RTCA

Thirty Seventh Plenary Meeting of SC-228

Minimum Performance Standards for Uncrewed Aircraft Systems

April 21, 2023

37th Plenary Agenda

Published Agenda

1. Call To Order – Welcome
2. Review RTCA Meeting Guidelines
3. Opening Remarks / Introductions
4. Review and Approve Agenda
5. Approve Meeting Minutes From Plenary #36
6. Schedule Update
7. EUROCAE WG-105 Update
8. WG1 Update
9. WG2 Update
10. WG3 Update
11. WG4 Update
12. Government Authorized Representative (GAR) Report (FAA MASPS/MOPS Usage Update)
13. Zipline V2V Prototype
14. Industry progress on MOPS-compliant equipment (General Atomics Aeronautical Systems Inc. & uAvionix)
15. FAA A2X (V2V) R&D Project Update
16. New Business
17. Adjourn

Agenda 2:
Review RTCA Meeting Guidelines

Brandi Teel, RTCA, Program Director

Anti-Trust Policy

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  - 2) Evidence that private pecuniary interests have not driven any decision to either include or exclude a system from the market;
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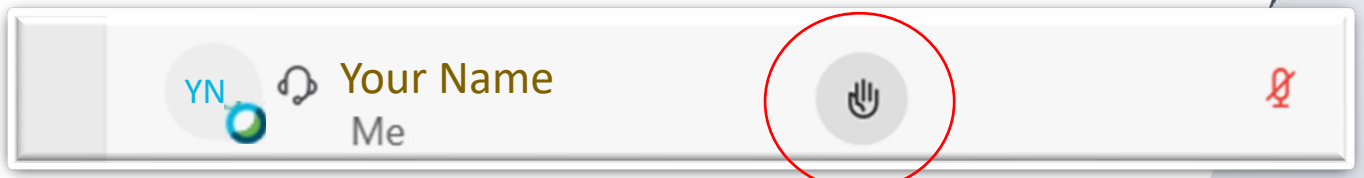
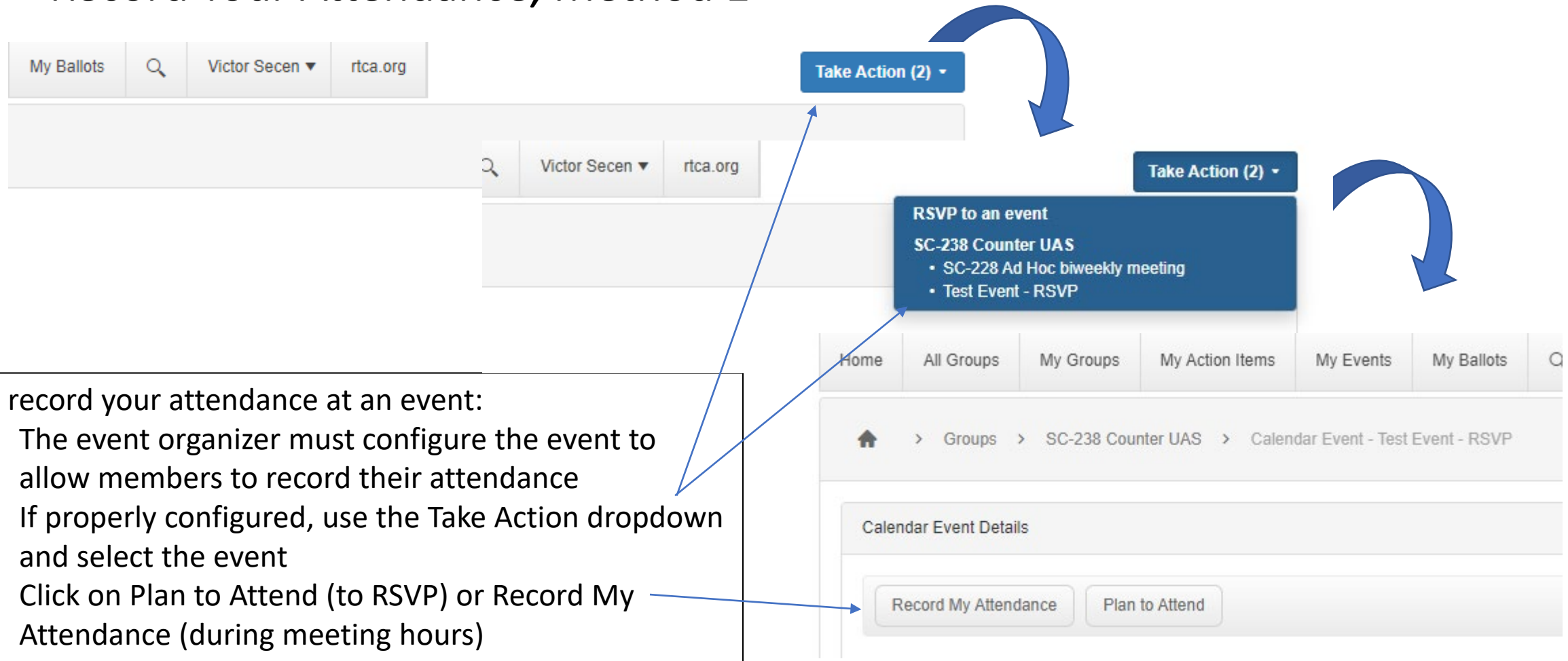
- Individuals from Non-RTCA member organizations may attend Committee Plenary meetings that are announced on the RTCA.org website and in industry publications. Non-member attendees have the option of requesting permission to be recognized to speak during the plenary meeting. Meeting summaries and related information from previous plenary meetings will be available to the public via RTCA's website. Documents undergoing final review can be obtained by contacting RTCA. Members of the public may also submit comments on documents undergoing final review.

