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The Concept of Interference in Telecommunications, Outer Space and Cyber Activities

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The avoidance of harmful interference is one of the central principles of radio communications. In radio communications, ‘interference’ has a distinct technical and physical meaning. In everyday language however, the meaning of ‘interference’ is broad. It is used to express “to conflict in such a way as to hinder something”.¹ The development of information and computer technology and its interdependencies with space technology and communications have created an environment, where the term ‘interference’ can have different meanings. Clear distinctions are desirable for a precise application of the concept of interference in telecommunications, outer space and cyber activities respectively.

A. Radio Communications

Article 45(1) of the ITU Constitution² about harmful interference in radio communications stipulates:

“All stations, whatever their purpose, must be established and operated in such a manner as not to cause harmful interference to the radio services or communications of other Member States or of recognized operating agencies, or of other duly authorized operating agencies which carry on a radio service, and which operate in accordance with the provisions of the Radio Regulations.”

The purpose of this rule is to allow the use of the electromagnetic spectrum for wireless communications efficiently and without disturbance. It takes into account the physical properties of electromagnetic wave propagation. Electromagnetic waves

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1 The new Lexicon, Webster’s Dictionary of the English language, Lexicon Publications, New York, 1987.

2 Constitution of the International Telecommunication Union, adopted by the 2018 Plenipotentiary Conference, Collection of the Basic Texts of the International Telecommunication Union adopted by the Plenipotentiary Conference, edition of 2019, https://www.itu.int/dms_pub/itu-s/opb/conf/S-CONF-PLN-2019-PDF-E.pdf, last accessed 21 October 2022.

emitted from multiple sources can physically interact and result in the attenuation,³ amplification, and distortion of each other. Radio transmitters use carrier waves of a determined frequency. If another radio transmitter transmits on the same frequency within the range of the first one, said effects will occur. Not only the carrier wave is then affected, but also the information signal it carries, like voice and data.⁴ In radio communications, interference describes a physical phenomenon.

1. The Nature of Interference in Radio Communications

The concept of harmful interference applies only to radio telecommunications, not to wired (voice and data) telecommunications. This follows from Article 45 ITU of the Constitution which is part of Chapter VII entitled ‘special provisions for radio’. Article 1.166 of the Radio Regulations⁵ adds additional clarification to the concept of radio interference. It links interference to the property of electromagnetic waves as to radiate and interact like energy:

“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.”

This definition clarifies that interference is an effect between at least two different sources of emissions, radiations or inductions. One radio transmitter emits ‘wanted’ energy; another is an ‘unwanted’ source of energy which effects the first. To qualify as interference, the effect of the unwanted energy must impact the receiver of a radiocommunication system. This depends not only on the strength of the ‘unwanted’ energy, but also on the distance to the receiver. Radiated energy decreases with the distance travelled.⁶ A radio receiver is not adversely affected, when the source of ‘unwanted’ energy is so far away that its interference with the ‘wanted’ energy does not lead to degradation, misinterpretation, or loss of information. Interference is thus

3 Up to neutralization.

4 Information signals (of a lower frequency than the carrier wave) are embedded in the carrier wave by modulation. Analogue modulation techniques date back to radio broadcasting in the early 20th century.

5 ITU Radio Regulations, edition of 2020, in English: <https://www.itu.int/pub/R-REG-RR-2020>, last accessed 21 October 2022.

6 By law of physics, radiation energy decreases inversely proportionally to the square of the distance travelled: $1/r^2$.

measured at the affected receiver, not at the source of ‘unwanted’ energy. A source of ‘unwanted’ energy may harmfully interfere with one receiving station, while it does not with another one in a greater distance. A source of emission can therefore not be qualified as harmful interference in absolute terms, but only in a spatial relation to the affected receiver.

2. The Severity of Interference in Radio Telecommunications

Not every interference in radio telecommunications is harmful. It depends on the severity of the interference measured as an impact on the receiving station. For that reason, the ITU Radio Regulations recognize ‘permissible interference’ in Article 1.167 as:

“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.”

