EUR 202-16 / WG96-25
RTCA Paper No. 195-16/SC236-002   10 October 2016

Minutes of Meeting
EUROCAE WG-96 / RTCA SC-236 Joint Plenary # 1
Standards for Wireless Avionics Intra-Communication System (WAIC)
within 4200-4400 MHz

Date	***Wednesday 21st through Friday 23rd September 2016***
Place	***Hamburg, Germany***
Venue	***ZAL Zentrum für Angewandte Luftfahrtforschung ZAL, Hamburg Hein-Saß-Weg 22, 21129 Hamburg***
Host	***Airbus***
Contact Persons EUROCAE RTCA	*Adrian Cioranu* *Adrian.Cioranu@eurocae.net* *Phone: +33 1 40 92 79 31* *And* *Rebecca Morrison* *rmorrison@rtca.org* *+1 202-330-0654*

AGENDA

1. Welcome/Administrative Duties
2. Presentation of RTCA/EUROCAE Joint Committee Organization and Coordination
3. IPR / Membership Call-Out and Introductions
4. Research Lab Tour – Wed Sept 21 – after lunch
5. Review and Acceptance of Meeting Minutes for the First Plenary of SC-236
6. Presentation of the goals of content for the MOPS
   a. Brief overview brief of WAIC (if needed); other ongoing activities (ICAO, AVSI…)
   b. Presentation on AFDX characteristics, requirements impact to MOPS (VK)
   c. Discussion of typical MOPS content (AeroMACS, VDL Mode 2), MASPS
   d. RTCA and EUROCAE guidance material on MOPS preparation and style
7. Discussion of Structure of Joint Committees
8. Formation of and Break-out into Initial Working Groups
9. Reports of the Plans for the Working Groups
   a. Approve Detailed Schedule
10. Review of Action Items
11. Plan for next meeting
12. Adjourn

Attachments:
- Attachment A Attendance List
- Attachment B Action Items List
- Attachment C : RTCA/EUROCAE presentation (IPR)
- Attachment D : FM – Presentation on WAIC[1]
- Attachment E Presentation on AFDX characteristics (VK)
- Attachment F TM presents "SC-236/WG-48 MOPS for WAIC".

Appendix 1: Sub-Working Groups topics (Established Sept 21-23 2016)
Appendix 2: Tentative list of plenaries to deliver to RTCA PMC/EUROCAE Council

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21. September – Starting time 10am

Agenda Item 1 - Welcome

Welcome from Chairman of RTCA-SC236 Michael Franceschini (MF) and Secretary Peter Anders (PA).
Robin Davies (Chairman of WG-96) apologized that he could not participate.

Notice: RTCA SC-236 had already a kick-off meeting on August 9-10, Washington DC. There, the RTCA ToR for the SC was adopted. Action items were established – see Agenda item #5.

Agenda Item 2 - EUROCAE/RTCA Introduction and Agenda Item 3 - IPR / Membership Call-Out and Introductions

Agenda item 2 and 3 were merged together because of its close relation.
Rebecca Morrison (RM) (RTCA), and Adrian Cioranu (AC) (EUROCAE) provided initial information and guidance on working principles of RTCA/EUROCE Joint Working Groups.

- Introduction to Organization (EUROCAE and RTCA)
- Introduction on **RTCA and EUROCA IPC policy and handling of proprietary content (see presentation – attachment C).**
- MOPS drafting Guides are similar for RTCA and EUROCAE
- It remains a group decision, which "template" (from RTCA or EUROCAE) will be used
- One doc with different title page and foreword (line numbers are identical)

What kind of information, in addition to MOPS drafting, will be retained by SC/WG content?
- conclusions of discussions (presentations, whitepapers, not just MoMs)
- Presentations shall be considered as "public", because they will be circulated in the group.

Drafting MOPS content (Chapter Numbering for ED and DO):
1. Purpose& scope (ED: 1, DO: 1)
2. General reqs (ED: 2, DO: 2.1)
3. Eq performance standard conditions (ED: 3, DO: 2.2)
4. Eq perf. Environmental conditions (ED: 4, DO: 2.3)
5. Test procedures (ED: 5, DO: 2.4)
6. Manufacturer conditions (ED: 6, DO: 3)
7. Operational performance characteristics (ED: 7, DO: 4)
8. Membership roster (ED: annex, DO: 5)

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[1] Note: It is the same as presented during RTCA SC236 meeting #1

EUROCAE Chaptering: 2,3,4,5 the use of "*shall*" is requested; for all other "*should*".

