understood at the time that “[i]n the present state of the development of wireless telegraphy such interruptions or ‘interference’ can be prevented only by the observance of regulations . . .”¹³¹ Another key driver of the legislation was “[t]o bring the United States in accord with the

124. JAMES HERRING & GERALD GROSS, TELECOMMUNICATIONS ECONOMICS AND REGULATION 239 (1936).

125. Pub. L. No. 62-264, 37 Stat. 302 (1912) [hereinafter Radio Act of 1912].

126. *Id.* § 4 (emphasis added).

127. *Id.* § 1; see HOWETH, *supra* note 70.

128. Radio Act of 1912, *supra* note 125, §§ 2 & 5 (emphasis added). “Such [willful or malicious] interference shall be deemed a misdemeanor, and upon conviction thereof the owner or operator, or both, shall be punishable by a fine of not to exceed five hundred dollars or imprisonment for not to exceed one year, or both.” *Id.* § 5.

129. *Id.* § 4 (emphasis added).

130. JOSHUA W. ALEXANDER, REGULATION OF RADIO COMMUNICATION, Report to Accompany H.R. 15357, H.R. REP. NO. 62-582, at 6 (1912) (emphasis added).

131. *Id.* (emphasis added).

advance of other nations . . . and to carry out the provisions of the [1906] Berlin Radiotelegraphic Convention.”¹³² Congress recognized that Article 8 of the Berlin convention was all about preventing “interference” and “to give effect to this article various regulations were attached to the convention” that authorized certain wave lengths for general public service and government stations.¹³³ However, the 1912 Act did not use the words “disturb” or “disturbance” anywhere. In hearings leading up to consideration of the legislation, the Navy’s witness offered the following general description of “interference”:

The interference of which so much is spoken is experienced by an operator trying to receive from one station while the signals from another are coming in at the same time, jumbling the dots and dashes of the two messages together. The greater the number of stations, the greater the confusion.¹³⁴

The 1912 law gave the President the power to preempt any radio transmission “in a time of war or public peril.”¹³⁵ In the U.S.,

all amateur and commercial use of radio was put to an abrupt halt on April 7, 1917 when, with the entrance of the United States into World War One, most private U.S. radio stations were ordered by the President to either shut down or be taken over by the government, and for the duration of the war it became illegal for private U.S. citizens to even have an operational radio transmitter or receiver . . .¹³⁶

After the war, the Navy Department and the Post Office each sought to claim radio under its sole control.¹³⁷ To avoid either fate, Commerce Secretary Herbert Hoover convened four annual Radio

132. *Id.* Other purposes included “[t]o prevent the establishment of a monopoly in the United States by any private corporation in the use of radiocommunication” and “[t]o give the greatest efficacy to the distress calls of vessels at sea.” *Id.*

133. *Id.* at 8-9. “To carry out the Berlin convention and to give effect to its provisions and regulations it was agreed a system of licensing both stations on shipboard and shore stations open to public business as well as operators was necessary.” *Id.* at 9.

134. *Id.* at 19 (Appendix B, Lieut. Commander D. W. Todd, United States Navy, *A Discussion of Wave Lengths and Interference*) (emphasis added).

135. Radio Act of 1912, *supra* note 125, § 2.

136. Thomas H. White, *Radio During World War One (1914-1919)*, UNITED STATES EARLY RADIO HISTORY (last visited Oct. 11, 2024), <http://earlyradiohistory.us/sec013.htm> [<https://perma.cc/E5W5-8FAA>]; see also Pub. Res. No. 65-38, 40 Stat. 904 (1918).

137. See HUGH R. SLOTTEN, RADIO AND TELEVISION REGULATION: BROADCAST TECHNOLOGY IN THE UNITED STATES 1920-1960, 10 (2000).

Conferences beginning in 1922. By “working closely with industry representatives, Hoover forged an essential link between government and private enterprise to keep radio out of exclusive governmental control.¹³⁸ At the third of those conferences, held in October 1924, the conferees examined in depth the “Interference Problems” caused by a wide range of sources.¹³⁹

On April 16, 1926, a key legal decision “momentarily shocked the radio world into awareness of the tenuousness of its regulation”¹⁴⁰ and caused “the breakdown of radio ‘law.’”¹⁴¹ In *U.S. v. Zenith Radio Corp.*,¹⁴² a commercial licensee complained that the Commerce Department had limited its hours of operations. Relying on the 1912 Radio Act’s provision on how to share frequencies by time,¹⁴³ the District Court found the Commerce Department’s similar licensing policies *ultra vires*.¹⁴⁴ This impeded the Department’s power to address radio interference problems.¹⁴⁵

On July 8, 1926, Acting Attorney General William Donovan followed with an official opinion holding that “the Secretary of Commerce had no power under the Radio Act of 1912 to regulate the power, frequency or hours of operation of stations.”¹⁴⁶ The next day, “Hoover announced that he was abandoning all efforts to regulate radio and urged the stations to undertake self-regulation.”¹⁴⁷ The Commerce Secretary’s plea went unheeded.

138. *Id.* at 11.

139. THIRD NAT’L RADIO CONF., *Recommendations for Regulation of Radio* § 4, Subcomm.6 (Oct. 6-10, 1924), <https://earlyradiohistory.us/1924conf.htm> [https://perma.cc/C7PD-X2T2] (last visited Oct. 10, 2024).

140. James H. Pobst, *Celebrating the Chaos: A local Re-examination of Early U.S. Radio Regulation*, at 52 (2009) (Ph.D. Thesis, University of Iowa). Three years earlier, another case reached similar conclusions. See *Hoover v. Intercity Radio Co.*, 52 App. D.C. 339 (1923).

141. CLINTON B. DESOTO, *TWO HUNDRED METERS AND DOWN: THE STORY OF AMATEUR RADIO* 132 (1936).

142. *United States v. Zenith Radio Corp.*, 12 F.2d 614 (N.D. Ill. 1926).

143. See HERRING & GROSS, *supra* note 124, at 242.

144. See generally, SLOTEN, *supra* note 137, at 37; see also Thomas W. Hazlett, *The Rationality of U.S. Regulation of the Broadcast Spectrum*, 33 J. L. & ECON. 133, 144-45 (1990).

145. For a good history of the *Zenith Radio* case and its aftermath, see BENSMAN, *supra* note 109, at 153-206.

146. 35 Op. Att’y. Gen. 126 (1926), quoted in *Nat’l Broad. Co. v. United States*, 319 U.S. 190, 212 (1943).

147. Secretary Hoover’s press release read: “Regulation has broken down and stations are under no effective restriction as to wave length or power used. The 1912 Act under these various constructions has failed to confer authority for the prevention of interference which was its obvious intent. Persons desiring to construct stations must determine for themselves whether there will be wave lengths available for their use without interference from other stations. They must proceed entirely *at their own risk*.” *Herbert Hoover Public Library Papers*, Correspondence, Press Releases (Jul. 9, 1916) (emphasis added), quoted in Pobst, *supra* note 140, at 55.

Between July 1926 and March 1927, “more than 200 stations ha[d] begun operating using any wavelength they might select which ha[d] resulted in a great deal of interference.”¹⁴⁸ In *Oak Leaves*, an Illinois State Court experimented with a common law property rights approach to managing spectrum rights.¹⁴⁹

E. U.S. Radio Act of 1927

The Radio Act of 1927¹⁵⁰ filled the legal hole exposed by the *Zenith* case.¹⁵¹ It also nullified *Oak Leaves*, confirming the prevailing “public interest” approach and no ownership of the radio spectrum.¹⁵² The Act was a product of a substantial compromise between House and Senate versions and Commerce Department proposals.¹⁵³ Its core requirement was prior licensing for all non-governmental radio stations – stations operated by the federal government were exempt.¹⁵⁴

The new law created a new body, a five-member Federal Radio Commission, with the power to license and regulate all communications within (and to or from) the United States.¹⁵⁵ The new Commission could craft regulations “to prevent interference”, and was also authorized to regulate radio equipment (apparatus) “with respect to its external effects and the purity and sharpness of the emissions.”¹⁵⁶

148. BENSMAN, *supra* note 109, at 154 (quoting letter from William D. Terrel to Rep. Ayers (Mar. 2, 1927)).

149. See generally, *Tribune Co. v. Oak Leaves Broad. Station* (Ill. Cir. Ct. Cook Cnty Nov. 17, 1926), discussed in Thomas W. Hazlett, *Oak Leaves and the Origins of the 1927 Radio Act: Comment*, 95 PUB. CHOICE 277, 284 (Jun. 1998).

150. Pub. L. No. 69-632, 44 Stat. 1162 (1927).

151. HERRING & GROSS, *supra* note 124, at 246 (“Drastic action was necessary. . . . Nothing short of it could have saved radio communications, especially broadcasting, from chaos . . .”).

152. Hazlett, *supra* note 149, at 278-80; see also BENSMAN, *supra* note 109, at 209 (“Broadcasting was being considered as analogous to the field of public utilities.”); Hugh G.J. Aitken, *Allocating the Spectrum: The Origins of Radio Regulation*, 35 TECH. & CULTURE 686, 712 (Oct. 1994) (citing Thomas W. Hazlett, *The Rationality of U. S. Regulation of the Broadcast Spectrum*, 33 J. OF LAW & ECON. 133, 145 (1990)); but see Charlotte Twight, *What Congressman Knew and When They Knew It: Further Evidence on the Origins of U.S. Broadcasting Regulation*, 95 PUB. CHOICE 247, 250-54 (Jun. 1998) (arguing the legislators who passed the 1927 Radio Act were not motivated to act by the *Oak Leaves* case).

153. BENSMAN, *supra* note 109, at 183-206.

154. Pub. L. No. 69-632, § 6, 44 Stat. 1162, 1165 (1927).

155. *Id.* §§ 3 & 4.

156. *Id.* § 4(e)-(f).

F. 1927 International Radio Conference (Washington)

The first treaty-making conference of the interwar era was the 1927 International Radio Conference in Washington.¹⁵⁷ Eighty countries participated, and official outcomes were printed in French and English.¹⁵⁸ In addition to government officials, the United States delegation included amateur radio representatives, the U.S. Chamber of Commerce, the National Association of Broadcasters, and private companies such as AT&T, General Electric, RCA, and Western Union.¹⁵⁹ The Conference was chaired by U.S. Secretary of Commerce Herbert Hoover, who, a few months earlier, celebrated the enactment of the Radio Act that he had championed.¹⁶⁰

In the fifteen years since the previous conference in London, “advances in technology made it apparent that radical revisions to the International Radiotelegraph Convention were required, and that the creation of a single set of regulations for all electrical communications was desirable.”¹⁶¹ Although the Conference wanted to merge radiotelegraphy and telegraphy into a single convention, it did not believe it was so empowered by its terms of reference.¹⁶²

The 1927 Radiotelegraph Convention included in Article 10 a provision entitled “Conditions to be observed by stations. Interference,” which required the following:

All stations, whatever their object may be, must, so far as possible, be established and operated in such manner as not to interfere with the radioelectric communications or services of other contracting Governments and of individual persons or private enterprises authorized by those contracting

157. See ITU, *International Radiotelegraph Conference (Washington, 1927)*, <http://handle.itu.int/11.1004/020.1000/4.39> [<https://perma.cc/2H9R-V6ME>] (last visited Oct. 10, 2024); see also Irvin Stewart, *The International Radiotelegraph Conference of Washington*, 22 AM. J. INT'L L. 28, 29 (Jan. 1928).

158. ITU, INTERNATIONAL RADIOTELEGRAPH CONVENTION OF WASHINGTON, 1927, AND GENERAL AND SUPPLEMENTARY REGULATIONS (Nov. 25, 1927) [hereinafter WASHINGTON 1927 CONVENTION].

159. ITU, *Liste des participants à la Conférence Radiotélégraphique Internationale de Washington, 1927* (1927). See generally, SLOTTEN, *supra* note 137, at 14 (“Concerns about the implications of international agreements for the radio industry continued to draw private industry and the Department of Commerce together.”).