Meeting tips

- Use the “connect audio via computer” if at all possible
- Please remember to MUTE your microphones if not speaking
- When dialing in (using your phone for audio) please announce yourself and ensure you are acknowledged
  - If you are muted by the host, * 6 will mute and unmute your mic
- If you are on both the Webex and Phone, please connect your call to your Webex USERID
- Call in users who do NOT identify themselves will be placed into the lobby – email the Program Director (if only on the phone) or chat with the Host to be admitted and restore audio
- If you would like to speak, please raise your virtual to be recognized



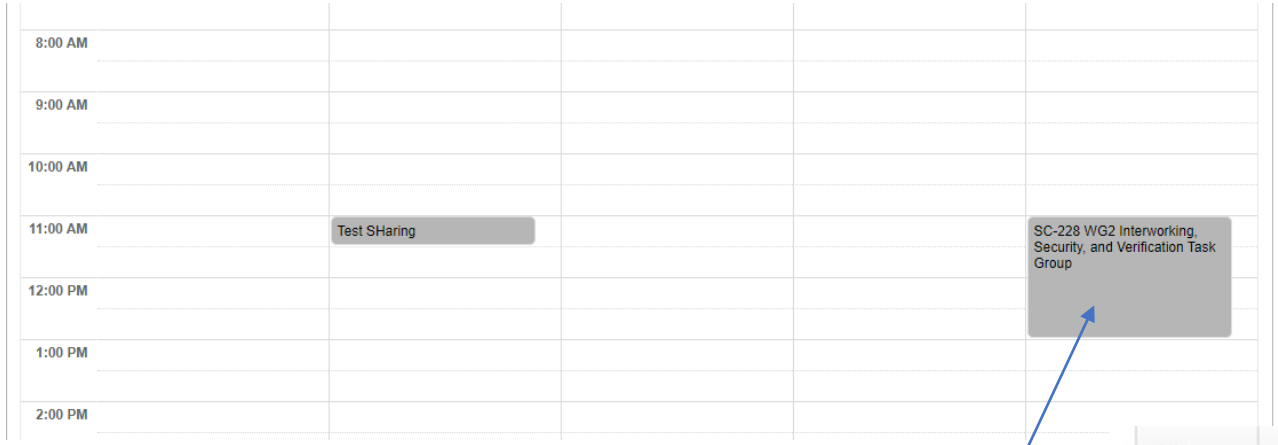
Record Your Attendance, Method 1



To record your attendance at an event:

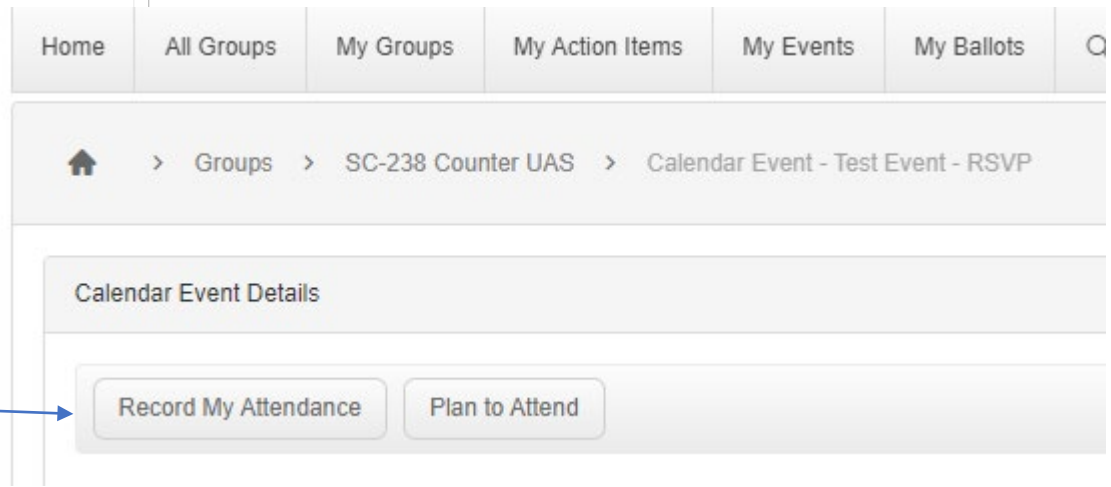
1. The event organizer must configure the event to allow members to record their attendance
2. If properly configured, use the Take Action dropdown and select the event
3. Click on Plan to Attend (to RSVP) or Record My Attendance (during meeting hours)

Record Your Attendance, Method 2



To record your attendance at an event:

1. Select the calendar event
2. If properly configured, click on Plan to Attend (to RSVP) or Record My Attendance (during the meeting hours)



Agenda 3:
Opening Remarks / Introductions

Brandon Suarez, SC-228 Co-Chair

Jim Williams, SC-228 Co-Chair

SC-228 Leadership Team

622 Registered Members at Present

164 Organizations Represented

Committee Leadership

Co-Chair: **Jim Williams**, Aura Network Systems
Co-Chair: **Brandon Suarez,** Reliable Robotics
Gvt. Auth. Rep: **Steve Van Trees**, FAA
Secretary: **Katie Edwards,** Boeing

RTCA Program Director

Brandi Teel
Program Director
RTCA, Inc.

WG1 Detect and Avoid

Co-Chair: **Don Walker**, Airbus SV
Co-Chair: **Fabrice Kunzi**, Boeing
Secretary: VACANT

WG2 Command & Control

Co-Chair: **Amelia Mahan**, Amazon
Co-Chair: **Steve Van Trees**, FAA
Secretary: **Jennifer Ledford**, FAA

WG3 Lost Link

Co-Chair: **Randy Willis**, NG
Co-Chair: **Paul Albuquerque,** FAA
Secretary: **Kerry Bowers**, FAA

WG4 Navigation

Co-Chair: **Joel Wichgers**, Collins
Co-Chair: **Matt Harris**, Boeing
Sec.: **Andrew Videmsek**, Reliable Robotics

