



EUR 86-18 / WG96-41
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23 April 2018

Minutes of Meeting
EUROCAE WG-96 / RTCA SC-236 Plenary #4
Standards for Wireless Avionics Intra-Communication (WAIC) Systems
within 4200 - 4400 MHz

Date	Tuesday February 27th – Friday March 2nd, 2018
Place	1150 18th St NW 9th and 4th Floors Washington, DC 20036
Venue	EASA Headquarters
Host	RTCA, Inc
Contact Persons EUROCAE RTCA	Sergiu Marzac <sergiu.marzac@eurocae.net> Phone: +33 1 40 92 79 31 And Rebecca Morrison rmorrison@rtca.org +1 202-330-0654

AGENDA

Tuesday February 27, 2018, 9:00 am-5:00 pm

1. Welcome/Administrative Duties
2. IPR / Membership Call-Out and Introductions
3. Acceptance of Meeting Minutes for the Third Joint Plenary of SC-236/WG-96
4. Review Plenary Agenda and Sub-working Group Schedule
5. Break into Sub-working Group meetings when plenary business complete

Wednesday February 28 – Thursday March 1, 2018, 9:00 am - 5:00 pm

6. Continue with Plenary or Sub-working Group Meetings

Friday March 2, 2018, 9:00 am – 12:00 pm

7. Continue with Plenary or Sub-working Group Meetings
8. Reports of the Sub-Working Groups
9. Status and review of the Draft Paper SC-236 Intermediate Report (dedicated for ICAO Job Card)
10. Review of Special Committee Schedule
11. Approve changes and updates to the Terms of Reference
12. New Business Discussions
13. Review of Action Items
14. Plan for next meeting

15. Adjourn.

Attachments:

- Attachment A : Attendance List
- Attachment B : Action List (SC-236-WG96 WAIC) - status

Appendix:

- Appendix 1: Notes and Reports of diverse SWG discussions on 27th Feb..1 March

Minutes of Meeting: November, 28th (start time 09:00)

Agenda Item 1 - Welcome

Welcome from EUROCAE Robin Davies (RD) (Chairman of WG-96) and Chairman RTCA-SC236 Michael Franceschini (MRF). Secretary Peter Anders (PA) will not join this Meeting. Radek Zakrzewski volunteered to take notes for the plenary sessions¹.

Rebecca Morrison (RTCA Inc) welcomes the group as well to the Plenary Meeting.

The list of attendees is contained in Appendix 1.

Agenda Item 2 IPR / Membership Call-Out and Introductions

This meeting is a Plenary meeting. It will be considered also as Joint Working Group meeting.

Rebecca Morrison (RTCA) gave an introduction to the RTCA meeting rules and procedures. Paul Siegmund (FAA) officially opened the public meeting of SC-236.

Paul Siegmund read the federal notice related to FACA.

Rebecca Morrison explained RTCA's "Proprietary Policy" and some general information on RTCA / EUROCAE membership modalities. She referred to the standard presentation SC236_WG96_EUROCAE_RTCA.pdf - RTCA workspace:

http://workspace.rtca.org/apps/org/workgroup/sc236_standards_for_waic/documents.php?folder_id=5608

Agenda Item 3 - Acceptance of Meeting Minutes for the Third Joint Plenary of SC-236/WG-96

MF went through the minutes from Cologne (Dec 2017), addressing also the agenda of the current meeting.

- Regarding SWG-1: There has been good progress since last plenary. SARPS draft has been submitted. There was a good AVSI session in College Station.
- Regarding SWG-4: FCC petition needs to be addressed.
- Regarding all SWGs:
 - New realistic timeline is needed
 - Extension will be necessary - to be discussed at this meeting.

There were no comments from participants relative to minutes from Cologne. MoM was approved pending submission of appendices.

¹ This MoM based on the notes recorded by RZ.