RM and AC explained **RTCA FRAC and EUROCAE Open Consultation Process:**
- Duration of the Process: assumed 3 months
- FRAC release
- Not less than 45 days waiting
- Preparation of team
- FRAC resolution
- Edit content
- Final clean; After 45 to 60 days (formatting, etc) PMC/council

Following the FRAC/OC all comments need to be reviewed and be answered (WG/SC)
- Finalization by EUROCAE/RTCA -> approved by chairs
- Publication as ED-nnn/DO-xyz.

RTCA / EUROCAE Workspaces:
- The workspace will be prepared on RTCA server by Rebecca (RM)
- All Presentations (including the one shown today) will be published on workspace.
- EUROCAE workspace will be in use further on for the WG-96 only on PS/WOBAN.

Because this meeting is the first Joint Plenary meeting, it was requested to compare the **"Terms of Reference" of WG-96 and SC-236**:
- Both are approved by the PCM / Committee chairmen,
- WG-96 introduced term WOBAN, which is generically wireless aircraft system, whereby WAIC is considered as a special implementation standard of WOBAN,
- Common objectives MOPS (establish coexistence standards and test procedures for demonstrate compliance to standards),
- Different scope: cyber-security: required by RTCA, but not explicitly by EUROCAE ToRs ,
- -> not considered explicitly, however in line with general approach of WG-96
- -> The Group agreed to consider it. **However, no revisions needed.**

A harmonized schedule of meetings and final deliverables to EUROCAE/RTCA is desired (Post meeting note: Appendix 2 provides a proposed schedule of meetings of the entire working program of SC 236).

Next question was related to possible co-operations with other existing WG/SC of EUROCAE/RTCA:
- WG-96 explained that they have already established on formal bases mutual exchange of information from WG-72, "Data security" and WG-99/SC-234 "Portable Electronic Devices (PED)".
- In both WGs (72, 99), WG-96 has members that maintain the link. In addition, two white papers were exchanges to explain the overlapping issues.
- There is an EUROCAE working group, that may have overlapping with SC236/WG96: WG-68 "Altimetry". This WG is working with SAE on following existing standards: ED-140, ED-241, and SAE AS8002.
- **Action item: AC – Approach WG-68, Clarification on frequency band for RA, general scope.**

- ❖ Break for Lunch

Agenda Item 4 – Research Lab Tour

The Lab tour took 1 hour in the "*Zentrum für Angewandte Luftfahrtforschung ZAL*". The tour was just to introduce the research environment and main projects of this Lab. It was just an informative journey; there is no link with activities of WG96/SC236.

Agenda Item 5 – Review, Acceptance of Meeting Minutes for the First Plenary of SC-236

The MoM of the first RTCA meeting was adopted without changes. The Action Items from the first RTCA meeting were transferred to the Joint WG96/SC236 Action items record Sheet (excel file). See actions and resolution in this file (attached to the MoM).

The group decided to use for the Joint Activities (WAIC/MOPS) the RTCA site exclusively. (Notice: The remaining activities of EURCAE WG-96 (PS/WOBAN) will be managed by the EUROCAE website, as done in the past.

There was a request that members get permission to up-load files to the RTCA web-space.

AI   **Action item: RM -** An uploading capability for all members will be checked.

Agenda Item 6 - Presentation of the goals of content for the MOPS

a. **Brief overview brief of WAIC and other ongoing activities (ICAO, AVSI…).** The chairman MF presents an overview of the current status and activities (see attachment D[2]):
   - Introduction to WAIC spectrum requirements
   - Introduction to WAIC model
   - High/Low-Inside/Outside (LI, LO, HI, HO) data rates
   - Radio altimeter protection criteria
   - AVSI Activities
       i. End of 2016: NASA Flight test scheduled to determine RA (Honeywell, Rockwell Collins and Thales) susceptibility to WAIC-like interference (Discussion: about privacy on flight test data, publication, result is necessary for WG/SC work)
       ii. Interference case analysis (RA/RA=N/A, WAIC/RA=IPL, WAIC/WAIC (same/adjacent A/C) and transients caused by WAIC to the RA) Notice: RA does not turn off until power down.
       iii. Result material are proprietary; But core results will be available (however maybe public restrictions).
   - ICAO Annex 10: SARPs amendment on preparation; Industry supports establishing of the JobCard (it is triggering the amendment process).
   - ITU: Resolution COM4/1 (WRC-15): WAIC is defined as stations on-board a single A/C and supporting safe operation of A/C
       i. no communication between A/Cs
       ii. Discussion on this bullet point due to the word "safe", which is not exactly identical with the definition of aviation industry → "safe flight and landing condition",
       iii. proposal by EASA (Kevin Hallworth) to issue an interpretation (certification memo/ advisory circular or similar).