Agenda 4:
Review/Approve Agenda

Brandon Suarez, SC-228 Co-Chair

Jim Williams, SC-228 Co-Chair

Agenda 5:
Approve Meeting Minutes From Plenary Meeting #36

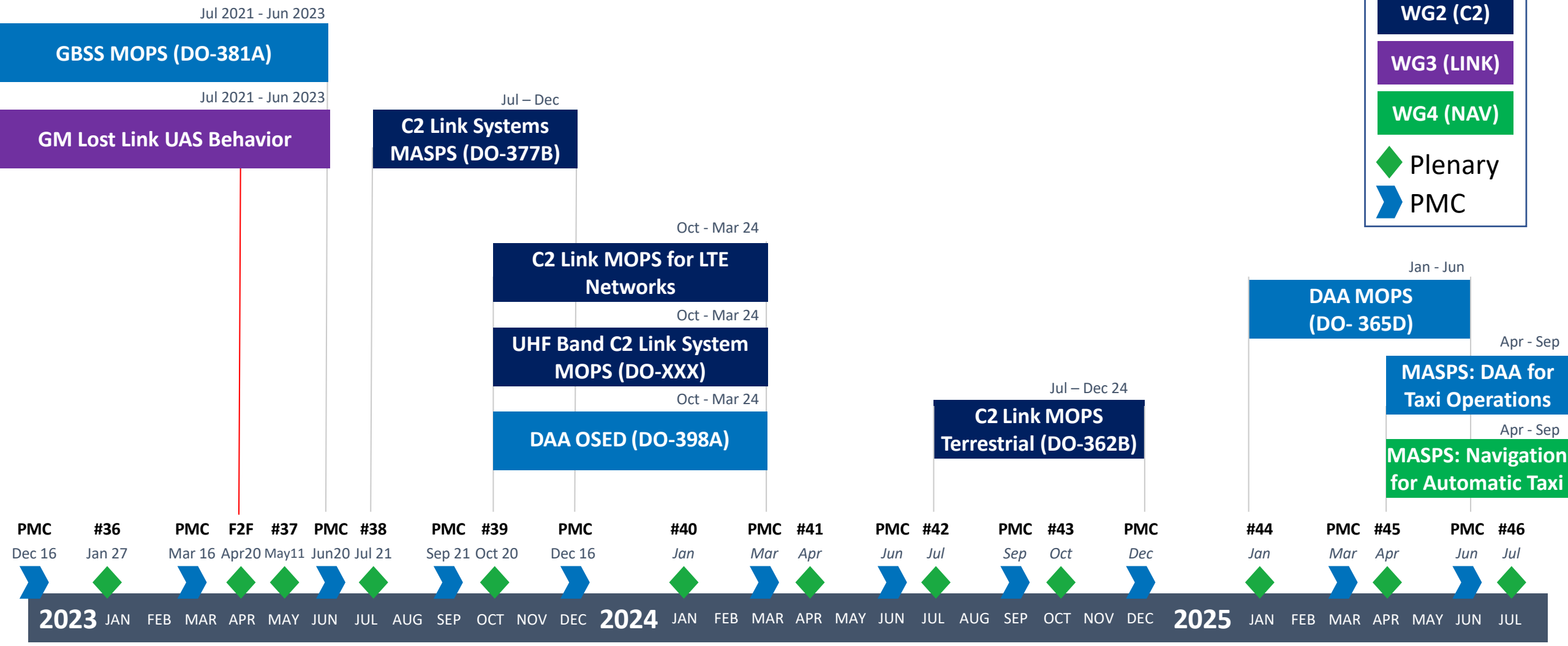
Katie Edwards, SC-228 Secretary

Agenda 6:
Schedule Update

Katie Edwards, SC-228 Secretary

SC-228 Master Schedule per TOR Rev 16

Each bar timeline shows document enter FRAC – PMC delivery and subsequent publication