Agenda Item 4 – Review Plenary Agenda and Sub-working Group Schedule

- **SWG-1 plans for the week**
 - SB said his main three objectives were:
 - agree on schedule and timeline
 - discuss feedback from ICAO FSMP
 - define receiver characteristics.
 - MF commented on receiver characteristics. WAIC on WAIC interference is crucial. From the AVSI study and results presented to ICAO it seems like altimeter on WAIC interference may be easier to handle.

- **SWG-2 plans for the week**
 - SR said his main objective was to agree on what documents/traceability/formal documentation are needed to define test procedures for radio/components/network. A lot of discussions will be procedural, focused on process. SWG-2 will start with an initial use case (TPMS).
 - SB proposed a joint session of SWG-1/2. SB is concerned about the overlap - which decisions made by one group will affect the group.
 - MF did not see a need for a joint session. The issue will be revisited at the end of Tuesday. Progress of SWG-1 and SWG-2 will be reviewed, and the need for a joint session assessed.

- **SWG-3 plans for the week**
 - SS said her main goal was to Define top-down requirements to assure traceability
 - MF suggested using the TPMS use case in two variants: (a) assuming it needs security; and (b) assuming it does not need security.
 - SR thought the rationale for including security in TPMS should be first discussed, before a split into two cases is done. MF said the main factor for security is whether the data link is unidirectional vs. bidirectional

- **SWG-4 Plans for the week**
 - PS said SWG-4 should team up with SWG-2 - this will be the most productive approach.
 - There may be a short separate session of SWG-4 on drafting the FCC petition.
 - Environmental issues are boiler-plate - quite straightforward.

At 10 am the plenary ended. The meeting is splitting into separate sessions of Subworking groups.

Agenda Items 5, 6 and 7: Break into Sub-working Group meetings:

Sub-working group notes of diverse SWG discussions during 27th Feb and 1 March have been recorded by Radek Zakrzewski (SWG2) and by Michael Franceschini (SWG1). The intermediate results of SWG1 are also attached: Attachment to Sub-Working Group 1 Breakout (The Path to Co-existence & WAIC RF Specifications for SARPS & MOPS).

All group notes are attached to the MoM - see Appendix 1 of this MoM.

Due to worse weather conditions, including cancelation and travel rescheduling issues, the Plenary Meeting adjourned for Thursday. On Friday the physical meeting has been cancelled, however a phone call was organized between accessible members discussing on future planning only (see Agenda item 14).

Agenda items 8...12 shift for next Plenary Meeting #4.

Agenda Item 13 Review of New Action Items

Refer to Attachment B Action List (SC-236-WG96 WAIC) - status 2018-03.

Agenda Item 14 Plan for next meeting

The next Joint plenary is planned **22.05. - 26.05. Toulouse/France**, hosted by AIRBUS France (VK).

The next meetings after this one are planned as following:

- 27.08. - 30.08 Washington/DC (Finalisation of RTCA Interims Report for ICAO SARPS WAIC in Annex 10)
- October Japan
- 21st – 26 January 2019 Melbourne / USA.

Agenda item 15 Adjourn (Friday 13:00)

The chairmen thanked participants for fruitful contributions and the host Rebecca of RTCA.

Complied by Peter Anders
Approved by Michael Franceschini
Approved by Robin Davies

Secretary of SC-236/WG-96)
Co-Chairmen of Joint SC-236/WG-96 (RTCA)
Co-Chairmen of Joint SC-236/WG-96 (RTCA)

Appendix 1: Notes and Records of SWGs sessions ²

SWG-2: Tuesday 2018-02-27 starting 10:22am

SR. Requirements management is crucial. It is not clear how much should be done. The scope of MOPS is the issue.

JC. This should be simple, this is just replacement of wires. The goal should be not to overcomplicate things. The two fundamental use cases are: (a) a standalone wire-to-wireless adapter; or (b) wireless integrated into other equipment.

RZ. These two cases are identical from the logical (communications) point of view.

SR. Wireless introduces the need for spectrum management. The question is how much network management content needs to be included in MOPS. An important issue is when links of different criticality use the same network - who manages security then?

