

## Informal Working Group 6

### DRAFT PROPOSAL FOR THE WORK OF THE CONFERENCE

**Agenda item 1.38** *to consider provision of up to 6 MHz of frequency spectrum to the Earth exploration-satellite service (active) in the frequency band 420-470 MHz, in accordance with Resolution 727 (Rev.WRC-2000).*

**ISSUE** The use of the frequency band 420-470 MHz by the earth exploration-satellite service (EESS)(active) without causing interference to incumbent services, such as radiolocation and the amateur services.

#### **BACKGROUND**

A similar agenda item was debated at WRC-97 resulting in a decision not to adopt proposed allocations for EESS (active) in the band 420-470 MHz. The need for forest monitoring was emphasized at the United Nations Conference on Economic Development (UNCED) (Buenos Aires - 1992). Since that Conference, Recommendation ITU-R SA.577 established requirements for the operation of spaceborne synthetic aperture radars (SAR) at a frequency near 400 MHz to measure soil moisture, tropical biomass, Antarctic ice thickness, and for documentation of geological history and climate change. Studies performed by the EESS community have identified a minimum bandwidth requirement of up to 6 MHz to satisfy mission objectives.

As a result of studies prior to WRC-97, consideration of the potential use of the band 410-470 MHz by active spaceborne sensors was limited to 430-440 MHz due to sharing considerations with other services. Studies since WRC-97 have examined the range 420-470 MHz, and the conclusions regarding sharing with other services have been updated accordingly. A number of studies were conducted by various administrations leading to a draft revision of Draft Revised Recommendation ITU-R SA.1260, sharing criteria between active spaceborne sensors and other services in the range 420-470 MHz.

#### **Sharing with the amateur and amateur-satellite services**

In the band 430-440 MHz, amateur services have allocations on a co-primary basis in Region 1 and on a secondary basis in Regions 2 and 3 (except in countries listed in No. **5.278**, where it is primary). Further, in accordance with No. **5.282** the amateur-satellite service may operate in part of this band (435-438 MHz) subject to not causing harmful interference to other services operating in accordance with the Radio Regulations.

Studies leading to the draft revision of Recommendation ITU-R SA.1260 determined that there would likely be periods where SAR transmissions would have some impact on reception by amateur services. One study indicates that there may be the potential for significant interference during periods of visibility of some high power SAR satellites to amateur and amateur-satellite services. Another study of a low power, low sidelobe SAR indicates that for a low sensitivity, low-resolution mode the average pfd could be lower than acceptable pfd levels in the amateur services.

It appears that the SARs and the amateur services could coexist if, and only if, the technical and operational constraints given in Draft Revised Recommendation ITU-R SA.1260 are met by EESS (active). Until the characteristics of EESS SARs are more clearly defined, the amateur community remains concerned about the potential for interference to amateur operations in the band 430-440 MHz and especially in the portion of the band 435-438 MHz.

### **Sharing with radiolocation service**

Airborne, shipborne, and land-based radars operate in the frequency band 420-450 MHz. Studies prior to WRC-97 concentrated on the very large aperture antenna radar systems used for space object tracking in the band 420-450 MHz. Studies since WRC-97 have included consideration of the compatibility of spaceborne SARs with the other types of radars operating in the band 420-450 MHz.

The ITU-R has determined that there is a potential for unacceptable interference from spaceborne SARs to a limited number (around ten worldwide) of terrestrial space object tracking radars operating in the frequency band 420-450 MHz if a SAR is within line-of-sight of these radars. It has been determined that the degree of compatibility is highly dependent upon the characteristics (and associated mission) of the spaceborne SARs, and that a spaceborne SAR intended for certain missions can be designed such that the compatibility situation is considerably improved. Field-testing may be required on a case-by-case-basis to confirm compatibility with specific systems.

The ITU-R has concluded that, taking into account the SAR processing gain; the interference to SARs caused by terrestrial radars is acceptable.

Operation by geographical separation (that is, spaceborne SAR operation beyond line-of-sight to the terrestrial radars) has been studied. Observation of significant portions of the landmass in the northern hemisphere will be denied to the spaceborne sensors under such a restriction. However, it does appear that if the SARs are limited to operations beyond line-of-sight of terrestrial radars an appreciable portion of the tropical forests or Antarctic ice sheets can still be observed, which are primary missions for active sensors at these frequencies.

Studies of the compatibility of spaceborne SARs with airborne and shipborne terrestrial radars have produced results that are quite similar to those for the land-based radars: a potential for significant interference (i.e. with regard to the likelihood and duration of interference events) exists for some of the SARs studied, but that the potential is highly dependent upon the characteristics of the SARs (orbits, transmitter power, antenna sidelobe characteristics). SAR design and operation in compliance with Recommendation ITU-R SA.1260 would greatly improve compatibility.

In addition to the terrestrial radars that operate in the 420-450 MHz band as addressed in the preceding paragraphs, a radar is located in Arecibo, Puerto Rico (United States) that is used for important atmospheric research programmes. It is an upward looking radar and there is a potential for interference from a spaceborne SAR. There will be a need to coordinate operations of the spaceborne SAR and the Arecibo radar. Such coordination is feasible since schedules for operation of the radar are known several weeks in advance, as are the times that the SAR will be visible and its planned operations.

