

Summary of the Ninety-Eighth Meeting

Special Committee 159

**Minimum Operational Performance Standards for Airborne Navigation
Equipment Using the Global Positioning System (GPS)**

The ninety-eighth meeting of SC-159 was held May 11th, 2017 at RTCA Headquarters, 1150 18th Street NW, Suite 910, Washington, D.C. 20036. The attendees were the following:

Christopher Hegarty (Co-Chairman)	The MITRE Corporation
George Ligler (Co-Chairman)	Project Management Enterprises Inc.
John Savoy (Secretary)	Honeywell International, Inc.
Ken Alexander (DFO)	Federal Aviation Administration (FAA)

NAME	COMPANY
Laurent Azoulai	Airbus
Michael Biggs	Federal Aviation Administration (FAA)
Rick Cassell	Systems Enginuity, Inc.
Barbara Clark	Federal Aviation Administration (FAA)
Yi Ding	Esterline CMC Electronics
Daniel Domey	Esterline CMC Electronics
Andrey Galyamov	NNC Consulting LLC
Adrian Hiliuta Esterline	CMC Electronics
Victor Iatsouk	Consultant
Barry Irwin	The MITRE Corporation
Andreas Lipp	EUROCONTROL
Rebecca Morrison	RTCA, Inc.
John Owen	Defence Science Technology Laboratory (DSTL)
Timothy Padden	U.S. Air Force
Patrick Reddan	ZETA Associates (Exempt, see note)
Zach Reynolds	L-3 Communications
Andrew Roy	Aviation Spectrum Resources, Inc.
Sergey Silin	ZAO "KB NAVIS"
Oleg Skubii	Research Design Lab NAVIS
Bob Stuckert	Federal Aviation Administration (FAA)
Dale Swanson	The MITRE Corporation
Monica Vafiades	U.S. Air Force
Joel Wichgers	Rockwell Collins, Inc.
Tin Ying	U.S. Air Force

The agenda for the meeting follows:

1. Introductory Remarks: Co-chairs, RTCA and DFO Statement
2. Review and Approve Previous Meeting Summaries
 - a. Ninety-Sixth Meeting held October 21, 2016, RTCA Paper No. 028-17/SC159-1057.
 - b. Ninety-Seventh Meeting held December 13, 2016, RTCA Paper No. 029-17/SC159-1058
3. Final Review and Comment (FRAC) consideration for document approval (a, b, d) or to open new FRAC (c, e)
 - a. DO-253C (LAAS MOPS)
 - b. DO-246D (LAAS ICD)
 - c. DO-235C (Radio Frequency Interference)
 - d. GPS/GLONASS L1 MOPS
 - e. L1/L5 antenna MOPS
4. Action Item Review
5. Other Business
6. Date and Place of Next Meeting
7. Adjourn

In accordance with the Federal Aviation Advisory Committee Act, Ken Alexander, Federal Aviation Administration (FAA), was the Designated Federal Official for this meeting.

Note that, with the agreement of the chairmen and other participants, the agenda was reordered to accommodate the availability of certain participants. The order in the minutes below reflects the actual sequence of topics.

Agenda Item 1. Chairman’s Introductory Remarks.

- Ken Alexander read a statement indicating that this Advisory Committee meeting is open to the public, that notice of the meeting was published in the Federal Register and that members of the public may present written or oral statements with the permission of the committee chairmen.
- Rebecca Morrison, Program Director of RTCA, discussed RTCA’s proprietary references policy and membership policy.
- At the suggestion of Co-Chairman George Ligler, attendees introduced themselves.
- Note that a significant portion of the attendees of this meeting participated using WebEx.
- There was an announcement regarding the RTCA Symposium to take place on June 13, and June 14, 2017. Interested parties were referred to the RTCA website.

Agenda Item 2. Approval of Summaries of Previous Meetings.

- a. Ninety-Sixth Meeting held October 21, 2016, RTCA Paper No. 028-17/SC159-1057.