160. See Stewart, *supra* note 157, at 31.

161. Glazer, *supra* note 50, at 276.

162. WASHINGTON 1927 CONVENTION, *supra* note 158, Note by the International Bureau, at 3-4.

Governments to conduct a public radiocommunication service.¹⁶³

The General Regulations Annexed to the Convention included the following provisions in Article 5 (entitled “Distribution and use of frequencies (wave lengths) and types of emission”):

§ 1. The Administrations of the contracting countries may assign any frequency and any type of wave to any radioelectric station under their authority upon the sole condition that no interference with any service of another country results therefrom.

§ 2. These Administrations, however, agree to assign to stations, which by reason of their nature are believed to be capable of causing serious international interference, frequencies and types of waves in conformity with the rules for the distribution and use of waves as set forth below.¹⁶⁴

Article 4 of the regulations included the following:

§ 5. Where bands of frequencies are assigned to a specific service, the stations engaged in such service must use frequencies which are sufficiently remote from the limits of such bands not to produce serious interference with the working of stations engaged in services to which the immediately adjacent bands of frequencies are allotted.¹⁶⁵

Other provisions adopted at the Washington conference mention “interference.”¹⁶⁶ For example, in Article 1 of the Convention, the definition of “international service” included “[a]n internal or national radiocommunication service, which is capable of causing

163. *Id.* art. 10, § 2. The French version of this provision was “*et exploitées de manière à ne pas troubler les communications ou services radioélectriques. . .*” *Id.* (emphasis added). The French verb *troubles* is used, and translated, exactly as it was in Berlin 1903 to mean “interfere,” but not as it was at the London 1912 Conference and elsewhere in the 1927 Convention and regulations to mean “disturb.” See, e.g., *id.*, *Regulations*, art. 17, § 1(5); art. 19, § 9(2).

164. *Id.* *Regulations*, art. 5.

165. *Id.* *Regulations*, art. 4, § 5 (emphasis added).

166. Cf. CODDING 1952, *supra* note 37, at 123 (“The changes made in the Regulations by the Washington Conference marked a turning point in the . . . approach to the regulation of radio communication. In the two previous conferences emphasis had been placed on establishing rules for traffic and operation and on minimum technical standards in order to provide a workable and predictable system of communication. By 1927 it was found necessary to forbid certain practices that were susceptible of creating harmful interference.”).

interference with other services outside the limits of the country in which it operates is considered as an international service from the point of view of interference."¹⁶⁷

"Probably the most important of the new provisions of the [1927 international] regulations," according to State Department official Irvin Stewart, was the first table of frequency allocations, which reserved frequency bands from 10 kilocycles per second to 60,000 kc/s (60 megahertz in today's measures) among a handful of different radio services.¹⁶⁸ However, the table served as a "guide" to the signatory countries.¹⁶⁹ Equally vital was the formal ratification of a system of international coordination and interference protection by priority. This involved giving the first country to request a frequency protection of that frequency. If a conflict arose, and "no arrangement to prevent interference can be reached" by the administrations involved, the parties could request arbitration.¹⁷⁰

G. 1932 International Radio and Telegraph Conferences (Madrid)

The following international conference took the institutional steps discussed but not implemented at Washington in 1927. Delegates from sixty-eight countries (including private sector representatives) gathered in Madrid in 1932 at simultaneous International Plenipotentiary Telegraph and International Radiotelegraph Conferences.¹⁷¹ "The principal item on the agenda of the two conferences was the fusion of the International Telegraph Convention with the International Radiotelegraph Convention."¹⁷²

167. WASHINGTON 1927 CONVENTION, *supra* note 158, art. 1. Leive asserted that this priority provision was "unintentionally broad." LEIVE 1971, *supra* note 49, at 45 n.29.

168. Stewart, *supra* note 157, at 48; *see also* CODDING 1952, *supra* note 37, at 124-125; WASHINGTON 1927 CONVENTION, *supra* note 158, *Regulations*, art. 5, § 17.

169. WASHINGTON 1927 CONVENTION, *supra* note 158, art. 5, § 3.

170. *See* DESOTO, *supra* note 141, at 134-35; CODDING 1952, *supra* note 37, at 126; WASHINGTON 1927 CONVENTION, *supra* note 158, *Regulations* art. 5, §§ 16-17.

171. ITU, *International Telegraph Conference (Madrid, 1932)*, <http://handle.itu.int/11.1004/020.1000/4.5> [<https://perma.cc/Z7GM-FT9L>] (last visited Feb. 5, 2025); *International Radiotelegraph Conference (Madrid, 1932)*, <http://handle.itu.int/11.1004/020.1000/4.41> [<https://perma.cc/QY5V-JEB9>] (last visited Feb. 5, 2025).

172. ITU, *50th Anniversary of the Madrid Conferences*, 49 TELECOMM. J. 510 (1982); *see also* Heidi Tworek, *A Union of Nations or Administrations? Voting Rights, Representation, and Sovereignty at the International Telecommunication Union in the 1930s*, § 10 ("The Madrid conference was convened for one main purpose: to fuse the International Telegraph Union (created in 1865) with conventions on radiotelegraphy."), *reprinted in* ITU HISTORY, *supra* note 40, at 243.

Thus, a new *International Telecommunication Union* was established.¹⁷³

The 1932 Madrid Convention addressed “interference” in three places. The most important was Article 35, titled *Brouillage* in the French original, which was “changed to some extent to provide greater protection to existing services from interference.”¹⁷⁴ Yet, notwithstanding the title, the French text of Article 35 began: “*Toutes les stations, quel que soit les objet, doivent, autant que possible, être établies et exploitées de manière à ne pas troubler les communications ou services radioélectriques...*”¹⁷⁵ This was translated as: “All stations, whatever their object may be, must, so far as possible, be established and operated in such manner as not to interfere with the radioelectric communications or services. . .”¹⁷⁶ The French Article 35 was titled with one term for interference, although its operative text used a different verb – and both were translated as the same English “interference.”¹⁷⁷ In refining the type of permissible emissions, the new regulations annexed to the Madrid Convention provided some practical guidance for establishing how interference could be ascertained.¹⁷⁸

The Madrid Radiocommunication Regulations included a more explicit table of allocations in Article 7.¹⁷⁹ While the 1927 regulations said the table was “a guide,” the 1932 regulations provided that the signatories would “undertake to assign frequencies to these stations [that are capable of causing ‘serious

173. See Allison, *supra* note 46, at 500 (“In an effort to maximize its acceptability to the participants, the convention itself was limited to setting forth the ITU’s organizational underpinnings, the treaty’s procedural details, and general universal principles regarding the communications services. Contentious matters were relegated to the particular regulations for each service.”).

174. HERRING & GROSS, *supra* note 124, at 365; MADRID 1932 CONVENTION, *supra* note 4, art. 35 (French/English on separate page 17s). The French *brouillage* also was used in Article 13 of the Convention: in a new definition of *Service international*; and in a footnote in the Regulations – and each time was translated as “interference.” *Id.* art. 13 (French/English on separate pages); *id.*, *Annexe*, Definition of Terms (French/English on separate pages); ITU, *General Radiocommunication Regulations* (Madrid, 1932), art. 6 n.56 (French/English on separate pages).

175. MADRID 1932 CONVENTION, *supra* note 4, art. 35 (emphasis added).

176. *Id.* (emphasis added).

177. See 56 J. TELEGRAPHIQUE 153, 163 (1932) (our translation from French: “stations must – as much as possible – be established and operated in such a way not to interfere (*troubler*) with telecommunications or services under the jurisdiction of other contracting governments.”)

178. The Madrid Regulations defined “Frequency assigned to a station” as the mid-frequency of the carrier wave, “Band of frequencies of an emission” as the occupied bandwidth, and “Frequency tolerance” as the maximum deviation permissible between the frequency assigned to a station and the actual frequency of emission.) ITU, *General Radiocommunication Regulations* (Madrid, 1932), art. 1 (Definitions).

179. *Id.* art. 7, § 7.

international interference’], according to the type of service, in conformity with the table . . .”¹⁸⁰

H. U.S. Communications Act of 1934

The Communications Act of 1934 repealed the 1927 Radio Act (terminating the Federal Radio Commission) and replaced it with “a comprehensive scheme for the regulation of telecommunications. . .” – not just radio.¹⁸¹ The new Federal Communications Commission (originally seven members, later reduced to five) was broadly delegated responsibility to “regulat[e] interstate and foreign commerce in communication by wire and radio so as to make available, so far as possible, to all the people of the United States, a rapid, efficient, nation-wide, and world-wide, wire and radio communication service with adequate facilities at reasonable charges . . .”¹⁸²

Although the 1934 Act retained the 1927 Act’s requirement of prior licensing for radio, it provided no clarity on interference. Rather, the 1934 Act extended the grant of broad authority in the 1927 Act to “prevent interference” and regulate apparatus.¹⁸³ FCC regulations did not mention “harmful interference” until 1948, and even then only cited to the international Conferences which did not contain a definition at the time of the 1934 Act.¹⁸⁴

I. 1938 International Radio Conference (Cairo)

Six years after the Madrid conferences, 70 countries (and private sector representatives) assembled for the Cairo International Radiocommunications Conference.¹⁸⁵ This conference did not amend the ITU Convention, but rather only addressed the Radio Regulations.¹⁸⁶ As such, the conference made “[n]o substantial modifications to the regulatory scheme.”¹⁸⁷

180. *Id.* art. 7, §§ 2-3.

181. HERRING & GROSS, *supra* note 124, at 376.

182. Communications Act of 1934, Pub. L. No. 73-416, § 1, 48 Stat. 1064 (1934).

183. *Id.* § 303(e)-(f) (codified as amended at 47 U.S.C. § 303(e)-(f)).

184. *See supra*, notes 22-24 and accompanying text.

185. *See* ITU, *International Radiocommunications Conference (Cairo 1938)*, <http://handle.itu.int/11.1004/020.1000/4.50> [<https://perma.cc/MMX3-8LD8>] (last visited Feb. 10, 2025); ITU, *Conférence internationale des radiocommunications (1938 : Le Caire, Égypte), Liste des participants*, <http://handle.itu.int/11.1004/020.1000/4.50.44.fr.200> [<https://perma.cc/REV8-GGWS>] (last visited Feb. 10, 2025).

186. *See* ITU, *General Radiocommunication Regulations and Additional Radiocommunication Regulations* (Cairo, 1938) (in English) [hereinafter *Cairo Regulations*].

187. LEIVE 1971, *supra* note 49, at 52.

According to Howeth, this conference “was important because of the rapid increase in hemispheric and transoceanic aviation, the increased uses of high frequencies, and the uses of the newly developed portion of the radio spectrum between 30 and 300 mc.”¹⁸⁸ If anything, the resulting regulations from 1938 would be remembered largely for introducing paragraph numbering and footnotes to a modernized table of allocations.¹⁸⁹

Several provisions adopted at the Cairo Conference continued to address ways of preventing interference and presented greater levels of disturbances in different ways. One example was the following English translation:

Where bands of frequencies are assigned to a specific service, the stations engaged in such service must use frequencies which are sufficiently remote from the limits of such bands as not to produce interference detrimental to the operation of stations engaged in services to which the immediately adjacent bands of frequencies have been assigned.¹⁹⁰

Here, the French “*brouillage nuisible*” was directly translated to “interference detrimental” whereas the 1927 regulations translated the same phrase as “serious interference.”¹⁹¹ The passage of time somehow changed the text.¹⁹²

Administrations continued to be admonished to assign frequency licenses that “*pour ne pas produire de brouillage nuisible dans le travail des stations appartenant aux services auxquels sont attribuées les bandes de fréquences immédiatement voisines.*”¹⁹³ This passage, again, addressed “adjacent channel” interference.¹⁹⁴

188. HOWETH, *supra* note 70, at 512.

189. *See Cairo Regulations, supra* note 186, art. 7 (showing that the Cairo table began at 10 kilocycles (fixed) through 200 megacycles (television)). *See also id.* art. 16, ¶ 340 (explaining that administrations were required “to notify the Bureau of the Union, with a view to publication in the List of Frequencies [today’s Master International Frequency Register], the frequencies assigned to fixed, land, and broadcasting stations, as well as the maximum power contemplated when those stations are capable of causing international interference.”.)

190. *Cairo Regulations, supra* note 186, art. 7, § 3; *see also id.* art. 22.

191. *See supra*, text accompanying note 165.

