Programme ETTC 2007

Spectrum for UAS (Unmanned Aircraft Systems) : Status of WRC-2007 preparation and proposal for a new agenda item for WRC-2011

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1. Introduction

Remotely piloted air vehicles have been used by the military for some considerable time and this technology is now finding applications within the civil environment with similar benefits in reducing human life exposure in long, dull, dirty and/or dangerous air missions. They are referred to as unmanned air vehicles (UAV) and operated by a remote operator through radio-transmission facilities, hence the broader concept of "unmanned airborne systems" or UAS. The tasks of these civilian UAV (Unmanned Aerial Vehicles) are similar to those of traditional civilian piloted aircraft while they also enable new tasks to improve human security and global Earth's surface surveillance.

A particular point is that the widely anticipated full scale development of these civilian UAV calls for their seamless operation with existing piloted aircraft in non-segregated airspace to ease today's operational constraints on their flight routes planning in coordination with ATC (Air Traffic Control).
Another specific point for UAS is the requirement for satellite communications to relay communications beyond line-of-sight limits and thus maintain mission and safety of flight beyond terrestrial communication and surveillance means.

There are now significant civil, governmental and military development programmes for these Unmanned Aircraft Systems (UAS) and, compared to piloted aircraft, proper flight and mission of UAS require additional communications between the different actors as well as additional functions, in particular, to ensure full safety of flight and, in particular the following communication links, which are shown in Figure 1:

- Communication links between the UAS remote pilot and the unmanned vehicle for the purpose of remotely piloting (generally designated "Command and Control").

- Communications between the remote pilot and Air Traffic Control (ATC) as soon as the UAS is intended to seamlessly operate with existing piloted aircraft in non-segregated airspaces

  In addition, this emerging trend of mixing piloted and non piloted aircraft in the same air spaces necessitates the UAS to be fitted with the capability of detecting nearby aircraft and changing its flight course as needed in order to ensure collision avoidance towards surrounding objects as is the case for piloted aircraft – which is generally designated "Sense & Avoid".

- Communications as needed to manage the UAS mission and transfer in real time sensor products, whenever the UAS carries such sensors (generally designated "Data transfer"). The associated data rates and bandwidth can be considerable even if all UAS are not concerned.

