Agenda Item 1.17 Wireless Avionics Intra-Communications (WAIC)

Joseph Cramer
The Boeing Company

Presentation for Working Parties 5A, 5B, 5C
Workshop on Preparations for WRC-15
May 23, 2012

WAIC and Next Generation of Aircraft

- Aircraft and the RF environment in which they operate have been evolving.
  - Mobile phones, Internet connectivity, wifi-based in-flight entertainment systems, live television, enhanced connectivity for airlines at gates and for aircraft maintenance, etc.
- Aircraft are on the verge of an important technological and design transformation.
- WAIC represents the aviation industry's effort to derive the benefits of wireless technologies for the future generation of aircraft for safety-related functions.
- The use of wireless technologies will reduce the overall weight of systems, reducing the amount of fuel required to fly and thus benefiting the environment.
- Operational efficiencies include the ability to obtain more data from aircraft surfaces, and to do so during all phases of flight.
- The goal is to enhance efficiency and reliability while maintaining, current required levels of safety as a minimum.

Wireless Avionics Intra-Communications

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

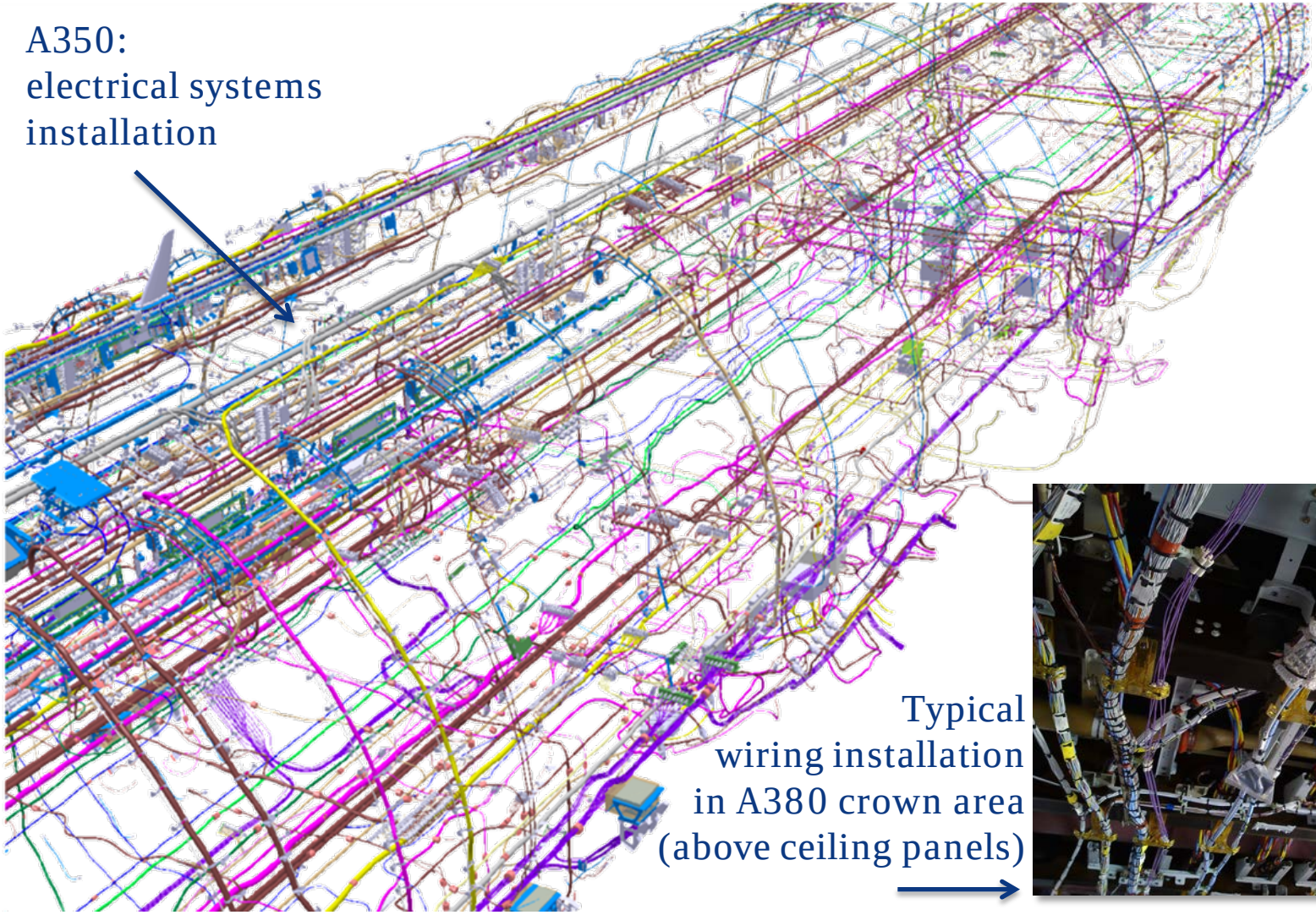
Importance of WAIC to Aviation Industry

- Technical Importance:
  - Safety Improvements:
    - Wireless links provide dissimilar redundancy
    - fewer connector pins/failures, lower risk of cracked insulation & broken conductors
    - Mesh networks could provide redundancy in emergencies.
  - Environmental Benefits:
    - Goal is to reduce wiring and associated aircraft weight, enabling 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

