International Civil Aviation Organization

WRC-15 Agenda Item 1.5

Fixed Satellite Service spectrum to support the safe operation of Unmanned Aircraft Systems

Aeronautical Spectrum Workshop

Preparation for WRC-15

Cairo, Egypt 16-17 February, 2015

Topics

- Background
- Agenda Item and Resolution
- Challenges
- ICAO position
- Studies

Terminology - What is UAS

UAS (Unmanned Aircraft System):

- An aircraft and its associated elements, operated without a pilot on-board.

ICAO standardized acronyms:

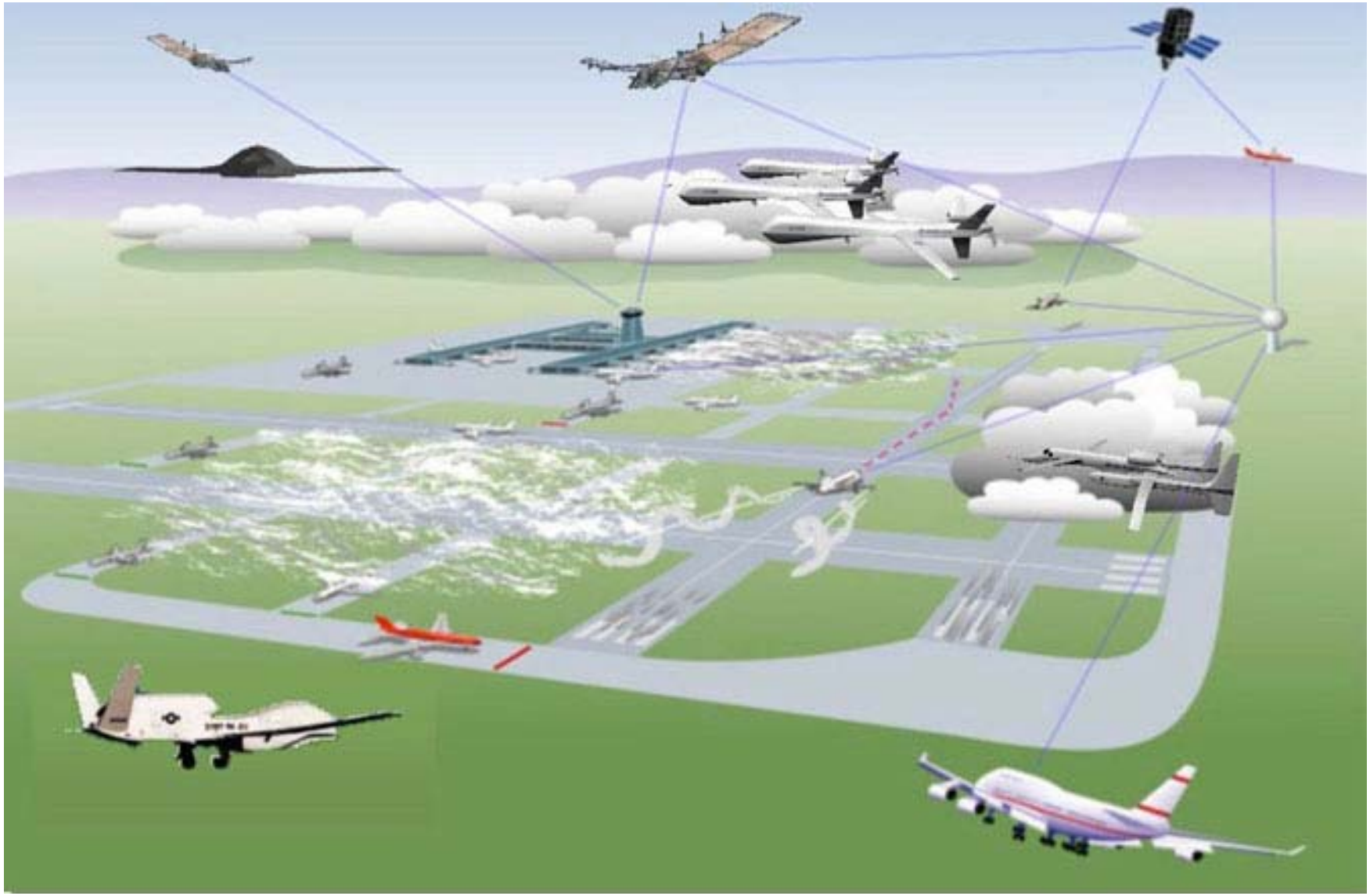
- **Remotely piloted aircraft (RPA)** – an unmanned aircraft which is piloted from a remote pilot station. (Article 8 ICAO convention)
- **Remotely piloted aircraft system (RPAS)** – a remotely piloted aircraft, its associated remote pilot station(s), the required command and control links and any other components as specified in the type design.
- **Remote pilot station (RPS)** – the component of the RPAS containing the equipment used to pilot the RPA.
- **Remote pilot** – a person charged by the operator with duties essential to the operations of an RPA and who manipulates the flight controls, as appropriate during flight time.