   - Notice from EASA/FAA: The final MOPS may be used as basic for new TSO/ETSO. A change in regulation is not envisaged; however, to support Certification process, an AC (FAA) and Certification Memo (EASA) would be useful.

b. **Presentation on AFDX characteristics, requirements impact to MOPS**
   VK presented the AFDX characteristics and how it may have relations with WAIC:
   - AFDX infrastructure
   - Determinism (this is from protocol point of view, no loss due to congestion, loss of link does not affect determinism, but is to be considered in safety analysis
   - Introduction to BAG and Jitter
   - Network Configuration (End-System, Switch)
   - Partitions segregate the functions by criticality
   - Conclusion:
       i. determinism is one answer to certification requirements (maybe there are others)
       ii. link characteristics may to be treated differently by WAIC
       iii. to support safety analysis and certification the determination of a baseline performance might be required.

================ End of the first Day ==================================

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[2] Note: It is the same as presented during RTCA SC236 meeting #1

c.   Discussion of typical MOPS content

PA (secretary) provided a view of A/C manufacturer expectation on the final MOPS and the benefits that are associated with:

Replacing cables/wires are seen as benefits generally, especially in two areas: weight reduction; and significant reduce effort to manage configuration variants of cabins. In first place, associated applications (aircraft functions) are good candidates for WAIC: Cabin interior (including windows, seat management, light control, sensing temperatures) is a target and diverse monitoring sensors (fuel, tire pressure, temperature anywhere,..).

However, replacing wires with wireless must still be justified in terms of costs and other challenges (availability, costs for security measures, etc). It is very likely that wireless technologies (WOBAN/WAIC) will find the way into commercial transport aircraft on an incremental step-by-step approach. Initial networks will base possibly on simplest architecture, and will focus on functions that tolerate challenges as mentioned above. **Performance and integrity requirements shall consider a broad variation of implementations and diversity of applications.**

The MOPS must focus on the challenge to operate different entities of WAIC networks in parallel, and to guarantee non-interference with the RA. It shall provide methods to determine the performance and integrity parameters of a WAIC component working in pre-determined environment. For instance, not each component must be operating in unpressurised area; instead it may be approved only for operation inside the cabin.

The MOPS must be able to manage flexibility of such characteristics. Last, but not least, PA remind the Group that the "M" in MOPS stands for "MINIMUM", which means that the Group shall find an optimum in such chapters that express requirements (MOPS chapters 2,3,4).

MF proposed to introduce several "classes" to manage such requirements. This is possibly a good approach. But, at current discussion the Group should remain open for all ways.

The Group agrees that a MOPS (as used for other aviation standard equipment) is not being sufficient to determine the specific behavior of a complete network. Therefore, an additional document (e.g. a MASPS) may also be acceptable. In this context, one question becomes important: Is network management necessary to guarantee coexistence? Technically, multiple solutions are discussed (statistical hopping or spectrum avoidance). However, no conclusion yet, whether such level of solutions will find its way into the MOPS. Maybe expressing "requirements" should be sufficient. The MASPS may more suitable to allow specifying "management functions" of WAIC.

Another discussion was raised on which level the so-called cyber security will be addressed. The certification responsibility is not obvious here (OEM, network integrator, WAIC component level). SC202/WG-72 is working on the basic principles for cyber security. Maybe there is an answer for the specifics on wireless systems:

Action item: FL will prepare a presentation on the works of WG-72 concerning this question until the next meeting.

The Group asks to obtain an overview about the latest Draft of the EUROCAE PS on WOBAN:

Specific discussions focus on points in relation to the WAIC/MOPS:
- Support of TC process, but also STC has to be considered. The PS considers both scenarios.
- Installation specifics, e.g. are lightning effects relevant? Yes, it is included.
- Data security: tread conditions; what is a sufficient level?
- Is encryption enough? Shall we mention specific methods in the MOPS?
- Are backups for WAIC communication to be considered in MOPS?
- Incremental approval approach: (MF) asks the question about minor software changes. Are they covered by the "incremental approval"? (in principle, yes.)

d.   RTCA and EUROCAE guidance material on MOPS preparation and style
This point was already discussed during the agenda item 2 and 3.
Both guidance materials from EUROCAE and RTCA will be taken into account.

Uwe Schwark (US) is appointed to become the Chief-editor of the MOPS document. Which template will be used finally could be decided later.

