ARINC Project Initiation/Modification (APIM)

1.0 Name of Proposed Project APIM 18-003

ARINC Project Paper 8xx: Next Generation Radio Systems Architecture Framework

1.1 Name of Originator and/or Organization

Airbus

2.0 Subcommittee Assignment and Project Support

2.1 Suggested AEEC Group and Chairman

Group: SAI Subcommittee

Chairmen: Rich Stillwell, United and Reinhard Andreae, Lufthansa

2.2 Support for the activity (as verified)

Airlines: American, Delta, Southwest, UPS, United
Airframe Manufacturers: Airbus, Boeing, Embraer
Suppliers: ACSS, Honeywell, Rockwell Collins, Thales
Others:

2.3 Commitment for Drafting and Meeting Participation (as verified)

Airlines:
Airframe Manufacturers: Airbus, Boeing
Suppliers:
Others:

2.4 Recommended Coordination with Other Groups

AGCS, DLUF, DLK, IPS,

3.0 Project Scope (why and when standard is needed)

3.1 Description

Enabled by the introduction of new technological advances in electronic components and capabilities, new concepts of distributed architectures are emerging for the CNS (Communication, Navigation, Surveillance) radio systems, which show very promising benefits in terms of costs, size, weight, and power consumption.

The baseline underlying principle of such distributed radio architectures is to relocate parts of the radio processing on a hardware placed at close proximity of the antenna, while residual functions and processing of the radio can be done with software running on less specific computing platforms installed in the avionics bay. Such distributed radio architectures allow notably:

- Simplification (and SWAP/cost savings) to RF signal processing parts, by avoiding signal attenuations/interferences over long coaxial wires
- Simplification (and Weight/costs savings) on the wiring, by replacement of RF coaxial cables with thinner, lighter, and more easily installed digital links
- Increased flexibility for evolution of the radio and its interfaces, and for adaptation to specificities of the targeted aircraft platform via software upgrade (e.g., Short range vs Long range mission according to regional environment)

- Paving the way to further optimization on the architecture, e.g., communalization of components of these architecture across multiple radio systems, simplification of the radio physical interfaces, or of the packaging of hardware parts.

Given the promising benefits of such radio architectures, initiatives from suppliers to propose distributed radio products should be encouraged. However, a risk arises that disparate and exclusive proposals from different suppliers may lead to a variety of supplier specific solutions, which would be with detrimental effects on:

- Interoperability and Interchangeability / mixability of product lines;
- Consistency and optimization of the overall A/C systems architecture with regards to the intended benefits;
- Fair and sustained competition between suppliers.
- Qualification /Certification workload and cost
- Supplier market size, and resulting product costs
- Trust of the final customers in these new products

It is proposed to develop a comprehensive framework setting the commonly agreed preferred approaches for future aircraft radio systems architectures, and providing recommendations, direction, required characteristics, transition scenarios and roadmap for possible new standards on constituents of these architectures.

That framework would come as an “overarching standard,” ahead of future individual CNS radio equipment standards to establish an industry consensus on the way forward to these future architectures.

The output of the subcommittee will be an ARINC Report.

3.2 Planned usage of the envisioned specification

Note: New airplane programs must be confirmed by manufacturer prior to completing this section.

New aircraft developments planned to use this specification

Airbus: (TBD) yes ☒ no ☐

Boeing: (TBD) yes ☒ no ☐

Other: (manufacturer, aircraft & date)

Modification/retrofit requirement yes ☐ no ☒

Specify: (aircraft & date)

Needed for airframe manufacturer or airline project yes ☒ no ☐

Specify: (aircraft & date)

Mandate/regulatory requirement yes ☐ no ☒

Program and date: (program & date)

Is the activity defining/changing an infrastructure standard? yes ☐ no ☒

Specify:

When is the ARINC standard required? __2021____

What is driving this date? _______________

Are 18 months (min) available for standardization work? yes ☒ no ☐

If NO please specify solution: ________________

Are Patent(s) involved? yes ☐ no ☒

If YES please describe, identify patent holder: __________________

3.3 Issues to be worked

Issues to be worked include an assessment addressing the following:

- A typology/classification of radio architectures, including new distributed radio architecture options
- Identification of the best architecture option(s) for each CNS radio in the future
- Possible future transverse combination/integration of CNS radio components
- Constraints for RF Front Ends installation and identification of Fit/Forms solutions
- Requirements on the digital interfaces to RF Front Ends and recommendations for the development of a standard
- Requirements on future avionics interfaces for the radio systems (data/audio) and recommendations for the development of a standard
- Characterization of radio computing platforms and recommendations for the development of standards
- Identification of potential opportunities for the factorization/rationalization of common services for the radios
- Data Security requirements, and approaches for isolation of the aircraft systems from attacks through RF interfaces
- Safety considerations on the architectures
- Certification considerations
- Transition approaches for the deployment of new products, including on current aircraft programs

Based on this assessment, the work should be completed by the definition of a plan to develop missing standards.