JC, RZ, SR. The timing issues (guaranteed timely delivery) cannot be fully addressed within the WAIC domain. Security (integrity) needs still to be addressed. Can we relegate data integrity issues to the two end-points (the end application)? The internet model is relevant here. For example, the internet does not provide any extra security to handle banking info - banks take care of data security on end-points of transmissions.

PS. FAA needs this guidance. FAA staff needs to understand from MOPS how to assure security. Pushing the issue out onto somebody else in the future doesn't solve the problem.

RM. Chapter 3 of MOPS requires installation suggestions/guidance, not requirements. There will be no "shall"s in Chapter 3.

SR. How do we define the data requirements and how are they traced?

JC. Disagrees that MOPS should differentiate between different DAL's in terms of requirements. E.g. security/encryption requirements are for SW implementation, and for system architecture, but not for the equipment performance requirements.

PS. Security requirements need to be captured somewhere.

SR. We will first capture requirements, then argue how to apportion them and where they should be included.

SR. Discussed tools to capture requirements. Visure has a tool that allows linking requirements written in Word and linking them with test procedures in other documents. They use a set of 15-20 key words that get recognized if used in a specific MS Word style. This may allow SR consolidate input from everybody and manage inputs from SWG-2 when drafting MOPS. Visure agreed to provide copies to the entire SC-236 free of charge to get exposure.

RM. There would be implications if it was made available to the entire committee. RM has no authority to allow the use of Visure by the committee, although SR may use whatever tool he wants in his work.

All: The group is OK with SR using the tool.

SR. Zodiac has a similar homegrown tool to capture requirements, but it is not as sophisticated as Visure.

PS. FAA could not accept a gift from Visure. But the team can use it.

RM. RTCA members can use the Visure tool, but RTCA cannot allow Visure to say that RTCA used Visure in SC-236.

SR. Visure just wants exposure. We can use the tool and if t's not useful we can abandon it.

SWG-2: Tuesday 2018-02-27 afternoon starting 1:20pm

SR. Gave an overview of TPTS application - walked the team through the use case Word document and through the system diagrams for different versions of system architecture.

SS. Top level requirements should address common threats that occur regardless of application.

SR. Multiple use cases will define an envelope of high level requirements. We hope we will cover the majority of germane requirements.

² These following notes were compiled by RZ, and have being copied in this MoM.

SR. Do we go forward with this structure of use case or do modify and rework? What use cases should we use. Possibilities are: cabin lighting control (bi-directional links), cargo bay/lavatory smoke detectors. Wire replacement examples - fuel tank sensors. Sensors communicating to flight data recorder - replacing wires from avionics.

RD. We don't need a specific application. A wide class of applications may be more suitable

SR. Talking about specific applications may be easier.

PS. Which functions qualify for 'safety and regularity of flight'? For example, cabin shades are required for regularity of flight - must be up for landing.

Whole committee (SWG-1/SWG-2/SWG-3/SWG/4) Wednesday 2018-02-28. Starting approx. 9:20am

- SR described to the whole committee the Visure solution for capturing requirements.
- MF said we need to differentiate between system-level and component-level requirements

SWG-2/SWG-4: Wednesday 2018-02-28 starting approx. 9:30am

SR. Plan for the morning - is to go through the TPTS use case and decide how deep we need to go. Which of the requirements are affected by using WAIC?

SR. The most obvious is availability of function

RD. Another requirements affected by using WAIC is data security

RZ. This is the CIA - confidentiality, integrity, availability - the three aspects of security

Configuration management discussion followed. Main question - Is there a centralized network manager allowing reconfiguration or is it fixed configuration file?

SR: For retrofits to add equipment, we may need a central network manager.

PS. The cabin light control is a complicated case. Network manager may reside in the "purser workstation".

SR. Location - association of a physical device with a logical device - is highly different from wired

JC. Amount of data is also a difference. You cannot add wires to increase data rate.

SR. This is not different. ICD for a WAIC system will define all the data that goes through the wired connection, just as it does for wires.

KH. TPST application is perhaps overly simple.