The permissible level of interference and related parameters are determined in the ITU Radio Regulations dependent on the radio service.⁷ Moreover, two or more national administrations may agree to accept a higher level of interference than defined as permissible interference, without prejudice to other administrations.⁸ Interference is harmful when it exceeds the levels of permissible and acceptable interference, and its severity meets the requirement of Article 1.169 of the Radio Regulations:

“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.”

The requirement of this rule is based on the impact of the affected (receiving) radio service. In radio communication services, the interference must result in a serious degradation, obstruction, or repeated interruption. The threshold for harmful interference is lower in radio navigation or safety services, where it is already reached when the functioning of such services is ‘endangered’.

7 Articles 21, 22 Radio Regulations.

8 Article 1.168 Radio Regulations.

The principle of avoidance of harmful interference is to mitigate a physical limitation that stems from the nature of radio communications, when interference energy surpasses permissible and acceptable levels and harmfully affects a radio service.

Interference can result from applying too high transmission power, transmitting on a wrong frequency, inadequate antenna orientation and, more generally, from non-compliance with the allocation of services, with the allotment to areas or assignments to stations.⁹ ‘Unwanted’ energy may also originate from electromagnetic applications, other than radio telecommunication transmitters, for example from electromagnetic engines and electrical induction coils.

3. The Legal Consequence of Harmful Interference

The legal consequences related to harmful interference take two different paths, depending on whether it is to be avoided *ex ante*, or which legal consequences follow *ex post* after harmful interference was caused.

In several instances, the *ex ante* rules are written as hard obligations. Article 45(1) of the ITU Constitution requires that “[a]ll stations [...] must be established and operated in such a manner as not to cause harmful interference[...]”. Moreover, under Article 15.1 of the Radio Regulations:

“All stations are forbidden to carry out unnecessary transmissions, or the transmission of superfluous signals, or the transmission of false or misleading signals, or the transmission of signals without identification ...”.

The wording of the *ex post* regime is softer. In accordance with Article 36 of the ITU Constitution:

“Member States accept no responsibility towards users of the international telecommunication services, particularly as regards claims for damages.”

ITU shall in particular “coordinate efforts to eliminate harmful interference between radio stations of different countries”.¹⁰ A detailed coordination procedure is defined in

9 For definitions of allocation, allotment and assignment see Articles 1.16, 1.17, 1.18, 5.1 Radio Regulations.

10 Art. 1, 2.b. ITU Constitution.

Article 15 of the ITU Radio Regulations. It indicates that harmful interference is not really considered a violation of an immutable obligation, when it reads:

“It is essential that Member States exercise the utmost goodwill and mutual assistance in the application of the provisions of Article 45 of the Constitution and of this Section to the settlement of problems of harmful interference.”¹¹

Article 15 of the Radio Regulations neither mentions binding obligations for remediation nor liability for resulting damage in the relationship among ITU Member States.

4. Jamming

In many cases, harmful interference results from non-deliberate actions. However, there can be reasons for intentional interference. It can be used to suppress radio signals, which are not desired. Intentional interference is undertaken by emitting electromagnetic energy on the same frequency as the carrier wave of the non-desired station to distort or fully suppress it. Intentional interference is also called ‘jamming’, albeit this term is not used in the ITU Radio Regulations. Reasons for jamming are manifold. They range from ideological reasons to hinder the spread of broadcast information of another State or ideological group to military reasons of suppressing radio communication, navigation and surveillance (radar) services of an adversary.

ITU does not distinguish between non-deliberate and deliberate harmful interference. Within the framework of ITU, jamming thus falls under harmful interference, when it takes effect in another State by exceeding the levels defined in the Radio Regulations. By definition of Article 45 ITU Constitution, harmful interference and the associated coordination procedure is limited to cases when the effect of jamming takes effect in another State. When a foreign broadcast station is jammed within national borders without exceeding the critical level of harmful interference (as defined in the Radio Regulations) in another State, it does not fall under the Article 45 regime. Attempts failed, to ban politically and ideologically motivated jamming of foreign broadcast stations under considerations of freedom of information.¹² Without prejudice to

11 Art. 15.22 § 14 ITU Radio Regulations.

12 *Price*, Jamming and the Law of International Communications, 5 Michigan Journal of International Law (1984), 391.