Agenda 7:
EUROCAE WG-105 Update

Maurizio Goiak

Alex Florin

WG-105 UAS
RTCA SC-228 Plenary Meeting

A. Florin, M. Goiak
April 21th, 2023

Agenda

SG-1 – DAA

- On-going activities
- Upcoming activities
- RTCA/Eurocae joint opportunities

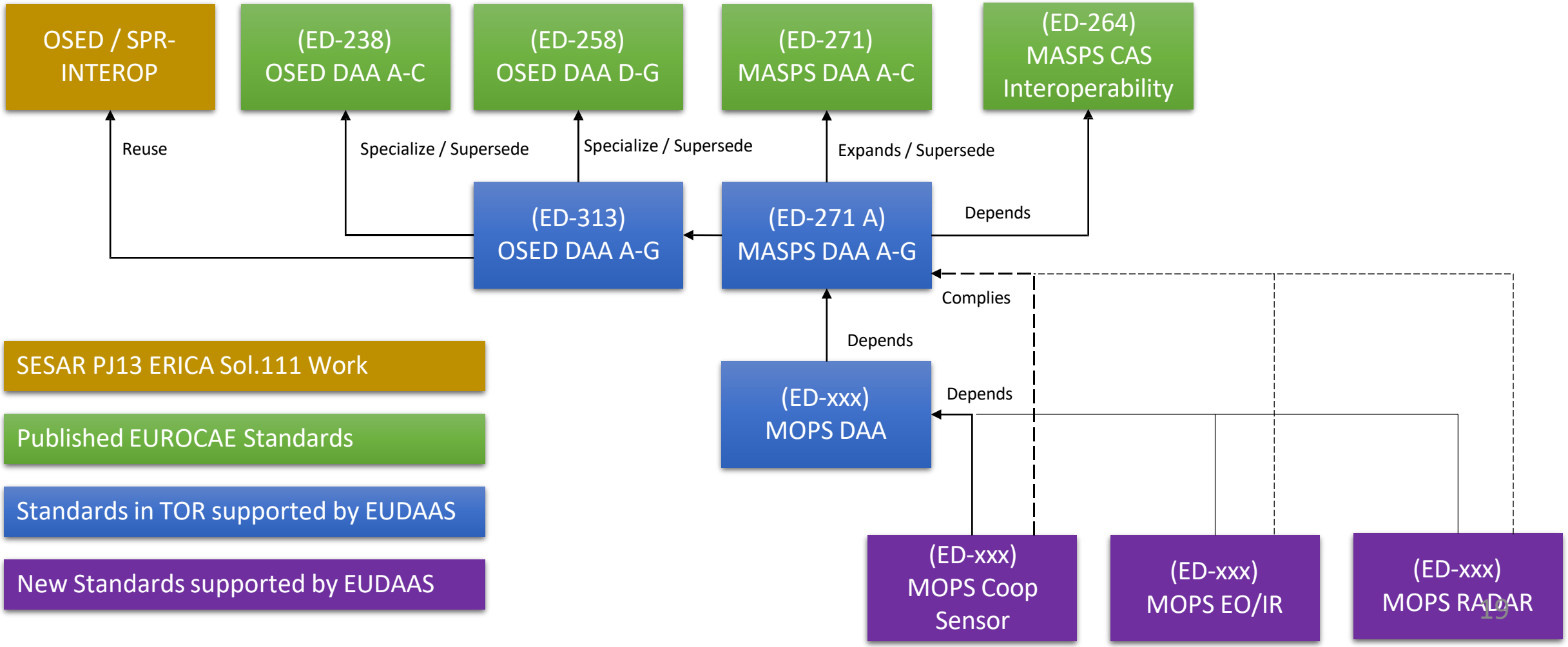
SG-2 – C3 & Security

- C2 cellular MOPS restarted
- ED-265/DO-362 interference issue

Other SGs: SG3 – UTM, SG-4 – D&AW, SG-6 – SORA

- Status of activities

SG-1 DAA Standards covering all airspace classes (IFR/VFR)



SG-1 On-going activities: DP004 DAA OSED A-G

WG-105 UAS

✈ ED-313 "OSED for DAA in class A-G airspaces under IFR"

- Open Consultation closed on April, 14th after a deadline extension.
- 141 comments were received from 6 companies and organizations:
  - Boeing (Fabrize Kunzi).
  - EASA (Hette Hoekema).
  - AIRBUS (Rob Eagles).
  - DLR (Marcel Riedel).
  - SAAB (B-G Sundqvist).
  - Thales.
- Comments classification: NC 9, H 32, M 55, L 9, E 29, Uncl. 7.
- The plan is to solve comments by the end of May and publish the document by next WG-105 Plenary in mid June.

SG-1 On-going activities: DP004 DAA MASPS A-G

WG-105 UAS

- **ED-271A "MASPS for DAA under IFR" for all the airspaces from A to G**
  - Work focused on updating main body (Chapter 4 Interoperability) and the Annexes:
    - A - Operational Performance Assessment,
    - B - Collision Risk Model,
    - D - Functional Architecture,
    - E - Remote Pilot Interaction,
    - F - Operational Safety Assessment
  - Bi-weekly teleconferences to present and discuss changes.
  - A Regulatory Advisory Group was set-up with EASA to agree on MASPS safety aspects and approach.

SG-1 Upcoming activities: DP005 DAA MOPS A-G

WG-105 UAS

- The objective is to specify the minimum requirements at equipment level for DAA to fulfill:
  - the operational description in the new ED-313 OSED.
  - the system requirements in the new ED-271A MASPS.
- The MOPS will standardize functions and sub-systems:
  - DAA design and function decompositions.
  - Collision Avoidance (CA) algorithm.
  - Remain Well Clear (RWC) suggestions to Remote Pilot.
  - Displayed symbols and guidance.
  - Sense function.
- Identify available material that can be used as a starting point for drafting MOPS.
- The RAG with EASA to agree on certification, requirements and MOC to be included into the DAA MOPS.

RTCA/EUROCAE Joint opportunities

WG-105 UAS

- EUDAAS project roadmap support sensors MOPS drafting.
- Some MOPSs were already published by RTCA, but most of them are not covering all the DAA function (e.g. CA) and are not in line with performances required by the EUDAAS.
- For each sensor technology, a whitepaper is under preparation, to identify gaps and define a possible way forward including the opportunities for joint activities with SC-147/WG-75 and SC-228.
- EO/IR and RADAR whitepaper are under review by EUDAAS CEG; results will be presented during EUROCAE WG-105 plenary in June

Cooperative Sensor
WG-75/SC-147 joint opportunity

WG-105 UAS

- RTCA SC-147 is proposing a MINI-MOPS with three classes of interrogators:
  - Class 1: current standard TCAS/ACAS-X directional antenna with hybrid surveillance.
  - Class 2: full active Surveillance with an omnidirectional antenna.
  - Class 3: active surveillance ADS-B validation with an omnidirectional antenna.
- EUROCAE WG-75 is in charge of MOPS for Active Surveillance, with the support of WG-105 (objective is to harmonize EU activities keeping the sensor MOPS compatible with the WG-105 DAA standard under definition). This MOPS shall have to be in line with:
  - European Airspace constraints.
  - EUDAAS constraints.
  - ACAS-X constraints.

Cooperative Sensor Merge Proposal

WG-105 UAS

The high level need in US and Europe are very similar; it is deemed very important to harmonize the text requirement and avoid text discrepancy for the same requirement. Proposal is to discuss two proposals in SWG meeting.

✈ OPTION 1:

- Interrogator MOPS will contain ACAS-X requirements that are common to both implementations (ACAS-X and EUDAAS).
- WG-105 DAA MOPS will contain specific cooperative EUDAAS requirements.

✈ OPTION 2: Split each interrogator MOPS Class into 2 sub-classes

- One sub-class for the interrogators that implement ACAS-X requirements.
- Another sub-class for the interrogators with improved performances and additional functionality required for Europe. These requirements will be in addition to requirements from the first class; not in contradiction to them, and optional.

