

# Wireless Avionics Intra- Communications (WAIC)

Agenda Item 1.17  
Update and Status  
Wireless Avionics Intra-  
Communications (WAIC)



ICAO Regional WRC-15 Preparatory Workshop  
Cairo, Egypt – February 2015

# Outline

- **What is WAIC**
- **Why is WAIC Important**
- **Regulatory Process Update**
  - Status of ITU Documents
  - Proposal
  - CPM Text Topics
- **Technical Effort**

# What is Wireless Avionics Intra-Communications (WAIC)

- **WAIC is:**
  - Radiocommunication between two or more points on a single aircraft.
  - Integrated with the aircraft.
  - Part of a closed, exclusive network required for aircraft operation.
  - Only safety-related applications.
  - Based on short range radio technology (< 100m).
  - Low maximum transmit power levels of 10mW for low rate and 50mW for high rate applications
  - Mostly internal - within fuselage/cabin.
- **WAIC does not:**
  - Provide off-board air-to-ground, air-to-satellite, or air-to-air service.
  - Provide communications for passengers or in-flight entertainment.

## **Importance of WAIC for Next Generation of Aircraft**

- Aircraft and the RF environment in which they operate are evolving.
- In striving to utilize wireless capabilities, aircraft are on the verge of important technological and design transformations.
- WAIC represents the aviation industry's effort to realize the benefits of wireless technologies and sensors for the future generation of aircraft for safety-related functions.
- Goal is to add operational efficiencies and reduce the overall weight of systems; and include the ability to obtain more aircraft systems and aircraft surface (wings) data during all phases of flight.
- Enhance efficiency and reliability while maintaining or improving current required levels of safety.
- The intent is to NOT mandate equipage changes or to require additional costs to airlines.