- Regulatory Importance:
  - Requires access to harmonized spectrum world-wide
  - Spectrum usage must fall within ICAO Convention in order to obtain benefits for equipment certification.

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

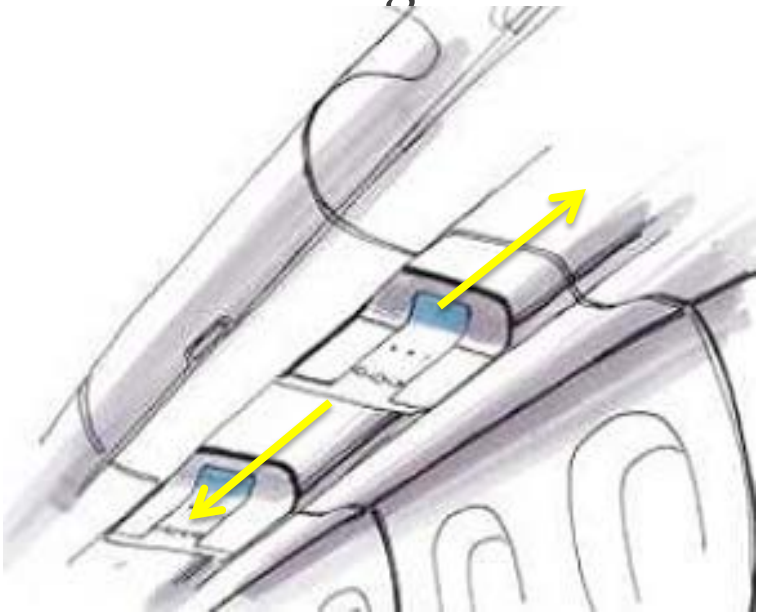
- Total wire count: ~100 000
- Total wire length: 470 km
- Total weight of wires: 5 700 kg
- About 30% of additional weight for harness-to-structure fixation

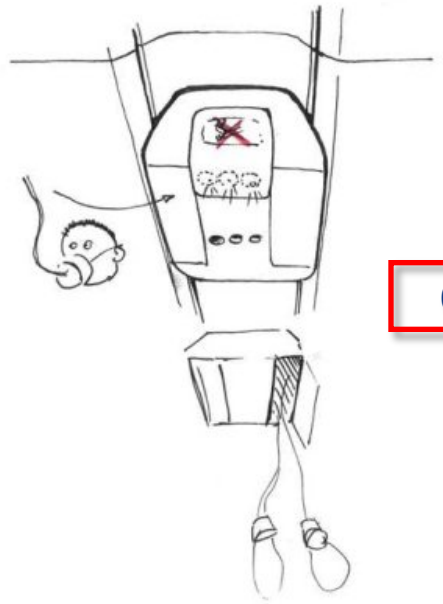
<u>About 30% of electrical wires are potential candidates for a wireless substitute!</u>