SG-1 - DAA
DO006 for DAA VLL

WG-105 UAS

- **MOPS for DAA in VLL operations**: activities are in progress, bi-weekly WebEx with a core team of 5 ~ 6 people (Fr, Ca, US mostly):
  - Document merged (Sections 1, 2, 3, OSED appendix)
  - Requirements integrated, rewording in progress.
  - Tests procedures section not started
  - Requirements justification
    - Definition of Monte Carlo supporting simulations supported by Carleton university and the National Research Council Canada. Use of Canada Statistical Data

SG1 – SG3: DAA in U-Space airspace. First exchanges of information needs to be re enforced → No progress on this topic

SG-1 - DAA
DP007 for DAA VLL

WG-105 UAS

- **European Industry Position Report on RTCA SC-147 ACAS sXu MOPS**
  - DO-396 OSED has been used as baseline for analysis on the sXu implementability in EU airspaces.
  - Discussions takes longer than expected.
  - Draft document started.
  - Draft proposed Q1 2023 → Delayed Q2
  - Delivery to EUROCAE end of Q2 2023, publication Q4 2023

SG-2 - C3 & Security

- **DP003** – C2 5GHz MOPS (ED-265)
  - Agreement found with RTCA SC-228 to solve the incompatibility issue between the MOPSs, but no joint document DO-362x/ED-265 is foreseen.
  - Technical work is in progress, a new draft of the modified ED-265 was reviewed in March.
  - Coordination meeting with SC-228 leadership is on-going.
  - An ad-hoc coordination group was set up and periodically meet discuss and agreed work on documents.

- **DP008** – UAS C2 MASPS European Stakeholders Report kicked off to produce a roadmap for C2 MASPS to become globally harmonized, based on RTCA DO-377.
  - RTCA granted access to some members only for the published version.
  - Without working on the rev. B the outcome of the report could be based on old information.

SG-3 - UTM DP002

DP002 - Technical Specification for Geographical Zones and U-Space data provision and exchange

- ✈ Activities are on schedule
- ✈ Publication planned in Q3 2023

SG-3 - UTM
DP003 N-RID

WG-105 UAS

Network Remote ID (N-RID)

- Development of an optional open-source protocol to support implementation of ASTM standard F3411-22a will be presented to the EUROCAE TAC in June for approval.

SG-4 – IAW related activities
DP002 MoC SC-Light UAS

WG-105 UAS

MoC for EASA Special Condition Light-UAS – Medium Risk

- ✈Incremental release anticipated
- ✈Subparts C, D, G and H will be first

SG-4 IAW DP003 MOPS RPS

WG-105 UAS

ED-311 “MOPS for Command Unit Core Layer of UAS to be operated in the EASA certified category of operations”: the OC concluded on 17/02/2023 (after deadline extension)

- **125 concur comments** received from 8 companies/institutions, including FAA, EUROCONTROL and EASA.
- Comments classification: H 57, M 28, L 9, E 22, Unclassified 9.
- Preliminary answers prepared and shared within SG-4 will be incorporated in the official answers and updated version to be distributed with reviewers (by end April)
- Ad-hoc meetings with reviewers to be planned and launched during next weeks (during May and June)

SG-6 – SORA related activities

WG-105 UAS

- All DPs except DP006 are re-launched and leads are allocated:
  - **DP003**: Automatic protection of the flight envelope from human errors (Daniel Gutierrez - ITG).
  - **DP004**: Safe Design for UAS (ED-280A) (Antidio Viguria - CATEC).
  - **DP005**: SAIL II Guidance (Alejandro del Estal - Rigi Tech and Antonio Pascual - Wingtra):
    - Publication planned in Q3 2023.
  - **DP007**: ED-301A – Multi-GNSS guidance for medium risk (Carlos Hernandez).

- DP006: scope was refined but still under discussion with EASA; planned to be presented to the EUROCAE TAC for approval in June 2023

Thank you, questions?

- Alexandra FLORIN – Wing Aviation
  florial@wing.com
- Maurizio GOIAK – Leonardo S.p.A.
  maurizio.goiak@leonardo.com

Agenda 8:
Working Group 1 (DAA) Update

Don Walker, WG1 Co-Chair

Fabrice Kunzi, WG1 Co-Chair

GBSS FRAC

- DO-381A – Ground Based Surveillance System MOPS
  - Modifications to support enroute operations
  - New Plan – Fabrice has taken over ownership of the draft
    - Plan to send out for FRAC next week in coordination with RTCA

WG1 Status

- Harmonization with European DAA standards progressing
  - Significantly improved alignment based on ED-313
  - Remaining differences evaluated this week for inclusion in DO-398A
    - No significant actions
- DO-398A OSED
  - Reviewed new scenarios
  - Reviewed Activity Diagrams
  - Drafting team is compiling document and doing an internal cleanup pass
  - Plan to have a WG1 Review and Comment in July

SC-228/SC-147 Alignment

- Relationship between 365D and Xr
- Structured Airspace RWC Volume
  - RWC definition for Urban airspace coverging on 450’ vertical/1500’ horizontal fix
  - Need to create clear definition of th “Urban Operational Environment” to support decision to drop RWC alerting
  - Operations are in close enough proximity that RWC alerts would be operationally unsuitable. Airspace class and structure, as well as required ATC interaction, provide sufficient separation benefits to justify removal of RWC in such airspace
- Vertiport Alerting/Terminal Alerting Discussion
  - Additional study required for altitude cutoff
  - Horizontal maneuvers in terminal airspace
    - Terminal operational concept does not include horizontal manevuers due to proximity to terrain during landing and take-off phases
    - ACAS Xr provides “Terrain-Aware alerting”, which could in turn allow for horizontal maneuvers during approach and departure

SC-228/SC-147 Alignment

- ACAS Xr V3 Performance Summary
- Use of non-certified, GNSS-only systems as inputs to ACAS Xr if validated by a non-cooperative intruder sensor
  - Need to verify that validation windows are a sufficient surrogate for the missing integrity checks

WG1 Status

- DO-365 Maintenance and Changes
  - Clarification of WC volume applicability
    - Original RWC definition sized by TCAS RA volumes
    - Analyze applying “non-cooperative” RWC to non-TCAS aircraft, even if cooperative
  - Right of Way Rules
    - Drafting requirements for Right of Way compliant directive RWC guidance
    - Plan is for this to be an optional function
  - Changes to Support ACAS Xr class of equipment

WG1 Status

- DO-366 ATAR Maintenance
  - UAS Minimum Altitude and Low Closing Intruder Radar Clutter Performance Limitations– Sid Theis
  - Introduce flexibility to allow for reduced performance related to effects from ground clutter
  - Tighten up requirements and tests to prevent manufacturer from designing a poor radar as a result
  - Is this a “Change 1” or a letter revision?