the freedom of information,¹³ the ITU Constitution is not the proper instrument to safeguard or enforce the freedom of information. The regime of telecommunications established through the ITU Constitution concerns “any transmission, emission or reception of signs, signals, writings, images and sounds or intelligence of any nature by wire, radio, optical or other electromagnetic systems”¹⁴, but not the information transmitted. The procedure in a case of harmful interference of Article 15 ITU Radio Regulations likewise mentions only the technical parameters of the radio transmission, not the information content:

“In the settlement of these problems, due consideration shall be given to all factors involved, including the relevant technical and operating factors, such as: adjustment of frequencies, characteristics of transmitting and receiving antennas, time sharing, change of channels within multichannel transmissions”¹⁵

With the increasing importance of cellular networks, local jamming for safety and security reasons has become common practice, for example in governmental facilities, to prevent cellular telephone and internet access. These types of jamming usually do not span across borders and Article 45 of the ITU Constitution is thus not applicable. To the contrary, national authorities may exercise or authorize this type of jamming based on their national powers to stop communications in accordance with Article 34(2) of the ITU Constitution:

“Member States [...] reserve the right to cut off, in accordance with their national law, any [...] private telecommunications which may appear dangerous to the security of the State or contrary to its laws, to public order or to decency”

This provision is not limited to wired communications and applies likewise to jamming. In said cases, jamming can be qualified as permissible radio interference based on Article 34(2) of the ITU Constitution. The same applies to jamming of navigation signals of Global Navigation Satellite Systems in peace time, provided the jamming is limited to the own territory of the State emitting the interfering signal.

13 Most notably enshrined in Art. 19 of the Universal Declaration of Human Rights (UDHR), UNGA Res. 217 A, 10 December 1948. Note Art. 29 UDHR which limits Art. 19 UDHR.

14 Definition of telecommunication in Art. 1.3 Radio Regulations.

15 Art. 15.23 Radio Regulations.

B. Outer Space

The concept of harmful interference is also used for space activities, but its meaning is by far not as precise as in telecommunications.

1. Article IX of the Outer Space Treaty

Article IX of the Outer Space Treaty (OST)¹⁶ uses the term ‘harmful interference’ twice. In both instances it relates to a consultation procedure among the parties to the treaty. Article IX OST (indicating each sentence) reads:

Sentence one: “In the exploration and use of outer space [...] States Parties to the Treaty shall be guided by the principle of co-operation and mutual assistance and shall conduct all their activities in outer space [...] with due regard to the corresponding interests of all other States Parties to the Treaty.”

Sentence two: “States Parties to the Treaty shall pursue studies of outer space [...] and conduct exploration of them so as to avoid their harmful contamination and also adverse changes in the environment of the Earth resulting from the introduction of extraterrestrial matter and, where necessary, shall adopt appropriate measures for this purpose.”

Sentences three and four: “If a State Party to the Treaty has reason to believe that an activity or experiment planned by it or its nationals in outer space [...] would cause potentially harmful interference with activities of other States Parties in the peaceful exploration and use of outer space [...] it shall undertake appropriate international consultations before proceeding with any such activity or experiment. A State Party to the Treaty which has reason to believe that an activity or experiment planned by another State Party in outer space [...] would cause potentially harmful interference with activities in the peaceful exploration and use of outer space [...] may request consultation concerning the activity or experiment.”

The third and fourth sentences mention ‘harmful interference’. They must be read in the context of the preceding two sentences. Only a potential violation of the principles embodied in the first or second sentence gives rise to the consultation procedures as ‘harmful interference’. The consultation procedures of sentences three and four apply

¹⁶ Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies, 1967, 610 U.N.T.S. 205.

“as the method of enforcing the obligations stated in the first two sentences.”¹⁷ This requires a closer look at the principles contained in the first and second sentence.

The second sentence of Article IX is the central provision of the OST for environmental protection. Cases of harmful contamination of outer space and/or adverse changes in the environment of the Earth, as mentioned in this second sentence, hence qualify as harmful interference.