PS. Consequences of compromised TPST data are low - A/C must be able to land regardless of low pressure, and false low-pressure warning will only affect aircraft operation

BV. EMI/EMC testing of aircraft will be affected - installing a WAIC TPST will affect the validity of previously done EM testing.

SR. Can we use carry-on devices for TPST?

RZ. The ITU allocation prevents us from this

PS. What about the maintenance devices that are used to configure and test A/C configuration? They are used all the time in other types of systems. They would be allowed.

SR. Such carry-on devices that are not installed on-aircraft open an attack avenue - they can reconfigure an installed configuration. This must be considered.

SR. Normally system requirements come from many different sides/groups. We are trying to capture as many functional system requirements in a "use case" document. They will allow us to construct the "systems of systems" requirement document. SR describes the system requirement document tree diagram. Requirements in a TSO flow down from the system requirements.

SR. ERD - Equipment Requirements Document - will become a part of section 2 of MOPS (what the equipment needs to do). In order to specify those requirements, we need to go down through the whole chain in system requirements (even if they are not included in MOPS).

KH expresses doubts if we need to follow the entire document tree.

JC. We need to start from a System Requirements Document and then go to ERD to then define what needs to go to MOPS. The use-case-derived system requirements should be captured by RTCA to document where MOPS requirements came from.

SR. At this point we stop at the System Functional Requirement Documents (SyFRD) - we can't go any further before we complete all Use Cases. Once we have all UCs then we can take all WAIC-specific (all WAIC-derived) requirements and define the SyFRD.

JC. Environmental requirements will be vague anyways and should not go into MOPS - we specify performance requirements for various environmental conditions.

SR marks on the document tree diagram the documents that need to be created/addressed within SWG-2. System of System Spec and System Spec will be the same for this activity.

JC requested to add federal regulations that may affect WAIC. PS and BV identified a number of FARs, SR added them to the diagram.

SR. A way forward may to construct an SC-236 document whose sections correspond to the documents in the diagram to provide traceability of the requirements. This may then become an appendix to MOPS and provide justification to equipment-level requirements that get in the end included in MOPS.

SWG-2/SWG-4: Wednesday 2018-02-28 afternoon starting approx. 1:20pm

SR reviewed the proposed set of documents to be generated. The group is OK with the proposal

SR reviewed the proposed structure of MOPS document. The issue of "fixed configuration" vs.

"dynamically configurable" creates some confusion. "Dynamically configurable" does not refer to HW configuration - it is about data flows, routing, or resource allocation. Installed HW in both cases is fixed. A better term is needed for "dynamically configurable" - this is an architecture with a central network manager providing common/shared services.

Discussion of control plane vs. data plane.

Control plane allows loading data (e.g. firmware) into devices. This does not involve delivering data to aircraft, which is done by authorized maintenance personnel. Procedures and guidance for this process exist already and this issue does not have to be addressed in MOPS - existing standards may be invoked. Data plane data-loading is about distributing control data via network over WAIC links. An issue to address: is it appropriate to reference ARINC standards within MOPS? PS will clarify this with RM.

Discussion on interoperability.

JC: Interoperability does not belong to MOPS. Only OEMs would be really interested in interoperability.

SR: Also airlines.

JC: Airlines are getting less and less control over their A/C.

Discussion on how many common/shared services are actually needed. Not many, depending on interoperability requirements (which are non-existent at the moment).

Discussion on how much non-TSO material should be included in MOPS.

PS: System integration/installation guidance in Chapter 3 should be quite extensive, to help FAA in the task of certifying a WAIC system out of TSO-ed components.

PS: Not sure to what extent non-TSO functions need to be tested to get a TSO.

JC: The best solution is not to reference such non-TSO functions in MOPS, remove them.

SR. All requirements, including non-MOPS requirements will be captured in the large document with all requirement hierarchy.

PS What to do with the nice-to-have requirements that are not real "shalls" for equipment? They should be pushed to Chapter 3.

Discussion on the "shall" vs "must" issue.

