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| Summary:  |
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| Proposal: |
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DRAFT CEPT BRIEF ON AGENDA ITEM 1.2

1.2 to consider in-band power limits for earth stations operating in the mobile-satellite service, meteorological-satellite service and Earth exploration-satellite service in the frequency bands 401-403 MHz and 399.9-400.05 MHz

# ISSUE

Resolution 765 (WRC-15) invites ITU-R to conduct and complete, in time for WRC-19, the necessary technical, operational and regulatory studies on the possibility of establishing in-band power limits for earth stations in the EESS and MetSat in the frequency band 401-403 MHz and the MSS in the frequency band 399.9-400.05 MHz.

It can be noted that this Agenda item may be linked by activities under WRC-19 AI 1.7, since the band 401-403 MHz is identified as a candidate band for a new space operations service (SOS) uplink allocation.

# Preliminary CEPT position

In order to ensure long term continuity for the operation of satellite data collection systems, CEPT supports the establishment of in-band power/e.i.r.p limits, as appropriate, for earth stations in the EESS and MetSat in the frequency band 401-403 MHz and the MSS in the frequency band 399.9-400.05 MHz, taking into account the result of studies. In addition, for the frequency band 401-403 MHz, CEPT is of the view that different sets of limits have to be established for GSO and non-GSO systems.

# Background

This agenda item was created as a result in the significant recent increase in use of the frequency bands 401-403 MHz and 399.9-400.05 MHz for telemetry, tracking and command (TT&C) purposes. This increase is largely attributable to increased interest by educational institutions and especially by private and commercial entities seeking to operate large fleets and constellations of satellites. These satellite networks are already filed and plan to use the frequency bands 401-403 MHz and 399.9-400.05 MHz for telecommand (see No. 1.135) (Earth-to-space) purposes under the EESS, MetSat or MSS allocations. The proliferation of such TT&C usage potentially poses a significant impact upon the large number of existing lower power data collection system (DCS) stations communicating to sensitive receivers on GSO and non-GSO satellites. The output power levels of the earth stations referred to these telecommand links (Earth-to-space) can be much higher than the power levels used for the operation of DCS systems in these frequency bands. An overall of tens thousands of DCS stations communicating with GSO and non-GSO are deployed worldwide for the purpose of collecting essential weather and climate data. Work under this item is to determine the potential impact of high power TT&C operations and to determine what, if any, power limitations are appropriate to protect the vital DCS operations.

399.9-400.05 MHz frequency band

Regarding the frequency band 399.9-400.05 MHz, systems deployed are limited to non-GSO orbits. The detailed characteristics of one of these systems (i.e. ARGOS) has been incorporated in the ITU-R PDNR in terms of capacity and DCP output power.

401-403 MHz frequency band

The frequency band 401-403 MHz is currently used by many geostationary (GSO) and non-geostationary (non-GSO) Data Collection Platform Systems (DCP). The DCPs gather information activity related to the Earth, the environment and scientific application, weather, environment observation: meteorological and oceanographic, seismic observation, volcanology, geodesy and geodynamics, fishing vessel monitoring, wildlife tracking, homeland security, law enforcement, test/evaluation, monitoring shipments of dangerous goods, humanitarian applications, managing water resources or tsunami warning system, etc. The data which are collected by DCPs, are sent and received by satellites in visibility of these platforms, that retransmit the retrieved information to dedicated earth stations.

The DCPs are particularly useful for the collection of data from remote and inhospitable locations where it may provide the only possibility for data relay. DCPs are also deployed in regions with a highly developed infrastructure and the corresponding installations required to relay the data, tend to be inexpensive, unobtrusive and normally blend easily into the local environment. DCPs may also transmit their current position, allowing movement to be determined. The DCPs, in particular communicating with non-GSO satellites are usually light and compact, and use little power as possible. DCPs are automatic, or semi-automatic, in-situ environmental observing systems, which may be integrated into an automatic weather station at a remote site; an automatic river or tide gauge, or on an aircraft, ship, balloon or buoy. DCS are provided by several geostationary meteorological satellite operators, giving almost total coverage around the world, except the polar regions. The EUMETSAT contribution to the global DCS network of geostationary meteorological satellites (also including satellites from Russia, China and USA) is provided by the current fleet of Meteosat satellites and will be continued by the Meteosat Third Generation satellites (MTG). The Meteosat satellites located at 0° longitude (Meteosat-10) and over the Indian Ocean (Meteosat-7) at 57.5°E and "brand new" Meteosat-8 at 41.5°E (replacing 57.5°E fully by April 2017), acquire DCP data, in the form of observations and environmental parameters (e.g. temperature, humidity, etc.), from operators of DCPs, which are located within the footprint of the satellites. When the platform is always under the footprint of a single geostationary meteorological satellite it is allocated to a regional transmission channel. If however it is located on a ship or aircraft, which travels across the footprint of several satellites, it is allocated to an International channel.

