

Special Committee 147

**MINIMUM OPERATIONAL PERFORMANCE STANDARDS FOR TRAFFIC ALERT AND
COLLISION AVOIDANCE SYSTEMS AIRBORNE EQUIPMENT**

The 88th meeting of the SC-147 was held on May 18th, 2018 at RTCA, Washington, DC. In accordance with the Federal Advisory Committee Act, Alan Sigman Federal Aviation Administration (FAA) was the Designated Federal Officer (DFO) for this meeting.

J. Stuart Searight	Co-Chairman, Federal Aviation Administration
Ruy Brandao	Co-Chairman, Honeywell
Alan Sigman	Acting Designated Federal Officer, Federal Aviation Administration
Donna Froehlich	Secretary, Aurora Innovations
Al Secen	RTCA

Note: All presentations from the agenda items summarized below can be found on the RTCA Workspace (<http://workspace.rtca.org/kws>) in the SC-147 Traffic Alert & Collision Avoidance System area.

Agenda Item 1. – Opening Plenary Session

- a. Mr. Stuart Searight and Mr. Bill Booth opened the meeting
- b. Mr. Al Secen welcomed the committee in behalf of RTCA. Separate (new) sign-in sheet for today.
- c. Mr. Alan Sigman read the DFO announcement
- d. Mr Secen summarized the RTCA Proprietary Policy, noted that RTCA oversight and EUROCAE TAC need to approve any proprietary information included in an RTCA/EUROCAE standard.
Mr. Alexander Engel and Mr. Bill Booth noted EUROCAE's proprietary information policy mirrors that of RTCA.
Mr. Al Secen commented that RTCA is changing from a Federal Advisory Committee (FAC) to Standards Development Organization, but that its role with regard to SC-147 would remain unchanged.
- e. Minutes of last meeting – Accepted by committee and APPROVED.
- f. Agenda for this meeting – Adding opportunity for WG-75 to report.
- g. Discussion of future meetings was deferred to end of meeting.

Agenda Item 2. – Updates on TSO Schedule

- Mr. Searight indicated that Ms. Mariano could not stay through Friday. He had talked with her about the TSO effort and indicated that the dates planned for TSO development and

review are still on track for the MOPS publication. That the [TSO schedule](#) dates provided in last plenary are still appropriate.

Agenda Item 3. – SC-147 TOR Revisions

Mr. Searight summarized the SC-147 TOR Revisions which were presented to and approved by RTCA Program Management Committee (PMC) on 22 March 2018.

- Donna Froehlich officially noted as Secretary
- Inclusion of interoperability MASPS into our TORs. – Mr. Searight indicated that this proposal was enthusiastically received by RTCA’s PMC. Mr. Searight provided a summary of interoperability MASPS and stated he had an action to complete the TOR revisions by adding some descriptive text about the MASPS in the “Scope” and “Expected Use of Documents” sections.

SC-147 committee members confirmed approval of the updates to the TORs.

Agenda Item 4. – ACAS Xa/Xo MOPS Volume I Comments and Volume II (ADD) Comments

a. Final Review and Comment/Open Consultation Overview

Mr. Walter Bender opened the meeting indicating that Surveillance and Threat Working Group (SWG and TWG) chairs had reviewed all comments and assigned them to the various Working Groups or sub-groups for review and recommended disposition. Each of the Working Groups then held virtual meetings to work through the comments assigned. He noted that the Xo Working Group (WG) had recommended disposition for all of their comments, and that the Coordination Sub-Group (CSG) had reviewed all of their comments and had a recommended disposition or had assigned a small team to develop recommended language. SWG and TWG were each assigned a larger portion of the comments; they had the opportunity to make initial recommendations for the comments designated as High and Non-Concur. Mr. Searight noted that for some of the Non-Concur comments, the submitter wasn’t available for the Working Group meeting so there was some outreach and discussion that was going on among Subject Matter Experts (SMEs) to ensure that the concern raised in the comment was addressed appropriately.