TM presents "SC-236/WG-96 MOPS for WAIC", which focus on technical perimeter expected by the final content of The MOPS. The presentation is attached as well (see Attachment F).

It underlines the expectations of aircraft manufacturers. TM focuses on a clear model that is needed as a baseline. This model is generally accepted by the group – however, the "management function" questions, discussed earlier, are back on the table.
A model for the diverse "coexistence" scenarios is included. Also this models (or scenario) were accepted. TM promotes to determine the coexistence conditions and the performance parameters. He is not in favor of defining protocol specifications, or other low level communication mechanisms within the MOPS. Such way of specification would be in conflict with the approach of flexibility as mentioned above.

=============== End of the second Day ================================

Agenda item 7.   Discussion of Structure of Joint Committees

Agenda item 7 was skipped, because the topic was addressed already by agenda items above (2,3).

Agenda Item 8.   Formation of and Break-out into Initial Working Groups

The chairman (MF) provided a plan for sub working groups. For this purpose, he prepared a draft paper that was discussed and continuously adapted. The result is provided in the appendix of the MoM. Following Sub-working Groups were proposed finally. See attached excel-file, which provides the current interest of SC/WG members to work in specific sub-working groups:

> SWG1: Co-Existence and Non-interference
>
> SWG2: Network Layer and System Layer
>
> SWG3: Security
>
> SWG4: Physical and Environmental Requirements.

Following SWG-Coordinators are nominated at current time:
> SWG1: Attendees 8; Coordinator: Sanjay ?; or Thomas Meyerhoff (TM)
> SWG2: Attendees 8; Coordinator: Scot M or Valentin K
> SWG3: Attendees 9; Coordinator: Falk Lindner
> SWG4: Attendees 3; Coordinator: Paul Siegmund.

Agenda Item 9.   Reports of the Plans for the Working Groups

Instead of break-out sessions, the whole group discussed the content of the subgroups.
Following topics were discussed (more a form of brainstorming):

Discussion on SWG4 (Physical and Environmental Requirements) Scope:

- Physical Environment shall cover installation conditions -> moved A/C installation to SWG4. Difficult to put it in the MOPS without any information about installation.
- Define requirements and test procedures (maybe generic). Also maybe consider maintenance (e.g. replacement and automatic configuration of defect nodes).
- **MF** showed an example of DO346 AeroMacs MOPS where section 3 only covers Power and some antenna characteristics requirements (e.g. cable VSWR, EIRP) (only 2 pages).
- Scope of this chapter: Make installer aware of that he is responsible for choosing suitable antennas for coverage and coexistence issues. The MOPS cannot cover all possible installation cases, but it has to make the integrator aware of that.
- **Comment by Paul Sigmud (FAA):** do not try to solve all problems for cases, but make integrators aware of problems they have to solve. Do not assume this as obvious for the reader. Also AeroMacs is a very simple case without any real harm.

Discussion on SWG2 (Network Layer and System Layer) Scope:

- Discussion how to consider the network/system without an application.

- TSO should cover network components but only with their functions to be part of the network. E.g. consider IMA as example which is TSO for an empty box with only networking functionality (no application).
- **MF:** Do not want to make it AFDX Wireless but VL capable

Discussion on Content (SWG4):
- Bus component (sensors, digital/analog, …)
- Power (prime, battery, energy harvest, …)
- Installation guidance and constraints
- Antenna locations, orientations, net far field pattern after considering lobing (reflections…)
- Maintenance, cont. airworthiness
- Reconfiguration, retrofit
- WAIC radio as device and radio + application element(s) (e.g. wireless sensor)
- Human protection (RF)
- Standards docs (DO160…) and ref section (HERF, lightning, EMC, temp/press/humidity/vibration, salt, SEU (single event upset))
    - Identify applicable DO160 tests to be done under (normal) WAIC operating conditions (this is to be further discussed).

The final result of topics allocated to the four SWG is included in this MoM (see Appendix).

It is recommended that each member / SWG coordinator should continue work on the individual topics, and to come with good ideas to the next meeting.

Agenda Item 10 - Review of Action Items

Due to timing constraints, a detailed review is not possible. The up-to-date Action items list is part of this MoM (see excel file/Attachment B), including recording of the new action items mentioned above:

3 new Action Items created during joint plenary meeting #1.

2 actions remained open from previous meetings.

All working group members are requested to check the status of the Actions items list. Please comment if any inconsistencies are listed.

Agenda Item 11 - Plan for next meeting

Date will be 6..9 of December. Next meeting will be in the USA. David Redman (AVSI) volunteered to host next meeting. The location will be College Station Texas. Notice from Rebecca, Washington DC is too much occupied at that time in December.