192. *See Cairo Regulations, supra* note 186, art. 7, ¶ 82, at 9 (English). The identical French phrase, translated the same way, appeared in a provision governing the mobile services. *See id.* art. 17, ¶ 374. Notably, the United States proposed an earlier version of art. 17, ¶ 374, § 2. (1), which read (in French) as follows. “*Avant d’émettre, toute station doit écouter pendant un intervalle suffisant pour lui permette de s’assura qu’elle ne produira pas un brouillage nuisible. . . troubler.*” ITU, *Documents De La Conférence Internationale des Radiocommunications Du Caire, Tome 1* (1938) at 134.

193. *Cairo Regulations, supra* note 186, art. 7, ¶ 82, at 9 (French).

194. *See supra*, text accompanying note 165.

The Cairo text retained the French phrase adopted at the 1927 Conference: *pour ne pas produire de brouillage nuisible*. Further along, one Regulation used “*troublent*,” translated as “disturb;” but “*troubler*” appeared three clauses later, translated as “interfere.” The French “*brouillage*” was used three additional times and each time translated into English as “interference.”¹⁹⁵

The 1938 Cairo Conference added several provisions that circle the concept of interference without actually defining it. One was the definition of “*Service international*,” or “International services.”¹⁹⁶ The clause also specified what would not be considered an “internal or national telecommunication service”: “*susceptible de causer des brouillages avec d’autres services au-delà des limites du pays dans lequel il opère*,” or “capable of causing interference with other services outside the limits of the country in which it operates.”¹⁹⁷ The conference also added two new regulations addressing interference-like concepts, but neither employed the term “*brouillage*” nor “interference.”¹⁹⁸ Finally, the Cairo Regulations added numerous technical provisions to assist in the prevention of interference.¹⁹⁹

* * * * *

World War II interrupted the schedule of regular international Conferences,²⁰⁰ just like the previous World War.²⁰¹ Up to this point in the history of radio communications regulation, “interference” had become something to universally avoid, and regulators were tasked to prevent it, but there was no definition of the term, nor any attempt to quantify the concept. Nevertheless, these regulators, whether they spoke French or English, began to

195. ITU, *Documents De La Conférence Internationale des Radiocommunications Du Caire, Tome 1* (1938) at 75. Compare ¶ 527 (*troublent*/disturb), with ¶ 530 (*troubler*/interfere), and with ¶¶ 532, 34-35 (*brouillage*/interference). These regulations all are within Article 22, entitled “*Brouillage*,” or “Interference” in English.

196. See *Cairo Regulations*, *supra* note 186, at 197-98 (adding a new ANNEX to the INTERNATIONAL TELECOMMUNICATION CONVENTION). *Brouillages* was used identically in the clause allowing Administrations to license domestic transmissions on a non-interfering basis to international services. See *id.* art. 7, ¶ 79 (*brouillages*/interference); *id.*, art. 7, ¶ 80 (*de sérieux brouillages*/serious interference).

197. *Id.* at 197-98; see also *supra*, text accompanying note 167.

198. A provision on “quality of emissions” required that waves emitted from a station be “free from any emission which is not essential to the type of communication effected” *Cairo Regulations*, *supra* note 186, art. 6, ¶ 69. Another provision requested countries to “frequently verify that the waves emitted by stations subject to their authority are in accordance with the provisions of these Regulations.” *Id.*, art. 6, ¶ 76.

199. See, e.g., *id.* at Appendix 2: “Table of [Frequency] Tolerances for the Intensity of Harmonics of Fixed, Land and Broadcasting Stations,” *id.*, APPENDIX 2; Power for Continuous Wave and Double-Sideband AM Transmitters, *id.*, art. 1, ¶¶ 12-13; “Table of Frequency Band-Widths occupied by Emissions,” *id.*, APPENDIX 3.

200. HUURDEMAN, *supra* note [47], at 359.

201. See *supra*, text accompanying note 123.

recognize that there were levels of interferences (or disturbances) such as “serious interference” or “interference detrimental.”

This pre-World War II era of inconsistent and undefined terminology may have led to some confusion, possibly contributing (along with the war itself) to a breakdown in the international regulatory approach to radio spectrum management. We turn next to the post-war era during which a completely new international regulatory regime led to promulgation of the terminology and definitions that are in force today.

IV. HISTORY OF THE DEFINITION OF “HARMFUL INTERFERENCE”

As mentioned above in Section II of this article, the ITU adopted the first official regulatory definition of “harmful interference” in 1947 while the official definition of “interference” came later in 1979. This section covers the post-World War II period of history during which the international and domestic regulatory regimes governing wireless telecommunications were changing drastically. These changes were deemed necessary in light of the major post-war demand for radio spectrum resources by broadcasting, satellite, and other new technologies developed and expanded during the war such as radionavigation and aeronautical mobile services.²⁰² This period was dominated by the complete overhaul of the ITU’s management of spectrum resources at the two overlapping international conferences held in Atlantic City, New Jersey, in 1947. The next major international radio conference held in Geneva, Switzerland in 1959 made slight revisions to the definition of “harmful interference,” and set the stage for the need for other interference definitions developed in the 1970s.

A. 1947 International Radio and Plenipotentiary Conferences (Atlantic City)

Two concurrent and extensive international conferences took place in Atlantic City from May to October 1947: the International Radio Conference, which convened on May 15, 1947, and the International Telecommunication Conference (Plenipotentiary), which began on July 1, 1947.²⁰³ The primary focus of the Radio

202. For a comprehensive review of the effects of World War II on wireless telecommunications and international activities immediately after the war, see CODDING 1952, *supra* note 37, ch. 4.

203. See ITU, *International Radio Conference* (Atlantic City, 1947), <http://handle.itu.int/11.1004/020.1000/4.62> [<https://perma.cc/R8K4-GG66>] (last visited Oct. 10, 2024); ITU, *International Telecommunications Conference* (Atlantic City, 1947), <http://handle.itu.int/11.1004/020.1000/4.7> [<https://perma.cc/8J3P-5SGN>] (last visited

Conference was a revamped and expanded Table of Frequency Allocations and the creation of a new administrative body, the International Frequency Registration Board (IFRB), to record and regulate the use of assigned radio frequencies and resolve interference disputes.²⁰⁴ The delegates to the Plenipotentiary Conference agreed to a new *International Telecommunication Convention* that included several treaty provisions which replaced “interference” with the new phrase “harmful interference” along with a definition that was identical to that adopted by the Radio Conference.²⁰⁵

1. U.S. Domestic and International Preparatory Activities

Because these were the first major international telecommunication conferences since the 1938 conferences in Cairo,²⁰⁶ a significant amount of planning took place, especially in the U.S. where “harmful interference” began creeping into the vernacular.

As early as 1943, in the midst of World War II, it became apparent that the U.S. Government needed to begin preparatory studies for the next international radio conference.²⁰⁷ The Interdepartment Radio Advisory Committee (IRAC) and the FCC designated special committees to undertake parallel efforts to develop an entirely new international table of frequency allocations. In September 1944, the FCC held a general allocation hearing to determine the present and future needs of the various non-government services for frequencies in the radio spectrum up

Oct. 10, 2024). The Radio Conference, planned to last for three months, went on for four and a half months; the plenipotentiary conference, planned for six weeks, lasted twice as long. See Mohamed Ezzeddine Mili, *Twenty-five Years Ago... Atlantic City*, 39 TELECOMM. J. 470, 471 (1972); see also Francis Colt De Wolf, *The Atlantic City Telecommunications Conferences*, 9 FED. COMM. B.J. 28 (1948).

204. For a comprehensive study of the ITU’s regulatory regime for spectrum following the Atlantic City conferences, see LEIVE 1971, *supra* note 49; see also David M. Leive, *Regulating the Use of the Radio Spectrum*, 5 STAN. J. INT’L STUD. 21 (1970) [hereinafter Leive 1970].

205. Compare INTERNATIONAL TELECOMMUNICATION CONVENTION (Atlantic City 1947), art. 40 (Special Arrangements) & art. 44 (Harmful Interference) with MADRID 1932 CONVENTION, *supra* note 4, art. 13 (Special Arrangements) & art. 35 (Interference).

206. Although World War II prompted tremendous advances in the radio art (*e.g.*, RADAR) it caused cancellation of the international telecommunications conference planned for Rome in 1942. As a result, the Atlantic City conferences followed a nine-year period in which the nations did not get together to seek up-to-date agreements on world use of the radio spectrum. See CODDING & RUTKOWSKI, *supra* note 39, at 20.

207. See Paul D. Miles, *Frequency Service Allocations*, 34 PROC. OF THE I.R.E. AND WAVES & ELECTRONS 188 (April 1946) (outlining U.S. priorities and proposals going into the Atlantic City conferences); see also E. M. Webster, *The Interdepartment Radio Advisory Committee, Its History, Motive Operation, and Relationship to Other Agencies*, 33 PROC. OF THE I.R.E. 495, 497 (Aug. 1945).

to 30,000 megacycles. In May 1945, the Commission, in cooperation with the IRAC, promulgated the United States allocation plan.²⁰⁸ This plan was the subject of discussions with other nations at meetings held in Rio de Janeiro and Bermuda in 1945 and in Moscow in 1946.²⁰⁹

A completely new international allocation table would impact the compliance of stations all over the world. They would need to be shifted into other bands and potentially lose the international priorities previously established under the International Radio Regulations. The existing International List of Frequencies became useless, containing many stations which no longer existed and omitting many stations established but not registered because of the war. Looking toward a solution to this problem, in 1946 the United States proposed that the next international conference should establish a permanent board to take over the enormous task of updating the international registration of frequencies.²¹⁰

Under the proposal, the IFRB's core responsibilities in assessing a nation's proposed registration of a frequency were to determine (a) "conformity" with the international table of allocations and other regulations and (b) "if harmful interference would result to the use of any other frequency previously registered with the Board."²¹¹ A successful frequency registration on the International Frequency List "would be taken as prima facie evidence . . . that the operation in question could take place without causing harmful interference with services rendered by stations for which assignments had previously been registered."²¹² In March 1947, the U.S. and other countries proposed definitions for the new phrase.

2. New International Radio Regulatory Regime and Definition of "Harmful Interference"

In summarizing the outcomes of the Atlantic City Radio Conference, the ITU *Telecommunication Journal* highlighted that, "the important definition of harmful interference . . ., for all who are concerned with operation will have to refer to it often."²¹³

208. Miles, *supra* note 207, at 188; *see also* THOMAS E. WILL, TELECOMMUNICATIONS STRUCTURE AND MANAGEMENT IN THE EXECUTIVE BRANCH OF GOVERNMENT 1900-1970 at 20, 156 (Routledge 1978); PRESIDENT'S COMMUNICATIONS POLICY BOARD, TELECOMMUNICATIONS, A PROGRAM FOR PROGRESS at 28 (U.S. Govt. Print. Off. 1951).

209. *Id.* at 32; *see also* CODDING 1952, *supra* note 37, at 196-204.

210. Miles, *supra* note 207, at 191.

211. *Id.* at 192 (emphasis added).

212. *Id.* (emphasis added). Miles, in this pre-conference article, used the phrase "harmful interference" two additional times, but did not reveal a proposed definition.

213. ITU, *The Radio Regulations of Atlantic City*, 15 TELECOMM. J. 16 (Jan. 1948).

However, the major changes to the table of allocations and a new regulatory regime governed by the IFRB took the bulk of the time and attention of the four-and-a-half month conference.²¹⁴ These changes were apparently dependent on the new “important definition” along with the resolution of other terminology issues.

David Leive described the three interrelated principles of the new ITU regulatory regime as follows:

First, rights and obligations of recorded frequency assignments to an extent were defined in the Radio Regulations and two new legal concepts were introduced: the “right to international protection from harmful interference, and the principle of “conformity with the Convention and Regulations.” . . . *Second*, the International Frequency Registration Board was created and granted a range of powers, such as the legal and technical examination of new notices and the issuance of findings with respect thereto . . . *Third*, a variety of other actions were taken designed to reach the objectives . . . of an engineered spectrum.²¹⁵

Leive emphasized that conformity with the Radio Regulations (and Convention) was required before a country could claim the right to international protection. “This new emphasis was reflected in the concept of harmful interference, which was defined as interference to stations operating in accordance with the Regulations.”²¹⁶

Concerning the large number of revised and new definitions in Article 1 of the Radio Regulations adopted at the 1947 Radio Conference, the ITU *Telecommunication Journal's* summary said, “The preamble should be studied for it explains the very judicious idea which led the conference to formulate definitions which anticipate specifically the criticism which linguistic purists might be attempted to express concerning them.”²¹⁷ It went on to explain, “the formulation of the definitions gave rise to very long and often animated discussions, during which arguments of political and economic character frequently clashed with philosophical or purely technical arguments.”²¹⁸ Other, more controversial definitional

214. *Id.* at 12; see also Colt De Wolf, *supra* note 203, at 29-30.