b. Working Group Comment Resolution Review and Status

Mr. Bender presented a snapshot of the status of all the FRAC comments:

Summary of Comments

	Number	Not Started	In Process	Complete
Non-Concur	8	0	8	0
High	126	0	88	34
Medium	209	132	64	13
Low	176	138	33	5
Editorial	0	0	0	0
<i>N/A</i>	<i>0</i>	<i>0</i>	<i>0</i>	<i>0</i>
<i>Substantive</i>	<i>0</i>	<i>0</i>	<i>0</i>	<i>0</i>
Total	519	270	193	52

c. Open Comments

Mr. Walter Bender noted that we received 4 new comments to review for official submission and initial disposition as well as a request to review 5 existing comments. We will be reviewing the comments as they were received by Working Group leadership. The comments will be incorporated in the appropriate comments spreadsheet with comment number before we reissue the comments tracking spreadsheet.

Ian reviewed a few comments:

- Comment #32147: The following statement “Algorithm 200: MergeModeCReplies in 6440 Appendix C of the ACAS Xa ADD describes a successful method that is recommended 6441 for assessing correlation of Mode C replies for merging” should be modified to state that this algorithm has met the Mode C surveillance flight test requirements and top not use the algorithm number because may change. – Ms. Kobzik-Juul made note of suggested wording.
Mr. Brandao and Mr. Panken to work on revised wording and bring back to SWG.
- Comment #32153: The GetTrackID algorithm does not differentiate between ADS-B and ADS-R tracks. This results in an inability to decorrelate ADS-R tracks – (Vol II comment related to Vol 1 comment #31781 Merged Targets) There is a problem with undesignated target if it is being merged with another target... If a target is being deleted, we don’t delete the tracks correctly, need to resolve that memory management issue.
Accepted without Change./Approved for ADD resolution (captured as Xa-0208).

- Comment #60177 , There are requirements within DO317() that require extrapolation. It is "guessed" that this same extrapolation is probably going to be replicated (at least in part) within the Julia code - which is wasteful processing. Why is it necessary to send in un-extrapolated data?

Initial response: the Julia extrapolates in its frame of reference which may be different from what manufactures have implemented as their reference frame. A MOPS cannot sufficiently address this. A manufacturer can investigate if the outputs of the STM tracker can be used to satisfy their DO-317 tracker if CPU utilization is a challenge. A manufacturer could provide the extrapolated inputs if they can pass the test suite verification.

Explanation accepted, Committee determined No Change required

Mr. Bender resumed comment review from prioritized (filtered on Category) MOPS, Volume I Comment spreadsheet.

- Comment 31397, Section 1, line 1601: Cost Reduction - Introductory material was received from TWG.
Approved; accepted recommendation to delete the sentence.
- Comment 60210, lines 7094-7095: Requirement language – Mr. Jacobson talked to the comment: Although this is a legacy requirement, there is no reason to have 2 SHALLs in the sentence; actual requirement is down further. Recommended language removing both SHALLs and replacing with a MUST was provided in the comment. ... With the edit, the NOTE needs to be moved below the remaining requirement below SHALL 1425.
Approved: Recommended language was accepted with change.
- Comment 60209, line 6895: Implementation of NARs – Question from Mr. Jacobson: Are we really treating NARs under passive surveillance differently than other NARs just because they are further away? This seems inconsistent. – Response: The inconsistency is due to use of hybrid surveillance; the front-end is doing all the actual validation. If front-end transitions to active surveillance and the target is validated, then it will still be displayed as NAR. This comes from DO-300.
Mr. Jacobson: OK, THANKS.
No Action Required.
- Comment 60204, line 5643: Receive Indication/System Feedback – Discussion revealed that the concern is related to turning off monitoring of the display. Commenter stated: This is new; it wasn't part of DO-185B or DO-300. It sounds ARINC 735-B-ish so not a real requirement. Response included the following observation: We still have the Monitoring of display requirement.
Approved; sub-section 2.2.3.12.9.4 to be deleted.
- Comment 60211, lines 7711-7712: Table 2-19 doesn't match advisories that are in Table 2-47. Decision to remove Table 2-19 and just reference Volume II, Table 2-34