# Importance of WAIC to Airlines



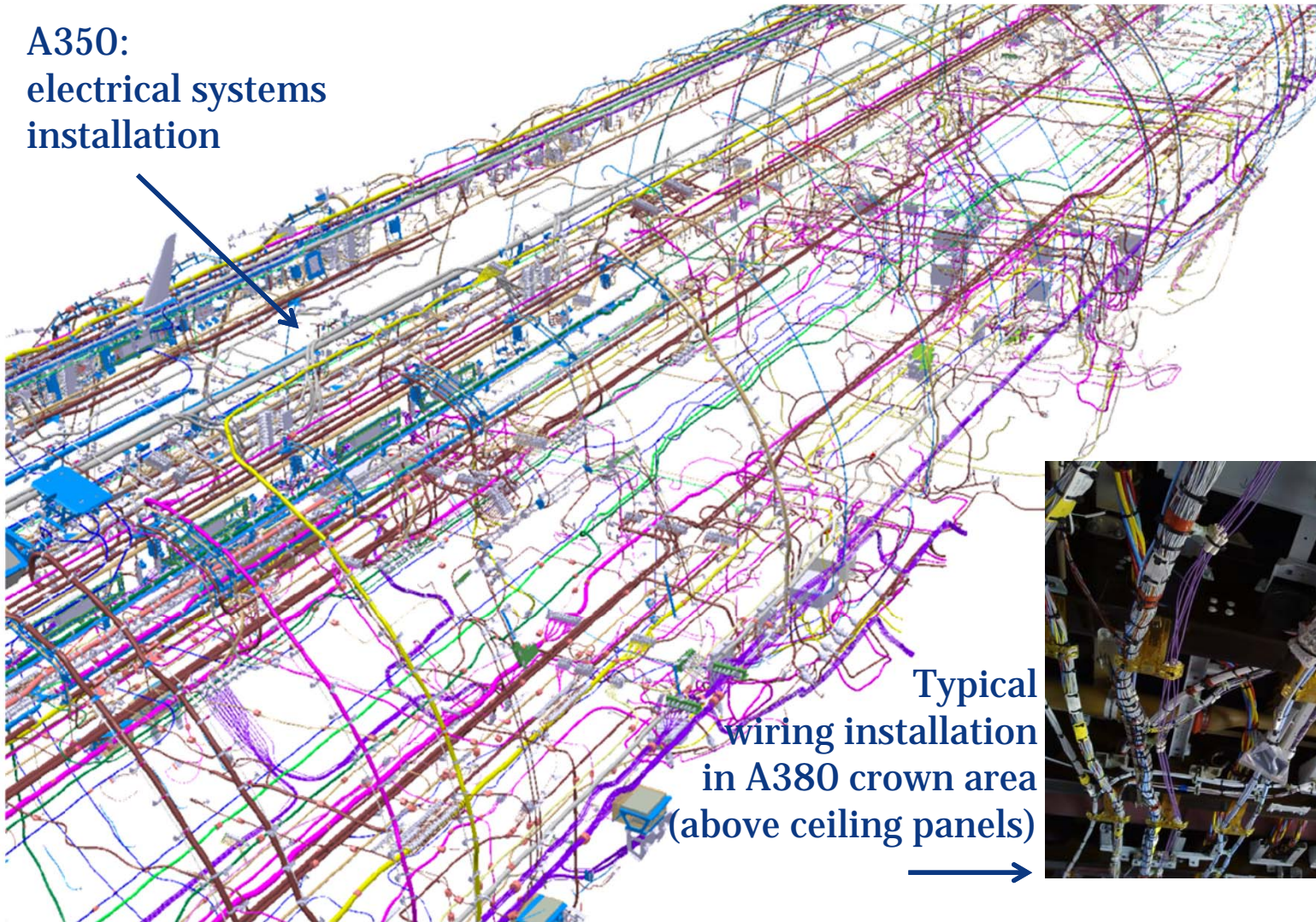
- **Safety Improvements:**
  - Provide dissimilar redundancy
  - Fewer wires means a reduction in connector pin failures, lower risk of cracked insulation & broken conductors.
  - Mesh networking could provide redundancy in emergencies.
- **Environmental Benefits:**
  - Reduced wiring and associated aircraft weight enables less fuel burn.
- **Increased Reliability**
  - Reduce amount of aging wiring
  - Simplify and reduce life-cycle cost of airplane wiring
  - Ability to obtain more data from aircraft systems and surfaces
  - Add new sensors and controls without additional wire routing
- **Provide operational efficiencies and associated cost savings.**
  - To monitor systems and surfaces that currently cannot be monitored without taking the aircraft out of service.

# Examples of Potential WAIC Applications

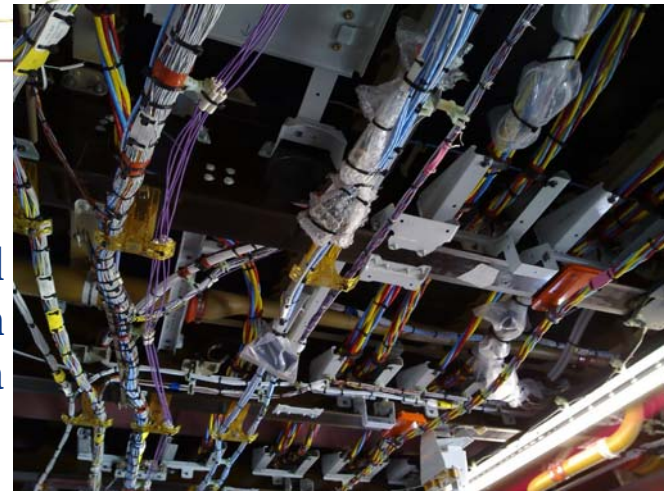
- **Low Data Rate, Interior Applications (LI):**
  - **Sensors:** Cabin Pressure - Smoke Detection - Fuel Tank/Line – Proximity Temperature - EMI Incident Detection - Structural Health Monitoring - Humidity/Corrosion Detection
  - **Controls:** Emergency Lighting - Cabin Functions
- **Low Data Rate, Outside Applications (LO):**
  - **Sensors:** Ice Detection - Landing Gear Position Feedback - Brake Temperature - Tire Pressure - Wheel Speed - Steering Feedback - Flight Controls Position Feedback - Door Sensors Engine Sensors - Structural Sensors
- **High Data Rate, Interior Applications (HI):**
  - **Sensors:** Air Data - Engine Prognostic - Flight Deck/Cabin Crew Images/Video
  - **Comm.:** Avionics Communications Bus - FADEC Aircraft Interface - Flight Deck/Cabin Crew Audio / Video (safety-related)
- **High Data Rate, Outside Applications (HO):**
  - **Sensors:** Structural Health Monitoring
  - **Controls:** Active Vibration Control