215. LEIVE 1971, *supra* note 49, at 56-57 (italics in original), (Leive asserted that “The procedure adopted concerning the [IFRB’s] activities, replacing the relatively simple and straight-forward prewar Regulations on the notification procedure, was highly complex and in some respects made intentionally ambiguous in order to reach agreement.”) *Id.* at 57. See also Leive 1970, *supra* note 204, at 34-39 (referencing Nos. 501 and 607 of the ITU Radio Regulations (1968 ed.)).

216. LEIVE 1971, *supra* note 49, at 57.

217. ITU TELECOMM J., *supra* note 213, at 12.

218. *Id.*

disputes centered around certain new services and technical concepts along with general terminology such as “telecommunications,” “radio,” and “tropical broadcasting.”²¹⁹

Leading up to the Atlantic City Radio Conference, five nations proposed the following specific definitions of “harmful interference” (English versions):

United States: “An emission which jeopardizes a safety service or which repeatedly obstructs or interrupts the normal service of any station.”²²⁰

Great Britain: “An emission which jeopardises any navigational aid or a safety service or which repeatedly obstructs or interrupts the normal service of any station operating in accordance with these regulations.”²²¹

Canada: “A signal which jeopardizes a safety service or which repeatedly obstructs or interrupts the normal service of any station.”²²²

USSR: “A transmission which endangers safety service, or which repeatedly interferes with or disturbs the normal work of any stations operating in accordance with these regulations.”²²³

219. *Id.*; see also CODDING 1952, *supra* note 37, at 240.

220. ITU, *International Radio Conference, Atlantic City, 1947, United States of America*, Proposal 495R, Doc. No. 11-R (Mar. 11, 1947) (providing the following “Reason”: “Since the assignment of a frequency exclusively to one station is not normally possible, it is necessary to define the condition beyond which interference becomes harmful.”).

221. *Id.*, *Propositions of the United Kingdom for Revision of the International Radio Regulations*, Proposal 48R, Doc. No. 8-R (Mar. 1, 1947) (emphasis added to show differences among the proposals). Great Britain did not provide a specific reason for its proposed definition but noted at the beginning of its proposals related to Article 1 that “[a]mendments to existing definitions and proposals for new definitions are suggested to take account of improvements in the state of technical developments and of new techniques” and that its proposed definitions were “produced primarily for the needs of the present Regulations and are not necessarily applicable to other purposes.” *Id.* at Proposal 34R.

222. *Id.*, Canada, *Proposals for Amendment of the General Radio Regulations*, Proposal 1540R, Doc. No. 19 R-E (Apr. 28, 1947) (emphasis added to show differences among the proposals). Canada did not provide any reason for its proposal, but it also proposed a definition (in a note) of “Safety Service” as “[a] radiocommunication service intended for the safeguarding of human life and including those others indispensable for navigation.”)

223. *Id.*, *Proposal of the U.S.S.R. Regarding Revisions of the General Radio Regulations*, Proposal 2389R-14, Doc. No. 142 R-E (May 26, 1947) (emphasis added to show the differences among the proposals). The Soviet Union did not provide any reason for its proposal.

France: "This is an interference which jeopardize the operating of a navigation or safety service or repeatedly obstructs or interrupts the normal operation of a Telecommunications service operating in conformity with the present Regulations. Such interference may result from an electromagnetic field originating with a transmitter of any type or with other simply electrical appliances or such which use energy of high frequency applied to purposes other than radio communications."²²⁴

France offered the most comprehensive reasoning behind its proposed definition. It stated that the definition would "provide a legal basis for international recourse against interference," "prevent excessive complaints," and "determine the possible origin of interference."²²⁵ As to the reference to "navigation and safety services," France further explained that these services which "cannot suffer delay, are considered as jammed as soon as they are hindered." On the other hand, "other services must have been inconvenienced or interfered with repeatedly before they will be considered as suffering harmful interference."²²⁶

At the Atlantic City Radio Conference, a General Technical Committee (Committee 7), at its first meeting on May 20, 1947, tasked Subcommittee 7A with studying the proposals concerning definitions in Article 1 of the General Radio Regulations.²²⁷ In addition to the five proposals set forth above, that subcommittee had 295 other proposals on its docket, including seventy-nine other "service" definitions, ninety-eight proposals on definitions of "stations," and fifty-five proposals on defining other "general terms."²²⁸ A month into the Atlantic City Radio conference,

224. *Id.*, France, *Proposals for Modification of the General Radio Regulations*, Proposal 1364R, Doc. No. 12 R-E (May 10, 1947) (emphasis added to show the differences among the proposals).

225. *Id.*

226. *Id.* France's "Reasons" also included that "it has appeared necessary to specify that all interfering media are handled by man and thus accessible to regulation" and that the text of the definition would need to be reconciled with France's proposal to modify Article 22 of the Radio Regulations. *Id.* Proposal 1437R (proposing to replace "serious interference" in Article 22, § 8 of the Cairo Radio Regulations (No. 538) with "harmful interference.").

227. *Id.*, *Report of the General Technical Committee (Committee 7) on First Meeting (May 19, 1947)*, Doc. No. 87 R-E (May 20, 1947). Subcommittee 7A was also assigned the task of revising Article 5 (classification of emissions).

228. *Id.*, *Report of the Chairman of Committee 7 Regarding the Present Status of the Work and its Future Progress (as of June 18, 1947)*, Doc. No. 397 R-Eat 1 (June 19, 1947). At this point, Subcommittee A had held ten working meetings, seven of which were devoted to studying definitions, and had completed the examination of less than half of the proposals. *Id.* See also *id.*, *Report of the General Technical Committee (Committee 7) on its Second Meeting (June 12, 1947)*, Doc. No. 399 R-E at Appendix 1.

pressure mounted on Committee 7 to “accelerate its work” on definitions so as not to impede the work of other committees and the Plenipotentiary Conference itself.²²⁹ For a few hours on July 25, 1947, Subcommittee 7A discussed the proposed definitions of “power of a radio transmitter” and “harmful interference,” but the delegates were unable to come to a resolution on both terms.²³⁰ So, the subcommittee referred the definition of “harmful interference” to a new Sub-subcommittee 7A2.²³¹

On that same evening, Sub-subcommittee 7A2 met for its first session (for only an hour) and adopted, over the partial objection of the U.S. Delegate, the following definition of “harmful interference”:

Any radiation or any induction which endangers the functioning of a radionavigation service or of a safety service or obstructs or repeatedly interrupts a radio service operating in accordance with these Regulations.²³²

The sub-subcommittee reported that “all these proposals were almost identical in meaning” and that a long discussion about France’s suggestion that interference caused by induction fields should be included in the definition.²³³ Of the five delegates that

229. *Id.* at 2. The Chief of Delegations “indicated urgently” that the subcommittee’s work be completed by July 1st, prompting the Chairman of Committee 7 to state that “it was clear that the progress of the Committee’s work depends not only upon the goodwill, assiduity, and undoubted ability of the chairmen and members of both sub-committees but also in a large measure upon the time available.” *Id.* The chairman of subcommittee 7A stated his view that fifteen more meetings would be required to complete the definitions, making it very difficult to meet the July 1st target date. *Id.*

230. *Id.*, *Report of Subcommittee A of the General Technical Committee (Committee 7) on its 31st Meeting*, Doc. No. 690 R-E at 3-4 (Jul. 25, 1947). The meeting convened at 10:10 a.m. and adjourned at 1:10 p.m. *Id.* The subcommittee chairman also agreed with the U.S. and U.K. and suggested modification to the French text to remove the explanatory clause on “electrical appliances.” *Id.* See also *id.*, *Chile Proposals for Amendment of the General Radio Communication Regulations (Proposal 1635R)*, Doc. No. 27 R-E (Apr. 28, 1947). Chile proposed to define “Interference” as “[a] foreign signal which interferes with or interrupts the normal service of any station whatsoever.” *Id.* See also *id.*, *France Proposal 1364R*, Doc. No. 12 R-E (May 10, 1947).

231. *Id.*, *Report of Subcommittee A of the General Technical Committee (Committee 7) on its 31st Meeting*, Doc. No. 690 R-E at 4 (Jul. 25, 1947).

232. *Id.*, *Report of Sub-Subcommittee A2 (Technical Definitions) of the General Technical Committee (Committee 7) on its First Meeting*, Doc. No. 631 R-E at 2 (Jul. 25, 1947). Later, the sub-subcommittee also adopted the proposed note defining a “safety service.” See *id.*, *Report of Sub-Subcommittee A2 (Technical Definitions) of Subcommittee A of the General Technical Committee (Committee 7) on its Second Meeting*, Doc. No. 682 R-E (Aug. 2, 1947).

233. *Id.*, *Report of Sub-Subcommittee A2 (Technical Definitions) of the General Technical Committee (Committee 7) on its First Meeting*, Doc. No. 631 R-E at 1 (Jul. 25, 1947).

participated, “only the Delegate from the United States opposed inclusion of the term ‘induction’ in the text.”²³⁴ The U.S. attached a statement to the sub-subcommittee report promising to attempt to adhere to the adopted definition, but warned of the “large and expensive modifications” of common devices which might not be able to be brought into conformance.²³⁵

The text adopted on the seventy-second day of the Atlantic City Radio Conference by the handful of delegates on Sub-subcommittee 7A2 became the final definition of “harmful interference.” It was incorporated into the Radio Regulations, which used the new phrase seventy-seven times, including in core provisions such as the following from Article 3, General Rules for the Assignment and Use of Frequencies:

§ 1. The countries, members of the Union, adhering to these Regulations, agree that in assigning frequencies to stations which, by their very nature, are capable of causing harmful interference to the services rendered by the stations of another country, they will make such assignments in accordance with the table of frequency allocations and other provisions of this chapter.

§ 2. The frequencies so assigned shall be selected in such a manner as to avoid causing harmful interference with services carried on by stations using frequencies assigned to them in conformity with the provisions of this chapter and which are entitled to international protection from harmful interference as provided in article 11.

²³⁴. *Id.*

²³⁵. *Id.* at 2. The U.S. statement cautioned further as follows:

Any apparatus which might cause induction interference would have to be screened or filtered in such a manner as to eliminate this interference.

This would necessitate great changes in household apparatus, the screening of sparking-plugs in automobiles, *etc.*

The United States believes that they have understood that the Nations which are proposing and supporting this definition will be obliged to act in the same manner, and that they are consequently prepared to make these large and expensive modifications in induction apparatus, household apparatus, gasoline engines with sparking-plug systems, *etc. etc.*

Id. The devices referenced in the U.S. statement were later covered in the first U.S. statute containing the phrase “harmful interference,” now in Section 302a of the Communications Act. *See* Pub. L. No. 90-379, 82 Stat. 290 (Jul. 5, 1968) (*codified at* 47 U.S.C. § 302a(b)).

§ 3. A country, member of the Union, shall not assign to a station any frequency in derogation of either the table of frequency allocations given in this chapter or the other provisions of these Regulations, except on the express condition that harmful interference shall not be caused to services carried on by stations operating in accordance with the provisions of the Convention and of these Regulations.²³⁶

The French version of the text used consistent wording for the new phrase. For example, the key clause of the first of the above provisions read:

*...par leur nature même, peuvent causer des brouillages nuisibles aux services assurés par les stations des autres pays.*²³⁷

In addition to the Radio Regulations adopted at the Radio Conference, the 1947 Atlantic City Plenipotentiary Conference adopted the same definition of “harmful interference” (*brouillages nuisibles*) in Annex 2 of the *International Telecommunication Convention*.²³⁸ The Convention used the new phrase ten times, including the following provision in Article 3 (Purposes of the Union):

[T]he Union shall in particular [. . .] effect [*sic*] allocation of the radio frequency spectrum and registration of radio frequency assignments in order to avoid harmful interference between radio stations of different countries.²³⁹

In June 1948, the United States ratified the Final Acts of the 1947 International Telecommunication and Radio Conferences,²⁴⁰ and the FCC commenced the domestic implementation of the new treaty.