At this time the leadership asked attendees if there were any other comments they would like to review while we are Face-to-Face. A summary of that discussion follows

- Comment# 31794, "Bearing estimates are used by the collision avoidance algorithm which determines if the predicted horizontal separation at closest point of approach is large enough not to declare the intruder a threat. Bearing estimates are also used to display traffic advisories in the cockpit of ownship." implies the bearing impacts safety of the system. – This concern was raised Tuesday. Mr. Brandao, and others asked: can we remove language suggesting active affects safety? Confirm bearing does affect overall safety. Current action is to leave reference language as is and direct reader to the integrated surveillance appendix. That appendix will have language added to discuss bearing impact on safety.
Wording change accepted by committee is captured in Proposed column.
- Comment #31443, line 5638: Functionality-Display Software Part Number – Garfield not quite happy with initial/recommended resolution of 31443, and this “Low” priority comment had not yet discussed. Mr. Garfield asked about final resolution of this and other comments that haven’t been reviewed during the Face-to-Face portion of this week. Regarding enabling Software Part Number – Mr. Rowlan stated that it doesn’t have to be through a discrete and provided a suggested edit.
Suggested language was provided and approved.

Discussion regarding disposition of comments not yet reviewed by SC-147 was raised due to comment 31443, above.

Mr. Searight said this was a topic that is on the agenda for later today, but we might as well address it now. He followed with: As mentioned at end of yesterday, WGs will be meeting in the next weeks, some meetings possibly joint. All final resolutions will be posted (in spreadsheet) and distributed Lows and Meds not discussed this week need to look at spreadsheet and come back to WG co-chairs to discuss.

Mr. Silbermann noted that TWG has provided initial disposition of comments, working with assignees and ensuring commenter reviews disposition. Follow-up on June 6 and June 20 to discuss and resolve any outstanding concerns. Mr. Bender indicated: SWG will be using same process.

Resuming comment review:

- **Comment 31570, lines 4386-4388: Sensitivity Level (SL)** – Is it necessary to define codes (e.g., SL) that are legacy, and that ACAS X doesn’t use? – Ken Carpenter indicated his suggested resolution might be ambiguous.
Decision was to: Incorporate Mr. Carpenter’s suggestion, but also resolve the TCAS requirement (1180) that points into that section; Mr. Rowlan agreed to draft new text
Accepted with Change.
- **Comment 31543, line 1806: Interference Limiting** – Insert a new section 1.3.4 (and renumber successors) "Control of Interference caused by Active Surveillance. Mr. Carpenter and Mr. Bender confirmed the proposed change is desired.
The committee approved the change.

- **Comment 31541, lines 1713-1716: Purpose of a TA** – Mr. Carpenter wished to discuss this comment whilst pilots are in the room. Mr. Carpenter provided suggested text to the effect of: "Prepares the pilot for a subsequent RA" This also reduces the length of statement.

The committee approved the change.
- **Comment 60178 , lines 9720-9723: TCAS Standby** – Mr. Brandao asked to review this comment and the proposed disposition. Our WG leadership displayed a new text proposal which removed “2500 ft” and clarified intent of “airborne”. Mr. Jacobson pointed out that this only happens when Transponder (fails or is in standby) and thus “TCAS Standby” is annunciated, and asked: “Why not annunciate actual failure (of the transponder)?” Mr. Brandao provided an overview of HMI and other SME opinions that we (TCAS/ACAS) cannot annunciate another system’s mode.

Also, Mr. Wes Olson added a historical note regarding annunciation of “TCAS” vs “ACAS”. It is currently annunciated TCAS and not ACAS even though the current system is known as ACAS in European (and most other countries beyond the US). Mr. Olson noted: The phrase “TCAS Standby” has been internationally accepted as it was decided that “TCAS” is easier to discriminate aurally on flight deck than ACAS.)