Terminology - other

- **Command and control link (C2)** – the data link between the RPA and the RPS for the purposes of managing the flight.
- **Command, control and ATC communications (C3)** – the C2 plus ATC communications.
- **Detect and avoid (D&A)** – the capability to see, sense or detect conflicting traffic or other hazards and take the appropriate action.
- **Control and Non-Payload Communications (CNPC)** – the ITU term to distinguish C2/C3 communications from those used for payload.

Why the interest?

Integration into Non Segregated Airspace



Integration requirements

- Derivation of technical/operational requirements by ICAO
- Certification: RPA, operator, remote pilot
- Approval: RPAS as a complete system
- Collision and hazard avoidance
- Interact with ATC and other aircraft
- Security: data links, RPA, remote pilot station
- Predictable actions (*not autonomous!*)
- Contingency procedures

Ability to act like any other aircraft!

Spectrum Requirements

- 34 MHz identified for UAS line of sight (LOS) command & control communications
- 56 MHz identified for UAS beyond line of sight (BLOS) (satellite)
  - Reports ITU-R M.2171, M.2204, M.2205, M.2229 M.2230, M.2233, M.2236, M.2237, M.2238
- WRC-12 outcome, 5030 – 5091 MHz available for both LOS and BLOS AM(R)S & AMS(R)S
  - Still considerable interest in additional BLOS allocations by means of FSS spectrum => WRC-15 Agenda Item 1.5

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WRC-15 Agenda Item 1.5

*To consider the use of frequency bands allocated to the fixed-satellite service not subject to Appendices **30**, **30A** and **30B** for the control and non-payload communications of unmanned aircraft systems (UAS) in non segregated airspaces, in accordance with **Resolution 153 (WRC-12)***

Resolution 153 (WRC-12)

resolves to invite WRC-15

to consider, based on the results of the ITU-R studies referred to in *invites ITU-R* below, the possible regulatory actions to support the use of FSS frequency bands for the UAS CNPC links, as mentioned in the above *considerings*, ensuring the safe operation of UAS CNPC links, consistent with *recognizing e)* (quote RR No. 4.10)

invites ITU-R

1. to conduct, in time for WRC-15, the necessary studies leading to technical, regulatory and operational recommendations to the Conference, enabling that Conference to decide on the usage of FSS for the CNPC links for the operation of UAS
2. to include, in the studies referred to in *invites* 1, sharing and compatibility studies with services already having allocations in those bands
3. to take into account information from operations referred to in *considering e)* (current UAS operations using FSS frequency allocations under RR No. 4.4)

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Challenges

- Bridging
  - Aeronatical expertise
  - Satellite expertise

- Discussion: FSS not being a safety service

  [Support][Oppose] the use of FSS systems for UAS CNPC links in non-segregated airspace [if][until] the technical and regulatory actions identified by studies under **Resolution 153** (WRC-12) satisfy the following conditions

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ICAO Position WRC-15 Agenda Item 1.5 (1)

