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**AERONAUTICAL COMMUNICATIONS PANEL (ACP)**

**THIRTIETH MEETING OF WORKING GROUP F**

**Pattaya, Thailand 13 - 19 March 2014**

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| **Agenda Item 7**  | Development of material for ITU-R meetings |

**WAIC Adjacent Band Discussion**

(Presented by Uwe Schwark)

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| **SUMMARY** |
| This paper is intended to initiate a discussion within Working Group F on the request made by one European Administration towards ITU-R Working Party 5B and Project Team C of the Conference Preparatory Group of CEPT to study potential adjacent band interference caused by future WAIC systems. The main concern of this request is that WAIC systems potentially operating in the band 4 200-4 400 MHz might cause harmful interference into the Fixed Satellite Service in the adjacent band 3 600-4 200 MHz. It is common practice that adjacent band interference is studied if the potentially impacted service is a passive service. This is not the case with regards to the Fixed Satellite Service. Therefore, and in particular because WAIC systems employ much lower e.i.r.p. levels than for instance airborne radio altimeters (the primary users of the band 4 200-4 400 MHz) it is believed that adjacent band studies are not required. If, however, an assessment of any potential impact from the users of the band 4 200-4 400 MHz into the Fixed Satellite Service in the band 3 600-4 200 MHz is envisaged, than first any potential impact from radio altimeters operated under the aeronautical radionavigation service within the band 4 200-4 400 MHz should be studied. |
| **ACTION**Working Group F is invited to consider the discussion contained in this Working Paper for the development of its view on the necessity to study the potential interference impact of WAIC systems in the band 4 200-4 400 MHz into the Fixed Satellite Service in the adjacent frequency band 3 600-4 200 MHz. |

# INTRODUCTION

To satisfy WRC-15 agenda item 1.17 it is proposed by several Administrations and ICAO, that suitable regulatory provisions are introduced into the Radio Regulations for the frequency band 4 200-4 400 MHz. During the last ITU-R Working Party 5B meeting in November 2013 and at the meeting of the Conference Preparatory Group (CPG) Project Team C (PT C) in February 2014 one European Administration raised concerns about potential interference caused by WAIC systems into the Fixed Satellite Service (FFS) in the adjacent frequency band 3 600-4 200 MHz. During both meetings, concerned Administrations commented the request. The predominant opinion expressed was, that given the low power nature of WAIC systems and the fact that the FFS is an active service, adjacent band interference studies are not necessary. This Working Paper provides a quantitative comparison between RF emissions from radio altimeters in operation today and WAIC systems, in order to demonstrate, that the additional RF emissions from WAIC systems can be effectively neglected.

# Discussion

Technical characteristics of WAIC systems are summarized in Report ITU-R M.[WAIC\_CHAR\_SPEC] and Working Document towards a Preliminary Draft new Report ITU-R M.[WAIC\_SHARING\_4 200-4 400MHz]. Technical characteristics of radio altimeters can be found in Recommendation ITU-R M.[RAD.ALTIM].

## Maximum radiated power of a WAIC equipped aircraft

### Antenna feeding power

Report ITU-R M.[WAIC\_CHAR\_SPEC] defines two main categories of WAIC systems; low rate WAIC systems and high rate WAIC systems. Low rate and high rate WAIC systems require a maximum transmit power level of 10 dBm and 17 dBm, respectively.

### Power aggregation

#### Inside WAIC systems

Working Document towards a Preliminary Draft new Report ITU-R M.[WAIC\_SHARING\_4 200-4 400MHz] introduces the concept of “Omni-directional point sources (OPS)” this model is used for studying the aggregate RF emissions of all WAIC transmitters installed inside the shielding aircraft structure as seen from a far distant point outside the aircraft. The OPS approach assumes that all WAIC transmitters installed inside the aircraft structure are virtually concentrated into a minimum number of omni-directional sources. Preliminary Draft new Report ITU-R M.[WAIC\_SHARING\_4 200-4 400MHz] also shows, that this approach provides a conservative upper bound estimate of the overall emissions stemming from all WAIC inside application onboard an aircraft.

To cover the data rate demand of all intended low rate applications inside the aircraft, three OPSs are required, which means that in total three radiating sources at 10 dBm transmit power level (the maximum power level defined for low rate WAIC systems) have to be considered. This leads to an aggregate power contribution of 14.8 dBm caused by the entirety of WAIC low rate inside applications.

Likewise, two OPSs are required to cover the data rate demand for all high rate WAIC applications inside the aircraft, leading to two radiating sources at 17 dBm transmit power level. The aggregate power contribution in this case is 20 dBm.

The total aggregate power contribution of all inside WAIC systems is 21.1 dBm (the sum of the contribution of low rate and high rate systems). This power level is reduced by 35 dB due to shielding effects of the aircraft structure leading to a total aggregate emission power of -13.9 dBm.

### Outside WAIC systems

For outside WAIC systems Preliminary Draft new Report ITU-R M.[WAIC\_SHARING\_4 200-4 400MHz] introduces a directional emission limit pattern which the total aggregate emissions from all WAIC applications must not exceed (see Figure 1 below). This pattern limits for instance the e.i.r.p. emissions into the horizontal plane (90° and 270°) to 3 dBm and into downwards direction (180°) to 20 dBm. Within these limits, WAIC systems can be operated co-frequency without causing harmful interference towards incumbent systems within the band 4 200-4 400 MHz.



**Figure 1: Maximum angle-dependent tolerable RF power emissions caused by WAIC systems
(Source: Preliminary Draft new Report ITU-R M.[WAIC\_SHARING\_4 200-4 400MHz])**

These emission limits are between 17 and 34 dB larger than the emissions caused by inside WAIC systems. Hence, WAIC inside systems contribute to less than 2% to the overall WAIC emissions of the aircraft. For this reason and for the sake of simplifying all further considerations, only the power emissions of outside WAIC applications are taken into account throughout the following.

### Comparison of worst-case WAIC and radio altimeter emissions

The maximum e.i.r.p. levels generated by radio altimeters can be derived from their technical characteristics as provided in Recommendation ITU-R M.[RAD.ALTIM]. With 100 W radio altimeter “A4” has the highest transmit power level from all quoted radio altimeter types. Considering the associated antenna gain of 13 dBi and a feeder cable loss of 6 dB for that radio altimeter type “A4”, the corresponding e.i.r.p. level in boresight direction of the radio altimeter antenna (i.e., into downwards direction) is 57 dBm. Taking into account that up to three radio altimeters can be installed on board large aircraft, another 4.7 dB have to be added. Thus in the worst-case, the aggregate radio altimeter system’s, e.i.r.p. level into the boresight direction of the antenna is 61.7 dBm. This value is more than 40 dB above the corresponding aggregate e.i.r.p. level allowed for all WAIC applications onboard an aircraft. Considering lower power radio altimeters using transmit power levels around 1 W (e.g. radio altimeter type “A2”) would still lead to around 20 dB higher e.i.r.p. levels than caused by WAIC systems.

# Conclusions

RF emissions caused by radio altimeters are at least two orders of magnitude (20 dB) larger than those of WAIC systems. Consequently, emissions caused by WAIC systems can be effectively neglected for any further consideration of potential interference effects of systems operated in the band 4 200-4 400 MHz into systems operated in the adjacent band 3 600-4 200 MHz. If those studies are still envisaged by the concerned Administration, then they should take into consideration the dominant application in terms of e.i.r.p. level which is radio altimetry operated under the aeronautical radionavigation service.