4.0 Benefits

4.1 Basic benefits

Operational enhancements yes ☒ no ☐

For equipment standards:

(a) Is this a hardware characteristic? yes ☒ no ☐

(b) Is this a software characteristic? yes ☒ no ☐

(c) Interchangeable interface definition? yes ☒ no ☐

(d) Interchangeable function definition? yes ☒ no ☐

If not fully interchangeable, please explain: __________________

Is this a software interface and protocol standard? yes☐ no ☒

Specify: __________________

Product offered by more than one supplier yes ☒ no ☐

Identify: (company name)

4.2 Specific project benefits (Describe overall project benefits.)

4.2.1 Benefits for Airlines

Weight and power consumption savings inducing lower fuel consumption:

The currently used long RF co-axial cables are relatively heavier than digital cables. The weight of the additional brackets needed to guide these RF cables over separate routes (to avoid electromagnetic interferences) is also not negligible. Hence, replacement of RF coaxial cables by thinner, lighter, and bundled digital cables or optical fibers can save tangible weight.

Replacement of the lossy RF coaxial cables by digital interface and location of the RF Front End in close proximity to the antenna, remove the need to compensate the cable loss and noise, and can allow using of smaller and lighter hardware, consuming less power.

Reduction of Interference Issues

Carrying analog signals over long RF coaxial cable present EMI radiation and susceptibility issues, notably crosstalk interferences, which are removed with the use of digital cables.

Flexibility for evolutions, and options management

Less constrained by the inflexibility of hardwired circuitry and wiring specificities, distributed radio architectures may reduce the work required to incorporate evolutions, and additions & removals to the Aircraft radio systems.

Interoperable with current Ground and Space infrastructures (No change required)

4.2.2 Benefits for Airframe Manufacturers

Faster aircraft production:

The conventional radio systems installation costs are driven by mechanical RF structures (high-quality connectors, waveguide, coax and brackets) which are numerous and globally heavy and expensive because of the relatively large number of discrete parts and the high labor content of assembly and installation. Many RF assemblies are virtually hand crafted on the production line.

The use of digital bus technology, on the other hand, reduces or eliminates most such manufacturing steps. Digital buses can be bundled together, which has the potential to reduce installation constraints. They can be auto-tested. A single bus or optical fiber may have the potential to replace number of RF cables. And digital technology is also much more amenable economies of scale in manufacturing.

Weight and power consumption savings inducing lower fuel consumption:

Similar to airline benefits

Reduction of Interference Issues

Similar to airline benefits

Flexibility for evolutions, and options management

Similar to airline benefits

4.2.3 Benefits for Avionics Equipment Suppliers

Lower Product Recurring Cost

With simpler physical interfaces, simpler packaging, a reduced number of hardware specific parts, and software reusability, future radio system architectures are destined to make radio products easier and cheaper to manufacture and maintain.

Better reusability across different aircraft platform

Distributed parts of the radio can be made less dependent on the target aircraft architecture and interfaces, and evolutions.

5.0 Documents to be Produced and Date of Expected Result

ARINC Project Paper 8xx: Next Generation Radio Systems Architecture Framework

5.1 Meetings and Expected Document Completion

The following table identifies the number of meetings and proposed meeting days needed to produce the documents described above.

Activity	Mtgs*	Mtg-Days* (Total)	Expected Start Date	Expected Completion Date
ARINC Project Paper 8xx: *Next Generation Radio Systems Architecture Framework*	*6*	*18*	*June 2018*	*Dec 2020*

* Shows SAI Subcommittee in-person meetings. Web conferences are expected to be held on a regular basis.

6.0 Comments

None.

6.1 Expiration Date for the APIM

Dec 2021

Completed forms should be submitted to the AEEC Executive Secretary.