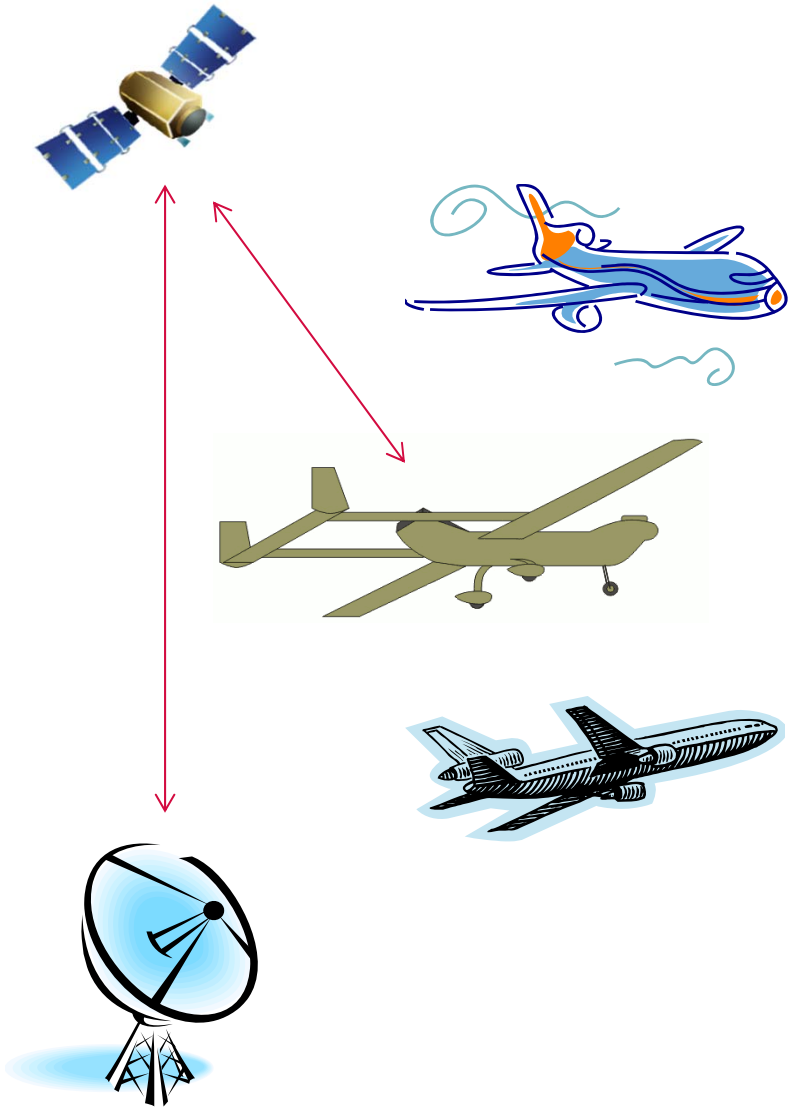
Unmanned aircraft systems (UAS) have great potential for innovative civil applications, provided that their operation does not introduce risks to the safety of life.

Taking into account Recommendations 1/12 and 1/13 of the Twelfth Air Navigation Conference (November 2012) "That ICAO … develop and implement a comprehensive aviation frequency spectrum strategy … which includes the following objectives: … **clearly state in the strategy the need for aeronautical systems to operate in spectrum allocated to an appropriate aeronautical safety service**"; and "That **ICAO support studies** in the International Telecommunication Union Radio Communication Sector **(ITU-R)** to determine what ITU regulatory actions are required to enable use of frequency bands allocated to the fixed satellite service for remotely piloted aircraft system command and control (C2) links to ensure consistency with ICAO technical and regulatory requirements for a safety service.", **in order to support the use of FSS systems** for UAS CNPC links in **non segregated** airspace, the technical and regulatory actions identified by studies under Resolution 153 (WRC-12) **must be consistent** with the above **Recommendations**, and satisfy the **following conditions**:

ICAO Position WRC-15 Agenda Item 1.5 (2)

1. That the technical and regulatory actions should be limited to the case of UAS using satellites, as studied, and not set a precedent that puts other aeronautical safety services at risk.
2. That all frequency bands which carry aeronautical safety communications need to be clearly identified in the Radio Regulations.
3. That the assignments and use of the relevant frequency bands have to be consistent with article **4.10** of the Radio Regulations which recognizes that safety services require special measures to ensure their freedom from harmful interference.
4. Knowledge that any assignment operating in those frequency bands:
- is in conformity with technical criteria of the Radio Regulations,
- has been successfully coordinated, including cases where co-ordination was not completed but the ITU examination of probability of harmful interference resulted in a favorable finding, or any caveats placed on that assignment have been addressed and resolved such that the assignment is able to satisfy the requirements to provide BLOS communications for UAS; and
- has been recorded in the International Master Frequency Register.
5. That interference to systems is reported in a transparent manner and addressed in the appropriate timescale.
6. That realistic worst case conditions, including an appropriate safety margin, can be applied during compatibility studies.
7. That any operational considerations for UAS will be handled in ICAO and not in the ITU.