# Need for WAIC - Complexity of electrical wiring in modern aircraft

A350:  
electrical systems  
installation



Typical  
wiring installation  
in A380 crown area  
(above ceiling panels)



# Need for WAIC - Complexity of electrical wiring in modern aircraft

- **Electrical wiring:**  
**some statistics for the example of the A380-800**
  - Total wire count: ~100 000
  - Total wire length: 470 km
  - Total weight of wires: 5 700 kg
  - About 30% of additional weight to fix the harness to the structure

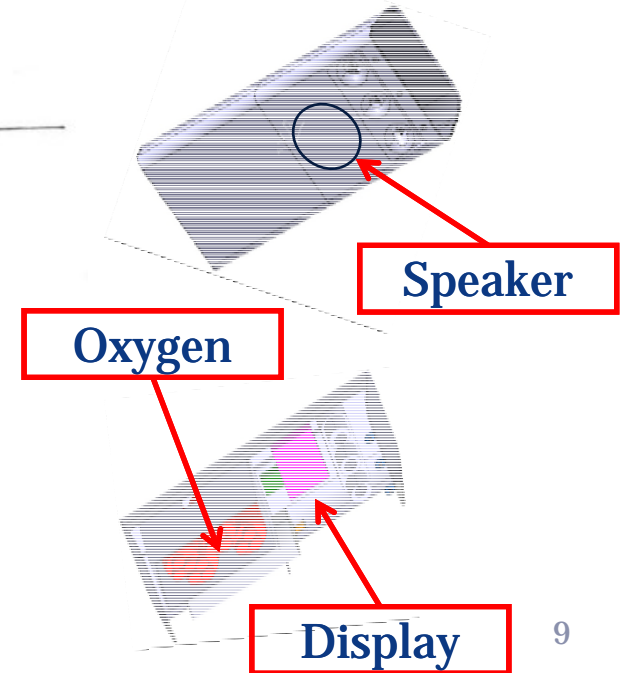
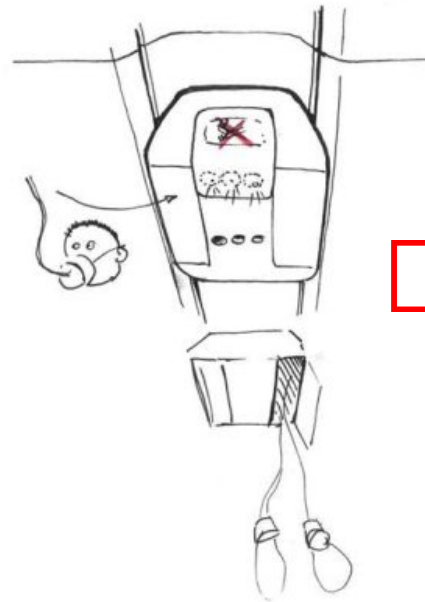
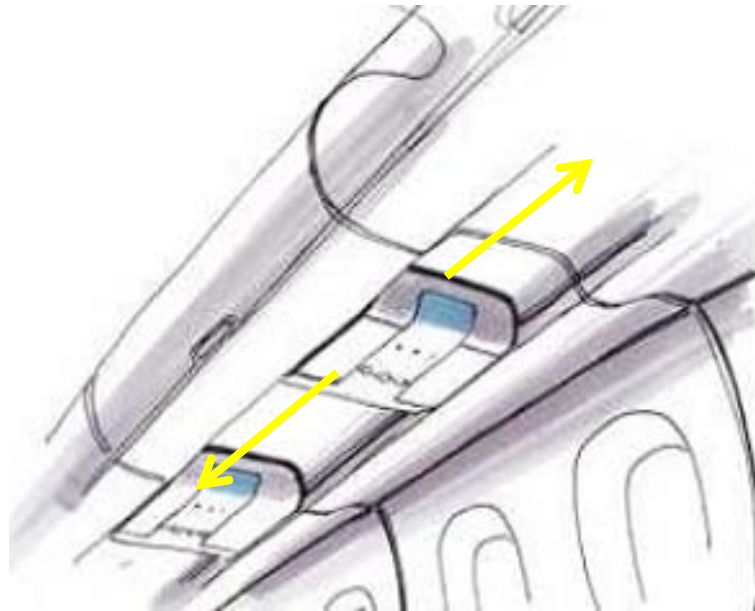
About 30% of electrical wires are potential candidates for a wireless substitute!