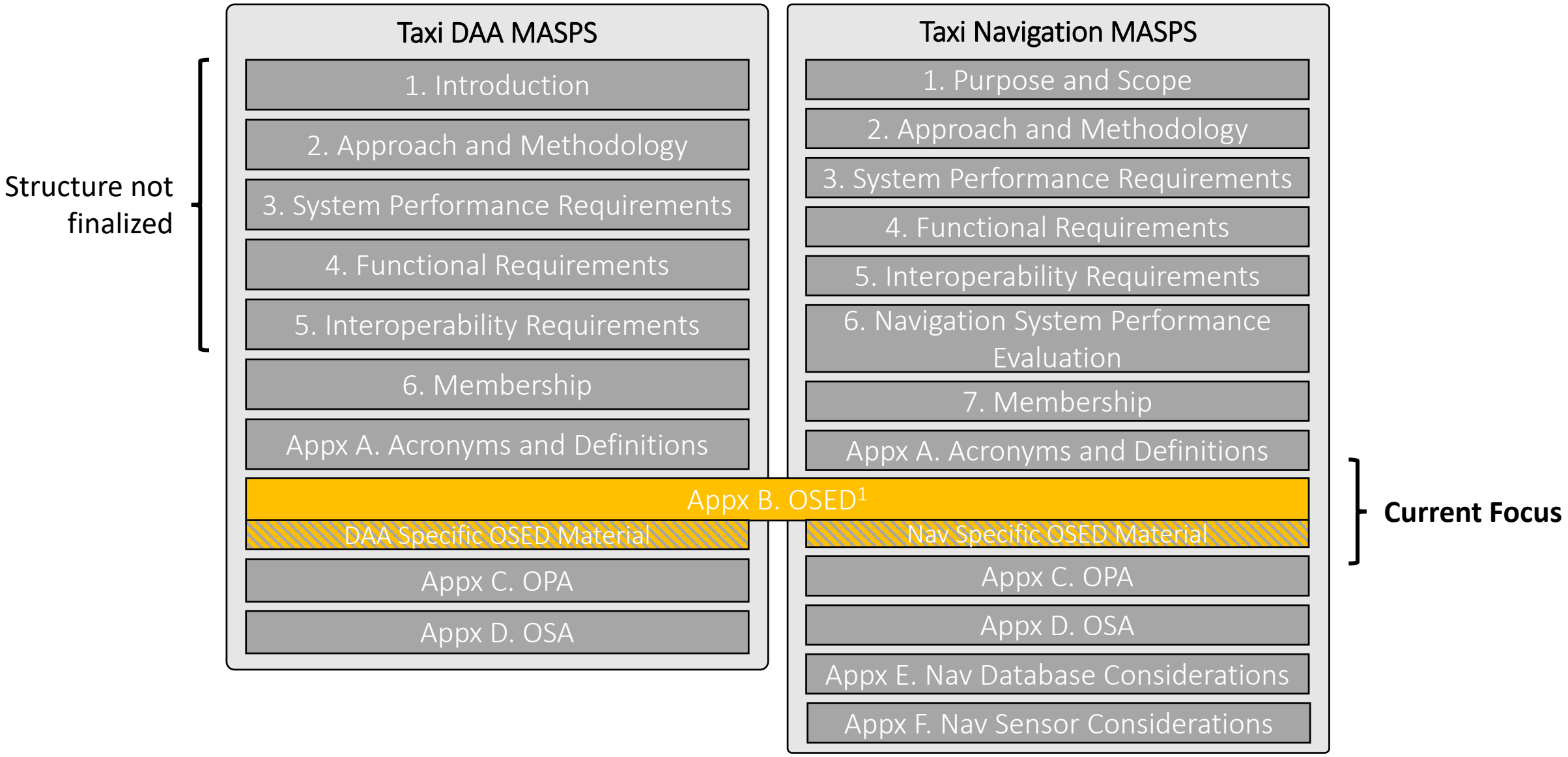
Taxi Breakout Session Accomplishments

- **All WG-1 taxi breakout meetings were held jointly with WG-4 (Nav)**
  - General theme of the discussions: OSED Review

- **Accomplishments:**
  - Reviewed through the entire OSED, focusing on:
    - Environment description
    - High level scenario
    - Detailed nominal use cases
    - Assumptions
    - Operational requirements
  - Discussed taxi hazard severities and airport efficiency metrics

- **Near Term Action Items:**
  - Incorporate feedback from this week into the OSED
  - Finalize OSED
  - OSED RAC kickoff at the July F2F

WG-1 / WG-4 Document Relationship



[1]Baseline OSED developed jointly between WG-1 & WG-4, each WG with then expand upon the baseline OSED as needed.

Open taxi questions coming out of this week

- **Name of system**
  - In February, the name Surface Hazard Avoidance System (SHAS) was chosen for the “surface DAA” system
- **“Line between surface and airborne DAA”**
  - Currently, the SHAS has detection of aircraft on the runway during approach and aircraft on approach prior to entering the runway in scope
- **Location of the Automatic Taxi OSED**
  - Right now, the intent is to include the same OSED in both the Surface DAA and Surface Nav MASPS
  - The question arose if the OSED should be broken out into its own document
- **Decision: High speed runway exits are out of scope in the initial revision**
  - The Ownship will come to a safe taxi speed on the runway (≲30 knots) before transitioning to taxi mode and exiting the runway
- **Should VTOL operations be in-scope**

m:N Whitepaper

- Agreed definitions
  - m:N - Single or a team of remote pilots commanding multiple (N) aircraft (N > m).
  - m – The number of remote pilots* commanding N aircraft.
- Agreed on initial set of assumptions
  - A PIC is always in command of each aircraft.
  - A pilot may serve as PIC for more than one aircraft simultaneously.
- Presentation of UAM use-case: Martin Kearney-Fischer.
- Single DAA example. Apply to multiple DAA.
- On track for whitepaper draft by JAN 2024

Agenda 9:
Working Group 2 (C2) Update

Amelia Mahan, WG2 Co-Chair

Steve Van Trees, WG2 Co-Chair

SC 228 WG 2 TOR 16 Documents

RTCA Paper No. 347-22/PMC-2386
December 15, 2022

TERMS OF REFERENCE
RTCA Special Committee 228
Minimum Performance Standards for Uncrewed Aircraft Systems
(Rev 16)