Possible updates to ICAO position under consideration…



Key requisite to ICAO:
Introduction of UAS into non-segregated airspace must not reduce the current level of safety

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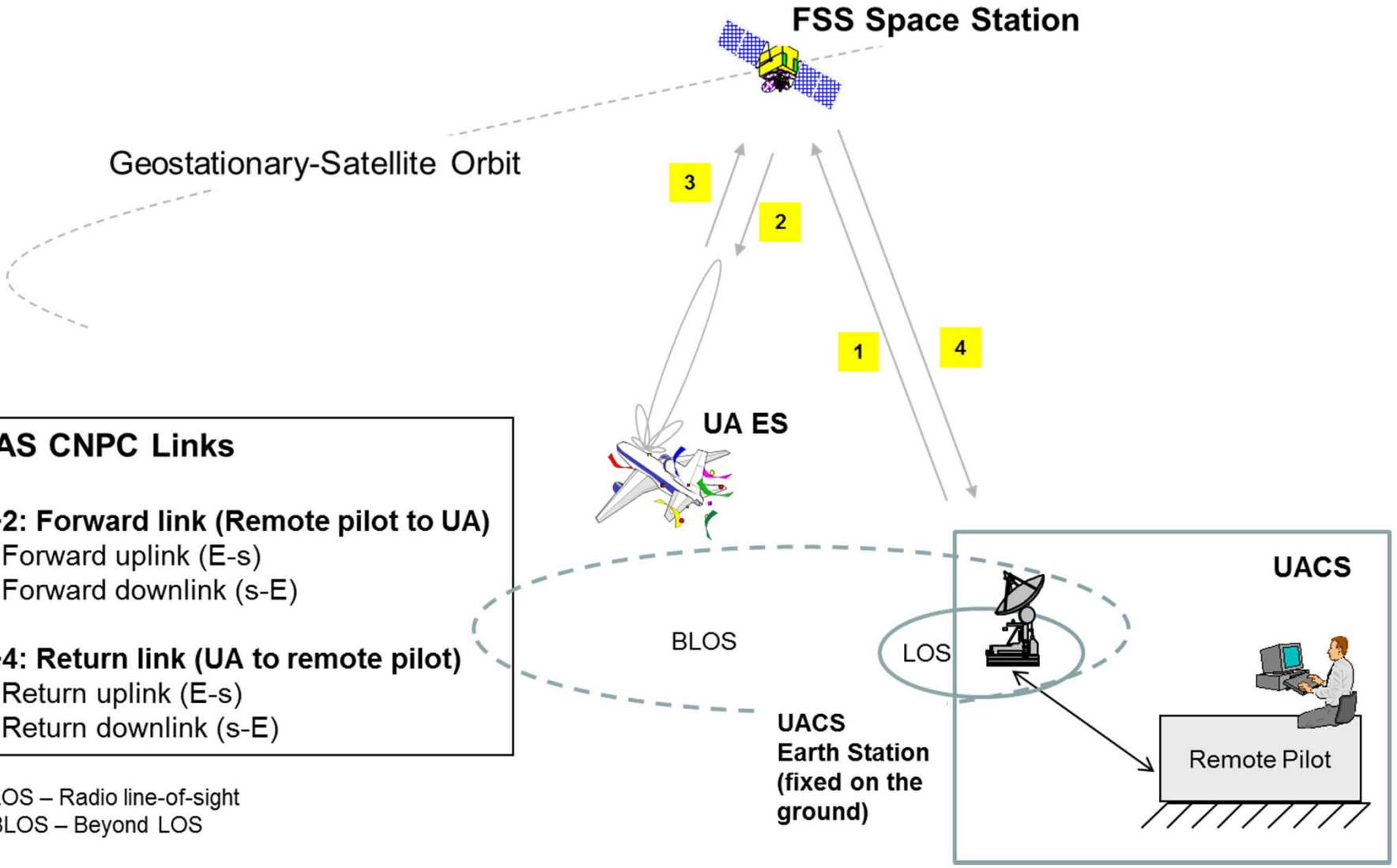
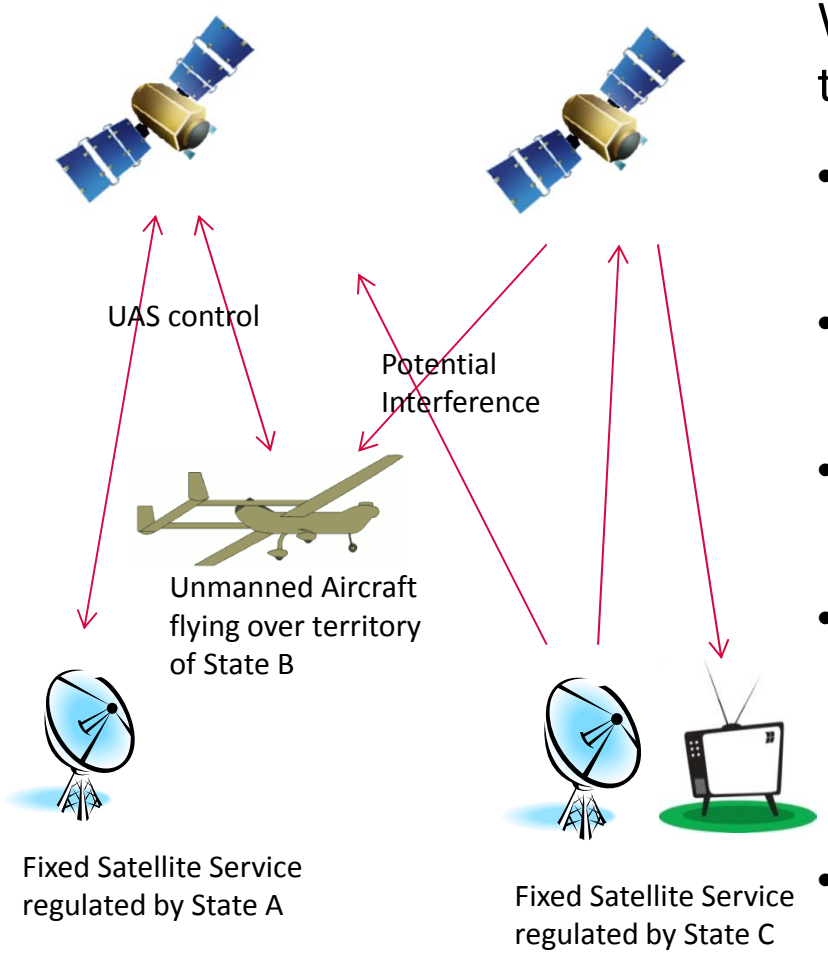
Current situation ITU (1)