However, the context of the first sentence allows a broader interpretation of ‘harmful interference’, namely as conducting space activities without due regard to the corresponding interests of other States. What means ‘due regard’ to the corresponding interests of other States? The meaning is broad and vague. Interests are not rights. Corresponding interests imply that all States which undertake space activities have the same interests in exercising exploration and use of outer space, on a basis of equality. But the substance of these interests is not defined in the first sentence. It can reasonably be argued that radio communications with space objects falls under these interests. The words ‘due regard’ are to be read as a qualifier like a “consideration in a degree appropriate to demands of the particular case”.¹⁸ While the breadth of this concept of ‘due regard’ for the other’s interests permits to apply it broadly, its vagueness strongly limits its effectiveness.

Interesting to note, section 6 of the Declaration of Legal Principles Governing the Activities of States in the Exploration and Use of Outer Space,¹⁹ the precursor to the Outer Space Treaty, uses similar wording as Article IX OST, except that the second sentence about environmental protection is missing. In said Declaration, the meaning of interference was thus stronger focused on the non-observance of due regard to the other States’ corresponding interest, while literature today links Article IX OST primarily to environmental protection.²⁰

17 *Dembling*, Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space Including the Moon and Other Celestial Bodies, p. 1, 21, in: *Jasentuliyana* (ed.), Manual on Space Law, Vol. I, Oceana Publications, 1979.

18 *Black*, Black’s Law Dictionary, St. Paul Minn. West Publishing, abridged 6th ed., 1991.

19 UNGA Res. 1962 (XVIII), 13 December 1963.

20 See for example, *Hobe*, Space Law, Baden-Baden, 2019, p. 88–90, *Diederiks-Verschoor/Kopal*, An Introduction to Space Law, Austin/Boston, 3. ed, 2008, p. 29-30, *Marchisio*, Article IX, in: *Hobe/Schmidt-Tedd/Schroegel* (eds.), Cologne Commentary on Space Law, Vol. 1, Cologne, 2009.

The legal effect of non-observance of the due regard principle, which can also be called harmful interference, is a consultation procedure. Its legal effect is not that of a breach of hard treaty law. It does not lead to sanctions or liabilities. Like harmful interference in international radio communications, harmful interference of Article IX OST leads to a consultation procedure among affected States.

2. Radio Communications and Outer Space

The consultation following interference under Article IX OST can in theory be applied to include harmful interference to radio communications in outer space. However, the ITU rules are *lex specialis*, and the related Radio Regulations define more precisely the parameters and the permissible level of interference than Article IX OST.

The structure of the ITU Constitution clearly shows that the concept of harmful interference in accordance with its Article 45 applies to space radio telecommunications like to any other radio communication service. Chapter VII of the ITU Constitution entitled ‘Special Provisions for Radio’ encompasses both, Article 44 on the ‘Use of the Radio-Frequency Spectrum and of the Geostationary-Satellite and Other Satellite Orbits’ and Article 45 on ‘Harmful Interference’. The related Radio Regulations address more specifically terrestrial and space services sharing frequency bands above 1 GHz,²¹ space services²² and radio services related to earth observation.²³ Article 22 of the Radio Regulations for radio communication space services contain detailed requirements for the avoidance of harmful interference.²⁴ This level of detail of the ITU regime constitutes a practically workable instrument for the avoidance of harmful interference – and the coordination procedure following such events – which is by far more precise than the vague concept of due regard for the interests of States in Article IX OST.

21 Article 21 Radio Regulations.

22 Article 22 Radio Regulations.

23 Article 29A Radio Regulations.

24 Sections of Article 22 Radio Regulations address cessation of emissions, control of interference to geostationary-satellite systems, station keeping of space stations, pointing accuracy of antennas on geostationary satellites, radio astronomy in the shielded zone of the Moon, off-axis power limits on earth stations of a geostationary-satellite network in the fixed-satellite service, limits to the interference into the frequency band 14.5-14.8 GHz by the fixed-satellite service (Earth-to-space) not for feeder links for the broadcasting satellite service.

C. Cyber Activities

Cyber activities concern information in digital format which is processed and stored in computers.²⁵

Cyber activities require an interaction between at least two computers connected through a network. The network must be capable of transmitting information in a digital format, for example the internet or a Local Area Network (LAN).²⁶ Cyber activities are prompted by cyber means; they are routed from one computer to another through networks operating with standardized transmission protocols²⁷ by applying digital information²⁸ that can be processed by the destination computer.

