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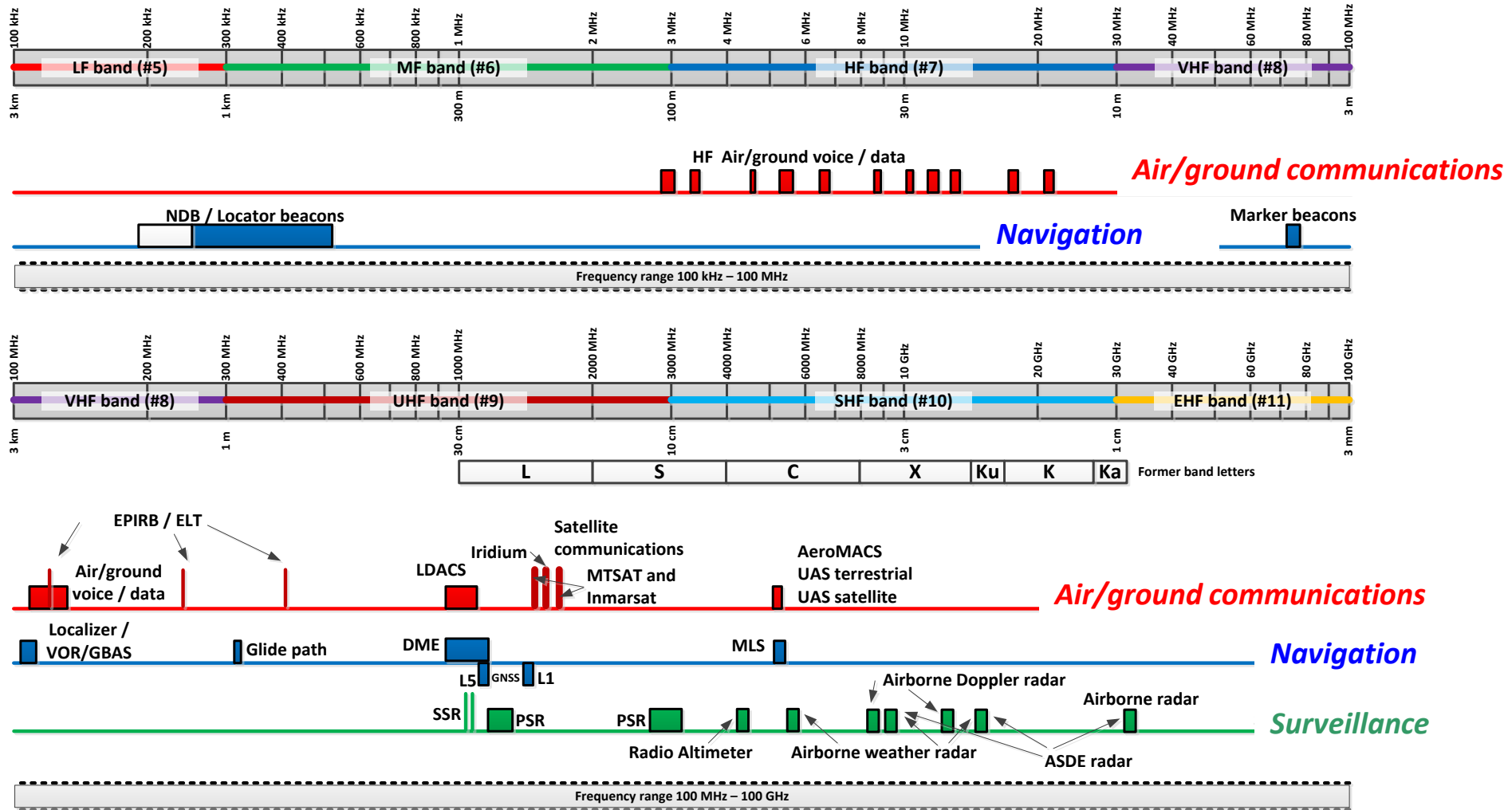
Future Aeronautical Communication and Navigation Technologies