236. ITU, *Radiocommunication Regulations*, ch. III, art. 3, §§ 1-3 (Nos. 86-88) (Atlantic City, 1947) (emphasis added). Article 11 referenced in paragraph 2 concerned the “Procedure in Connection with the International Frequency Registration Board.”

237. *Règlement des Radiocommunications, Chapitre III, art. 3, ¶ 86-88* (Atlantic City, 1947) (emphasis added).

238. See INTERNATIONAL TELECOMMUNICATION CONVENTION (Atlantic City 1947) *Annexe 2*.

239. *Id.*, *Purposes of the Union*, ch. I, art. 3, No. 2(a) (emphasis added).

240. INTERNATIONAL TELECOMMUNICATIONS CONVENTION, INTERNATIONAL RADIO REGULATIONS, 63 Stat. 1399 (1948).

3. U.S. Domestic Implementation of Atlantic City International Radio Regulations

One week before the U.S. Senate consented to ratification, the FCC issued a Notice of Proposed Rulemaking (NPRM) proposing to amend Part 2 of the Commission's rules "in conformity with the Atlantic City radio regulations . . . to define all currently recognized radio services and stations, and to list all domestic frequency allocations between 25 megacycles and 30,000 megacycles."²⁴¹ The Part 2 NPRM also proposed other rules that used the phrase "harmful interference" eleven times—and the word "interference"—without the new modifier, forty three times. At the same time in three separate NPRMs, the FCC proposed rules for a variety of other services in various rule parts.²⁴² Without mentioning the Atlantic City International Radio Regulations or including any discussion of the proposed definitions, the other FCC NPRMs proposed to adopt the exact same definition of "harmful interference" as contained in Article 1 of the Atlantic City regulations.²⁴³

On December 10, 1948, the Commission amended its rules to make them "consistent with existing treaties, conventions and the Final Acts of the International Telecommunication and Radio Conferences, Atlantic City, 1947."²⁴⁴ The revised regulations in Part 2 of the rules included its first definition of "harmful interference," which was slightly different than the text proposed in the NPRM (and contained in the Atlantic City Radio Regulations): the language adopted by the FCC added "in this part" at the end thereby (intentionally or unintentionally) conditioning interference protection on a claimant's compliance only with Part 2 of the FCC's rules.²⁴⁵ In other words, although the Atlantic City Radio Regulations (and Telecommunications Convention) required

241. *Fourteenth Annual Report of the Federal Communications Commission* 24 (June 30, 1948); see also *Frequency Allocations and Radio Treaty Matters*, Proposed Rule, Docket No. 9022, 13 Fed. Reg. 3376 (June 23, 1948).

242. See *Industrial Radio Services*, Proposed Rule, Docket No. 9018, 13 Fed. Reg. 3421 (June 23, 1948) (proposing a new Part 11); *General and Domestic Public Mobile Services*, Proposed Rule, Docket No. 8658, 13 Fed. Reg. 3403 (June 23, 1948) (proposing Part 6 rules); *Public Safety Radio Services*, Proposed Rule, 13 Fed. Reg. 3411 (June 23, 1948) (proposing revisions to Part 10).

243. See *Frequency Allocations and Radio Treaty Matters*, Proposed Rule, *supra* note 241, at 3377 (proposing Part 2, Subpart A - Definitions); *Industrial Radio Services*, Proposed Rule, Docket No. 9018, 13 Fed. Reg. 3421, 3422 (June 23, 1948) (proposing Part 11, Subpart A, § 11.2(r)).

244. *Part 2*, Final Rule, *supra* note 23, at 8130-8131.

245. *Id.* at 8133. The FCC definitions excluded the definition of "safety service" set forth in No. 69.1. Compare *Frequency Allocations and Radio Treaty Matters*, Proposed Rule, *supra* note 241, 3378 n.2.

conformity with all of the International Radio Regulations, the FCC's definition adopted in 1948 required conformity with the domestic table of allocations (which theoretically conformed with the international table).²⁴⁶ The new Part 2 rules used the term "harmful interference" eight times.²⁴⁷ The FCC's first definition of "harmful interference" remained unchanged until the Commission implemented changes adopted by the ITU at the 1959 Administrative Radio Conference.

B. 1959 Administrative Radio Conference (Geneva) and U.S. Implementation

For the first time in the twelve years since Atlantic City, the ITU convened an "Administrative Radio Conference" in Geneva, Switzerland, from August 17 to December 21, 1959, to revise the Radio Regulations.²⁴⁸ According to the ITU, "[i]t was essential to revise Article 1 of the Radio Regulations to incorporate several new definitions in response to the swift advances in radio engineering and the emergence of new radio services, namely: the space service, the earth-space services, and the radio astronomy service."²⁴⁹

Leading up to the conference, several countries proposed additional text to supplement the Atlantic City definitions. For example, India proposed inserting into the "harmful interference" definition the phrase "or degrades" after "repeatedly interrupts" and proposed a footnote that read (in English):

The operation of a radio service would be deemed to have suffered a degradation if:

- a) the average speed of message reception; or
- b) the average error rate; or
- c) the average signal to interference ratio

is adversely affected by the presence of the interfering transmission.²⁵⁰

246. The current definition, however, requires affected services to be operating in accordance with [the ITU] Radio Regulations. 47 C.F.R. § 2.1(c) (2023) (brackets in original).

247. *Part 2*, Final Rule, *supra* note 23, at 8131-8150.

248. See ITU, *Administrative Radio Conference* (Geneva, 1959), <http://handle.itu.int/11.1004/020.1000/4.85> [<https://perma.cc/H8TG-6PS6>] (last visited Apr. 11, 2025).

249. *Id.* See also William H. Watkins, *Report on World Radio Conference, Geneva, Switzerland, 1959*, BC-6 IRE TRANS. ON BROAD. 3 (Aug. 1960) (reporting that "[m]ajor decisions of interest to engineers in the United States [included] new terminology which engineers will be expected to learn gradually in the years ahead.").

250. ITU, *Proposals for the International Radio Conference*, Proposals 215-216 (1959).

The Federal Republic of Germany (West Germany) proposed to add at the end of the definition of “harmful interference” the following sentence:

What should be regarded as interference, and how interferences can be avoided or reduced in any particular case is indicated in the pertinent recommendations of the CCIR [International Radio Consultative Committee].²⁵¹

France proposed a new definition of “interference” that read (in English):

Disturbance to the reception of a useful signal by an undesired signal or a disturbance.²⁵²

France did not provide an explanation for this proposed change but proposed several other new and revised definitions for Article 1 of the Radio Regulations.²⁵³

At the Geneva Radio Conference, Committee 6 (Technical) focused on terminology issues and assigned Working Group 6A the task of studying “the greatest possible number of definitions of terms used in the Regulations” including new definitions regarding the “Radiolocation,” “Space,” “Earth-Space” and “radioastronomy” services.²⁵⁴ On September 16, 1959, Subgroup 6A8 of Working Group 6A agreed to and submitted the following revised definition of “harmful interference”:

Any radiation or any induction which endangers the functioning of a radionavigation service or of other safety services or seriously degrades, obstructs or repeatedly

251. *Id.* Proposal 217. This proposal referenced CCIR Recommendations 161 (Bandwidth and Signal-to-noise Ratio in Complete Systems), 162 (Use of Directional Antennae), 163 (Signal-to-interference Protection Ratios), and 164 (Fading Allowances for the Various Classes of service). These CCIR recommendations, as of April 1959, are available in International Radio Consultative Committee, *Documents of the IXth Plenary Assembly*, Vol. I (Los Angeles, 1959), <http://handle.itu.int/11.1004/020.1000/4.275.43.en.1001> [<https://perma.cc/ZM4L-KT2X>]. Recommendation 163 was replaced by Recommendation 240.

252. ITU, *Proposals for the International Radio Conference*, Proposal 290 (Geneva, 1959); see also *id.*, Proposal 291 (France’s proposal to replace “[a]ny radiation or any induction” with “interference” in the definition of “harmful interference”) and Proposal 292 (proposing a definition of “Safety service” instead of a note).

253. *Id.* Proposals 267-289.

254. See A. Henry, *The Administrative Radio Conference*, 27 TELECOMM. J. 66, 69 (1960).

interrupts a radio service operating in accordance with these Regulations.²⁵⁵

The sub-working group provided no explanation or elaboration about the recommended changes, which appear to be based on India's proposal to "cover the effect of degradation of the service" (but without the footnote on quantitative approaches to showing "degradation").²⁵⁶ Nonetheless, the sub-working group rejected the separate definition of "interference" proposed by France as simply "not necessary."²⁵⁷ The group also did not consider Article 1 of the regulations as the "proper place" for the language proposed by West Germany referencing CCIR technical recommendations.²⁵⁸

The sub-working group's recommended language for "harmful interference" was approved and submitted for inclusion into the Geneva Radio Regulations as well as the Telecommunications Convention considered at the Plenary Conference. However, an *ad hoc* group at the Plenary Conference, without explanation, added "emission" to the beginning of the definition.²⁵⁹ In the new radio regulations, "harmful interference" had over 140 instances – nearly double the number in the Atlantic City regulations.

On February 3, 1961, while ratification of the 1959 treaty documents was still pending before the U.S. Senate, the FCC issued a NPRM in Docket No. 13928 putting forth proposals to change the Commission's rules "based on the Geneva (1959) Radio Regulations."²⁶⁰ The NPRM said that "the definitions of services and stations in the Radio Regulations have been changed appreciably, both editorially and in number."²⁶¹ Without discussion of any of the proposed definitions, the FCC proposed to adopt the revised international definition of "harmful interference," except at the end (as with the 1948 Part 2 rules): services affected by such

255. ITU, *1959 Geneva Radio Conference Documents, Report of Sub-Working Group 6A8 to Working Group 6A*, Doc. No. DT 243-E (Sep. 23, 1959) (emphasis added to show revisions from the Atlantic City regulations). The sub-working group also adopted a separate definition of "safety service" as opposed to a footnote. *Id.*

256. ITU, *Proposals for the International Radio Conference* (Geneva, 1959) at 83 (Proposal 216). No document was found regarding specific discussion or consideration of India's proposed footnote.

257. *Id.* A definition of "interference" became necessary in 1979. *See infra* V.B.2.

258. *Id.* at 2.

259. *See* ITU, *1959 Geneva Radio Conference Documents, Summary Record, Seventeenth Meeting of Committee 6 (Technical)*, Doc. No. 849-E at 2 (Dec. 11, 1959).

260. *Frequency Allocations and Radio Treaty Matters*, Proposed Rule, Docket No. 13928, FCC 61-121, 26 Fed. Reg. 1499 (Feb. 22, 1961). The FCC noted the new International Radio Regulations were scheduled to come into force on May 1, 1961, but had yet to be ratified by the United States. *Id.*

261. *Id.*

interference must operate “in accordance with regulations in this part.”²⁶² The other proposed rules used the phrase “harmful interference” ninety-eight times.

On October 18, 1961, the Commission amended its rules to incorporate, “to the extent practicable,” the 1959 Geneva Radio Regulations into Subparts A and B of Part 2.²⁶³ The final definition of “harmful interference” was identical to the proposed definition in the February 1961 NPRM, except it required victim services to operate in accordance with “this chapter” instead of “this part.”²⁶⁴ That is, while the 1948 FCC definition required conformity with Part 2 of its rules, the new definition was conditioned on conformance with all FCC rules contained in Chapter I of the Code of Federal Regulations.²⁶⁵ “Harmful interference” was mentioned over one hundred times in the FCC’s final rules.

The international and domestic definitions of “harmful interference” remained unchanged from the late 1950s and early 1960s until new definitions of the terms “interference,” “permissible interference,” and “accepted interference” came along in the late 1970s.