Victor Iatsouk, the chairman of WG 2A provided the following comment:

“In SC-159-96 summary for Agenda item 4b in the 4th line after the words “...by a small task group” add “within WG-2A framework” to read “... by a small task group within WG-2A framework”

The summary was then approved with this change.

- b. Ninety-Seventh Meeting held December 13, 2016, RTCA Paper No. 029-17/SC159-1058

The summary was approved without further modification.

Agenda Item 6. Date and Place of Next Meeting

The 99th meeting of RTCA SC-159 will take place the week of October 23rd, 2017. A schedule for the meeting was not proposed at this time. Working group chairmen were to send requests to committee co-chairmen George Ligler and Chris Hegarty and to program director Rebecca Morrison for coordination.

Agenda Item 3a and 3b. Final Review and Comment (FRAC) consideration for document approval DO-253C (LAAS MOPS) and DO-246D (LAAS ICD)

Joel Wichgers, chairman of WG-4, presented the results of the FRAC process for DO-253 and DO-246.

- 268 comments were received regarding DO-253. 50 comments were addressed for DO-246.
- All DO-246 comments have been addressed and required changes implemented and verified.
- 264 of 268 comments for DO-253 have been addressed and required changes implemented and verified.
- The four remaining comments for DO-253 have been addressed and appropriate changes have been identified. These changes are purely editorial and will be completed in the next few days.
- A summary of changes followed:
 - DO-253 was updated to be compatible with the latest revision of the ICAO Annex 10 SARPs as approved by the Navigation Systems Panel. Care was taken to ensure backward compatibility with existing equipment.
 - The link budget for the VHF Data Broadcast (VDB) was modified to allocate additional variability to ground transmitters. This was achieved by reducing the allowed aircraft implementation loss and reducing allowable antenna gain variation. This was accompanied by additional description regarding the link budget.

- A second class of VDB receiver was defined to accommodate aircraft with implementation losses outside the currently standardized range.
- Support was added for VDB ground transmitter diversity. That is, provisions were made to allow multiple VDB transmitters to broadcast data in the same transmission slot to ensure continuity and maintain the validity of the authentication protocols.
- Changes were made to GBAS Approach Service Type (GAST) D to address findings from various requirements validation efforts.
- Changes were made to GAST D ionospheric gradient monitoring.
- Changes were made to the VDB authentication protocols.

Joel also outlined additional ongoing work for WG 4

- Additional effort remains to ensure compatibility of the GBAS VDB with ILS, VOR, and VHF communication systems.
- It is time to begin work on requirements for dual-frequency, multi-constellation GBAS systems.

Joel thanked the team for their extended effort and expressed appreciation for the work performed.

Joel formally recommended, on behalf of WG 4, that SC-159 approve of the new DO-253 and DO-246 and forward the documents to the RTCA PMC for acceptance.

The members of the committee present approved the recommendation with no further comment.

Agenda Item 3c and 3e. Final Review and Comment (FRAC) consideration for document approval DO-235C (Radio Frequency Interference) and L1/L5 antenna MOPS

At the request of George Ligler, Sai Kalyanaraman discussed the status of the dual-frequency/multi-constellation antenna MOPS.

- The document currently exists in a draft form with several known issues (e.g. noise figure).
- Working Group 7 is actively meeting to address these issues.
- The working group expects to have the draft MOPS ready for final review and comment (FRAC) by August 2017.

A motion was made to initiate the FRAC process for the dual-frequency/multi-constellation antenna MOPS prior to the next plenary meeting. This was approved without comment.

Sai further discussed the status of revisions to DO-235.

- Working Group 6 is also meeting frequently with EUROCAE colleagues.
- The joint group is working to address multi-constellation issues at L1 as they are related to GPS and Galileo.
- The group expects to have the document ready for final review and comment by early June 2017.

A motion was made to initiate the FRAC process for updates to DO-235 prior to the next plenary meeting. This was approved without comment.