BY Isaiah Kofi Tefutor (CNS Technical Officer ICAO)

For the PRIDA Workshop
19-21 May in Abidjan , Côte d'Ivoire

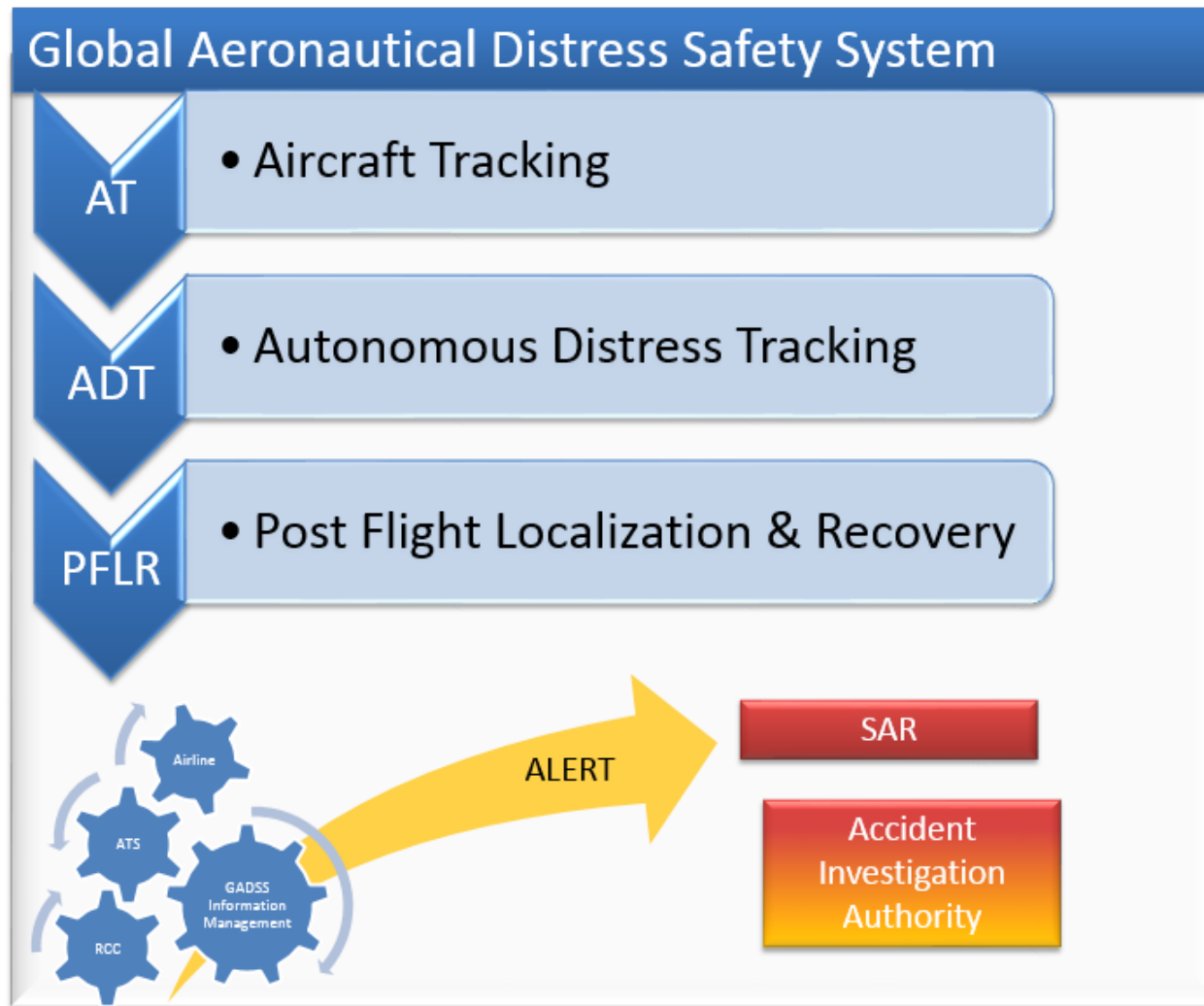
Aeronautical Frequency Spectrum Management