V. HISTORY OF THE DEFINITION OF “INTERFERENCE” AND RELATED TERMS

This section covers a more condensed but equally significant period of the post-World War II era, starting in the early 1970s when the foundation (and subjective approach) of the 1947 “harmful interference” definition started to show cracks. Satellite and digital technologies appeared to be the principal drivers of most proposed changes to the International Radio Regulations during this time frame. As global satellite services became more prevalent and as developing nations gained technical and procedural clout at the ITU, quantitative and flexible approaches were considered necessary to promote equitable spectrum sharing and planning.²⁶⁶

262. *Id.* at 1502 (emphasis added). The FCC also proposed the same definitions of “Radionavigation service” (and related terms) and “Safety service” as those in the new International Radio Regulations. *Id.* at 1503.

263. *Frequency Allocations and Radio Treaty Matters*, Second Memorandum Opinion and Order, Docket No. 13928 *etc.*, 26 Fed. Reg. 10655, 10659 (Nov. 15, 1961).

264. *Id.* at 10657.

265. See 47 C.F.R. Chapter I – Federal Communications Commission (1963).

266. Developing countries began asserting their leverage in the United Nations and the ITU when, for example, eight “Equatorial Nations” claimed ownership of the Geostationary Arc (and frequencies therein). See, e.g., Andrzej Gorbiel, *The Legal Status of The Geostationary Orbit: Some Remarks*, 6 J. SPACE L. 171, 173-174 (1978); see also A. M. Rutkowski, *The 1979 World Administrative Radio Conference: The ITU in a*

These and other technology developments began to strain the 1947 ITU regulatory regime, which soon started to “suffer[] from numerous weaknesses and defects.”²⁶⁷

This period began with the 1971 World Administrative Radio Conference for Space Telecommunications in Geneva, where the effectiveness and qualitative nature of the “concept of harmful interference” was called into question. It culminated with the 1979 World Administrative Radio Conference (also in Geneva) and the FCC’s adoption, in 1983, of new definitions (to align with the ITU Radio Regulations) of the terms “interference,” “accepted interference,” “permissible interference,” and a slightly revised definition of “harmful interference.” Between the 1971 and 1979 international conferences, extensive study of these definitions took place under the guise of the ITU’s International Radio Consultative Committee (CCIR).²⁶⁸

A. 1971 World Administrative Radio Conference for Space Telecommunications (Geneva) and its Aftermath

The definition of “harmful interference” initially came under fire with the adoption of recommendations at the 1971 World Administrative Radio Conference for Space Telecommunications (“Space WARC”) (held in Geneva from June 7 to July 17, 1971), where the delegates called for clearer definitions related to interference to enable sharing between satellite and terrestrial services. The delegates to the Space WARC recommended new terminology defining “acceptable (or unacceptable) interference.”²⁶⁹

Changing World, 13 INT’L L. 289 (1979); Thomas A. Hart, Jr., *A Review of WARC-79 and Its Implications for the Development of Satellite Communications Services*, 12 LAW AM. 442 (1980); Glen O. Robinson, *Regulating International Airwaves: The 1979 WARC*, 21 VA. J. INT’L L. 1, 27-28 (1980).

267. Leive 1970, *supra* note 204, at 41 (“The legal principles have several serious and important deficiencies and are not even applicable to many interference situations; the IFRB’s powers and procedures are severely limited, inhibiting its ability to determine actual spectrum usage and take effective steps to regulate it.”). Presumably, the introduction of digital modulation techniques in the early 1970s impacted how the ITU and national regulators addressed forthcoming radio frequency interference problems. See, e.g., HUURDEMAN, *supra* note 47, at 371-374; see also ITU, REPORT ON THE ACTIVITIES OF THE INTERNATIONAL TELECOMMUNICATION UNION IN 1974 32 & 35 (Geneva 1975). However, our research found little documented evidence that the ITU or the FCC revised its interference terminology in the 1970s and early 1980s in anticipation of digital modulation techniques.

268. The 1927 International Radiotelegraph Conference in Washington established the CCIR to study technical and operating questions related to radio communications and to issue recommendations on them. See RICHARD C. KIRBY, FIFTY YEARS OF THE INTERNATIONAL RADIO CONSULTATIVE COMMITTEE (CCIR) (ITU 1979).

269. See *Final Acts of World Administrative Radio Conference for Space Telecommunications*, Geneva, 1979, ITU (1979) 345-347 (Recommendation No. Spa2-12,

Recommendation No. Spa2-12 opened by considering “that the definition of harmful interference (No. 93 of the Radio Regulations), being of a qualitative nature, leads to a purely subjective estimation of the nuisance.”²⁷⁰

In preparing for the Space WARC, the IFRB, in April 1971, offered some “observations relating to the concept of harmful interference,” including a summary of how the IFRB applied the concept when it assessed “the probability of harmful interference to the service rendered” pursuant to the ITU Radio Regulations.²⁷¹ In carrying out its regulatory tasks, the IFRB adopted in its technical standards “[v]alues for the ratio between the wanted signal and the interfering signal, below which harmful interference may be expected.”²⁷² The IFRB explained that “[t]here can therefore exist below a value considered as a limit, a margin within which, due to the fluctuations in the propagation, the interference is considered as harmful only if the specified limit is not reached during a certain percentage of time.”²⁷³

A few months later, Brazil proposed a draft recommendation to consider a definition of “permissible interference” and a modification to the definition of “harmful interference.” The proposal used the same rationale of the IFRB report quoted above and said that permissible interference might be understood as the effect of any emission, radiation or induction that does not affect “a radiocommunication service beyond specific limits established for its performance with regard to the quality and reliability required by the nature of the service.”²⁷⁴ Brazil’s proposed revised definition

Relating to Technical Standards for the Assessment of Harmful Interference in the Frequency Bands above 28 MHz; *id.* at 350-356 (Recommendation No. Spa2-15).

270. *Id.* at 345. Professor Francis Lyall observed that the current interference-related definitions “parallel the concept of nuisance in civil law.” FRANCIS LYALL, *Harmful Interference and the ITU*, in 5 HARMFUL INTERFERENCE IN REGULATORY PERSPECTIVE, LEGAL RULES FOR INTERFERENCE-FREE RADIO COMMUNICATION 19, 28 (Mahulena Hofmann ed., Routledge, 2015). For a comprehensive evaluation of the application of common law concepts of nuisance and trespass to spectrum access and interference disputes, see Ellen P. Goodman, *Spectrum Rights in the Telecosm to Come*, 41 SAN DIEGO L. REV. 269 (2004).

271. ITU, *Report of the International Frequency Registration Board (I.F.R.B.) to the World Administrative Radio Conference for Space Telecommunications*, Doc. No. 61-E Annex, at 19-21 (1971).

272. *Id.*

273. *Id.* The IFRB also referenced CCIR recommendations regarding such “values” that ensure “a satisfactory service” in the absence of harmful interference. *Id.* However, the IFRB said “it does not possess data on the increases of these recommended values and on the associated percentages of time which can be considered as causing ‘a serious degradation of the quality’ in accordance with No. 93 of the Radio Regulations.” *Id.*

274. ITU, *Report of the Chairman of Sub-working Group 4E-1 to the World Administrative Radio Conference for Space Telecommunications*, Doc. No. 121-E (1971) (Draft Recommendation No. H, relating to technical standards for the assessment of interference in the frequency bands above 28 Mc/s).

of “interference” would have inserted “[t]he effect of” at the beginning because “[t]he interference is not the emission, radiation or induction, but the undesired result of these.”²⁷⁵

Although the outcomes of the 1971 Space WARC did not change the ITU definitions, recommendations to the CCIR led to a comprehensive report at the 1974 CCIR Plenary Assembly in Geneva and a concrete proposal at the 1978 CCIR Plenary Assembly in Kyoto, Japan. Building off the Brazilian proposal’s focus on the “effect,” the CCIR in 1974 reported that it was “desirable to define the term ‘interference’ itself before defining qualifications or gradations of it. “Since the sole purpose of a receiving system is to extract information from a wanted emission, it appears reasonable to judge unwanted energy by its effect on such wanted information, and to define that effect as interference.”²⁷⁶ The CCIR report assessed various tentative and alternative definitions for “interference,” “interfering signal,” “harmful interference,” “permissible interference,” and “acceptable (or unacceptable) interference.” It recommended further study of these terms and their practical applications to various radiocommunication services along with consideration of “the quantitative interference and sharing criteria which will be essential to meaningful use of the qualitative definitions.”²⁷⁷

As a result, in 1978, the CCIR recommended that “the following definitions be employed in ITU texts dealing with radiocommunication interference:”

Interference: The effect of unwanted energy due to one or a combination of emissions, radiations, or inductions upon reception in a radiocommunication system, manifested by any performance degradation, misrepresentation, or loss of information which could be extracted in the absence of such unwanted energy;

Interfering source: An emission, radiation, or induction which is determined to be a cause of interference in a radiocommunication system;

Permissible interference: Observed or predicted interference which complies with quantitative interference and sharing criteria contained in the Radio Regulations or in

275. *Id.* at Doc. No. 70-E at 7-8 (Brazil Proposed Amendments to Article 1 of the Radio Regulations).

276. ITU, Report 529 on Outcomes of the CCIR at 265-268 (XIIIth Plenary Assembly, Geneva, 1974) (Spectrum Utilization and Monitoring, Definitions of Interference). The report noted that “Harmful interference is the term which has been in widest use for a long time. There appears general agreement to retain the definition . . . with no more than minor change to make the term consistent with the definition of interference . . .”

277. *Id.* at 268.

Recommendations of the CCIR or in regional agreements as provided for in the Radio Regulations;
Harmful interference: Any interference which endangers the functioning of a radionavigation service or of other safety services or seriously degrades, obstructs, or repeatedly interrupts a radiocommunication service operating in accordance with the Radio Regulations.²⁷⁸

According to the head of the U.S. delegation to the 1979 WARC, “the work of the CCIR has been extremely important in creating effective international standardization and regulation. Because of the technical professionalism of the group, the CCIR has offered a means of obtaining international agreement with minimal dispute over abstract or ideological issues.”²⁷⁹ As part of the conference proceedings, the CCIR contributed a five-hundred-plus page preparatory report on the “Technical Bases” for the conference, of which less than a page addressed the proposed “qualitative definitions” regarding interference developed by the CCIR “after extensive consideration.”²⁸⁰ The Final Acts of the 1979 WARC included, nearly *verbatim*, each of these proposed definitions, except for the term “interfering source,” which was omitted.²⁸¹

278. ITU, Recommendations and Reports of the CCIR (XIVth Plenary Assembly, Kyoto, 1978), Recommendation 506 (describing definitions of radiocommunication interference). The recommendation included a Note that read:

It is recognized that, under certain circumstances, a higher level of interference than that defined as permissible may be accepted by agreement between the Administrations concerned without prejudice to other Administrations, but it is not considered possible to set down any precise values for this interference level – each case must be treated on its merits. This interference level may be called accepted interference.

Id.; see also *id.* at Report 776 (providing definitions of interference and units of measurement and emphasizing the importance of retaining in the definition of “harmful interference” “the connotation that radionavigation services are safety services” and other “present provisions of Radio Regulations No. 93”).

279. Robinson, *supra* note 266, at 8. Professor Robinson, who previously served as an FCC Commissioner from 1974 to 1976, was Chairman of the U.S. Delegation to the 1979 WARC. *Id.* at 1.

280. ITU, *1979 Geneva Radio Conference Documents*, Doc. No. 13-E ch. 2, (1979), *Technical Bases for the World Administrative Radio Conference 1979*, Report of the Joint Meeting of CCIR Study Groups Special Preparatory Meeting for the WARC-79. The CCIR reported that “that these definitions could be used as a basis for the development of quantitative values of interference for various radio services.” *Id.*

281. See *Final Acts of World Administrative Radio Conference*, ch. I, art. 1, § VII, Nos. 160-163 (Geneva, 1979) [hereinafter WARC-79 Final Acts].