1. Unauthorized and Malicious Cyber Activities

Unauthorized cyber activities can take different forms. Typically, a first step is to gain non-authorized access to the target computer through a network. Software tools can be used to defeat technical security measures of the target computer, like password protections and firewalls. With (non-authorized) access to the target computer, a perpetrator can:

- Compromise the protection and privacy of information, like personal data or commercial and industrial information, including intellectual property.
- Manipulate, erase, misuse or deny access to information on the target computer.
- Manipulate or disable functionalities of the target computer.
- Take over control, disable control, or destroy physical applications which are intended to be controlled by the target computer, for example critical

25 Computers process digital information with (hardware) micro processors (typically called Central Processing Units - CPU) and keep digital information in (hardware) short-term memories and longer-term storage based on (software) programmable instruction sets.

26 Access can also be established through digital wireless short distance data links like Bluetooth.

27 For the internet: Internet Protocol version 6 (IPv6) or the older version IPv4. These internet protocols are based on the 1981 Defense Advanced Research Projects Agency (DARPA) Internet Protocol Specification, prepared by the Information Sciences Institute of the University of Southern California, <https://www.rfc-editor.org/rfc/rfc791>; the latest version of IPv6 is based on rfc8200 of the Internet Engineering Task Force (IETF), <https://www.rfc-editor.org/rfc/rfc8200>. For Local Area Networks: Institute of Electrical and Electronics Engineers Ethernet standard IEEE 802.3.

28 Including software.

infrastructures,²⁹ medical and life support applications, commercial, industrial and private/domestic applications.

The term of ‘malicious cyber activity’ is typically used for unauthorized cyber activities undertaken deliberately with an intent to harm the target.

2. The Role of Internet Protocol Based Networks

Cyber activities depend on networks capable of exchanging digital information among computers. They are commonly referred to as ‘Internet Protocol-based networks’ or short ‘IP-based networks’. On one hand, IP-based networks are part of the telecommunication infrastructure, on the other they consist of hardware elements with computer technology,³⁰ like web servers and routers.³¹ As part of the telecommunications infrastructure, IP-based networks include wired and wireless terrestrial networks, wired submarine connections and wireless satellite links.³² Their computer elements are nonetheless prone to the vulnerabilities of unauthorized cyber activities.

3. Cyber Activities and Telecommunications

Like radio communications in general, also wireless elements of IP-based wireless networks can be subject to harmful radio interference. In this event, Article 45 of the ITU Constitution and related Radio Regulations apply. However, this harmful radio interference must be distinguished from unauthorized or malicious cyber activities. As defined by Article 1.166 of the Radio Regulations, radio interference is an effect of unwanted energy upon reception in a radiocommunication system. An energy emission from another transmitter than the intended signal emission disturbs or extinguishes the latter by a physical effect rooted in electromagnetic wave propagation. The

29 Critical infrastructures are not limited to the telecommunication infrastructure but include physical infrastructures which are computer-controlled through networks, like energy, water, traffic. See also the definition of Article 2 (a) of Council Directive 2008/114/EC of 8 December 2008 on the identification and designation of European critical infrastructure and the assessment of the need to improve their protection.

30 *Supra* footnote 25.

31 Web-servers and routers have distinct internet protocol addresses like the connected computers of end-users.

32 Today’s wired connections are based on copper cables for electrical signals or on fibres for optical transmissions. Wireless radio transmissions are used for terrestrial trunk routes, satellite links and wireless area networks like cellular telephone networks, Wireless Local Area Networks (WLAN) and other forms of wireless internet service provision.

resulting effect of harmful radio interference on a radio link of an IP-based network is an interruption of this connection, like an interruption of the physical network infrastructure, for example when a cable connection is physically ruptured. The physics of this effect is fundamentally different to an unauthorized or malicious cyber activity, which is prompted through a functioning network and uses digital information, especially software tools, with a harmful effect on data residing in a computer, or on the proper functioning of the computer, or on control functions for physical applications the target computer is intended to execute.

The same applies in case of a denial of service (DoS) event, by which a targeted computer or network shuts down as the result of a high volume of messages that surpasses the capacity of the target and is sent through the IP-based network. The effect of DoS is similar to that of harmful radio interference of a radio communication link which is part of an IP-based network: the service is interrupted. Nevertheless, a DoS event does not qualify as harmful radio interference in the meaning of Article 45 of the ITU Constitution, because it is not caused by the emission of energy that interferes with the communication link from outside.