Wind profiler radars operate in the radiolocation service in the range 440-450 MHz unless compatibility cannot be achieved with existing services, in which case the bands 420-435 MHz and 438-440 MHz could be considered for use by wind profiler radars in accordance with Resolution 217 (WRC-97). Operation in separate frequency bands may be necessary for spaceborne SARs and wind profiler radars in order to preclude interference to the SARs.

### **Sharing with fixed and mobile services**

The frequency ranges 410-430 MHz and 440-470 MHz are allocated to the fixed and mobile services on a primary basis in all three Regions. The frequency range 430-440 MHz is allocated to the fixed service in over 40 countries on a primary basis, by footnotes to the Radio Regulations.

Draft new Recommendation ITU-R F. [Document 9/47] gives channel arrangements for digital radio systems operating in the frequency range 406.1-450 MHz. General guidance on the performance characteristics of FS systems in the band 420-470 MHz are available in Recommendation ITU-R [F.758 (9/131)].

The fixed service protection criteria to be applied is a Fractional Degradation of Performance (FDP) of 10% (which is equivalent to  $I/N = -10$  dB in case of permanent interference) from a primary service, and 1% FDP (equivalent to  $I/N = -20$  dB in case of permanent interference) from a secondary service. The pfd derived from this criterion should not be exceeded. Recommendation ITU-R F.758 provides the receiver thermal noise as  $-143$  dBW in a 3.5 MHz IF bandwidth.

A design of some low power, low-side lobe, spaceborne SARs has been considered that may produce power flux-densities at the surface of the Earth lower than the levels imposed in frequency bands near 400 MHz allocated to the fixed and mobile services in order to protect fixed and mobile operations.

In the range 450-470 MHz, interference to land mobile receivers used for critical purposes is unacceptable if any interruption occurs, even for a brief period of time, as the interference could impact protection of life and property. It is essential that the pfd of any interference to the land mobile service from EESS be less than the level specified in Table 1 of the annex to the Draft Revised Recommendation ITU-R SA.1260.

The maritime mobile service may use some frequencies within the band 457-467 MHz for on-board communications stations (No. **5.287**). Receiver characteristics are similar to those of land mobile equipment listed in Recommendation ITU-R M.1174-1.

### **Sharing with Space operation service (range safety command receivers)**

Range safety command receivers are used to send arm, destruct, and safe commands to an airborne missile or drone, as well as to launch vehicles. Terrestrial missile and drone operations are accomplished at all flight altitudes (from just above ground level up to maximum flight altitudes). Commands to space launch vehicles may need to be sent from nearly ground level (just after lift-off) up or approaching early parking orbit altitudes of 100 km or so (e.g. to send a final "safe" command).

Studies conducted within the ITU-R have demonstrated the potential for interference from spaceborne SARs operating in the EESS into launch vehicle range safety command receivers. Considering the safety implications of interference into range safety command receivers from SARs operating in the EESS, co-frequency sharing is not feasible during a launch window. Launch vehicle range safety command destruct receivers operate in the band 449.75-450.25 MHz (No. **5.286**), as well as at 420-430 MHz and 440-445 MHz with a 600 kHz bandwidth in the United States, and, in the band 433.75-434.25 MHz in India on a primary basis and certain countries in

Region 2 on a secondary basis (No. **5.281**). Compatibility could be achieved by frequency avoidance or other interference avoidance measures.

**PROPOSAL**

**USA/1.38/1**

**NOC**

ARTICLE 5

**Frequency allocations**

**410-470 MHz**

<b>Allocation to services</b>		
<b>Region 1</b>	<b>Region 2</b>	<b>Region 3</b>
<b>420-430</b>	FIXED MOBILE except aeronautical mobile Radiolocation 5.269 5.270 5.271	
<b>430-440</b> AMATEUR RADIOLOCATION 5.138 5.271 5.272 5.273 5.274 5.275 5.276 5.277 5.280 5.281 5.282 5.283	<b>430-440</b> RADIOLOCATION Amateur 5.271 5.276 5.277 5.278 5.279 5.281 5.282	
<b>440-450</b>	FIXED MOBILE except aeronautical mobile Radiolocation 5.269 5.270 5.271 5.284 5.285 5.286	
<b>450-455</b>	FIXED MOBILE 5.209 5.271 5.286 5.286A 5.286B 5.286C 5.286D 5.286E	
<b>455-456</b> FIXED MOBILE 5.209 5.271 5.286A 5.286B 5.286C 5.286E	<b>455-456</b> FIXED MOBILE MOBILE-SATELLITE (Earth-to-space) 5.286A 5.286B 5.286C 5.209	<b>455-456</b> FIXED MOBILE 5.209 5.271 5.286A 5.286B 5.286C 5.286E
<b>456-459</b>	FIXED MOBILE 5.271 5.287 5.288	

<b>459-460</b> FIXED MOBILE  5.209 5.271 5.286A 5.286B 5.286C 5.286E	<b>459-460</b> FIXED MOBILE MOBILE-SATELLITE (Earth-to-space) 5.286A 5.286B 5.286C 5.209	<b>459-460</b> FIXED MOBILE  5.209 5.271 5.286A 5.286B 5.286C 5.286E
<b>460-470</b> FIXED MOBILE Meteorological-Satellite (space-to-Earth) 5.287 5.288 5.289 5.290		

**Reasons:** The U.S. does not support an allocation to EESS (Active) in the band 420-470 MHz unless measures are in place to protect existing services. Further study is needed to determine the duration and rate of recurrence of interference between the earth exploration-satellite service and other services in this band.