B. 1979 World Administrative Radio Conference (Geneva)

More than two thousand delegates (from 150 countries) and support staff gathered in Geneva (from September 24 to December 6, 1979) for the first Conference governing all radio services in twenty years.²⁸² According to Professors Coddington and Rutkowski, the Conference's most significant results included "the revision of many technical and operational standards for radio, particularly the Table of Frequency Allocations. . . [and a modification] in the various bands to reflect increased use of satellite communications."²⁸³ The head of the U.S. Delegation, Professor Glen O. Robinson, highlighted as "possibly the greatest accomplishment of the Conference" as "not in what was done but in how it was accomplished – with a minimum of rhetorical or ideological confrontation and a strong emphasis on compromise and consensus."²⁸⁴

1. U.S. Domestic and International Preparatory Activities

Professor Robinson testified twice, before and after the 1979 conference, at hearings convened by the Subcommittee on International Operations of the House Committee on Foreign Affairs, at which he summarized the elaborate government-wide, bilateral, and multilateral preparatory efforts and the conference outcomes.²⁸⁵ He outlined the U.S. objectives related to, among other things, achieving "incremental" changes to international frequency allocations and related regulations.²⁸⁶ None of the hearing materials mentioned definitional or terminology issues.

In late 1974, the FCC and the executive branch, through the IRAC, began parallel efforts in preparation for the 1979 WARC. The FCC established a Steering Committee, four specialized functional committees, and twenty-two industry advisory committees to study spectrum requirements and to suggest appropriate changes to the

282. See ITU, *World Administrative Radio Conference (Geneva, 1979)*, <http://handle.itu.int/11.1004/020.1000/4.101> [<https://perma.cc/23V8-S9YN>] (last visited Oct. 10, 2024); see also Robinson, *supra* note 266, at 12.

283. CODDINGTON & RUTKOWSKI, *supra* note 39, at 51.

284. Robinson, *supra* note 266, at 12.

285. *The World Administrative Radio Conference and International Communications Policy, Hearings Before the Subcomm. on Int'l Operations of the H. Comm. on Foreign Aff's.*, 96th Cong., 3-4 (1980) [hereinafter House Hearings on WARC-79]. The first hearing was held on June 14, 1979, and the second was held on July 31, 1980. See also Robinson, *supra* note 266, at 13-14 n.44 (describing the five-year, interagency U.S. preparatory process).

286. See House Hearings on WARC-79, *supra* note 285, at 8, 22-23, 77, 82, 116.

ITU Radio Regulations.²⁸⁷ The White House Office of Telecommunications Policy also established a preparatory infrastructure within the IRAC. Between 1975 and 1978, the FCC issued nine Notices of Inquiry in Docket 20271 that sought comments and recommendations from the public regarding the proposals that the U.S. should make to the conference.²⁸⁸ In December 1978, the FCC released a comprehensive set of recommended proposals “representing the combined thinking of the Commission and the Executive Branch,” which the Department of State used to develop the formal U.S. proposals that were submitted to the ITU. None of the recommended proposals at this stage addressed terminology issues because the existing definitions were likely to be satisfactory.²⁸⁹

In early 1979, the U.S. submitted over nine hundred different proposals to the conference.²⁹⁰ In regard to terms, definitions, and nomenclature issues in Article 1 of the Radio Regulations, the U.S. proposals indicated a clear satisfaction with the existing terminology and a general proclivity to keep changes to “an absolute minimum” “[b]ecause of the profound effect that terms and definitions have on the interpretation of the Radio Regulations.”²⁹¹ It also supported terminology relating to the “distribution of frequencies” to ensure it was “expressed in the appropriate working language of the Union.”²⁹²

287. See *Implementation of the Final Acts of the World Administrative Radio Conference, Geneva, 1979*, *supra* note 24.

288. *Id.* See also FCC, *ITU 1979 World Administrative Radio Conference (WARC), Announcement of Proposals (Summary)*, Docket No. 20271, 44 Fed. Reg. 2683 (Jan. 12, 1979).

289. The Federal Register summary cited in the previous footnote was a summary of a 437-page document, which may have mentioned these issues. “Because of the cost of printing so voluminous a text, it will not be published in the Federal Register. However, the FCC has prepared a limited number of copies that [were] available upon request.” *Id.* at 2685.

290. See House Hearings on WARC-79, *supra* note 285, at 83. Most of the proposals were submitted to the ITU in January 1979, but others “dealing with [high-frequency] spectrum in particular were delayed pending the internal resolution of a domestic conflict and controversy over the allocations for high-frequency broadcasting.” *Id.* at 3.

291. ITU, *1979 Geneva Radio Conference Documents, United States of America Proposals Relating to General and Administrative Matters*, Doc. No. 49-E at 2 (Jan. 31, 1979); see also *id.*, *United States of America Proposals Relating to Technical Matters*, Doc. No. 47-E at 2, 10-11 (Jan. 31, 1979) (proposing “minimum changes required to clarify the terms used in coordination procedures for the mobile-satellite service”).

292. *Id.*, Doc. No. 49-E at 6, referencing Resolution No. 6, Administrative Radio Conference (Geneva, 1959).

2. New International Definitions of “Interference,” “Permissible Interference,” and “Accepted Interference”

A few other countries proposed new interference definitions along the lines presented by the CCIR recommendation discussed above.²⁹³ In particular, the German Democratic Republic (East Germany) supported the CCIR’s proposed definition of “interference” over “that contained in the International Electrotechnical Vocabulary, 60-08-025, reading: ‘Disturbance experienced in the reception of a wanted signal, caused by an unwanted signal or noise.’”²⁹⁴

At the 1979 WARC, a number of committees were tasked with studying the proposals concerning Article 1 terms and definitions of the Radio Regulations.²⁹⁵ On October 23, 1979, Committee 4 (Technical Regulations Committee) approved new definitions of “interference” and “permissible interference” and a modified definition of “harmful interference.”²⁹⁶ While there was little or no deliberation on the first two new definitions, the committee delegates had two interesting exchanges concerning “harmful interference” before its slight revisions were approved.

The first issue concerned, as discussed above, the modification of the French version from “*brouillage nuisible*” to “*brouillage préjudiciable*.” The Committee Chairman observed that the “matter was of a legal rather than a technical nature” and should be handled in a plenary session of the conference.²⁹⁷ Yet again, a new

293. See, e.g., *id.*, *Paupa New Guinea Proposals for the Work of the Conference, Addendum to Proposals for Article N1/1*, Doc. No. 39-A-E at 3-4 (Jun. 1, 1979); *id.*, *German Democratic Republic Proposals for the Work of the Conference, Chapter I, Terminology, Article N1/1, Terms and Definitions*, Doc. No. 20-E at 2 (Jan. 22, 1979).

294. *Id.* East Germany also supported the CCIR modifications to the definition of “harmful interference” along with “explicitly mentioning the radio navigation service, as a type of safety service, to emphasize its importance.” *Id.*

295. See ITU, *Union Activities, World Administrative Radio Conference 1979*, 46 TELECOMM. J. 662 (1979).

296. See ITU, *1979 Geneva Radio Conference Documents, Summary Record of the Fourth Meeting of Committee 4 (Technical Regulations)*, Doc. No. 529-E at 4-6 (Nov. 7, 1979). The Committee also decided that “interfering source” would not be included in the regulations. *Id.*; see also *id.*, *Second Report of Working Group 4A to Committee 4*, Doc. No. 241-E at 6-7 (Oct. 16, 1979) and *id.*, *Third Report of Working Group 4A to Committee 4*, Doc. No. 307-E at 2 (Oct. 19, 1979).

297. *Id.*, Doc. No. 529-E, *supra* note 296, at 4. “The delegate from France said that the matter had been fully discussed not only in the Working Group [4A] but also at the Special Preparatory Meeting.” *Id.* There is no record of this being handled at a plenary meeting.

French term was introduced modifying *brouillage*, but this one – *préjudiciable* – came closer to the English word “harmful.”²⁹⁸

The second discussion exposed how the delegates read and interpreted the current definition of “harmful interference.” The delegate of Iraq thought the contrast between “permissible” and “harmful” interference was too strong, questioning whether “seriously” and “repeatedly” should continue to describe harmful interference or whether some “intermediate term” (such as “accepted interference”) could be adopted and defined.²⁹⁹ The delegate of the United Kingdom “strongly opposed” changing the current definition while the Chairman of Working Group 4A and the French delegate both interpreted the definition to mean “catastrophic interference, hence interference that was seriously degrading” and at “a level that prevented transmission entirely.”³⁰⁰ Great Britain also opposed adopting a definition for the phrase “accepted interference,” which it claimed was “entirely superfluous.”³⁰¹

The Chairman of Committee 4 attempted to explain the basis for the three “levels” of interference in the proposed definitions with the following points:

- Harmful interference, a well known term which can be found also in the Convention, relates to a level of serious degradation of the system . . . ;
- Accepted interference relates to a level of interference agreed upon by two or more Administrations concerned, without prejudice to other Administrations . . . ;
- Permissible interference relates to a level of interference agreed upon by all Administrations or by a special agreement . . .

It follows that the level of “accepted” interference is normally above the level for “permissible” interference.³⁰²

298. Collin’s Dictionary, *English translation of ‘préjudiciable,’* (last visited Oct. 10, 2024). <https://www.collinsdictionary.com/dictionary/french-english/préjudiciable> [<https://perma.cc/G8DX-5Z7R>].

299. *Id.*, Doc. No. 529-E, *supra* note 296, at 5.

300. *Id.*

301. *Id.*, *Summary Record of the Eighth Meeting of Committee 6 (Regulatory Procedures)*, Doc. No. 559-E at 2 (Nov. 8, 1979); *see also id.*, *Summary Record of the Sixth Meeting of Committee 4 (Technical Regulations)*, Doc. No. 558-E at 2 (Nov. 8, 1979).

302. *Id.*, *Note from the Chairman of Committee 4 to the Chairman of Committee 6*, Doc. No. 478-E (Nov. 2, 1979) (emphasis in original, document references omitted).

Committee 4 approved the definition of “accepted interference” on November 8, 1979.³⁰³

The 1979 WARC Plenary session held on November 24, 1979 approved an amendment to the definitions of “accepted” and “permissible” interference by adding a footnote, proposed by the Soviet Union’s delegate, that read, “[t]hese terms are applied in coordination of frequency assignments between Administrations.”³⁰⁴ The French language original tracked the English translation because, as discussed above, “harmful interference” was (and still is) “brouillage préjudiciable.”

Although “harmful interference” appeared more than 380 times in the 1979 WARC Final Acts, the three new terms (“interference,” “accepted interference,” and “permissible interference”) were used only a few times. For example, one of the restrictions placed on certain space stations in the 29.95-30 GHz band (still the only such restriction in place today in the International Radio Regulations) provided as follows:

Whenever the emissions from the geostationary satellites are directed towards the geostationary-satellite orbit and cause unacceptable interference to any geostationary-satellite space system in the fixed-satellite service, these emissions shall be reduced to a level at or less than accepted interference.³⁰⁵

The only other provision of the 1979 Radio Regulations that used the term “permissible interference” was the definition of “accepted interference.”³⁰⁶ The current ITU Radio Regulations use the phrase “permissible interference” twice more in the definitions of

303. *Id.*, *Summary Record of the Eighth Meeting of Committee 4 (Technical Regulations)*, Doc. No. 824-E at 2 (Nov. 23, 1979) (noting “a reservation made by the United Kingdom delegation”).

304. *Id.*, *Minutes of the Sixth Plenary Meeting*, Doc. No. 970-E at 9 (Dec. 7, 1979). Following editorial review, the footnote in the *WARC-79 Final Acts* (and in the current Radio Regulations) read: “The terms ‘permissible interference’ and ‘accepted interference’ are used in the coordination of frequency assignments between administrations.” WARC-79 Final Acts, *supra* note 281, at Nos. 161.1 and 162.1 (3142A.1 and 3140B.1), compare ITU, *Radio Regulations* (2024), art. 1, Nos. 1.167.1 and 1.168.1; see also *id.* art. 22, No. A.22.1 (“In applying the provisions of this Article, the level of accepted interference . . . shall be fixed by agreement between the administrations concerned, using the relevant [ITU] Recommendations as a guide.”)

305. WARC-79 Final Acts, *supra* note 281, art. 29, § II (No. 2614) (emphasis added, footnotes omitted). The footnotes (No. 2614.1) said, “The level of accepted interference shall be fixed by agreement between the administrations concerned, using the relevant CCIR Recommendations as a guide.” Compare ITU Radio Regulations (2024) art. 22, Nos. 22.4 and A.22.1.

