SIGAT

Study On Military Spectrum Requirements for the Insertion of UAS Into General Air Traffic.

Currently, Unmanned Aerial Systems (UAS) remotely piloted from ground are mainly used by military forces with flights restricted to specific airspaces. These are mainly military areas, called "segregated airspaces" where no other aircraft are allowed.

Now that UAS have proven their advantages for many applications, the next major milestone will be the ability for UAS to share civil airspace with other aircraft in General Air Traffic (GAT), instead of being restricted to segregated airspaces as today. UAS development promises to take off once this capability is ensured.

To this end, a major challenge is to ensure UAS safety of flight for other airspace users at the level of international civil aviation. Given that UAS are remotely piloted through a Command & Control (C^2) radio-frequency data-link and use a Sense & Avoid (SAA) system for anti-collision purposes, there is a need for a specific spectrum allocation consistent with such safety requirements. C^2 spectrum is needed for Line of Sight (LOS) communications and for BLOS (Beyond Line of Sight), also called SAT (Satellite) communication.

From a spectrum perspective, the issue is the shortage of dedicated and internationally protected frequencies against harmful interference, capable of maintaining high level of integrity and availability required.

In that respect, SIGAT objectives are to study, identify and synthesise European Military interests in frequency spectrum requirements needed for insertion of UAS in GAT within the framework of the next "World Radio-communication Conference" (WRC), The next one is being programmed in 2012 with an agenda item related to UAS C_2 and SAA frequency allocation.

Therefore, an international consortium gathering 9 European countries and 23 companies has been set up. Its goal is to present commonly agreed results to be promoted at WRC12. Throughout the study, contact with participating Member States and organisations has been maintained in order to share hypotheses and results discussed in dedicated workshops.

SPECTRUM REQUIREMENT

After agreeing scenarios and taking airworthiness and security aspects into account, the technical study carried out within the SIGAT study concludes to following spectrum requirement that can be compared to ITU-R estimations in this table:

UAS in non segregated airspaces in 2020	Functions related to C2 and SAA		
	C^2 LOS	C^2 SAT (BLOS)	SAA Sensors
SIGAT estimate (Military UAS)	**15 MHz**	**12 MHz**	**150 MHz**
ITU-R estimate (UAS, including Military)	34 MHz	56 MHz	No bandwidth requirement

C^2 bandwidth requirement for Military UAS insertion in non segregated airspaces is properly provisioned in the ITU-R scenario.

MILITARY UAS IN NON SEGREGATED:

GAT versus OAT

GAT: In order to fly in non-segregated airspaces, all aircraft & UAS, civil or Military have to comply with GAT rules harmonised by States and the International Civil Aviation Organisation (ICAO). Therefore, Aircraft and UAS need to be fitted with ICAO compliant equipment.

OAT: However, military aircraft with specific features and possibly not equipped with all ICAO compliant equipment, or not using aeronautical frequencies, are allowed to share non-segregated airspace under Military "Air Traffic Control" (ATC) with specific rules called "Operational Air Traffic" (OAT). These rules result from an agreement between Civil and Military ATC and are generally limited to national flights.

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SIGAT recommendations for WRC12 depend on which options are chosen:

- Support WRC-12 in provisioning 34 MHz (LOS) and 56 MHz (SAT) of specific aeronautic bands complying with ICAO Safety of flight requirements.
- Take urgent decision on option 3 suitability.

Outside WRC-12 schedule/mandate:

- Support Eurocontrol (or other) efforts to harmonise OAT (option 4).
- Decide how to convince ICAO to change its safety of flight requirement in case of option 2.

SIGAT CONCLUSIONS:

SIGAT proposes four possible options including frequency spectrum needs with associated levels of difficulty, performance and timeframe:

Option 1 (LOS & SAT): *Use existing civil aviation bands and fly GAT*

This option is the nominal solution that complies with ICAO safety of flight requirements and the use of specific aeronautic frequency bands listed below as Candidate Bands:

Candidate frequency band for GAT	C^2 LOS	C^2 SAT (BLOS)	SAA	Comment
960-1164 MHz	LOS	-	-	Sharing seems difficult
2700-2900 MHz	-	-	SAA	Sharing seems difficult
4200-4400 MHz	LOS	-	-	Sharing seems difficult
5030-5091 MHz	-	BLOS	-	-
5091-5150 MHz	LOS	-	-	-
8.75-8.85 GHz	-	-	SAA	Sharing seems difficult
9.0-9.2 GHz	-	-	SAA	Seems possible
15.4-15.7 GHz	LOS	BLOS	SAA	Other claims to WRC-12
>33.4 GHz	-	-	SAA	New ARNS allocation needed

Current satellite constellations do not offer sufficient C^2 BLOS capacity today. Additional satellite capacity is needed.

Option 2 (SAT): *Use commercial bands and fly GAT:*

This option consists in the use of non aeronautical bands and doesn't comply with ICAO safety of flight requirements. This solution benefits from existing satellite constellations, such as TV broadcast services in Ku band.

A significant drawback to this solution is the fact that ICAO is strongly opposed to this alternative today.

Option 3 (SAT): *Turn a portion of existing commercial band into an aeronautic band and fly GAT:*

This alternative combines the use of existing satellite constellations with the safety of flight requirements of specific aeronautic bands.

The drawback of this option is the predictable opposition of commercial operators that must release part of their spectrum.

Option 4 (LOS & SAT): *Use existing bands and fly OAT*

This alternative complies with ICAO requirements and benefits from existing Satellite constellations. The main advantage is that this option is straightforward and can be used at short term. One disadvantage is the lack of OAT harmonisation between countries, raising some complexity for international cross-border flights. One way to lower this disadvantage is to better harmonise OAT, a task which has been initiated by Eurocontrol.