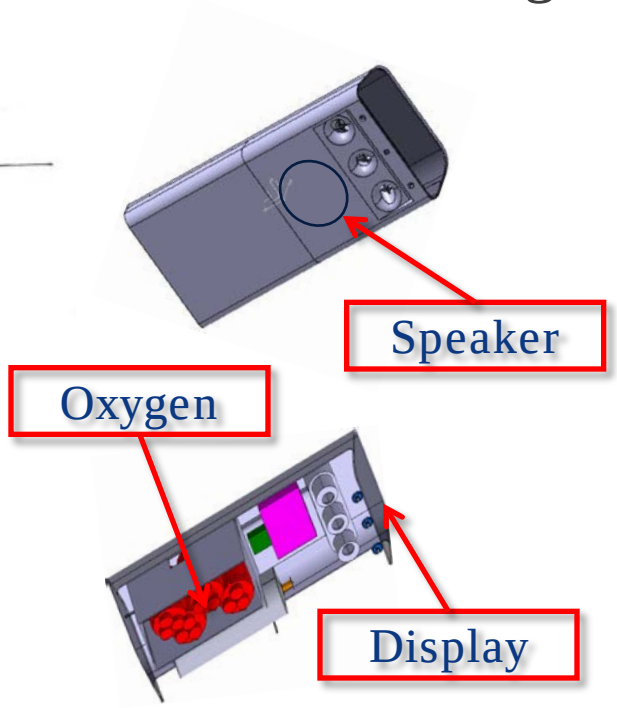
Need for WAIC - Reconfigurability

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

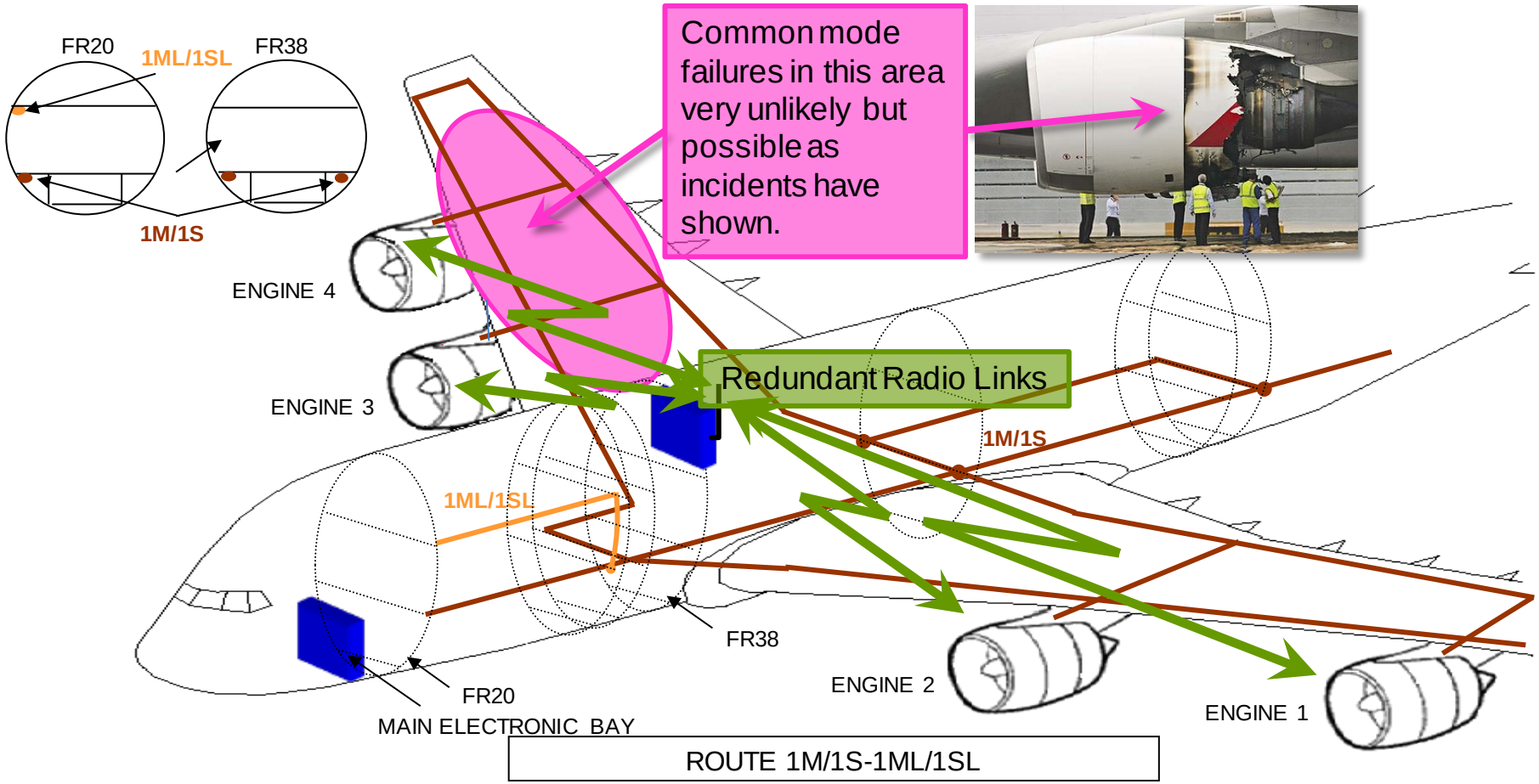
Example: Redundant communication paths

- Aircraft wiring typically features twice 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 extend 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



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),

Conclusion

- **The civil aviation industry's interest is broad based, including the world's leading aerospace companies and major providers of aircraft avionics.**
- **Worldwide Allocation(s) are required – aircraft fly "everywhere."**
- **Close work with ITU-R and ICAO necessary.**
- **WAIC will benefit airlines, passengers, the environment.**