Protected Spectrum for Wireless Avionics Intra-Communications

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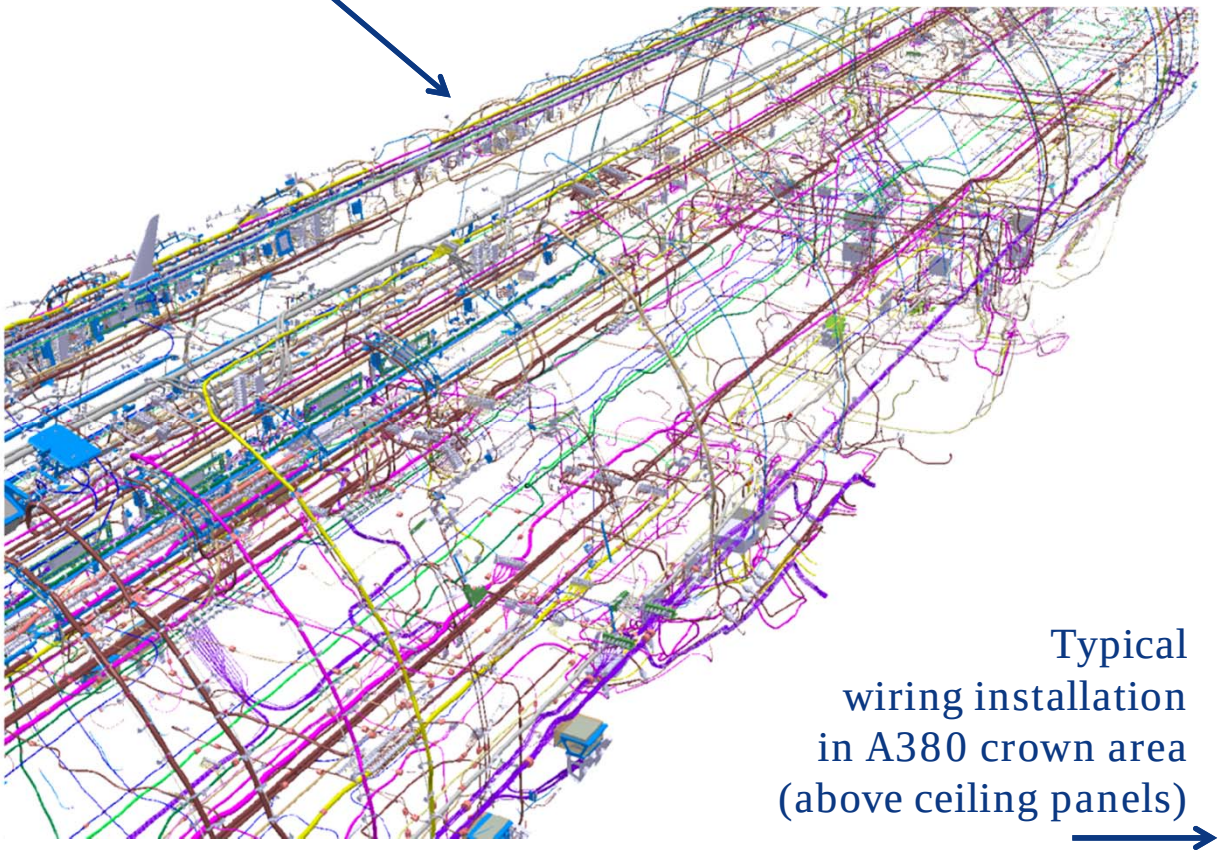
Motivation for wireless: Complexity of electrical wiring in aircraft

A350:
electrical systems
installation

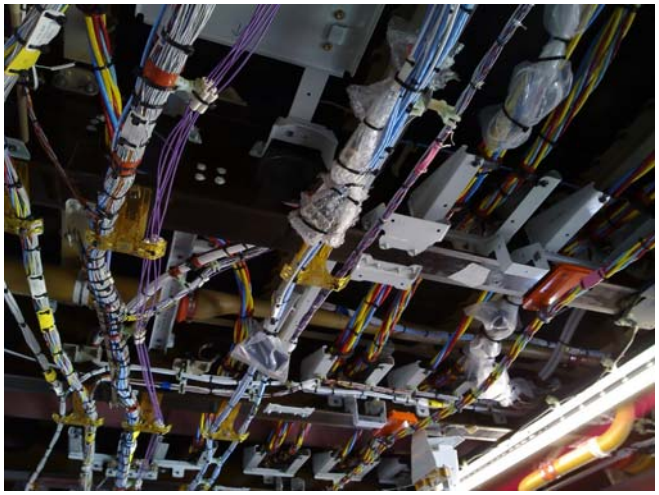


A380-800 wiring:

- Total wire count: ~100 000
- Total wire length: 470 km
- Total weight of wires: 5 700 kg
- About 30% of additional weigh for wire mounting

About 30% of wiring can be potentially substituted by wireless

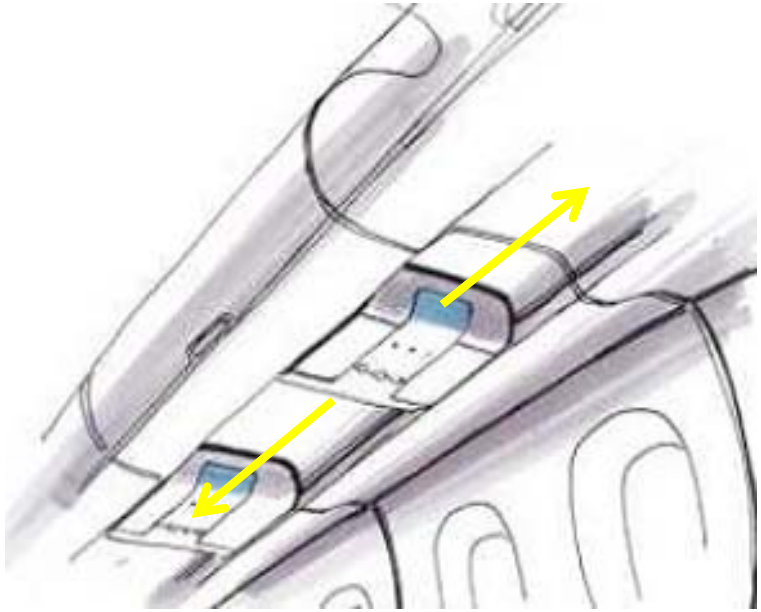
Typical
wiring installation
in A380 crown area
(above ceiling panels)

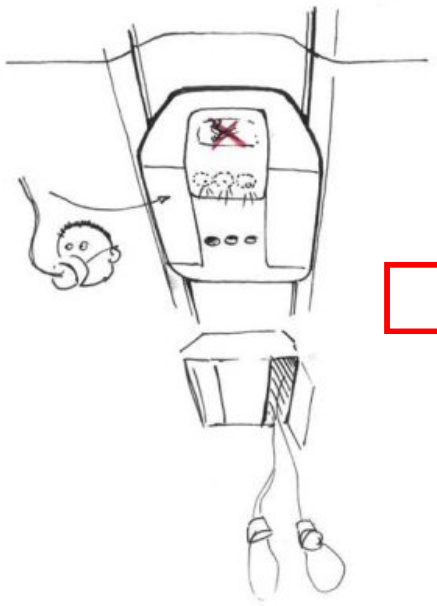


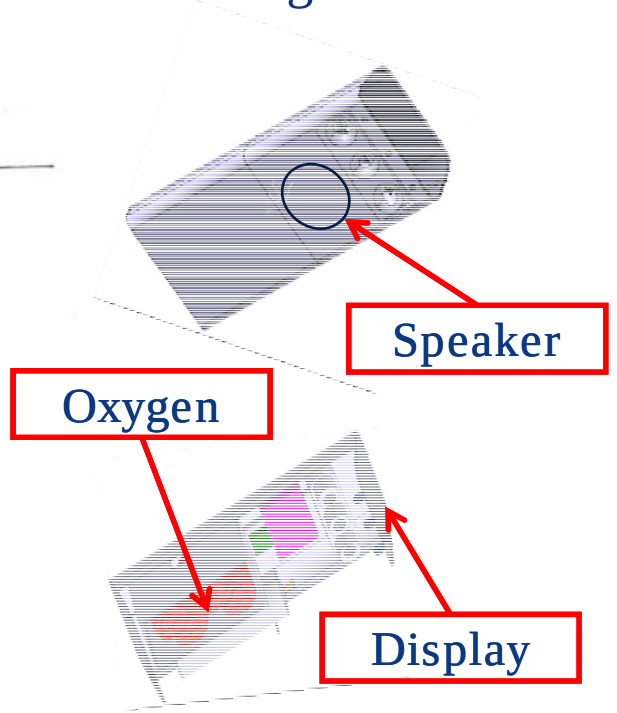
Motivation for wireless: Reconfiguration of aircraft systems