Over 1 GHz of frequency spectrum in global allocations to aeronautical safety services



Notes:
 Drawing not to scale
 Not all Regional or sub-Regional allocations are shown
 Band identification (e.g. VHF) and band # per Radio Regulations
 The satellite communication bands used by MTSAT and Inmarsat are not allocated the the Aeronautical Mobile Satellite (R) Service

Global Aeronautical Distress & Safety System (GADSS)



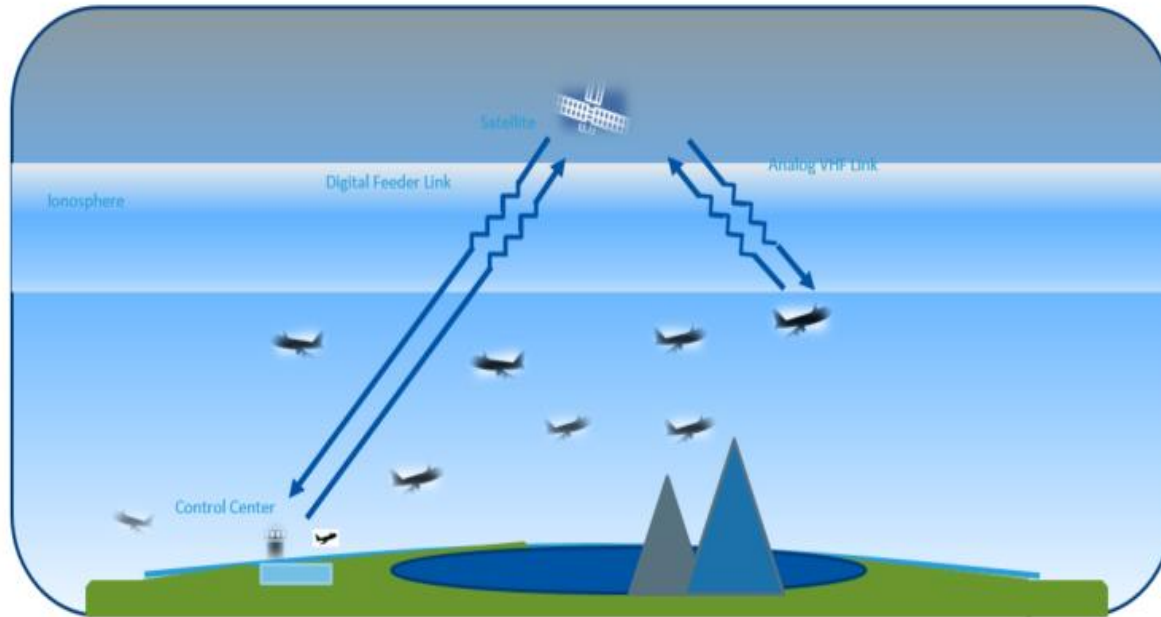
➤ **Related to**

WRC-19 Agenda Item 1.10

- Performance-based Standards and recommended practices
 - **Not technology specific**
- To ensure global interoperability, the equipment utilized for GADSS:
 - conform to agreed performance standards,
 - must be licensed by appropriate authorities, and
 - must be operated by licensed personnel if appropriate.