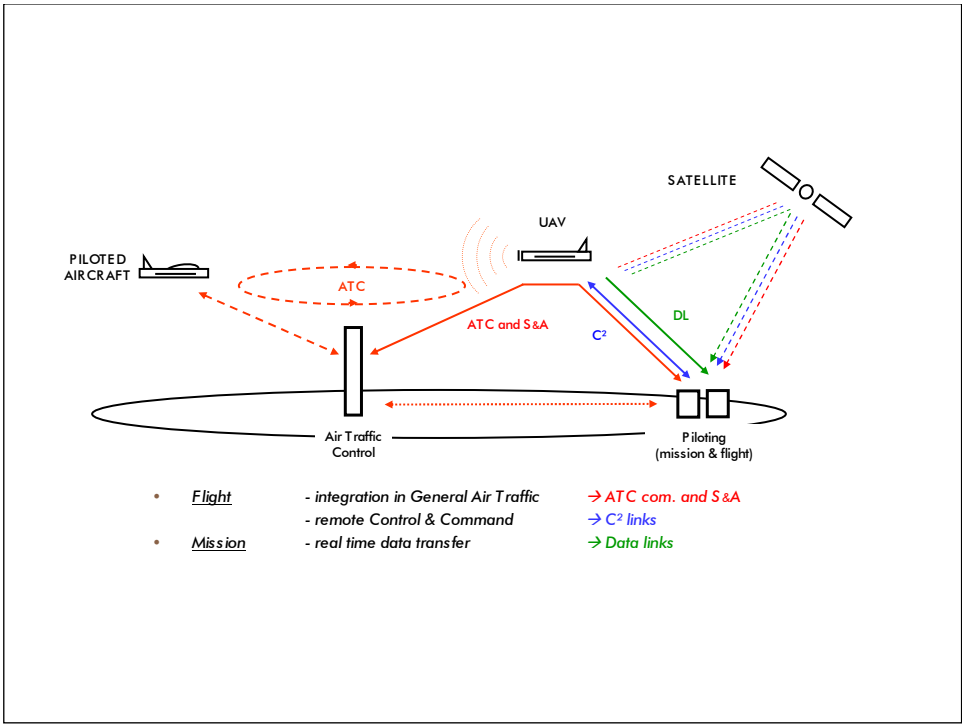

Figure 1 : UAS communications and other functions

In that respect, this document draws the status of ITU-R studies on UAS spectrum requirements.
It first presents the proposals on the spectrum requirement for terrestrial UAS communications to be discussed at WRC-07 (World Radiocommunication Conference 2007), which will take place 22nd October to16th November 2007.
It also identifies the areas where complementary studies are needed and presents a European proposal to task WRC-11 to complete studies and provide a global answer on UAS spectrum needs (including telecom, other spectrum and satellite requirements).

2. Spectrum for "High bit rate telemetry and associated telecommand" under Agenda Item 1.5 of the WRC -07

Under Agenda Item 1.5 WRC-07 will consider the following task:
*…"to consider spectrum requirements and possible additional spectrum allocations for aeronautical telecommand and high bit-rate aeronautical telemetry, in accordance with Resolution **230 (WRC-03)**"*
This item is of direct relevance to unmanned aerial vehicles as pointed out by the following extracts of the Resolution 230 :
"…considering:
a) that there is a need to provide global spectrum to the mobile service for wideband aeronautical telemetry systems;
b) that there is an identified need for additional spectrum required to meet future wideband aeronautical telemetry demands;

c) that there is also a need to accommodate telecommand operations associated with aeronautical telemetry...
recognizing :
....that the future technologies and performance expectations for airborne platforms contemplate a need for real-time monitoring of large data systems with multiple video streams (including high-definition video), high-definition sensors, and integrated high-speed avionics
...
resolves:
that WRC-07 be invited to:
1 consider the spectrum required to satisfy justified wideband aeronautical mobile telemetry requirements and associated telecommand above 3 GHz "

The original intention of this Agenda item has been to deal with the spectrum needs stemming from flight testing of modern aircraft, requiring the real time acquisition of on-board parameters for the purpose of aircraft air-worthiness certification. The terms "wideband aeronautical telemetry" and "associated telecommand" however makes quite explicit that the associated spectrum requirement refers to the needs of both conventional aircraft flight testing and UAS operations. The UAV need has been identified in the ITU-R Question 231/8 which is referred in the Resolution 230 and has been brought to the attention of ICAO.

The provisional WRC-07 conclusions, as detailed from the CPM-07 (Conference Preparatory Meeting 2007, February 2007) document, indicate that an aggregate spectrum of 700 MHz is deemed necessary in the short term for the provision of terrestrial UAS telemetry services based on a regional deployment scenario of civil UAS around 2020. The text also states that these needs may be satisfied within the existing spectrum allocated to worldwide terrestrial mobile applications between 3 and 16 GHz. These estimations are based on the studies already presented in the UVS International Yearbook 2006 /2007 ("UAV Radio Frequency Spectrum Requirements and the next World Radio Conference (WRC)") .

Nevertheless, WRC-07 will likely not go beyond this estimation of aggregated bandwidth need. In particular, it is not expected to designate the frequency bands to satisfy this frequency requirements in the various regions of the world nor is expected to address long term spectrum needs. It is not also expected to designate spectrum for the provision of satellite UAS telemetry and telecommand services.

3. Aeronautical frequency allocations under Agenda Item 1.6 of WRC-07

Agenda item 1.6 reads as follows :
To consider additional allocations for the aeronautical mobile (R) service in parts of the bands between 108 MHz and 6 GHz, in accordance with Resolution 414 (WRC-03)….
The *aeronautical mobile (R) service* (AM(R)S) designates a radiocommunication service aimed at and limited to ensuring "safety (and regularity) of flight".