In short: harmful radio interference disturbs a wireless communication link from the outside, whereas unauthorized or malicious cyber activities harm digital information or computers, through a functioning digital data network or link. Why is this distinction important? Because unauthorized or malicious cyber activities do not qualify as radio interference as defined in Article 1.166 of the Radio Regulations. Cyber activities are prompted by cyber means; they are transmitted through networks or data links, but do not disrupt networks and data links from the outside by external emitters of electromagnetic energy. Harmful radio interference can disrupt network access, but not compromise the privacy of data, nor manipulate and erase data, nor take control of physical applications (other than disrupting control).

Recognizing that the rules relating to cyber activities are a new field, where terminology is not fully established and still inconsistent, a clear terminology should be used to distinguish radio interference from unauthorized cyber activities. While (harmful) radio interference is an established term under Article 45 of the ITU Constitution, unauthorized or malicious cyber activities must be distinguishable. The term 'cyber interference' may linguistically provide a certain level of distinction to 'radio interfer-

ence’ or ‘harmful interference’, but for avoidance of ambiguity should better not be used for unauthorized or malicious cyber activities.

4. ITU’s Approach

Within ITU’s purpose to maintain and extend international cooperation among its Member States for an improved and rational use of telecommunications,³³ IP-based telecommunication networks pose new challenges for ITU in comparison to older (analogue) data networks. IP-based networks comprise software programmable hardware elements based on computer technology which themselves can be subject of unauthorized or malicious cyber activities. From a high-level perspective, ITU approaches these issues in the context of the global information economy and society, based on Article 1(1) g) of the ITU Constitution:

“The purposes of the Union are [...] to promote [...] the adoption of a broader approach to the issues of telecommunications in the global information economy and society, by cooperating with other [...] organizations concerned with telecommunications.”

From this high-level base line, internet related issues can easily be addressed, for example through Resolution 3 (Dubai, 2012),³⁴ which recognizes in b):

“[...] that the Internet is a central element of the infrastructure of the information society, which has evolved from a research and academic facility into a global facility available to the public”.

Though Article 1(1) g) of the ITU Constitution is broad enough to include issues of IP-based networks, like malfunctions through unauthorized cyber activities, matters of society and information³⁵ reach beyond ITU’s role. By cooperating with other organizations involved in society matters and information (content), common definitions and approaches have the potential of blurring the telecommunications perspective. As *Lyall and Larsen*³⁶ note:

33 Article 1(1) a) of the ITU Constitution.

34 Resolution 3 to foster an enabling environment for the greater growth of the Internet, World Conference on International Telecommunications, Dubai, 2012.

35 Information content transmitted by means of telecommunications.

36 *Lyall/Larsen, Space Law, A Treatise*, London/New York, 2nd ed. 2018, pp. 223, 224.

“In its conception and for decades in its operation the ITU was dedicated to technical matters. The content of what passed through the telecommunication connexions that it facilitated was not part of its remit. To an extent that detachment is disappearing. [...] [the Internet] is an area within which the work of the ITU in its technical aspect can be affected – arguably unnecessarily, and perhaps to its detriment – as attempts are made to recruit its organs to an objective irrelevant to its major functions.”

Broad definitions and approaches may be all embracing, but they tend to lack the focus required for regulating specific technical elements. ITU’s definitions of (harmful) interference in the Radio Regulations are a good example of precisely defined parameters. IP-based networks raise new technical issues.³⁷

A general provision about telecommunication networks can be found in ITU’s International Telecommunications Regulations (ITR).³⁸ The ITRs are not limited to radio communications. Article 6.1 ITR about the security and robustness of networks uses the term of ‘avoidance of technical harm’:

“Member States shall individually and collectively endeavour to ensure the security and robustness of international telecommunication networks in order to achieve effective use thereof and avoidance of technical harm thereto, as well as the harmonious development of international telecommunication services offered to the public.”