Highlevel overview of the GADSS identifying the main functions

Space Based VHF



Original image from ICAO CP-DOIWG

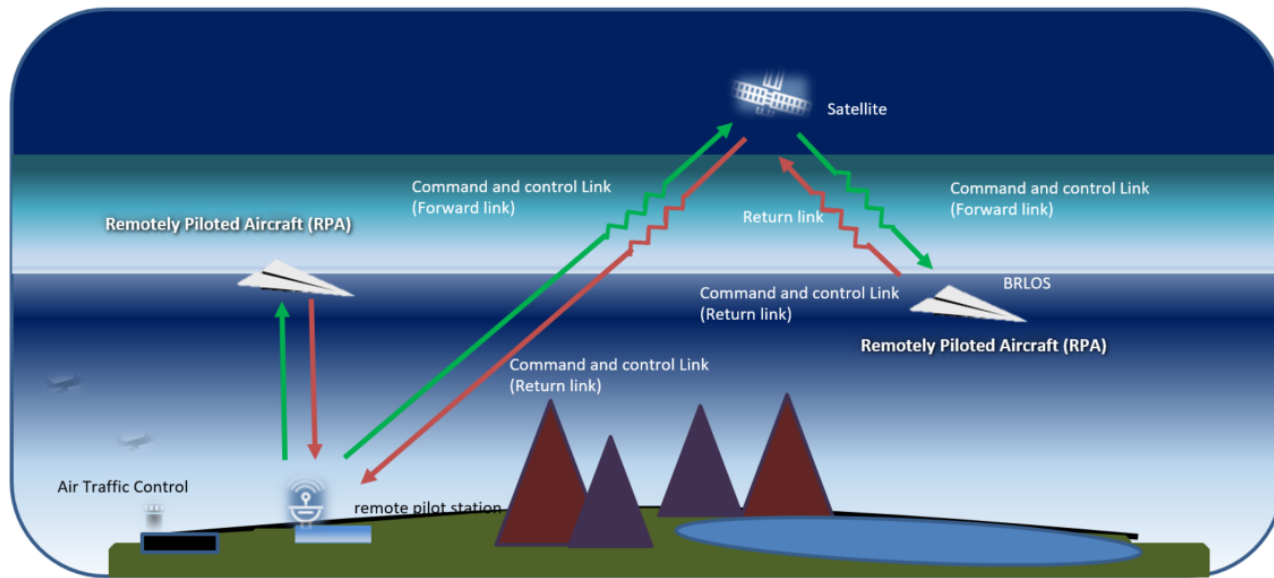
WRC-23 Agenda Item 1.7: Potential facilitation of aeronautical VHF over satellite

➤ Related to **WRC-23 Agenda item 1.7**

Expected benefits include:

- improvements in com capability and performance in oceanic and remote airspace.
- may also increase com performance and bandwidth required for aircraft, airlines and ATM operations.
- will be designed to complement existing terrestrial VHF voice/datalink services and should be fully interoperable with existing VHF infrastructures and avionics.

Command and Control (C2) Link for Remotely piloted aircraft systems (RPAS)



- Main frequency band for Line-of-sight: **5030-5091 MHz**,
- **5030-5091 MHz** can potentially also be used for Beyond-line-of-sight, if infrastructure becomes available
- Use of **Fixed Satellite Service** for Beyond-line-of-sight, , including existing infrastructure is related to **WRC-23 Agenda Item 1.8**

The C2 link connects the RPS and the RPA for the purpose of managing/controlling the flight and enable the remote pilot to safely integrate the RPAS into the global aviation operational environment.