- Studies and reports under development
  - CPM (5B/636 Annex 01)
  - WDPDNR UAS-FSS (5B/761 Annex 18)
    - sharing and compatibility studies required by WRC-15 Agenda item 1.5 as described in Resolution **153 (WRC-12)** to enable the conference to decide on the usage of the fixed satellite service (FSS) for the command and non-payload communications (CNPC) links for the operation of unmanned aircraft systems (UAS)

Current situation ITU (2)



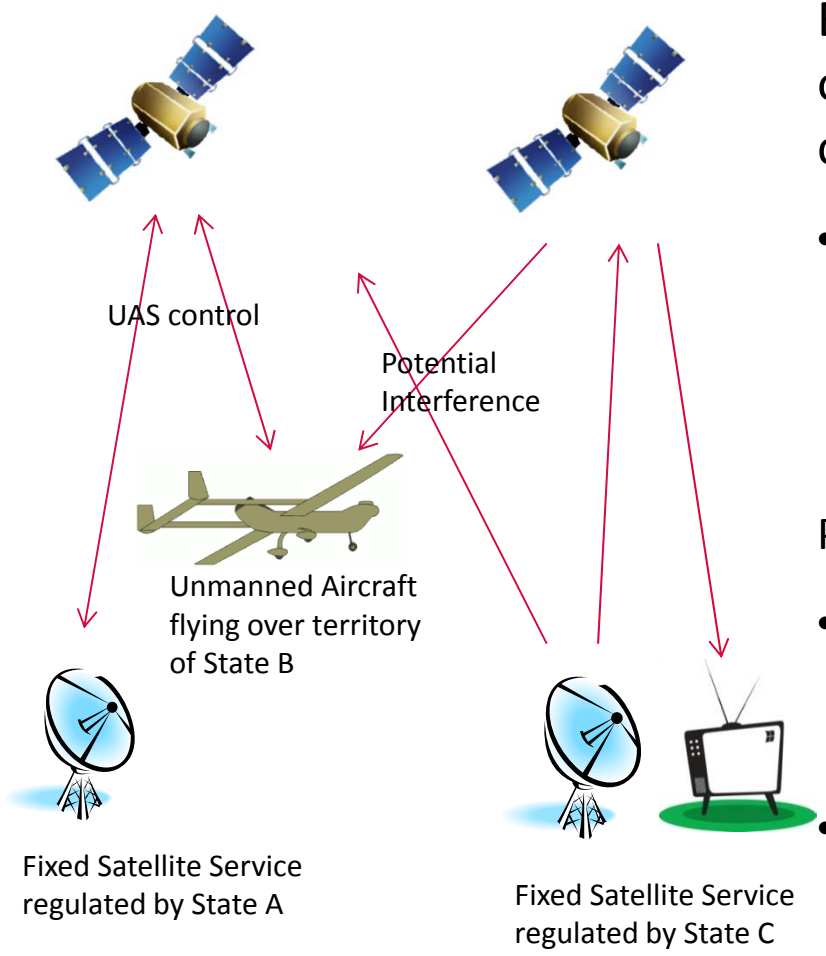
Questions, Concerns (1) …



Without AMS(R)S need additional regulations to address:

- Jurisdiction/responsibility for interference mitigation
- Special measures in ITU Radio Regulations for protection and interference mitigation
- In a shared frequency allocation scenario, priority of access to UAS control
- Many FSS allocations are not fully co-ordinated. In case incompatible assignments are made in two separate States, need to ensure not used for UAS control
- In case of interference resolution, the UAS control service not treated equally or lower than a television broadcast service

Questions, Concerns (2) …



Biggest issue is ICAO has not defined technical or operational requirements for UAS/RPAS control in any airspace.

- Impossible for ITU to decide "link X" can be used in non-segregated airspace … or any airspace for that matter

Possible approach: Separate the issues.

- Allow ITU to make the necessary regulatory changes to make FSS an option for UAS/RPAS CNPC in some, as yet undefined, airspace.
- Decision on what airspace it can actually be used in will be made by ICAO after requirements are developed.