The committee accepted Mr. Brandao’s proposal with minor edits.
- **Comment 31166 (line 8502-8510) Range Rings** – Discussion of suggestion led to reword decision: indicate a way of indicating range shall be placed at specified radii from the ownship symbol, but don't require that they be rings. Or make rings a recommended/optional display feature as long as other means of indicating range is provided.

Accepted with Change.
- **Comment 31832, line 19597: Coordination flight test** – Mr. Stacey Rowlan indicated: There is a paragraph with requirement that the flight be at 3,000 (AGL, not MSL) over calm water in order to increase likelihood of Multi-Path. Mr. Rowlan recommended that this be considered a recommendation for the coordination flight test. Mr. Carino asked what other vendors think: Mr. Brandao responded: OK. Mr. Dwight Unruh provided: “You have to be within ½ mile to get the RA and you would be distorting the message. The geometry to get RA isn’t optimal to get multi-path.” After further discussion, Mr. Unruh indicated: “It would stress the DMTL.” Mr. Brandao agreed. Mr. Rowlan asked about only requiring a portion of the test being over calm water to which Mr. Carino agreed. Mr. Unruh wanted to clarify: How much time is required for partially over calm water? Mr. Rowlan: the requirement should reflect that this is only needed once; recommending we make it (the requirement) a “FIRST of MODEL”.

Mr. Panken asked that a few of the SMEs in the discussion look at intention of tests and then propose suggested re-wording and discuss at SWG. Mr. Bender, Mr. Rowlan and others concurred with this approach.

Accepted with Change.

Mr. Alan Sigman took this opportunity to ask about additional comments that recommend changing 2 legacy Shall statements in one sentence to 2 separate sentences. Mr. Searight confirmed these should be reviewed by WGs, and not be accepted on the

whole for a global search and replace by the editor. [It was noted that these additional comments were rated “Low” by commenter.] This was accepted as a good approach.

d. ACAS Xa/Xo MOPS Approval Consideration

Mr. Bender showed us the phenomenal progress we made today in resolving the Comments.

Summary of Comments				
	Number	Not Started	In Process	Complete
Non-Concur	8	0	8	0
High	126	0	88	34
Medium	209	132	64	13
Low	176	138	33	5
Editorial	0	0	0	0
<i>N/A</i>	<i>0</i>	<i>0</i>	<i>0</i>	<i>0</i>
<i>Substantive</i>	<i>0</i>	<i>0</i>	<i>0</i>	<i>0</i>
Total	519	270	193	52

Upon review of all Non-Concurs, and Highs as well as the Mediums and Lows that were raised for discussion:

Summary of Comments

	Number	Not Started	In Process	Complete
Non-Concur	8	0	7	1
High	126	0	86	36
Medium	209	60	111	38
Low	177	136	35	6
Editorial	0	0	0	0
<i>N/A</i>	<i>0</i>	<i>0</i>	<i>0</i>	<i>0</i>
<i>Substantive</i>	<i>0</i>	<i>0</i>	<i>0</i>	<i>0</i>
Total	520	196	239	81

Mr. Brandao noted that FRAC can feel quite challenging. Since this is the formal review of the MOPS there are a lot of people that are taking the time to perform an in-depth review. The fact that there are so many people reviewing the document means that there will be comments and recommendations that may seem contradict. Additionally, although some of the reviewers have “fresh eyes”, this also means that they are not familiar with some of the document structure and wording trade-offs that have already been discussed. So the FRAC comment resolution can feel like a struggle to get everyone in a longboat rowing in the same direction. Mr. Brandao noted the progress we have made so far and encouraged the participants to continue working together to identify an acceptable resolution/closure for each comment.

Mr. Alexander Engel noted the fantastic work that has gone into this MOPS over many years. He applauded our efforts noting that everyone has been upbeat and willing to work to resolution. Mr. Al Secen concurred and also thanked the committee members for their hard work.