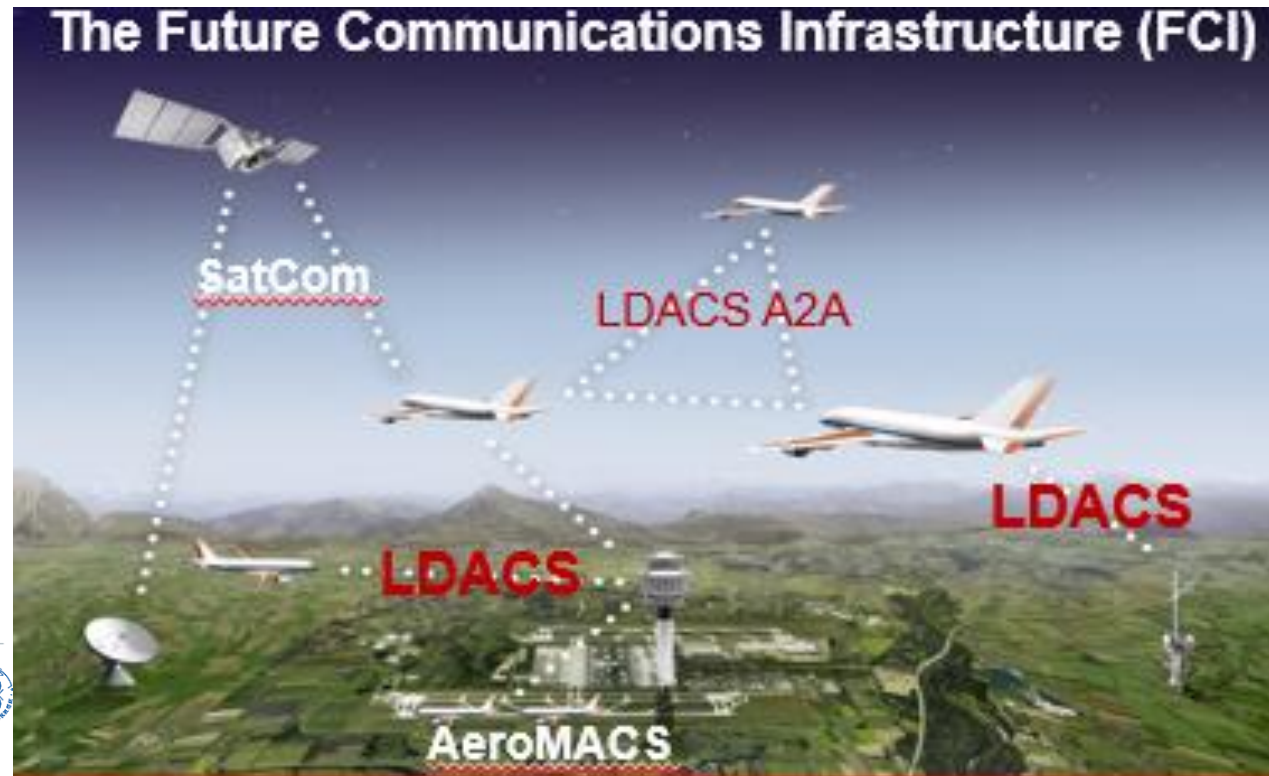
ICAO expert group is working on development of SARPs and guidance material.

WRC-23 Agenda Item 1.8:

Finalization of a satellite allocation enabling beyond-line-of-sight C2-link for RPAS

L-Band Digital Aeronautical Communications System (LDACS)

➤ Related to Spectrum efficiency



- a broadband system based on Orthogonal Frequency-Division Multiplexing (OFDM) like current/future mobile radio standards, applies modern and highly efficient transmission concepts and advanced recover design for interference robustness.
- Shares the **960-1215 MHz** frequency band with existing Navigation and Surveillance systems
 - *highly flexible and scalable and, thus, enables long-term evolution.*
 - *supports high-rate data communications and voice, which enables important future applications.*

Dual-Frequency, Multi-Constellation (DFMC) Global Navigation Satellite System (GNSS)



