The International Amateur Radio Union
Since 1925, the Federation of National Amateur Radio Societies
Representing the Interests of Two-Way Amateur Radio Communication

CONTROLLING SPACE STATION TRANSMITTERS[1]

Every space station transmitter must be capable of being turned off quickly by telecommand [remote control]. Good engineering practice requires that this system function independently of all other systems.

I. Why?

1. Enlightened self-interest. If another station causes interference to your operation, you would want it turned off. Quickly, too.

Reciprocity applies. So, if your station causes interference to another, they will want you to turn off the offending transmitter reasonably quickly.

2. International treaty law. Enlightened self-interest is the basis for the treaty concerning the use of radio worldwide: the International Telecommunication Convention, including the radio regulations (RR), which form a part of the treaty.

> **RR 22.1** *Space stations shall be fitted with devices to ensure immediate cessation of their radio emissions by telecommand, whenever such cessation is required under the provisions of these Regulations.*

The amateur-satellite service[2] includes an additional requirement.

> **RR 25.11** *Administrations[3] authorising space stations in the amateur-satellite*

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[1] RR 1.143 *Station:* One or more transmitters and receivers or a combination of transmitters and receivers, including the accessory equipment, necessary at one location for carrying on a radiocommunication service, or the radio astronomy service. Each station shall be classified by the service in which it operates permanently or temporarily.
RR 1.164 *Space Station:* A station located on an object which is beyond, is intended to go beyond, or has been beyond, the major portion of the Earth's atmosphere.

[2] RR 1.56 *amateur service*: A radiocommunication service for the purpose of self-training, intercommunication and technical investigations carried out by amateurs, that is, by duly authorized persons interested in radio technique solely with a personal aim and without pecuniary interest.
RR 1.57 *amateur-satellite service:* A radiocommunication service using space stations on earth satellites for the same purposes as those of the amateur service.

[3] RR 1.2 *administration:* Any governmental department or service responsible for discharging the obligations undertaken in the Constitution of the International Telecommunication Union, in the Convention of the International Telecommunication Union and in the Administrative Regulations (CS 1002). For a complete list of ITU Member States and Administrations, see: http://www.itu.int/cgi-bin/htsh/mm/scripts/mm.list?_search=ITUstates&_languageid=1

*service shall ensure that sufficient Earth command stations are established before launch to insure that any harmful interference caused by emissions from a station in the amateur-satellite service can be terminated immediately. (See No. **22.1**).*

NOTE: The capability to turn off a space station transmitter quickly by telecommand (remote control) is mandatory for ALL space stations in ALL radiocommunication services.

If interference caused by a space station cannot be terminated quickly, the result may lead to unforeseeable consequences, both technical and diplomatic, and by endangering life and property. Do not give anyone a reason to bring up an issue.

II. What does "immediate" mean?

Many ask for a specific time limit within which a space station must be able to be commanded off. A minute? An hour? A day? A week? The treaty text leaves us with room for interpretation. The practical answer: "It depends on the situation."

If interfering with a safety service[4], immediately probably means **NOW**, or at very least, within a few minutes.

Interference to other services should be terminated in ***no more than a few hours***.

III. How can adequate control over a space station be accomplished?

1. Use an *independent* telecommand receiver and receive frequency on the space station.

   Note A: Telecommand signals must be receivable, even when the space station is transmitting.

   Note B: Telecommand signals must be receivable, even when users or interfering signals occupy the main receiver(s).

2. Design the space station so that the capability to command the transmitter "off" works independently of the normal housekeeping or control computer. Once a "turn off" command is received and executed by the space station, a positive command from the ground should be required to re-enable the transmitter. Power reset following eclipse should ***not*** re-enable a transmitter.

3. Arrange for enough telecommand stations to keep the gaps between available satellite

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[4] **RR 1.59** *safety service:* Any radiocommunication service used permanently or temporarily for the safeguarding of human life and property.

passes reasonably short. The required locations of these telecommand station will depend on the space station orbit.

> Note A: When the space station is in a high-inclination, low-Earth orbit, try to locate telecommand stations closer to the poles (north and south). These will see the satellite more often than stations closer to the equator.
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> Note B: Keep telecommand stations far away from each other so that they will not be affected at the same time by local weather and other problems. Keeping telecommand stations far apart also increases overall satellite access time.

4. In the special case of a space station intended (1) for low Earth orbit and (2) for transmission over a small number of Earth stations, design the space station to include a transmitter time-out timer that works *independently* of and in addition to the normal housekeeping or control computer. The time limit should be set to about the length of a single pass over an Earth station so it will automatically turn off the transmitter when out of range. A positive command from an Earth telecommand station should be required to re-enable the transmitter.

> NOTE: The radio regulations explicitly require control by *telecommand*. Using a time-out timer attempts to meet the spirit of the radio regulations when a separate telecommand receiving system (the best option) cannot be accommodated. ***Acceptability of using a time-out timer should be confirmed by your administration (national radio authority).***

Part IV. Discussion and Conclusions.

The meaning of "immediate" depends on the situation. The principle of enlightened self-interest, the basis of the Convention and radio regulations, should be taken into account.

Reciprocity always applies. If you set the example of being able to respond quickly to a request to cure interference, others likely will feel obligated to respond as quickly.

Being a good neighbour in the radio spectrum serves your own best interest and adheres to international treaty law.

Always build space stations with adequate Earth station telecommand support so the space station can be turned off quickly and reliably.

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NOTE: For more information on the general subject of radio frequency planning, definitions of terms, mission planning, and more, see:

http://www.iaru.org/satellite/IARUSATSPEC_REV15.6.pdf.

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