# Need for WAIC - Reconfigurability

## Example: Wireless Supply Unit

- Release of oxygen masks and trigger of oxygen flow
- Passenger Address Function (audio announcement)
- Display providing safety information to the passenger
- Needs to feature flexible installation locations for allowing fast reconfiguration of seat layout



# Need for WAIC - Dissimilar Redundancy

## Example: Redundant communication paths

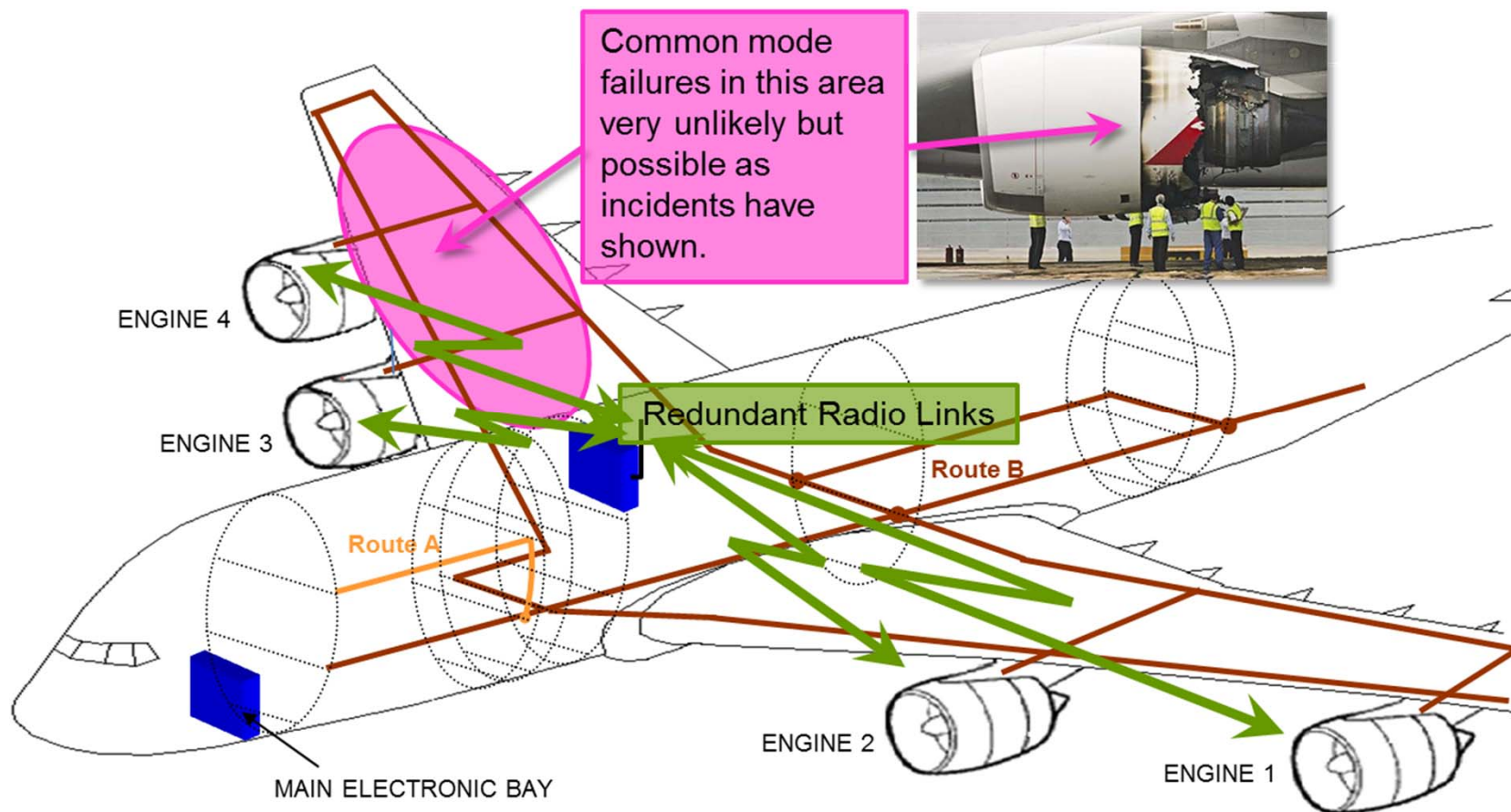
- Aircraft wiring typically features dual or triple redundancy.
- Redundant wiring routes in different areas within the aircraft structure mitigate risk of single points of failure
- Wiring routes are segregated to the farthest possible extent allowed by the aircraft geometry