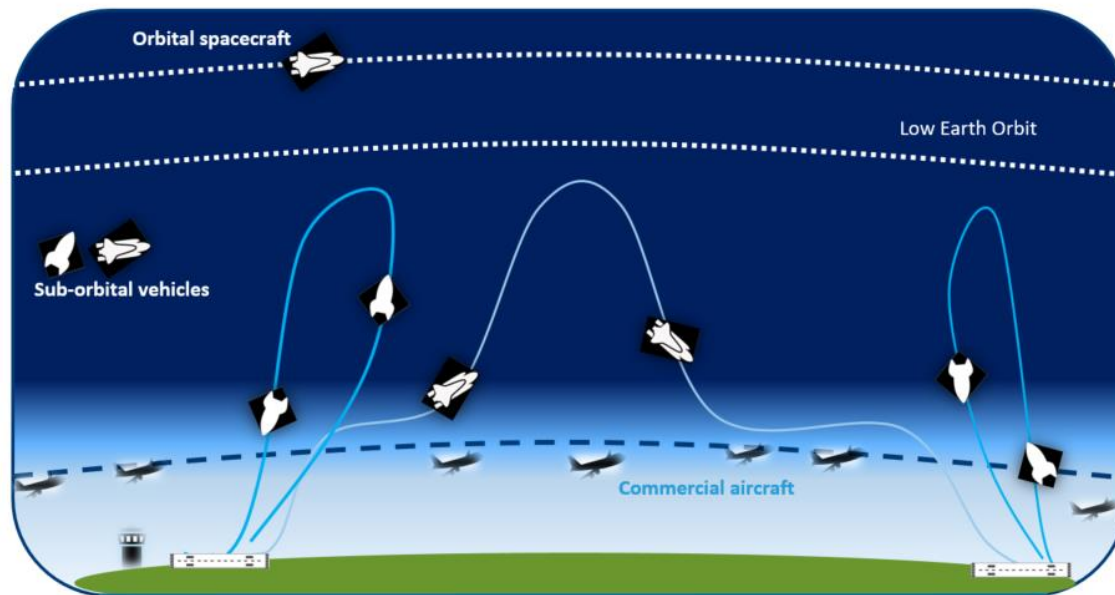
GNSS satellite constellations
(Baidu, Galileo, Glonass and GPS)



New 1090 MHz Extended Squitter ADS-B Version 3 Format

ADS-B version 3 will provide new capabilities including :

- autonomous distress tracking support;
 - Related to **WRC-19 Agenda item 1.10**
- Lost C2 link state for UAS/RPAS;
 - Related to **WRC-23 Agenda item 1.8**
- functionality to support sub-orbital vehicle operations.
 - Related to **WRC-23 Agenda item 1.6**