All "shall"s are in Chapter 2 of MOPS. They are hard requirements for the equipment suppliers. The "must" requirements are in Chapter 3 - they are like "shall"s but they don't apply to the equipment so they are not the responsibility for the equipment vendor. "Must"s are the integrator's responsibility - they "must" be satisfied when the system is built, but the equipment supplier doesn't have to worry about them. (Explained by PS and RS)

Whole committee (SWG-1/SWG-2:/SWG-3/SWG 4) Thursday 2018-03-01, starting approx. 9:05am

SR gave an overview of the requirement document subset we will use to derive the requirements needed in MOPS. A simplified document flow diagram was presented. Security risk assessment is included in the flow.

Discussion on where which requirements should go.

MF: Installation requirements that go into Chapter 3 are "must"s. Interoperability needs will not be defined in MOPS. Every A/C can have its own interoperability rules.

RM. MOPS cannot supplant rule making from FAA/EASA. There may be appendices with additional "shall" requirements - these would be mandatory requirements for equipment that implements additional (non-TSO-required) functions, which, if implemented, have to satisfy those additional requirements. E.g. key exchange mechanisms may not be needed for equipment that does not exchange security keys. But if keys need to be established, there may be additional requirements.

JC: As a potential supplier, R-C would like to limit MOPS to HW aspects of the equipment. Applications should be irrelevant to the transceiver box/module manufacturer. How the data is created, including encryption and other security measures, would be done by applications.

JC: Connections of WAIC nodes to data sources/sinks is not a part of MOPS. The equipment supplier will specify how the box/module connects to the rest of the A/C. MOPS will specify what kind of info needs to be specified by vendors to achieve such connections, but not what the actual characteristics are. The product sheet will specify the numbers and the mechanisms to adjust those.

MF. If a box exceeds the TSO-mandated minimum requirements, how will the vendor test the functions he says are implemented.?

PS. This is not a part of TSO. This is tested and presented to FAA

SR. The system integrator is responsible for verifying that all characteristics make a functioning network.

PS. Clarification: TSO includes minimum requirements. TSO Authorization confirms conformance to the TSO.

SR. We have now a process to define which requirements are coming from where and which are mandatory. Both groups agree.

MF. SWG-1 will focus on RF parameters for transmit and receive - to assure coexistence with altimeters and other WAIC devices. SWG-1 does not touch bit structure of frames or anything above PHY layer.

Thursday 2018-03-01, SWG-2,3,4 starting approx. 10:50 am

Discussion on who does the final system certification.

JF. Operators can modify the A/C any which way they want without involving the OEM.

Discussion on modifying an A/C modification and coordinating dissimilar systems.

SR. The mechanisms to allow co-use of spectrum will be in Chapter 3 in form of "must"s. The critical issue is what minimum information must be provided by one system integrator to allow another system to operate and share the resource.

PS. E.g. how does Saffron let Rockwell know how they are using the spectrum?

JF. We have never had such a case before - different systems sharing info how they operate.

RD. What is needed is a shared A/C-wide configuration - maintained by the A/C operator - that lists how each system used spectrum - channels, data rates, number of nodes etc. - some set of minimum information allowing everybody to assess the usage of WAIC spectrum

JF. This is similar to electrical load manual (?) - When new electrical systems are added this is consulted and modified to document the usage of electrical power resource.

SR. Security engine. There is no strict requirement for all WAIC components (applications) to use security engine. Security requirements will be placed in Chapter 3 as non-TSO "must"s.

SR. What is needed now is a mechanism (process) to separate issues relative to "WAIC System" (A/C-wide) and a "WAIC Network" (as single "system" from one system integrator/vendor)

SWG-2/SWG-3/SWG-4: Thursday 2018-03-01 afternoon, starting approx. 1:05 pm

SR. updated the document flowchart.

Discussion on terminology:

The term "System of Systems" will be replaced with "WAIC System", and individual "Systems" will be WAIC Networks.

No further disagreements with SR's updated diagram.