The reason to also consider this WRC agenda item is the key objective of the UAV (unmanned air vehicle) community –developers and operators- to make possible for UAV products to fly into "unsegregated airspace", open to international civil aviation under ATC (air-traffic control).

One of the conditions for such a possibility to materialize is the establishment of reliable radio links between UAV and ground ATC, and accordingly the need for these to operate in frequency bands designated as AM(R)S (terrestrial aeronautical communications) and AMS(R)S (satellite aeronautical communications) reserved to ensure safety and regularity of flight.

The provisional WRC-07 conclusions, as detailed from CPM-07 (Conference Preparatory Meeting 2007, February 2007), lists probable new allocations to AM(R)S around the VOR/VHF band (i.e. in 112-118 MHz), around the DME band (i.e. in 960-1164 MHz) and around the MLS band (i.e. in 5030-5150 MHz) mainly based on bandwidth requirements for piloted aircraft.

Nevertheless, WRC-07 will most likely again not go beyond this conclusion and in particular not address specific UAV spectrum needs, in particular for their seamless integration in unsegregated airspace, nor any other specific UAS needs related to AM(R)S or AMS(R)S spectrum It is not expected neither to address associated spectrum for satellite UAS "safety of flight" services.

4. A global solution for Unmanned Aircraft Systems (UAS) spectrum by WRC-11

Up to now, ITU-R has partially examined the terrestrial radiocommunication needs of UAS in the preparation of WRC-07. Nevertheless, the issue has not been considered in its entirety yet and it is the purpose of a European proposal to promote global ITU-R studies between 2007 and 2011 and in order to seek more comprehensive ITU-R decisions by WRC-11.

Content of the proposal

"To consider spectrum requirements and possible spectrum allocations to support remotely controlled air operations as well as payload radiocommunication applications of unmanned aerial vehicles based on the results of ITU-R studies.'' with the following guidance :

- Globally answer UAS spectrum requirements and identify existing or new frequencies for the purpose of supporting the development of remotely controlled air operation (i.e. seamless integration in segregated airspaces, including "Sense & Avoid" functions and "Command and Control" communications) as well as payload radiocommunication applications (i.e. "Data Transfer").
- Answer terrestrial and satellite communications needs together
- Answer with a view to international spectrum harmonisation for the purpose of equipment inter operability and harmonisation.

In the end, a large range of ITU radiocommunication services may have to be considered to pave the way for safe and beneficial UAS operation such as AMS, AMSS, AM(R)S, AMS(R)S, MS, MSS, ARNS.

Coordination with aeronautical safety regulations

Aeronautical requirements for the seamless integration of UAS in non-segregated airspaces are not fully defined while they will be the key elements for consideration in a global answer to UAS spectrum requirements.
Both aeronautical and spectrum studies should therefore be progressed in parallel to avoid a situation where the spectrum identified by the ITU-R would not be adequate to satisfy the requirements from aeronautical safety regulations.
Accordingly it is highly a recommended to ensure appropriate coordination between these two interconnected questions.

Schedule of the proposal

UAS larger scale take-off is expected before 2015. Therefore, it calls, as a prerequisite for the availability of appropriate spectrum in advance to that date and WRC-11 is the only opportunity, time-wise for an ITU-R decision on this matter between now and 2015.
To make it possible, WRC-11 has to be formally mandated with this question, and it is the task of ITU-R member administrations at WRC-07 to decide on WRC-11 mandate. It will then be the task of UAS promoters and their administrations to contribute to ITU-R studies between WRC-07 and WRC-11.

The UAS community as well as international aeronautical administrations (ICAO, Eurocontrol, RTCA, Eurocae…) will be invited to actively contribute to these studies in preparation of WRC-11.

Conclusion

Inclusion of UAS on the agenda of WRC-11 will thus depend on the support brought by administrations to this issue during the discussions at WRC-07.

UAS promoters, manufacturers and operators should therefore convince their respective administrations to provide support at WRC-07, e.g. on he basis of the draft European proposal.