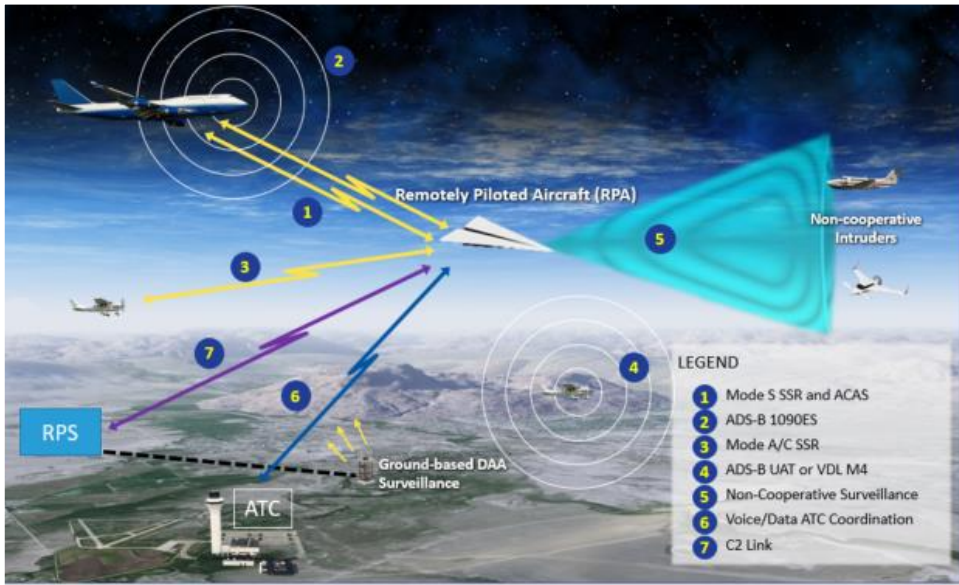
Free images of spacecraft from Pixabay

**WRC-23 Agenda Item 1.6:
Spectrum use by sub-orbital vehicles**

Detect and Avoid (DAA) Systems and

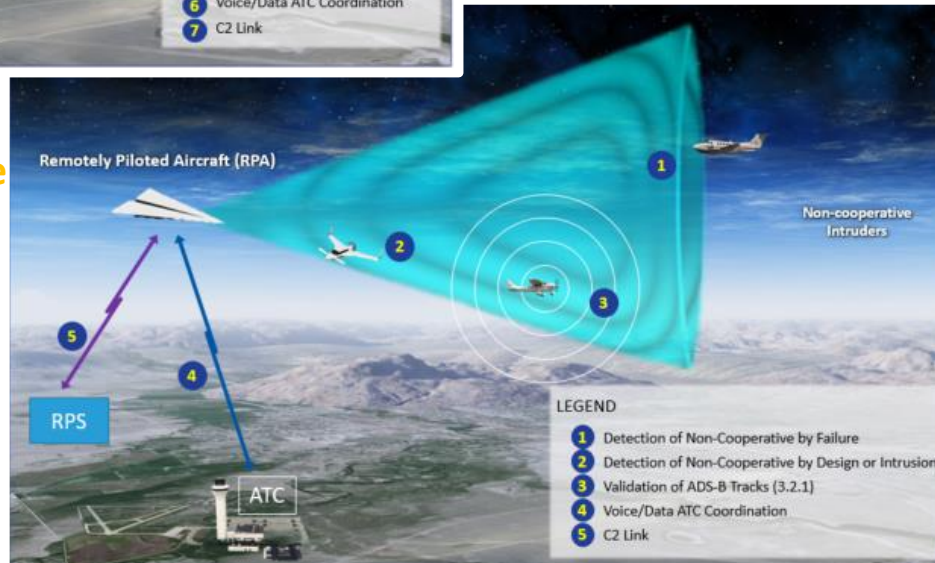
Airborne Collision Avoidance System-unmanned aircraft (ACAS-Xu)

DAA Surveillance



➤ Related to ITU-R WP 5B activities

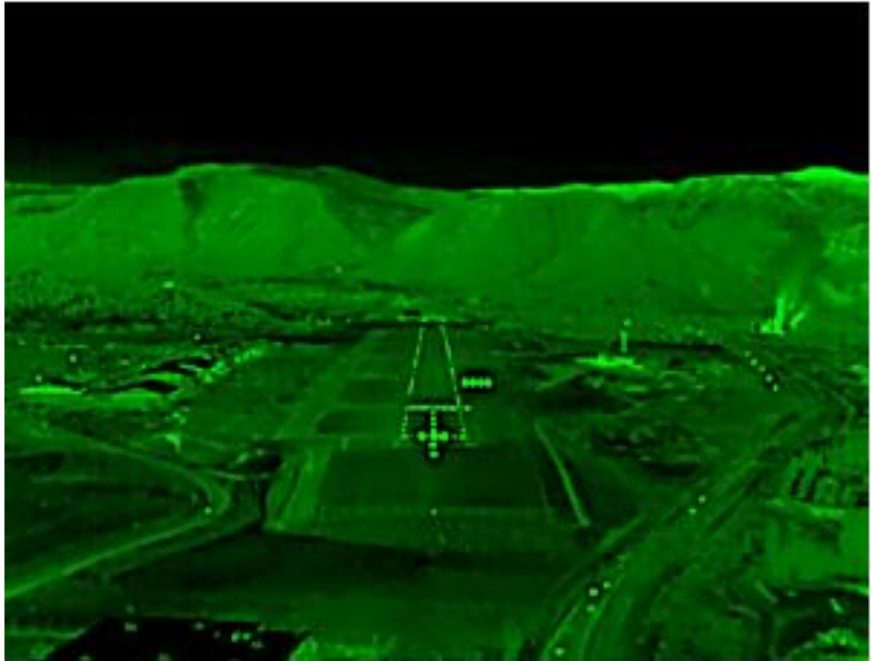
DAA Non-Cooperative Surveillance



Enhanced flight Vision System (EVS) applications



[A320 - 360 cockpit view | Virtual tour generated by Panotour \(airbus.com\)](#)



[Collins Aerospace's next-generation Enhanced Vision Sensor](#)



Thank You!