Regarding the non-geostationary meteorological satellites, the ARGOS receivers are operated on board the current generation of EUMETSAT’s Metop, the NOAA (National Oceanographic Atmospheric Administration) satellites on non-GSO orbits and SARAL (Satellite with ARGOS and ALtiKa). It can be noted that concerning the monitoring of the oceans, the ARGOS system ensures the collection of most ocean observations gathered by buoys or drifters, thereby contributing to the forecasts of the ocean-atmosphere coupled system together with the observations provided by EUMETSAT’s satellites and the Jason altimetry missions. ARGOS is therefore a key tool in predicting climate change and gauging its effects.

Additionally, incorporating such a data collection system on a moving satellite allows for locating an in-situ platform using Doppler shift calculations. This positioning capability permits applications such as monitoring drifting ocean buoys and studying wildlife migration paths.

Unlike the DCS on GSO meteorological satellites, through ARGOS it is possible to send messages back to the platform in the band 460-470 MHz. This provides the ability for message acknowledgement, time sync of the beacon, update of the beacon activity profile, and updating of the satellite status/position for the beacon.

In the framework of the global DCS system through geostationary meteorological satellites, currently Meteosat-10 collects 23000 messages from 1126 DCP stations per day. Meteosat-7 collects 3600 messages per day from 152 DCPs. In addition, according to information published in the framework of the Coordination Group of Meteorological Satellites (CGMS), there are 531 DCPs transmitting their data through Elektro N L1 at 76°E.

In the framework of the non-geostationary DCS system ARGOS, 22000 platforms are in operation worldwide sending more than 3 million messages per day.

The increased spectrum requirements for both geostationary and non-geostationary MetSat and EESS systems require all operators to respect a basic general partitioning of the band 401-403 MHz for current and future DCS systems accompanied by sharing conditions (see figure 1 below derived from Recommendation ITU-R SA.2045 providing the basic general partitioning and sharing conditions for the band 401-403 MHz for future long-term coordinated use of data collection systems on geostationary and non-geostationary MetSat and Earth exploration-satellite service systems). The studies on deriving the proper power limits have to take into account the partitioning and sharing conditions as outlined in this recommendation. It should be noted that there are DCS using spread spectrum technique reducing the interference to other systems. Due to the spreading of the signal, these systems may not fit in the general partitioning.



Figure 1: Basic general partitioning of the band 401-403 MHz for future long-term coordinated use of DCS systems on geostationary and non-geostationary MetSat and EESS systems

According to on-going ITU-R studies, in practice, for non-GSO satellite networks, the values of output power range from –3 dBW (bandwidth of 800 Hz) up to 7 dBW (bandwidth of 6400 Hz). In some applications, the power may decrease down to –25 dBW using specific techniques such as Spread Spectrum Multiple Access. The maximum value of the corresponding antenna gain is below 3 dBi. The antennas are most of time omnidirectional and whip antennas are used.

Thus, any additional use, other than for DCS, of this limited and unique spectrum resource for DCS systems would have to blend in with appropriate power levels such that the reception of signals from data collection platforms at the satellite receivers is not interfered.

For GSO networks, it can be noted that the International Data Collection System (IDCS) of the DCP is based on the usage of GSO satellites, and the e.i.r.p. at the antenna output shall not exceed 12 dBW under any combination of operational conditions. The transmitted radio frequency shall use the 11 IDCS channels (with centre frequencies spaced 3 kHz apart), from 402.034-402.067 MHz regardless of the GSO spacecraft. Other GSO channels are reserved for DCP, and there are various types of DCP transmitters in operation generally ranging from 5 W, 10 W and 20 W output power with a directional antenna, or 40 W or even higher output power with an omnidirectional antenna. The resulting uplink equivalent isotropically radiated power (e.i.r.p.) is between 6 to 22 dBW.

Given the significant difference in the power level ranges of non-GSO data collection platforms compared to platforms communicating to GSO MetSat and EESS satellites, as outline above, the establishment of power/e.i.r.p. limits will have to differentiate between non-GSO and GSO DCS in the 401-403 MHz frequency band.

To this respect, the establishment of an appropriate set of in-band power/e.i.r.p. limits in the 401 - 403 MHz band will have to take into account the framework set forth by the general partitioning in Recommendation ITU-R SA.2045 (as described in Figure 1 above) to ensure the protection of existing and future use of meteorological operations (MetSat and EESS (Earth-to-space)) in the 401-403 MHz frequency band for both non-GSO and GSO DCS systems.

ITU-R WP7B which is responsible for this Agenda item began drafting a Preliminary Draft New Report regarding this agenda item. This report provides detailed technical characteristics of the deployed systems for non-GSO in the 401-403 MHz frequency range and 399.9-400.05 MHz, and a more consolidated list has to be drafted for GSO systems in the 401-403 MHz frequency range.