The plenary at large further discussed the possibility of including additional material regarding GLONASS frequencies in the antenna MOPS document. This additional material was noted to be out of scope for WG 7, but if a suitable “Informational Appendix” or “Normative Appendix” could be provided, the WG would consider incorporating it into the document for review.

Agenda Item 3d. Final Review and Comment (FRAC) consideration for document approval GPS/GLONASS L1 MOPS

Victor Iatsouk, chairman of Working Group 2A, summarized the work performed by WG 2A during the development of the GPS/GLONASS MOPS.

- The MOPS development process was initiated in 2014 by a group of Russian research and development organizations and GNSS avionics manufacturers.
 - The complexity of this task was initially underestimated.
- A development plan and initial draft of the MOPS was presented to SC-159 at the 91st meeting in March of 2014.
- DO-316 was used as a template for content and structure.
- On Jun 18, 2015, the RTCA PMC approved revised terms of reference for SC-159 including a task to develop a new MOPS for GPS/GLONASS L1-only airborne equipment to be delivered by March 2016.
- The FRAC process for the MOPS was initiated by SC-159 at the 95th meeting in March of 2016.
- The FRAC process raised several significant issues ultimately resulting in the completion of the MOPS being significantly delayed.
 - In total, 187 comments were received with 75 classified as “High Priority” or “Non-concur”.
 - The FRAC process identified many concerns regarding the integrity of the combined GPS/GLONASS constellation.
 - Data for the determination of individual satellite and constellation failures is an essential precondition for MOPS development.
 - Institutional issues are beyond the scope of RTCA MOPS development.
- All comments resulting from the FRAC process have been resolved and the required changes to the MOPS implemented and verified.
- Victor thanked those who contributed for their participation.

Victor formally recommended, on behalf of WG 2A, that SC-159 approve the MOPS for GPS/GLONASS (FDMA + antenna) L1-only airborne equipment.

Discussion followed Victor’s presentation.

- Some questions remained regarding integrity. In particular, there was a concern that there should be a mechanism for deselecting an entire constellation of satellites. This was motivated by the need to address single, dual and constellation wide faults. It was

noted that these failure modes are specifically addressed by the requirements and associated test procedures.

- There was further concern that the document was not fully mature. It was noted that many typographical errors remained and the group discussed that these would be addressed prior to publication.
- The fact that the MOPS allows variability in the definition of the integrity algorithm rather than explicitly identifying the particular algorithm was also a point of contention. The group noted that this was intentional and consistent with the way this is handled in DO-316 and DO-229. The test procedures provided are intended to demonstrate that the algorithm chosen by the manufacturer can adequately protect the integrity when faced with the multiple failure modes noted earlier.
- There were some questions regarding the definition of antenna requirements. The GPS/GLONASS L1 MOPS will include antenna requirements in an appendix rather than in a dedicated document. The chairman of WG 7, Sai Kalyanaraman, confirmed that, consistent with the discussion of Agenda Item 3(e) above, the multi-frequency, multi-constellation antenna MOPS may address GLONASS-specific antenna characteristics. A prototype antenna compliant with the requirements in the appendix is available.
- There was some discussion regarding the vulnerability of the combined GPS/GLONASS receiver to interference from SATCOM systems. Victor referred interested parties to Appendix C. It was noted that DO-235 does not have updated guidance regarding GLONASS interference. The team discussed that the material in DO-235 would remain but there were no current plans to update it.

A motion was made for the SC-159 plenary to accept the new document. It was approved with the provision that all outstanding editorial comments be resolved.

One participant noted that this is the first explicit multi-constellation MOPS approved by SC-159 and reflected on what a significant milestone this represents.

Agenda Item 4. Action Item Review

There were no new action items to review.

Agenda Item 5. Other Business

There was no further discussion and the meeting concluded.

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John Savoy
Secretary

CERTIFIED as a true and accurate summary of the meeting.

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Christopher Hegarty
Co-chairman

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George Ligler
Co-chairman