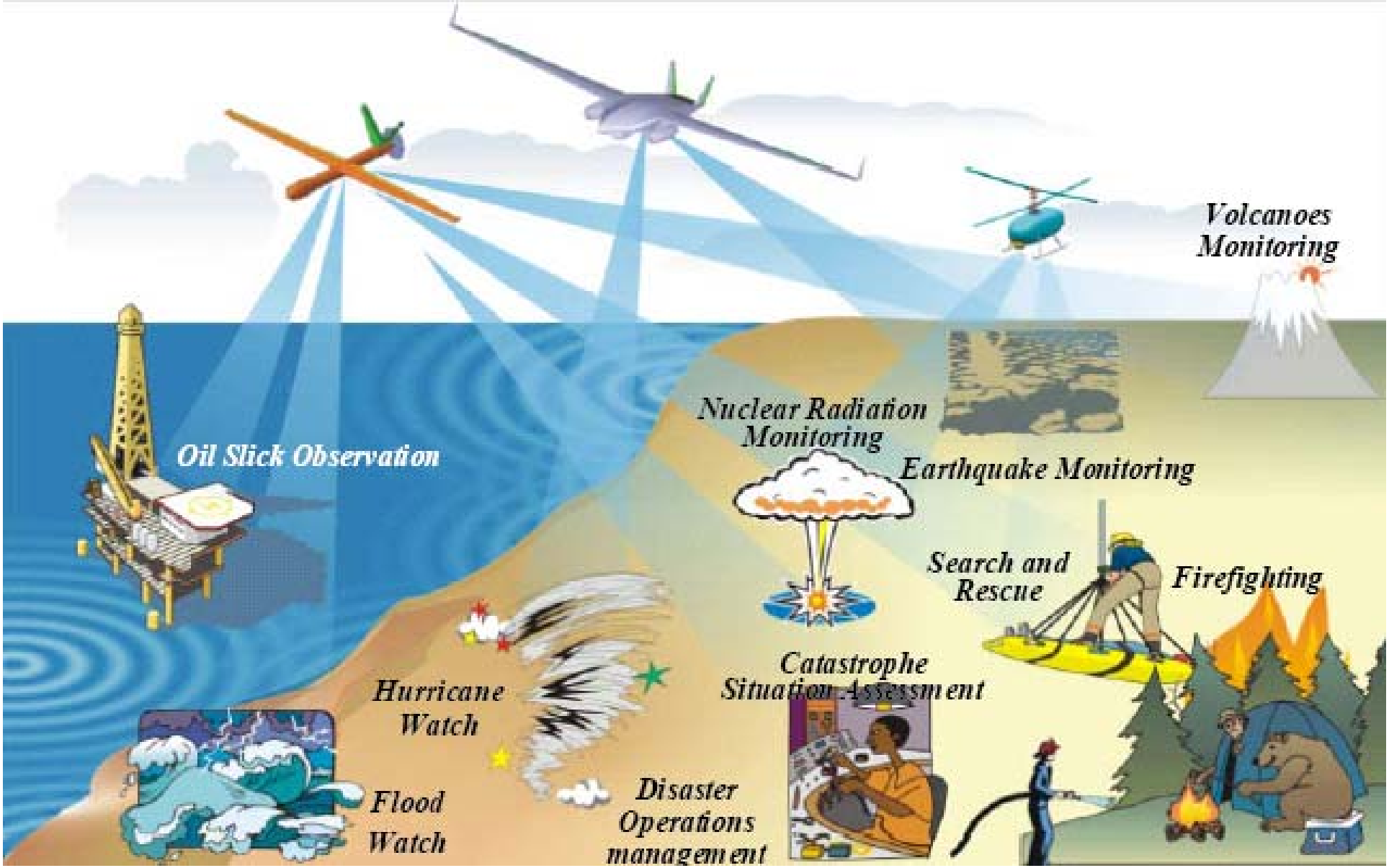
What are your views…

ICAO

Uniting Aviation on

Safety | Security | Environment

Why the interest?



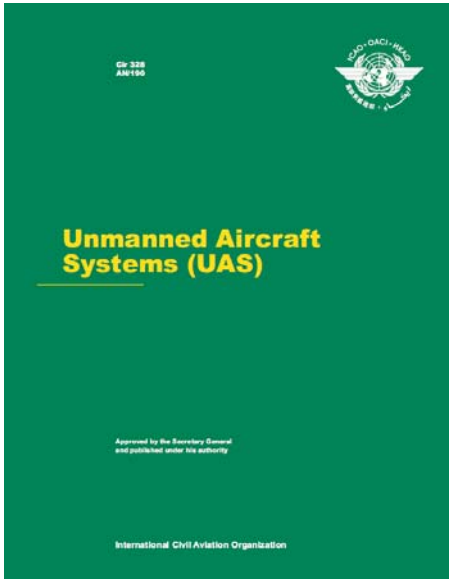
Article 8

Pilotless aircraft

on board

No aircraft capable of being flown without a pilot shall be flown without a pilot over the territory of a contracting State without special authorization by that State and in accordance with the terms of such authorization. Each contracting State undertakes to insure that the flight of such aircraft without a pilot in regions open to civil aircraft shall be so controlled as to obviate danger to civil aircraft.

Unmanned Aircraft Systems (UAS) *(Cir 328)*



- Overview of UAS with regard to
- ICAO framework Terminology
- Legal considerations (re Articles of the
- ICAO Convention)
- Operations (rules of the air, ATM, SAR, AVSEC, aerodromes, environment)
- Equipment (aircraft, remote pilot station, ANS infrastructure)
- Personnel (remote pilot, ATCO)

Will become obsolete once guidance manual is published. (~2015)

ICAO standards and guidance material development to support RPAS

Some of the subjects being considered

1. RPAS Airworthiness and suitability for use
2. RPA Registration
3. Certification of RPAS operators
4. Personnel licensing
5. RPAS Operations
6. Rules of the air and detect and avoid (D&A)
7. Command, control and communications
8. Remote Pilot Stations
9. Instruments, equipment and flight documents
10. Integration of RPAS operations into ATM
11. Use of aerodromes and operating sites
12. Special operations

Spectrum requirements for Aeronautical *safety of life* radio systems

Conditions for *safety of life* spectrum defined in ITU Constitution

- Article 1 (sub-article 2 g)
- Article 40

Aeronautical Safety of Flight allocations:

- ARNS, AM(R)S, AMS(R)S

RR No. 4.10 ...safety services require special measures to ensure their freedom from interference;...

ICAO Standards for aeronautical communications systems require appropriate aeronautical safety of flight allocations