***A wireless connection provides a dissimilar redundancy if wires are disconnected.***

# Need for WAIC - Dissimilar Redundancy

## Example: Redundant communication paths (cont'd)

- Route segregation, combined with redundant radio links, provides dissimilar redundancy and mitigates risk of single points of failure



# Regulatory Process Update

- **The safety of the aircraft is the #1 priority!**
- **The ITU is only the first of many regulatory processes.**
  - Work on sharing studies is completed.
  - Draft CPM Text finalized.
- **Updating ICAO, regional spectrum organizations, and industry organizations.**
- **ICAO SARPS effort is expected to begin immediately after WRC-15.**
- **WAIC Standardization process.**
  - EUROCAE Working Group 96 is actively working on certification guidance material for WAIC systems.
  - RTCA is encouraged by EUROCAE to join effort.
- **Ultimately, aircraft certification will support the safe installation of WAIC on any aircraft.**

# Agenda Item 1.17 – Resolution 423

## ***resolves***

that WRC-15 consider, based on the results of ITU-R studies, possible regulatory actions, including appropriate aeronautical allocations, to support the implementation of WAIC systems, while taking into account spectrum requirements for WAIC and protection requirements for systems operating in accordance with existing allocations,

## ***invites ITU-R***

- 1 to conduct, in time for WRC-15, the necessary studies to determine the spectrum requirements needed to support WAIC systems;
- 2 to conduct sharing and compatibility studies, based on the results of *invites ITU-R 1*, to determine appropriate frequency bands and regulatory actions;
- 3 when conducting studies in accordance with *invites ITU-R 2*, to consider:
  - i) frequency bands within existing worldwide aeronautical mobile service, aeronautical mobile (R) service and aeronautical radionavigation service allocations;
  - ii) additional frequency bands above 15.7 GHz for aeronautical services if spectrum requirements cannot be met in frequency bands studied under *invites ITU-R 3i*),

# Technical Effort

- **Technical information about WAIC can be found in ITU-R Report M.2283**
- **Document Contains:**
  - Technical Characteristics grouped by “key” characteristics
  - System architecture
  - Aircraft shielding analysis
  - Bandwidth and data rate requirements
  - Other information necessary to conduct compatibility studies