SR. What do we do about WAIC applications?

JC: Applications do not belong in MOPS.

RD. We should define boundaries what goes in MOPS

SS: Can we confirm equipment authentication and encryption will be a part of MOPS?

SR. Not yet - not until we have flown down use case requirements

RZ We could push off authentication and encryption requirements onto applications (the post office example)

JC would prefer to remove authentication and encryption from MOPS completely. The WAIC link should not care whether the data being passed is DAL A or DAL E - application should take care of proper encapsulation/protection of high DAL data

PS is getting convinced the only radio characteristics should go into Chapter 2

Security discussion.

The group is close to consensus that provisions for basic initial authentication and key update mechanism will be needed in MOPS as the minimum security requirement.

RD. Regardless of all the derived analysis, we can agree that a node should provide basic security. We know this is needed.

RZ. Agree - all combined VOC from many years points to security being the prime concern.

JC Agrees - basic security should be included.

SR. Agrees - but without a network manager function.

RD Wants a diagram showing the scope of MOPS - what is included in MOPS domain

SR Will prepare a diagram for tomorrow (2nd March).

SWG-1 Break out session: 2018-02-27 to 2018-03-01

The SWG 1 breakout sessions addressed WAIC co-existence with radio altimeter (RA) on other aircraft, focused on addressing the needs for the white paper to the ICAO FSMP for the SARPs support. It also addressed the need for a menu of transceiver RF parameter specifications, some of which will be specified in the MOPS, others that will identified by the MOPS for the manufacturer to specify and incorporate into the TSO..

The group reviewed the results and initial conclusions of the WAIC-only interference tests that had been performed by AVSI at TAMU so far; these had been presented in a working paper at ICAO FSMP WG-6 just two weeks earlier. These tests indicated a healthy margin (> 10 dB) before single-aircraft WAIC only interference created any noticeable effect (< 0.1 % error degradation) on RA performance at all altitudes up to 3000 feet; it was particularly robust for the most critical stages of landing (20-30 dB). This also means that there is adequate margin for aggregate WAIC -only interference from multiple aircraft (which would only add some 6-10 dB of aggregate energy). However, we discussed that there is still a need to generate tests results and analysis of multiple RA + WAIC interference RA susceptibility, and could not draw any conclusions on how much margin, if any, that would ultimately yield. Various worst case scenarios were discussed to create an aggregate interference environment, and such tests are being planned by AVSI. We also identified an analytical approach that could prove that WAIC interference is additive with RA crossover interferers, and the RA performance effects are independent, so that WAIC is only providing noise-floor elevation and doesn't exacerbate the crossover interference effects. The hope is this will obviate many aggregate environment test cases, and in particular, the need to simulate up to as many as 30-45 RA FMCW sweep signals each creating a crossover interferer in the victim RA. We discuss some interference path loss (IPL) situations that we project encountering, referencing some IPLP measurements taken by Airbus and Luftansa Technic. Shunichi presented the results of some ENRI simulations (FDTD - finite difference time domain) about E-field strength around an A320 aircraft from a radiator in the cabin on the aisle, at various heights for the victim outside the fuselage. These results resonated well with the actual IPL measurements already taken; suggestions were provided for subsequent simulation geometries and data analysis/presentation approaches.

We also addressed the issue of RA+WAIC interference to WAIC receivers, with the recommendation that we not specify the actual WAIC receiver parameters to survive the environment, but rather, specify the worst case interference environment that a WAIC receiver would be subjected to. This would allow the system integrator to engineer the WAIC links so that it can take into account different locations on the aircraft, shielding effects, and LRU capabilities (filters, signal processing, coding/modulation, etc.), as well as the actual link distance, in deriving the link budget to survive the interference attack. The manufacturer of the LRU would then provide all the details of its product capability on the data sheet, which would then be invoked in the TSO for that device. Towards that end, the group began to identify MOPS parameters of interest, some values of which might be specified in the MOPS itself (such as spectral masks, transmit power..), others which would be identified as parameters that the manufacturer must provide values for on its data sheet. This again allows flexibility for the WAIC system integrator to design the system/network to meet the needs of the applications supported, without necessarily typing the MOPS and LRU to the applications and their safety impact directly.