306. WARC-79 Final Acts, *supra* note 281, art. 1, No. 162. Compare ITU, *Radio Regulations* (2024), art. 1, No. 1.168.

“coordination area” and “coordination distance” when “determining the need for coordination.”³⁰⁷

C. U.S. Domestic Implementation of the 1979 International Definitions

With the ratification of the 1979 WARC Final Acts on September 6, 1983, according to the FCC, “[the treaty] now has the force of law in the United States and we are obliged to adhere to its provisions.”³⁰⁸ On December 30, 1982, the FCC released an NPRM in Gen. Docket No. 80-739, proposing modifications to Part 2, Subparts A and B (§§ 2.1 through 2.108), of the FCC’s rules.³⁰⁹ “Due to the broad scope of this proceeding,” the FCC previously issued five notices of inquiry in Gen. Docket No. 80-739, soliciting comment on proposed modifications to Part 2 to make the FCC’s allocations “as consistent as possible with international allocations in light of foreseen domestic needs and U.S. proposals to accommodate those needs going into the WARC.”³¹⁰

The Third Notice of Inquiry in the proceeding, released on August 7, 1981, proposed modifications to § 2.1 (Definitions) of the FCC’s rules “to include all the terms and associated definitions contained in Article 1 of the International Radio Regulations.”³¹¹ Similarly, the NPRM simply stated, without elaboration, that the FCC was “modifying [its] definitions to be consistent with the international definitions approved at the 1979 WARC.”³¹²

In comments on the Third Notice of Inquiry, however, AT&T suggested that the FCC’s rules in Subpart B of Part 2 (§§2.102(b), 2.102(f), 2.102(g)(2) and 2.103(a)(3)) “be amended to alert potentially interested users that there are different levels of interference (i.e., ‘permissible’ and ‘accepted’), and that the value for the levels are defined by either the Radio Regulations, FCC Rules, or CCIR Recommendations.”³¹³ The FCC’s response to AT&T

307. *Id.* art. 1, Nos.1.165 and 1.167.

308. *Implementation of the Final Acts of the World Administrative Radio Conference, Geneva, 1979*, *supra* note 24.

309. *Id.*

310. *Id.*

311. *Implementation of the Final Acts of the World Administrative Radio Conference, Geneva, 1979*, Third Notice of Inquiry, Gen. Docket No. 80-739, FCC 81-323, ¶ 7 (Aug. 10, 1981); *see also Frequency Allocations and Radio Treaty Matters Gen. Rules and Regul.*, Announcement of Third Notice of Inquiry, Docket No. 80-739, 46 Fed. Reg. 40536 (Aug. 10, 1981).

312. *Implementation of the Final Acts of the World Administrative Radio Conf., Geneva, 1979*, Notice of Proposed Rulemaking, Gen. Docket No. 80-739, FCC 82-508, at ¶ 16 and Appendix C (Dec. 30, 1982).

313. *Id.* at ¶ 19.

in the NPRM was that “such amendments are unnecessary as the operating rules define the particular interference criteria adopted by the FCC for each service and frequency and those rules provide adequate information for current and future users of the radio frequency spectrum.”³¹⁴ The NPRM also explained that “there are a number of CCIR Recommendations that have not been adopted by the Commission and are therefore not applicable.”³¹⁵

The FCC’s Second Report and Order in Gen. Docket No. 80-739 (released on December 8, 1983) modified – again without elaboration or discussion – the “definitions to be consistent with the international definitions approved at the 1979 WARC.”³¹⁶ Nonetheless, the agency made a slight change to the definition of “harmful interference” to insert the bracketed language in the following:

Interference which endangers the functioning of a radionavigation service or of other safety services or seriously degrades, obstructs, or repeatedly interrupts a radiocommunication service operating in accordance with these [international Radio] Regulations. (RR)³¹⁷

The FCC’s current rules define “harmful interference” the same way, conditioning interference protection on a claimant’s compliance “with [the ITU] Radio Regulations.”³¹⁸ In other words, both the 1979 WARC and FCC regulations required conformity with the International Radio Regulations. The FCC’s Part 2 regulations, implementing the 1979 international regulations, used the term “harmful interference” 178 times. They did not use the other three new terms outside of the list of defined terms except

314. *Id.* at ¶ 20.

315. *Id.* Appendix C of the NPRM set forth proposed definitions for Section 2.1(c) of the FCC’s rules, including the 1979 WARC definitions (*verbatim*) of “Accepted Interference” and “Permissible Interference” along with the footnote that said these terms “are used in the coordination of frequency assignments between administrations.” *Id.* at C-1, C-12, and C-20.

316. *Implementation of the Final Acts of the World Administrative Radio Conference, Geneva, 1979*, *supra* note 24, at 2359, ¶ 14.

317. *Id.* at 2370 (bracketed language in original). This FCC definition, like the ITU definition, included a footnote referencing Resolution 68 of the Radio Regulations, which pointed out that “Harmful Interference” and other terms were also defined in Annex 2 to the INTERNATIONAL TELECOMMUNICATION CONVENTION (Malaga-Torremolinos, 1973), which was re-examined at the next Plenipotentiary Conference.

318. 47 C.F.R. § 1.2(c) (2023); *compare* discussion IV.A.3 regarding “U.S. Domestic Implementation of Atlantic City International Radio Regulations.”

where “harmful” did not already modify “interference” in the existing regulations.³¹⁹

CONCLUSION

The previously untold history of “harmful interference” and related terminology used in the regulation of radio frequency communications reveals two different eras. During the first era (from the early 1900s to the late 1940s, or pre-World War II), interference concepts were not specifically defined in any way. The second era (post-World War II, from 1947 through the 1980s) was the period in which specific definitions were developed within small groups of technical experts at international radio conferences without much attention or controversy. Then, domestic regulators in the U.S. adopted the terminology without much, if any, deliberation or thought.

Reviewing the pre-war “undefined” era and the regulatory context, before the drastic changes in the international regulatory regime for radio, reveals what it could be like if the post-war definitions are eliminated (or ignored). Early regulators were concerned about impeding the development of a new and innovative technology, but their undefined terminology may have led to regulatory and operational uncertainty. This lack of clarity, along with a world war, contributed to a complete breakdown of the international regulatory system for radio communications.

On the other hand, careful study of the original purposes, context, and usage of these regulatory terms of art – to the extent they can be discerned by the historical record during the second era – may shed some light on the modern-day critiques of the longstanding vocabulary and the terminology’s regulatory definitions. Follow-up research efforts could explore the historical interpretations and applications of these interference concepts, from a technical/engineering perspective, by the ITU’s former IFRB and the current Radio Regulations Board.

From a legal perspective, the flexible definition of “harmful interference,” on its face, is not as bad as some critics suggest, so long as disputants know how to plead and present evidence on each of the elements of the definition similar to how lawyers must plead, argue, prove and defend against antitrust, negligence, trespass, nuisance, or similar criminal and civil causes of action.³²⁰ For

319. See, e.g., *Implementation of the Final Acts of the World Administrative Radio Conference, Geneva, 1979*, *supra* note 24, at 2445, § 2.106 n.NG129.

320. See Tenhula, *supra* note 3, at 8 (“A key component will also be a good reporting/digest system so that precedents and trends can be more easily researched,

example, one apparently overlooked element in the development (and plain language) of the longstanding definition of “harmful interference” is the “conformity” requirement identified by David Leive:

Interference is not harmful under the Regulations if the station which suffers such interference is not itself in conformity with the Regulations. . . Accordingly, whether harmful interference has occurred in any particular case is a legal as well as a technical question.”³²¹

The legal component of this question would potentially constitute a threshold issue (or an affirmative defense) in every alleged instance of harmful interference. Indeed, the FCC’s rules now (and since 1983) require the victim operations to be in conformity with the ITU or FCC regulations, or both, before a claim of harmful interference can be successfully asserted.³²² Similarly, the alleged interferer could assert as a defense that the complainant was not technically or legally operating in accordance with the applicable regulations.

Another observation from this historical overview is the general frustration with the definition’s qualitative nature and demands for more quantitative approaches to assessing when interference is harmful and when it is not. As we have shown above, this led (at the 1979 WARC) to new, intermediate “levels” of interference, which by their actual terms are limited to international coordination situations among countries.³²³ Since then, U.S. regulators have seemed generally content with the terminology itself but have considered other ways to deal with ongoing frustrations.

In 2002, the FCC’s Spectrum Policy Task Force defended the Commission’s “flexible” harmful interference “standard,” but recommended that the FCC consider using quantitative metrics to

understood and tracked.”); *see also* Margie, *supra* note 3, at 11 (“The [harmful interference] standard recognizes that it is difficult to quantify exactly how much interference is too much for a particular case [and] allows the FCC the flexibility to know interference when it sees it . . . much like the flexibility of the antitrust standard and the obscenity standard”); Goodman, *supra* note 270, at 330 (explaining how common law in the spectrum context will rely primarily on a balancing approach typical of nuisance); LYALL, *supra* note 270, at 28.

321. Leive 1970, *supra* note 204, at 23; *see also* NAT’L ACAD. OF SCI., ENGG & MED, *supra* note 11, at 2 and 35.

322. For complaints alleging harmful interference by devices regulated under Parts 15 and 18 of the FCC’s current rules, this threshold question would assess the victim’s conformance with any rule contained in Chapter I of Title 47 of the Code of Federal Regulations. *See, e.g.*, 47 C.F.R. §§ 15.3(m) & 18.107(b) (2023).

323. *See supra* notes 7, 304 & 315.

augment and clarify the application of the existing definition.³²⁴ Similarly, in a 2009 Notice of Inquiry, the FCC said its challenge in applying interference criteria “often devolves to a case-by-case interpretation of conflicting data,” noting as follows:

The definition [of “harmful interference”] provides no quantitative guidance on what degree of signal degradation or how many interruptions over what period of time would meet the “harmful” threshold. Moreover, there are other factors that have a strong bearing on this determination, such as the nature and purpose of the communications (*e.g.*, voice, video, data, entertainment, public safety, *etc.*) that must be taken into account.³²⁵

More recently, in a non-binding Policy Statement, the Commission set forth its “expectations” that proponents of a harmful interference claim should, among other things, “supply sufficiently complete, transparent, and reproducible quantitative analytical models of the interactions between radio services, with respect to transmitter and receiver performance characteristics and the RF environment.”³²⁶

The FCC staff or other researchers might look back at the studies and struggles of the ITU’s IFRB and CCIR in addressing these kinds of technical questions. Exploration of the history and evolution of standardized “technical” definitions developed over the decades by the Institute of Radio Engineers (IRE) and IEEE could also shed light on the relative lack of devotion to the legal/regulatory definitions chronicled in this article.³²⁷ Finally,

324. See SPECTRUM POLICY TASK FORCE REPORT, *supra* note 3, at 26 (“On balance, the Task Force concludes that the current general definitions of interference sufficiently address the broad operational and technical characteristics of the many communications services contained in the Commission’s Rules.”). The Task Force recommended an “interference temperature” metric to establish maximum permissible levels of interference and characterizing the “worst case” environment in which a radio receiver would be expected to operate. *Id.* at 27-30; see also *Establishment of an Interference Temperature Metric to Quantify and Manage Interference and to Expand Available Unlicensed Operation in Certain Fixed, Mobile and Satellite Frequency Bands*, Notice of Inquiry, ET Docket No. 03-237, 18 FCC Rcd 25309 (2003), *proceeding terminated*, Order, 22 FCC Rcd 8938 (2007).

325. *Fostering Innovation and Investment in the Wireless Communications Market*, Notice of Inquiry, GN Docket No. 09-157, 24 FCC Rcd 11322, 11332 n. 32 (2009).

326. *Principles for Promoting Efficient Use of Spectrum and Opportunities for New Services*, Policy Statement, 38 FCC Rcd 3682, 3693 (Apr. 2023). In a footnote to this Policy Statement, the FCC said that it generally used terms such as “emissions,” “unwanted emissions,” “interference,” and “harmful interference” as they are defined in existing regulations “and are applied in [FCC] decisions.” *Id.* at 3686 n. 19 (*citing* 47 C.F.R. § 2.1, but no “decisions”).

327. See, *e.g.*, Hagn, *supra* note 12.

while only addressed briefly herein, the principal *ex ante* approach to preventing harmful interference since the 1920s, internationally and domestically, has been the Table of Frequency Allocations. The detailed history of this approach, and its effectiveness, deserves more attention by researchers as well.