Mr. Stuart Searight asked for motion for approving the WG-75 and SC-147 MOPS. At which, Mr. Andy Zeitlin moved for approval; the motion was Seconded. There was No Opposition to approval, and a consensus for approval. SC-147 MOPS Volume I and Volume II (ADD) was APPROVED.

Mr. Searight congratulated FAA TCAS PM, Neal Suchy, in addition to the Co-Chairs and WG leads. Mr. Neal Suchy congratulated and thanked his PO team and reminded them that there is still a bit more to do in order to get the FRACed MOPS to the PMC this summer.

e. Next Steps:

Mr. Searight transitioned to Next Steps; he indicated the committee will be referring to the PMC approved package as ACAS X Version I.

He then began identifying the materials that will be considered as supporting the ACAS X/Xo MOPS (ACAS X Version 1 MOPS) and stated these materials will also be available on the RTCA Portal. Mr. Secen added that these materials will be supplied with purchase of the MOPS.

Mr. Searight outlined the next steps providing a timeline for getting the MOPS to RTCA PMC and positioning for EUROCAE approval.

[2018 RTCA Timeline \(slide 3\)](#)

- May 21-July 20 implementation of comment resolution
- July 23 all materials posted on workspace
- July 23-Aug 8 Joint Committee Agreement that all FRAC/WC issues addressed
- Aug 8- Final (Internal Run15R3+/R4) Test Suite Released
- Aug 9 (Thurs) Telecon for official closeout of FRAC/OC.

Mr. Secen noted the 2 options for managing the formal close-out of FRAC/OC is: to go through an Adjudication or to have an Official Ballot which can be managed electronically. The chairs selected an electronic ballot.

Mr. Secen and Mr. Engel noted that the committee will need explicit (written/email) agreement from Non-Concur commenters that these comments have been resolved appropriately

Mr. Searight noted that we will have time for coordinating with RTCA on formatting during and immediately after addressing the comment resolution.

- Aug 10 Delivery of Final MOPS to PMC
- Sep 20 PMC Meeting
ACAS X Version 1 MOPS nominated for RTCA Approval for Publication

Mr. Alexander Engel noted: EASA requested European validation of the MOPS. This might affect EUROCAE approval for publication, potentially causing a delay from the RTCA PMC Approval date.

Mr. Bill Booth added: EASA stated that to trigger the ETSO/Rule Change procedures they required the availability of the MOPS and a statement of acceptability from WG-75. Mr.

Booth then noted: the MOPS is now available, this part has been satisfied; and now they are working on the final European study.

[Agenda Item 5. – Report from ACAS Xu Working Group Report \(slide 4\)](#)

At this point, Mr. Searight transitioned to Status Reporting from Xu Working Group, with Mr. Charles Leeper reviewing scheduled Xu meetings at RTCA. Mr. Leeper also noted that the ACAS Xu v5 (Flight Test/Demo version) will be Feb 2019 timeframe.

Agenda Item 6. – Summary and Adjourn

Mr. Stu Searight noted that there will be a little restructuring within the committee to better support Xu and that the chairs along with the Working Group and Tiger Team leadership will figure out what the resulting structure will be prior to the next Face-to-Face (F2F) and Plenary session at RTCA on 16-18 October 2018.

Regarding the Interoperability MASPS that are now included in our TORs, committee leadership would like to initiate preliminary review this week or next week. The plan is to include key DAA SMEs and report out in the July 2018 F2F for the Xu Working Group. This is in preparation for a formal FRAC/OC in or by October 2018.