Other random technical bullet notes:

WAIC links shall be designed to tolerate at least x [-70 dBm] interference from other AIC systems on other aircraft

3 ITEMS FOR LINK DESIGN consideration:

- shielding factor (additional IPL attenuation)
- location/distance factor (fuselage vs wing)

- directivity factor

TM: want to use [6 dBm/MHz] as a guideline for bubble pfd limits, but allow systems on aircraft (especially interior) to exceed that as long as it still meets bubble limits

- (for example, 16 dBm/MHz with 10 dB minimum shielding attenuation)
- May not need to specify transmitter EIRP limits at all ??

No additional SC-236 tasks for now - monitor AVSI aggregate interference environment testing
However, need analyze and specify WAIC-to-WAIC interference co-existence between aircraft

Still need to generate an OOB interference Tolerance mask for the WAIC receiver for the FSMP SARPS: bathtub tolerance protection criteria. Dynamic range + filter, & in-band limits

- Issue about making hard spec to meet existing interference sources, vs future sources.
- Again, minimum protections for WAIC, about 10 dB better than RadAlts

Test procedure: the test "R" and therefore the allowable pfd at a distance is unique for each aircraft, since the wingspan (farthest point from fuselage) is different for each a/c
The radiated power spec (SARP xx4.3) should reflect an EIRP AFTER any shielding effects

Test "C" needs to have an aggregate interference environment comprising WAIC+Altimeter interference

What is the test pass/fail criteria for WAIC victims - that it continues to perform its intended function as designed/installed ??

<u>Fuselage Length:</u>	A318 = 103 ft =	31.4 m	RA antenna is 25m from nose
	A350 = 219 ft =	66.8 m	RA antenna is 10m from nose

Also, make all a/c E-plane in landing scenario. Increase d=77m for A350s

In a joint working session of all SWGs we also agreed to a plan for how to specify what is included in the body of the MOPS for the most basic LRU functionality, while allowing for enhanced functionality extensions as well. This is extremely important, since some were of the opinion that "Minimum" might imply only the minimum requirements, and options/enhancements/extensions might not belong in the MOPS. We now clarified how to address LRU enhanced functionality, as the result of an "{If (function x provided)...Then (requirements y...z apply)}" option. If such an option identified in the MOPS is provided by the manufacturer product offering, its requirements and tests have been specified in an informative Appendix - and these will become "shalls" for that functionality (not "shoulds", if it were identified in Section 3 for Manufacturer considerations). This is particularly important with regard to functions such as network control plane capabilities and security protections, which may or may not be utilized by the system integrator depending upon the application(s) supported and aircraft WAIC architecture. It therefore allows both LRU manufacturer and system integrator flexibility to make a range of product types, system capabilities, and supportable applications without violating the "Minimum" philosophy of a MOPS. This approach achieved consensus, and allows the committee to proceed on a common path for any identified functionality, minimal or enhanced.

Attachment to Sub-Working Group 1 Breakout Notes :
The Path to Co-existence & WAIC RF Specifications for SARPS & MOPS
(Note: this is also posted on the RTCA SC-236 workspace)

CoExistence

Non-Interference to Off-Board Radio Altimeters (on Other Aircraft)