# List of relevant documents

ITU-Documentation (Recommendations, Reports, other)

* Recommendation ITU-R SA.2045: Basic general partitioning and sharing conditions for the band 401-403 MHz for future long-term coordinated use of data collection systems on
geostationary and non-geostationary MetSat and Earth exploration-satellite service systems
* Recommendation ITU-R SA.2044: Protection criteria for non-GSO data collection platforms in the band 401-403 MHz
* Recommendation ITU-R SA.1163-2: Interference criteria for service links in data collection systems in the Earth exploration-satellite and meteorological-satellite services
* Recommendation ITU-R SA.1627: Telecommunication requirements and characteristics of EESS and MetSat Service systems for data collection and platform location
* Recommendation ITU-R SA.1162-2: Performance criteria for service links in data collection and platform location systems in the Earth exploration and meteorological-satellite services
* Recommendation ITU-R SA.1164-2: Sharing and coordination criteria for service links in data collection systems in the Earth exploration-satellite and meteorological-satellite services
* Recommendation ITU-R M.2046: Characteristics and protection criteria for non‑geostationary mobile-satellite service systems operating in the band 399.9-400.05 MHz
* Recommendation ITU‑R SA.1159-3: Performance criteria for data dissemination, data collection and direct data readout systems in the Earth exploration-satellite service and meteorological-satellite service
* Annex 16 to Working Party 7B Chairman’s Report, April 2016: working document toward a PDN
Report ITU-R SA.[400 MHz-LIMITS], Sharing studies to consider in-band power limits for earth stations operating in the frequency ranges 399.9-400.05 MHz and 401-403 MHz within the MSS, EESS and MetSat services
* Recommendation ITU-R RA.769: Protection criteria used for radio astronomical measurements

CEPT and/or ECC Documentation (Decisions, Recommendations, Reports)

EU Documentation (Directives, Decisions, Recommendations, other), if applicable

# Actions to be taken

* Complete the list of GSO characteristics in the ITU-R PDNR, taking into account all the various ranges of values for different GSO systems
* Establish the range of output power and other relevant characteristics for both GSO and non-GSO systems planned or in operation for the frequency bands 399.9-400.05 and 401-403 MHz
* Study the establishment of the relevant limits for both types of satellite orbits (GSO and non-GSO) and for both frequency bands (the use of the frequency band 399.9-400.05 MHz is limited to non-GSO systems)

# Relevant information from outside CEPT (examples of these are below)

## European Union (date of proposal)

## Regional telecommunication organisations

APT (date of proposal)

ATU (date of proposal)

Arab Group (date of proposal)

CITEL (date of proposal)

RCC (September 2016)

The RCC Administrations consider that studies should be conducted to establish power limits for earth stations used for space operation functions in the frequency bands 401-403 MHz and 399.9−400.05 MHz in order to avoid interference to data collection systems in the meteorological-satellite service, Earth exploration-satellite service and mobile-satellite service.

## International organisations

IATA (date of proposal)

ICAO (date of proposal)

IMO (date of proposal)

SFCG (June 2016)

SFCG supports studies and analyses under Agenda Item 1.2 towards establishing appropriate in-band power limits for earth stations operating in mobile-satellite service, the meteorological satellite and the Earth exploration-satellite service in the frequency bands 399.9-400.05 MHz for MSS (Earth-to-space), and 401-403 MHz for EESS (Earth-to-space), in order to preserve a long term basis the operation of Data Collection Platforms.

This agenda item may be impacted by activities under WRC-19 AI 1.7, since the band 401-403 MHz is identified as a candidate band for a new space operations service (SOS) uplink allocation. Negative impacts on the DCS activities in 401-403 MHz should be avoided.

SFCG Members are encouraged to perform studies to identify an in-band power limit that will ensure continued successful operation of DCS.

WMO and EUMETNET (21 November 2016)

Support the establishment of in-band power limits to ensure the proper continuation of METSAT and EESS (Earth-to-space) operations in the 401-403 MHz

## Regional organisations

ESA

Same as SFCG

Eurocontrol (date of proposal)

EUMETSAT (February 2017)

EUMETSAT supports the establishment of an appropriate set of in-band power/e.i.r.p. limits, differentiating between non-GSO and GSO DCS systems, to ensure the protection of existing and future use of meteorological operations (MetSat and EESS (Earth-to-space)) in the 401-403 MHz frequency band.

 In addition, EUMETSAT stresses that the frequency bands 401 - 403 MHz and 399.9 - 400.05 MHz are unique spectrum resources for the operation of data collection systems (DCS) through GSO and non-GSO meteorological satellites. EUMETSAT embarks receivers on their currently operational Meteosat and Metop satellites and their next generation satellites (already under development), namely Meteosat Third Generation (MTG) and Metop Second Generation (Metop-SG), in order to provide continuity in the measurement data gathered by the variety of data collection platforms. Thus, it is of paramount importance to preserve the usability of these frequency bands 401 - 403 MHz and 399.9 - 400.05 MHz for DCS systems in the long term. OTHER INTERNATIONAL AND REGIONAL ORGANISATIONS

EBU (date of proposal)

GSMA (date of proposal)

CRAF (November 2016)

CRAF supports the studies towards the establishment of in-band power limits for earth stations in the EESS and MetSat in the frequency band 401-403 MHz and the MSS in the frequency band 399.9-400.05 MHz. The RAS stations operating at 406.1-410 MHz may benefit from the presumably reduced power limits of such earth stations.