# Status of ITU Documents

- ITU-R Recommendation, ITU-R M.2059; Operational and technical characteristics and protection criteria of radio altimeters utilizing the band 4 200-4 400 MHz.
- ITU-R Report, ITU-R M. 2283; Technical characteristics and spectrum requirements of WAIC systems to support their safe operation.
- ITU-R Recommendation, ITU-R M.2067: “Technical characteristics and protection criteria for Wireless Avionics Intra-Communications systems.”
- Reports approved at November 2014 Study Group 5 Meeting:
  - Report ITU-R M.2319: Compatibility analysis between wireless avionics intra-communication systems and systems in the existing services in the frequency band 4 200-4 400 MHz.
  - Report ITU-R M. 2318: Consideration of the aeronautical mobile (route), aeronautical mobile, and aeronautical radionavigation services allocations to accommodate WAIC
- Preliminary Draft New Recommendation ITU-R M.[WAIC\_Conditions] still being considered at WP-5B.
- Studies of bands 2700-2900 MHz, 5350-5460 MHz, 22.5-22.55 GHz and 23.5-23.55 GHz were conducted but studies concluded non-compatibility.

# Proposal

## **4200-4400 MHz:**

- Current worldwide allocation to the ARNS, and more specifically to only radio altimeters onboard aircraft.
- Radio altimeters and WAIC systems located on the same aircraft and are under full operational control of the aircraft manufacturer thereby allowing the manufacturer to take measures to ensure compatibility.
- ITU-R studies show no negative impact to WAIC or radio altimeters.
- ICAO position (clean version) supports use of the band 4 200 – 4 400 MHz.
  - Support a global aeronautical mobile (route) service allocation in the frequency band 4 200 – 4 400 MHz exclusively reserved for Wireless Avionics Intra-Communications (WAIC) systems operating in accordance with recognized international aeronautical standards.
- Consensus from regions for AM(R)S allocation for WAIC in this radio frequency band.



# CPM Text

## Proposals:

All Methods allocate the band 4200-4400 MHz for AM(R)S limited to WAIC systems.

### Method A:

- Option 1: Proposes a footnote containing a new Resolution to define WAIC systems, mandate protection for ARNS (radio altimeters), clarifies Article 43.1 does not apply.
- Option 2: Same as above. However, provides additional considering regarding potential issue with adjacent FSS users.
- Option 3: Similar to Option 1, but provides additional technical limitations on WAIC systems.
- Instead of a Resolution, another option provides text with “critical” information (Definition, ARNS protection and Art. 43.1) to be located directly in a footnote.
- Method B: proposes a Recommendation to be used instead of a Resolution.

## **CPM Text (continued)**

### **Proposed Changes to CPM Text:**

There are no proposals for “No Change” to the radio regulations.

- **CEPT: Agreed on a Common European Proposal based on Method A Option 1:**
  - addition of an aeronautical mobile (route) service allocation in the frequency band 4 200 – 4 400 MHz
  - modification of Footnote 5.438
  - introduction a new footnote reserving the AM(R)S allocation exclusively to WAIC systems and referencing new Resolution [A117]
  - and the introduction of a new Resolution [A117], containing definition and detailed regulatory provisions to satisfy the agenda item
- **US: Proposes editorial modifications and provides a separate option for the footnote containing the “critical” information without an accompanying resolution or recommendation.**
- **IUCAF: Supports an allocation for AM(R)S limited to WAIC in the band 4200-4400 MHz.**

# Conclusion

- **WAIC technology will benefit the airlines and aviation industry.**
- **Safety will be enhanced.**
- **ITU, ICAO, ASMG, APT, ATU, CITEL, CEPT, RCC and aviation groups are all being updated.**
- **All groups interested in aviation spectrum issues are welcome to participate.**
- **The ITU effort is the first regulatory process. The ITU will only define, at a high level, the ability for WAIC to use a frequency band.**
- **ICAO, RTCA and EUROCAE efforts are critical to the eventual implementation of WAIC systems.**
- **ICAO plays a particularly important role in implementing the link with the regulatory framework provided by ITU-R ensuring that WAIC systems are being developed on the basis of internationally accepted minimum operational performance standards.**

# Questions?





**THANK YOU**