1. Evaluate RadAlt Interference Susceptibility
 - a. Against WAIC interference alone
 - i. Single Interferer - done by TAMU (AVSI) testing
 1. Only went to 80 MHz interference bandwidth - what about 200 MHz?
 - ii. Aggregate WAIC, multiple aircraft - by analytical extension of (1a1)
 1. Pick a number of aircraft to aggregate, and distances (scenario based)
 - b. Against RAs on other aircraft
 - i. Need to identify a "representative" number of FMCW sweeps and characteristics
 1. Will be based on what our testbed at TAMU can achieve
 2. This may be needed to satisfy ICAO and industry FRAC
 - ii. Test RA performance against representative scenario at TAMU testbed
 - iii. Is there a need to generate a worst case scenario from airbus geometries?
 1. Extract pertinent information from Rockwell & Honeywell tests/simulations for these parking/taxi/landing/takeoff scenarios
 2. Talk to Nicholas about pruning scenarios, identify 1 or 2 critical cases
 - c. Against aggregate multiple WAIC + RA interferers
 - i. Superimpose sources from above scenarios/tests in b
 - ii. Try to prove that WAIC does not degrade RA further in presence of other RA interferers without needing extensive testing
 1. Combination of Honeywell analyses of baseband spectral jamming spikes and airbus paper on simulation of WAIC impact
 2. Convince Nicholas that we cannot perturb the altimeters with a WAIC interference below some level, since we have so much margin already, even with the RadAlt interference background turned on. Then Hon, RC, Thales
 3. Goal - show WAIC interference does not make RA performance "worse" than the effect of all the RA interference sources alone
2. Define Interference pfd limit "bubble" for all aggregate WAIC emitters on a/c
 - a. NOTE: this "bubble" is for WAIC constraints so that an aircraft does not interfere with altimeters on any other aircraft. It is required by both ICAO SARP and MOPS
 - b. Different pfd for each aircraft based on different extremity distance from a/c center

Non-Interference to Off-Board WAIC Systems And Altimeters (on other Aircraft)

1. Should start from pfd "bubble" from 2b above as the interference source from any WAIC aircraft, and impose "n" of those as the aggregate WAIC interference onto a victim aircraft
 - a. Derive initial requirements for what WAIC systems on the victim aircraft need to meet in order perform their intended function
 - i. For example, WAIC links shall be engineered so as to tolerate an interference level of Q dBm/channel, but include shielding, directivity, and location/distance factors to reduce Q appropriately for the location of the link on the aircraft
 - ii. Use manufacturer specs for the receiver (co-channel blocking, adjacent channel blocking, sensitivity, etc - for each data rate / mode)
2. Add some number "K" of RA FMCW interference sources
 - a. Do we use a nominal or worst case from the scenarios documents??
 - b. We need to specify sweep rate ranges and power levels
 - c. Redo (1) above with FMCW and document specification

- i. WAIC links shall be engineered to operate in the interference environment of 1ai above, augmented by "K" FMCW sweeps at power levels of "L_k" dbm each at rates Z GHz/sec

Ownship Coexistence (MOPS only)

1. ICAO does not need this - it is ours to define independently. Let's get to this after the SARP
2. Manufacturer specifications / data sheet may be used (not a TSO issue)
3. May have special modes and capabilities to exploit (signal processing, RA synchronization...), but are not required

RF Specifications

1. Transmit Parameters
 - a. Transmit PSD limit - [6] dBm/MHz- finalize
 - b. Out-of-band emissions limits
 - c. Transmit spectral mask
2. Receiver Parameters (referenced to input point)
 - a. In band interference tolerance (-xyz dBm/5MHz across 4200-4400 MHz)
 - b. Out-of-band interference tolerance/rejection
 - i. Need to identify all current aviation equipment that impact spec (ATC radars...)
 - ii. Document mask (bathtub) for ICAO FSMP in Sept
 - c. Damage threshold power (short pulse / low duty factor)
 - d. Receiver saturation/overload recovery time
3. Interference tolerance capability for coexistence
 - a. Link design - shall be capable of withstanding X dBm/MHz + Y number of FMCW sweeps through channel - power levels TBD
4. Parameters to be specified by manufacturer (for MOPS ONLY)
 - a. Data rate, sensitivity, co-channel blocking, adjacent channel blocking (for each mode)
 - b. Modulation, coding, signal processing characteristics
 - c. Dynamic range, OOB interference tolerance...
 - d. Transmit power, waveform, spurious emissions...
 - e. Switching times - between channel recovery time, tx/rcv
 - f. Settable/adjustable and ICD for control/programming