Product	Description	FRAC Completion Due Date*	Change
C2 Link Systems MASPS (DO-377B)	Address safety risk and performance requirements for air taxi, surface operation at public use airports, and low altitude small package delivery.	**October 2023**	**April 2023**
C2 Link MOPS for Cellular Networks (DO-YYY)	Create a joint standard with EUROCAE WG-105 for use of Cellular commercial networks for C2 Links used for type certificated UAS.	**January 2024**	**January 2023**
UHF Band C2 Link System MOPS (DO-XXX)	Create a standard for use of UHF spectrum band for C2 Links used in type certificated UAS.	**January 2024**	**July 2023**
C2 Link MOPS (Terrestrial) (DO-362B)	Incorporate changes required to harmonize SATCOM compatibility with EUROCAE Standard. Updates required as a result on initial implementation of A revision.	**October 2024**	**October 2023**

agnostic

4G / LTE

454-459 MHz

5030-5091 MHz

DO-377B Status

- Main Section
  - Updated Section 3 based on new scenarios
  - Refinements to Section 4
- Appendices
  - February RAC Comments Resolved
  - OSED complete
  - Additional changes expected based on iterative processes
    - OSA “done” – 5/5 scenarios completed – entire OSA will be updated by the May RAC
    - OPA “ongoing” – 3/5 scenarios completed – entire OPA will be updated by the May RAC
  - Still need additional review of status information exchanges (Use Cases 0.1, .2, .3, & .4) and will be addressed when OPA is “finished”
  - OSA for takeoff and landing has been completed and evaluated in C3-S1 and C3-S3(mostly video data)

DO-377B – Appendices (Continued)

- Removed inapplicable sections of Appendix E (User Data Rates)
- Refinements being made in Appendices G (Networks) and I (Service Level Agreements
- Removed Appendix H (Overview of Satellite Services)
- Added *Appendix E of DO-362* "Video Considerations in Civil Airspace for Unmanned Aircraft Operations“ as new *Appendix M* in DO-377B

SC-228 WG-2.4 UHF Status

- No change to current schedule
  - Exit FRAC @ January 2024
- Discussion of current draft:
  - Introductory sections of the AURA Normative appendix
  - Presented initial material describing the ground network, coverage assurance and security
- Tests (bench/flight) ongoing through the summer for verification & validation of MOPS requirements

EUROCAE WG-105 Updates for C2

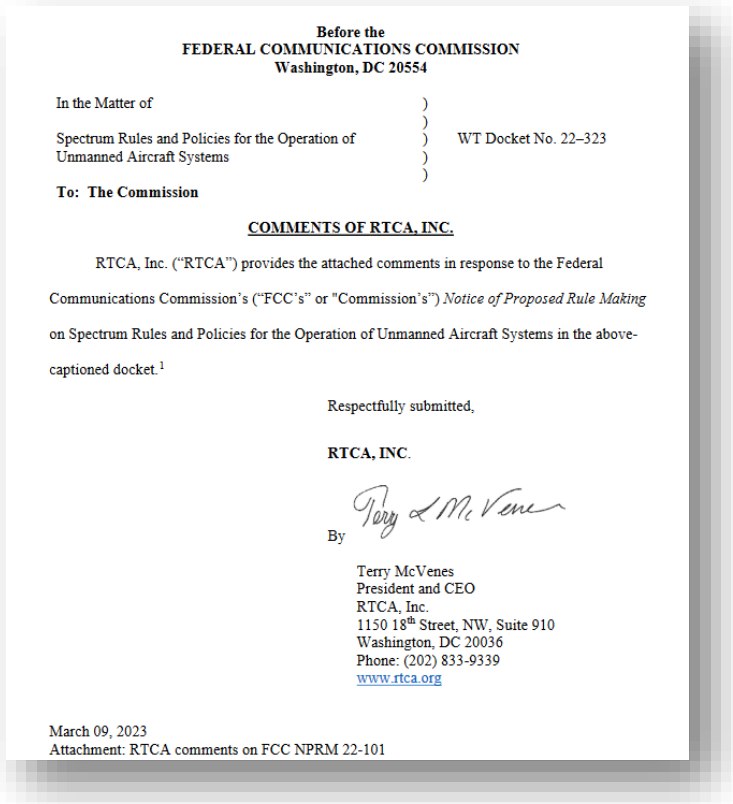
- European Stakeholder Report
  - Received 8 survey responses on the suitability of DO-377 in Europe
  - Target completion date of July 2023
  - Seeking EASA engagement on the survey
- C-Band Satcom
  - Work is ongoing within Airbus to update their designs per the *Compatibility White Paper* to the proposed updates to DO-362B
  - Next meeting expected in late 2Q2023

Cellular MOPS Joint with EUROCAE WG-105

- Making progress towards planned internal RAC for May 2023
- AJCA Open Actions
  - Antenna Considerations (currently under review)
  - Auxiliary downlinked parameters (due in May)
  - 3GPP verification (they have a sister document in work) in July
- WG-2.2/WG-105 Actions
  - V&V development in progress
  - Operational material updates (Amelia) based on the SPD Use Case – need to make updates based on the US vs Europe sections
  - Environmental considerations
- RTCA Action – Schedule meetup with ASTM F38 leadership to align on communications related tasks and applicability

RTCA Response to FCC NPRM 22-101

- Thanks to the team who supported this effort!
- RTCA prepared a total of 39 specific responses to questions relating to DO-362A and DO-377A
- Themes in our response
  - For maximum spectral efficiency, TDD is required across the entire band for both non-networked and networked solutions
  - Clarified statements regarding contents of the standards RTCA has published



Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, DC 20554

In the Matter of)
)
Spectrum Rules and Policies for the Operation of) WT Docket No. 22–323
Unmanned Aircraft Systems)
)

To: The Commission

COMMENTS OF RTCA, INC.