‘Avoidance of technical harm’ is a broad concept. It covers unauthorized and malicious cyber activities against networks, harmful interference affecting wireless networks, physical actions against components of the physical infrastructure of networks, power outages that lead to network stoppages and other harmful events. Yet, for unauthorized cyber activities we should have more precise instruments. A possible approach

37 See also Resolution 101 (rev. Dubai, 2018) on ‘Internet Protocol-based networks’, which is not specific about unauthorized cyber activities against such networks.

38 International Telecommunications Regulations (ITR), WCIT Dubai 2012.

could be the concept of cyber security. Unfortunately, ITU's definition of cyber security³⁹ lacks sharpness:

“Cybersecurity is the collection of tools, policies, security concepts, security safeguards, guidelines, risk management approaches, actions, training, best practices, assurance and technologies that can be used to protect the cyber environment and organization and user's assets. Organization and user's assets include connected computing devices, personnel, infrastructure, applications, services, telecommunications systems, and the totality of transmitted and/or stored information in the cyber environment. Cybersecurity strives to ensure the attainment and maintenance of the security properties of the organization and user's assets against relevant security risks in the cyber environment. The general security objectives comprise the following: Availability[,] Integrity, which may include authenticity and non-repudiation[,] Confidentiality”.

This definition mentions ‘cyber environment’ three times but does not explain what it means. It does not define the nature of the causes against which protection is sought; it fails to define cyber security as the protection against activities undertaken by cyber means. As a result, there is no distinction between cyber security and physical security. The definition is too broad for identifying cyber activities, because it includes physical actions against networks and computers, like destruction, theft, physical disconnection from power or networks. Furthermore, it is not clear if this definition covers the unauthorized control of physical applications through computers and networks.

D. Conclusions

The concept of avoidance of harmful interference in radio communications is well established and defined in Article 45 of the ITU Constitution and related Radio Regulations. Radio interference is a physical effect among electromagnetic waves that can lead to the distortion or loss of the transmitted information. The Radio Regulations contain detailed provisions on the permissible, acceptable and harmful levels of radio interference and it establishes comprehensive technical parameters for the avoidance of radio interference, also for space radio communication services. The purpose of

39 ITU-T X.1205; Resolution 181 (Guadalajara, 2010) Definitions and terminology relating to building confidence and security in the use of information and communication technologies, <https://www.itu.int/en/council/Documents/basic-texts/RES-181-E.pdf>, last accessed 21 October 2022.

these regulations is to warrant radio services free from the effect of unwanted energy, which means free from harmful radio interference.

Article IX OST likewise uses the term 'harmful interference', but its origin is not rooted in the physical property of electromagnetic waves. Under Article IX OST an activity which potentially causes harmful interference leads to a consultation procedure. This consultation for harmful interference follows cases of potential (environmental) harmful contamination or the non-observance of 'due regard' to the corresponding interests of other States. While literature today links Article IX OST mainly to environmental protection, the non-observance of 'due regard' can possibly be applied to a broader range of cases, also to harmful interference of radio space services. However, Article 45 OST and the Radio Regulations that relate to radio space services are *lex specialis* and provide by far more precise technical parameters than the broad wording of Article IX OST.

Cyber activities add another level of complexity to communications. Cyber activities are prompted by cyber means, as they are routed from one computer to another through IP-based networks. Unauthorized cyber activities target computers and can compromise the protection of information, manipulate, erase or misuse information, disable the target computer, or manipulate control functions of physical applications. IP-based networks play a crucial role in cyber activities: they are part of the telecommunications infrastructure; at the same time, they are composed of devices with computer technology. As far as IP-based networks comprise wireless data transmissions, they can be subject to harmful radio interference in the meaning of Article 45 ITU Constitution. Independent thereof, their computerized network devices can be subject of unauthorized cyber activities. In an effort of advancing regulation about unauthorized cyber activities against IP-based networks, ITU has adopted a broader approach to the issues of telecommunications in the global information economy and society. This approach runs the risk of blurring technical aspects of transmission through an IP-based network with the content of information that is routed through it. Cyber security can be an approach to capture unauthorized cyber activities against IP-based networks. Unfortunately, ITU's definition of cyber security lacks sharpness and does not clearly distinguish cyber security from physical security. In any way, unauthorized cyber activities are not a result of the physical properties of interacting electromagnetic waves and therefore need to be distinguished from harmful radio interference.