A half day would be used for the WG-96 on finalizing the PS/WOBAN.

Complete tentative planned plenaries are listed by Annex 2.

Agenda item 12 Adjourn

================ End of the third Day / End of Meeting ============================

Complied by Peter Anders
Secretary of SC-236/WG-96

Approved by Michael Franceschini

Chairmen of Joint SC-236/WG-96 (MOPS for WAIC)

Appendix 1 : Sub-Working Groups   topics   (Established Sept 21-23 2016)

1. **Co-existence and Non-Interference**
    a. RadAlt –WAIC – on ownship
    b. RadAlt – WAIC between aircraft; also, between altimeter effects if appropriate
    c. WAIC-to-WAIC Interference between aircraft
        i. Coexistence approaches: interference avoidance, FH, others. Compatibilities between different techniques. Network/Control Plane implications
    d. Out-of-band / unintentional interference
    e. Co-existence scenarios: landing to taxi/hold; terminal/parked, others??
    f. Generate Aggregate Interference environment (in-band detail, out-of band TBD)
        i. Measurement campaign – RadAlt interference susceptibility, ground scattering
        ii. IPL - analyses + measurement Propagation data (on board)   for
    g. Waveform PHY/MAC layers (not for interoperability, only coexistence)
    h. Hi and low [burst OTA data rates, data rate ranges], bandwidths, transmit power, receiver sensitivities, dynamic range….
    i. spectral confinement: transmit and receive spectral masks, in-band and out-of-band
    j. Channelization plan *(sub-channelization?)*
    k. MAC approach: TDMA, CSMA, timing/synchronization (local/*global?)*
    l. [Modulation types, industry standards (IEEE, ISA 100), PDUs…. (guidelines, or firm specs?)]
    m. Antenna patterns, gain…
2. **Network Layer and System Level Issues**
    a. Control plane, centralized vs. local (gateway/subnet) responsibilities
    b. Coexistence management mechanisms (for inter-aircraft coordination) – liaison with SWG1
    c. Integrity, reliability, availability (QoS)
        i. Determinism – data is delivered correctly & on time – as intended (within bounds)
    d. [Application layer interface / QoS capability assurances (latency, jitter, BAG, rates…)]
    e. [Compatibility with avionics busses, protocols, interfaces…]
    f. [Net routing topologies – hub/spoke, relay spokes, mesh, peer-peer??]
    g. *Certification Issues – system level guidance? Net Manager as a class of node?*
3. **Security**
    a. Threat assessment, vulnerabilities/probabilities/costs
    b. Airworthiness implications (SC-216/WG-72 liaison)
    c. Encryption approaches
    d. Key management, distribution, compromise recovery…
    e. Anti-tamper, physical protections
4. **Physical and Environmental Requirements**
    a. Bus and component (sensors, digital/analog..) interfaces
    b. Power (prime, battery, energy harvest…)
    c. Installation guidance and constraints
    d. ANTENNA locations, orientations, net far-field pattern after considering lobing (reflections…)
    e. *Certification Issues – system level guidance? Net Manager as a class of node?*
    f. Maintenance, continued airworthiness
    g. Reconfiguration, retrofit
    h. WAIC radio as a device AND radio + application element(s) (e.g. – wireless sensor)
    i. Human protection (RF)
    j. Standards docs (DO-160) HIRF, lightning, EMC, temp/pressure/humidity/vibration, salt. SEU
        i. *Identify applicable DO-160 tests to be done under WAIC operating conditions.*

Appendix 2: Tentative list of plenaries to deliver to RTCA PMC/EUROCAE Council in March 2019

Joint Plenary Meetings	639 days	W 9/21/16	M 3/4/19
Joint Plenary #1	3 days	W 9/21/16	F 9/23/16
Joint Plenary #2	3 days	T 12/6/16	T 12/8/16
Joint Plenary #3	3 days	T 2/28/17	T 3/2/17
Joint Plenary #4	3 days	T 4/25/17	T 4/27/17
Joint Plenary #5	3 days	T 7/18/17	T 7/20/17
Joint Plenary #6	3 days	T 11/7/17	T 11/9/17
Joint Plenary #7	3 days	T 2/6/18	T 2/8/18
Joint Plenary #8	3 days	T 4/24/18	T 4/26/18
Joint Plenary #9	3 days	T 7/24/18	T 7/26/18
Joint Plenary #10 - Into FRAC	3 days	M 12/3/18	W 12/5/18
Joint Plenary #11 - Resolve FRAC and send to PMC	3 days	T 2/28/19	M 3/4/19