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

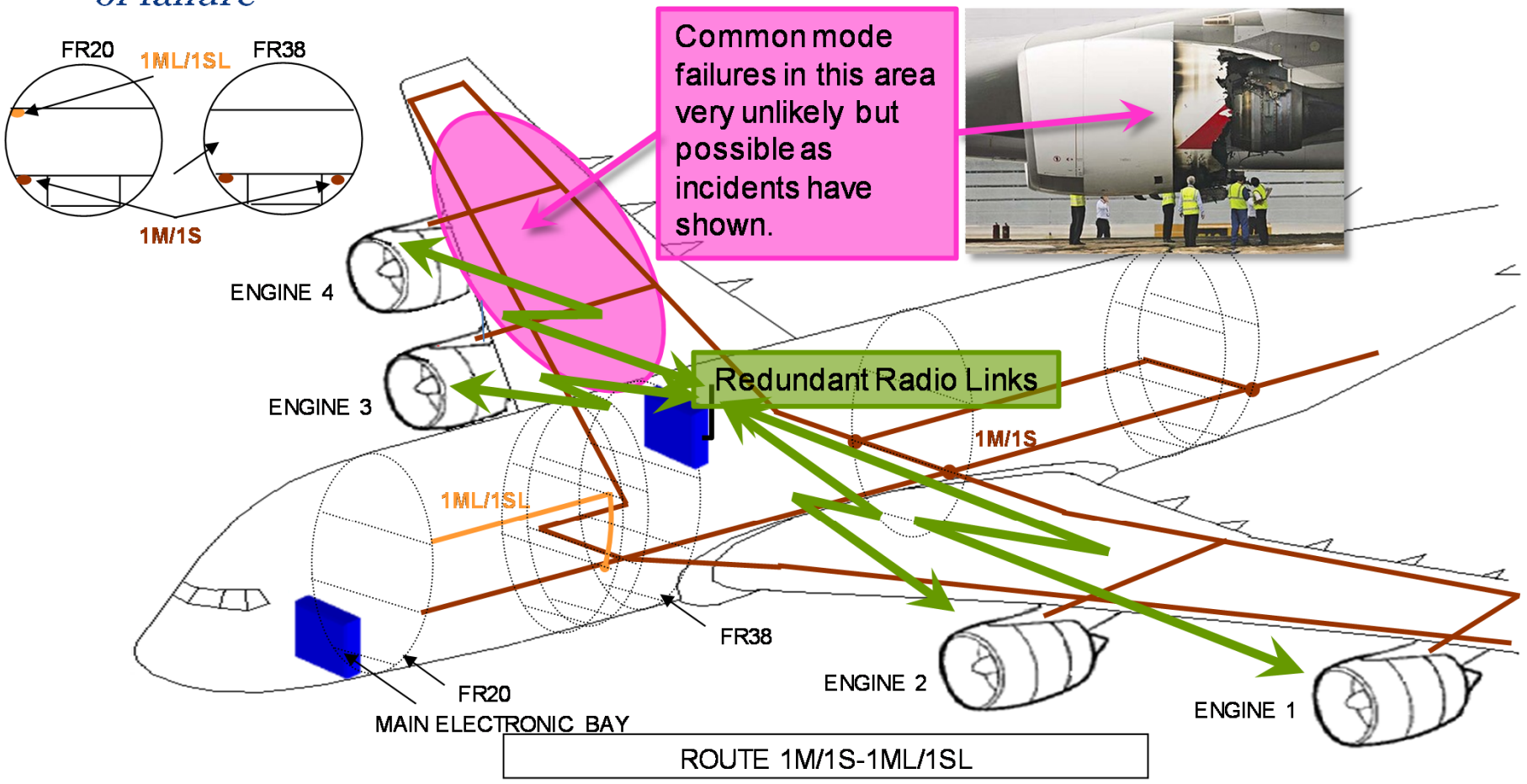






Motivation for wireless: Dissimilar redundancy

- Safety-critical wiring features usually twice or triple redundancy
- Wireless may provide dissimilar redundancy if wires are disconnected
- Radio links combined with route segregation may mitigate risk of single points of failure