Mr. Garfield Dean noted that there has been some new developments in horizontal coordination and the allocation and designation of the CCCB bits; this will be on Xu Coordination Tiger Team and possibly other Xu agendas over the next few months

Ms. Donna Froehlich requested 5 minutes of the committee’s time to provide an update to the CM process being used to manage FRAC comments against the Volume II, ADD, which further refines the functional and performance requirements as well as coordination between ACAS Xa/Xo and other Collision Avoidance Systems. Ms. Froehlich displayed [SC-147 FRAC-CM Status](#) slides and explained that this presentation was to provide transparency into how the FAA TCAS/ACAS Program Office was identifying, managing, and tracking the changes to the ADD as a result of the FRAC comments on Volume II. This is a continuation of the process that has been used well over a year. In this iteration, the FRAC Comments are reviewed and those that require changes to Volume II are identified as text/editorial, prescriptive vs. suggestive, code clean-up, or a necessary change (correction) to the algorithm description. With that assessment, each category is assigned an ID for tracking the change. These IDs can be thought of as the equivalent of an RTCA Change Proposal, except that we are providing that level of visibility to algorithms that are not yet approved and published. Ms. Froehlich indicated that an internal Change Proposal will capture the ADD changes resulting from the FRAC comments; she noted that Accept or Accept with Change from the cognizant Working Group is considered sufficient for assigning the comment to an ID on the Issue Tracker, with the internal Change Proposal being captured as time allows during the FRAC implementation period.

Next Face-to-Face meeting dates below:

Year	Dates	City	Venue	Host Organization	Focus
2018	July 24-26	Washington, DC	RTCA Headquarters	RTCA	ACAS Xu
2018	Oct 16-18	Washington, DC	RTCA Headquarters (w Plenary)	RTCA	ACAS X/Xu

Mr. Searight again congratulated the committee, thanking all the contributors for their hard work and perseverance. He summarized with: “We have ourselves a MOPS” then indicated: if there are no more additions, we will adjourn.

There were no additional comments; the meeting adjourned at 11:05.

Certified as a true and accurate summary of the meeting.

Co-Chairman

Co-Chairman

-S-

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Mr. Stuart Searight

Mr. Ruy Brandao

FAA

Honeywell

Attendance
SC-147 Plenary #88

Name	Organization
Abi, Deebu	Garmin Ltd.
Bender, Walter	The Johns Hopkins University
Bess, Peter	Air Line Pilots Association (ALPA)
Booth, Bill	EUROCONTROL
Brandao, Ruy	Honeywell International, Inc.
Carino, Joslin	Federal Aviation Administration (FAA)
Carpenter, Ken	QinetiQ (EUROCAE member)
Ciaramella, Kathryn	Federal Aviation Administration (FAA)
Dean, Garfield	EUROCONTROL
Drozdowski, Stanislaw	EUROCONTROL
Edwards, Matthew	MIT Lincoln Laboratory
Engel, Alexander	EUROCAE
Foster, Craig	UK National Air Traffic Services
Froehlich, Donna	Aurora Innovations
Gallo, Wayne	Federal Aviation Administration (FAA)
Hahn, Edward	Air Line Pilots Association (ALPA)
Jacobson, Randy	Rockwell Collins, Inc.
Jessen, Ian	MIT Lincoln Laboratory
Klaus, Robert	MIT Lincoln Laboratory
Kobzik-Juul, Barbara	The Johns Hopkins University
Law, John	Federal Aviation Administration (FAA)
Leeper, Charles	The Johns Hopkins University
McLain, Cynthia	MIT Lincoln Laboratory
Monk, Walter	CSSI, Inc.
Olson, Wesley	MIT Lincoln Laboratory
Panken, Adam	MIT Lincoln Laboratory
Robin, Jean-Luc	Airbus
Saunders, Jonathan	Aurora Innovations
Searight, Stuart	Federal Aviation Administration (FAA)
Secen, Al	RTCA, Inc.
Shafaat, Taji	The Boeing Company
Sigman, Alan	Federal Aviation Administration (FAA)
Steiner, Timothy	Federal Aviation Administration (FAA)
Suchy, Neal	Federal Aviation Administration (FAA)
Teller, Tom	MIT Lincoln Laboratory
Ulm, Brian	L3Technologies
Zeitlin, Andy	The MITRE Corporation