Summary of wireless benefits

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

- 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

AVSI
AEROSPACE VEHICLE SYSTEMS INSTITUTE

Protected spectrum for wireless avionics

- License-free bands (ISM) not suitable for safety-critical uses
  - Interference from unpredictable number of sources
  - No regulatory protection available
  - Demonstration of reliable communication difficult (impossible)
- Protected spectrum needed for safety-critical systems
  - Necessary for certification – FAA and industry consensus
  - *Protected*, but not *dedicated* – all spectrum is already allocated to someone
- Aeronautical spectrum allocation desired
  - Spectrum usage within ICAO Convention gives benefits for equipment certification.
  - World-wide frequency allocation(s) must be obtained
- **Protected spectrum pursuit**
  - **Project initiated within Aerospace Vehicle Systems Institute (AVSI)**
  - **Aimed at securing new frequency allocations**

AVSI Project AFE73 - WAIC

Aerospace Vehicle System Institute (AVSI)

- Consortium of companies, academia and government agencies
- Operated by Texas A&M University
- Enables cooperative research projects
- More info at http://www.avsi.aero/ or contact AVSI Director David Redman (dredman@tamu.edu)

Project AFE73

- Active since 2008
- Members have included: Airbus, BAE Systems, Boeing, Bombardier, Embraer, Goodrich, Gulfstream, GE Aviation, Honeywell, NASA, Sikorsky
- Build broad support for WAIC
- Provide technical justification for spectrum request
- Work within ITU-R and other international organizations

Scope of WAIC

WAIC = Wireless Avionics Intra Communications

What WAIC is:

- Radio communications between aircraft stations installed on a single aircraft.
- Includes integrated wireless and/or installed components.
- Part of a closed, exclusive network required for operation of the aircraft.
- Only safety-related applications.
- Based on short range radio technology (< 100m).
- Will utilize low transmission power (< 10 mW).
- Most applications are internal - within fuselage/cabin.
- External transmission via directional antennas (e.g. landing gear, engines, wings)

What WAIC is not:

- Systems for air-to-ground, air-to-satellite, or air-to-air communication.
- Systems for passengers communication or in-flight entertainment.

Spectrum Regulatory Process Overview

Spectrum allocation is part of Radio Frequency Management.

Radio Frequency Management is done by experts who meld years of experience with a curious blend of regulations, electronics, politics, and not a little bit of larceny. They justify requirements, horse-trade, coerce, bluff and gamble with an intuition that cannot be taught other than by long experience.

Dr. Jon L. Boyes (1921-2004)
Vice Admiral, United States Navy

- The process is long, convoluted and not quite rational
- Follows the 3-4 year World Radiocommunication Conference cycle
- The only way to get the desired spectrum allocations

Recent WAIC Milestone
WRC-15 Agenda Item

World Radiocommunication Conference in Geneva on February 15, 2012, adopted an Agenda Item for Wireless Avionics Intra-Communications (WAIC)

- One of the two most supported agenda items
- Result of four years of hard work
- Means that the next WRC-15 will vote on new frequency allocation

RESOLUTION COM6/22 (WRC-12)

The World Radiocommunication Conference (Geneva, 2012) (…)

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 (…)

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* 3 i),

invites

the **International Civil Aviation Organization (ICAO)** to contribute to these studies,

instructs the Secretary-General

to bring this Resolution to the **attention of ICAO**.

Frequency allocations will be changed

Aeronautical allocations are desired

Technical work to be completed by WAIC team

Primary target spectrum

Secondary target spectrum

ICAO will be involved

Protected Spectrum Timeline

Compatibility and spectrum sharing studies
- Justify band(s) can be safely used by WAIC
- Convince existing users, build industry consensus
- Conference Preparatory Material must be ready by mid-2014

Now

Initial Spectrum Workshop 2007	2008–2011	World Radio Conference Feb. 2012	2012	2012–2014	World Radio Conference Nov. 2015	2016+
Industry consensus on need for new spectrum	ITU-R Report and Agenda Item proposals	Agenda Item for WRC-15 adopted at WRC-12	Specific spectrum proposal	Official spectrum sharing studies	New spectrum allocation	New allocations ratified by member states

Current work
- Substantiate amount of spectrum requested
- Specify targeted frequency band

New systems can be deployed

Questions?