RTCA, Inc. ("RTCA") provides the attached comments in response to the Federal Communications Commission's ("FCC's" or "Commission's") *Notice of Proposed Rule Making* on Spectrum Rules and Policies for the Operation of Unmanned Aircraft Systems in the above-captioned docket.[1]

Respectfully submitted,

RTCA, INC.

By

Terry McVenes
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www.rtca.org

March 09, 2023
Attachment: RTCA comments on FCC NPRM 22-101

Aeropus link to response

DO-362B Kickoff – WG-2.6

- Jeremie Miller (uAvionix) officially kicked off the DO-362B subgroup
- Plan to meet fortnightly – meeting timeslot TBD
- Discussed sections of the current document with the intent to gather top priority technical topics to address in the revision
  - TDD details – need to coordinate with EUROCAE C-Band Satcom
  - Concluded redesign of the waveforms not required
- Further details to be discussed at future working meetings

Additional Briefings

- SC-242 Spectrum Compatibility Brief out– requested support to complete spectrum survey for DO-362A

- Voice Latency Testing from FAA Tech Center & AURA
  - Reviewed testing for all five NAS voice switches in the terminal environment to validate the voice latency assumptions in our documents
  - Awaiting final results in May 2023

- ICAO Update on C2 Link RLP
  - Held discussion on how various stakeholders will use Required Link Performance (RLP) concept (e.g., State, UAS designers, UAS operators)
  - Will continue this discussion in the WG-2 Interworking session
  - Potentially draft a section to DO-377B explaining this concept and how it relates

SC 228 WG-2 Summary for Plenary 37

- All documents currently on track per TOR 16 schedule; DO-362B schedule will be reassessed based on FCC rulemaking
- Awaiting results of the voice latency testing (expected May 2023)
- Open Actions across the WG2
  - Schedule leadership level meet with ASTM F38 to discuss communications standards
  - Action item taken to respond to SC-242 RF survey (Date ASAC)
- Near Term Events
  - May 2023 DO-377B Full RAC
  - May 2023 Cellular MOPS Partial RAC
- Help Needed
  - Looking for internal resource to complete SC-242 survey

Agenda 10:
Working Group 3 (Lost Link) Update

Randy Willis, WG3 Co-Chair

Paul Albuquerque, WG3 Co-Chair

RTCA SC-228 WG-3 Update Plenary #37

- WG-3 meetings this week
  - Convened F2F and Virtually (Apr 19/20) with a primary focus on resolving all remaining issues to the guidance document to exit FRAC.
    - Finalized all comments
    - Matured references and formatting
    - Obtained WG-3 approval on the final draft guidance document to exit FRAC
  - Discussion on potential next work efforts for WG-3
  - Fair attendance of WG members (averaged 11)

RTCA SC-228 WG-3 Update Plenary #37

- Guidance Document Framework

Guidance Material:

Standardized Lost C2 Link Procedures for Uncrewed Aircraft Systems

  - Executive Summary
  - Section 1 - Introduction
  - Section 2 - Stakeholders
  - Section 3 - Current Policy and Regulations
  - Section 4 - Operational Considerations
  - Section 5 - Verification & Validation
  - Appendix A (Acronyms)
  - Appendix B (Referenced documents)
  - Appendix C (Membership)
  - Recommendations/Gaps (incorporated into Sections 4 & 5)

- RTCA DO-400 has been assigned

RTCA SC-228 WG-3 Update Plenary #37

- Comments received/resolution

	Number	Not Started	In Process	Complete
Non-Concur	23	0	0	23
High	91	0	0	91
Medium	111	0	0	111
Low	43	0	0	43
Editorial	337	0	0	337
Total	605	0	0	605

  - Overview of non-concur/high comments
    - 16 of 23 Non-Concurs in Section 4 (Operational considerations)
      - A few oversteps – standards vs implementable guidance
      - Identifying specific waypoints for phase of flight transitions
      - Better clarity on LC2L UA interacting with the NAS
      - Needed to scope down potential operational environments (airport designs)
  - Overview of comment resolution process
    - Multiple WEBEX/emails utilized to adjudicate comments
    - WG-3 conducted additional review after FRAC comments adjudicated

RTCA SC-228 WG-3 Update Plenary #37

- WG-3 Schedule to publication
  - August 1: Entered FRAC
  - Comment period: August 5 - September 12, 2023
  - Comment resolutions: September 13 – March 26, 2023
    - March 27-March 30: Reviewed by limited group
    - March 31-April 4: Integration
    - April 5-11: Review by WG-3
    - April 12-16: Integration
    - April 17-18: WG-3 Leadership final review
    - April 19: Discussion of changes at SC-228 WG-3 F2F/Virtual
    - April 20: Changes made based in F2F/Virtual discussion
  - April 21: Plenary approval to exit FRAC
  - April 26: To RTCA (final formatting)
  - May 22: To PMC
  - June 22: PMC Approval

RTCA SC-228 WG-3 Update Plenary #37

- Motion for guidance document to EXIT FRAC
  - On behalf of RTCA SC-228 Working Group 3, I make a motion for:

Guidance Material:
Standardized Lost C2 Link Procedures for Uncrewed Aircraft Systems

to exit from FRAC
and provide final draft document to RTCA on Wednesday April 26, 2023 for final processing and preparation for June 2023 PMC

Appreciation

- Thanks to all that participated in WG-3 efforts on this guidance document!
- Specific appreciation to:

Marv Hammond	**Tod Lewis**	**Steve Young**
Rose Merchant-Bennet	Martin Koschel	Xavier Redondo
Paul Albuquerque	**Kerry Bowers**	**Barbara Cassidy**
	Upekesha Ngugi	

Thank you!

Agenda 11:
Working Group 4 (NAV) Update

Andrew Videmsek, WG4 Secretary

WG-4 TOR Summary

TERMS OF REFERENCE
RTCA Special Committee 228
Minimum Performance Standards for Uncrewed Aircraft Systems
(Rev 16)

Product	Description	FRAC Completion Due Date*	Change
MASPS: Navigation for Automatic Taxi (DO-XXX)	Define navigation performance requirements to support automatic taxi operations.		**July 2025**

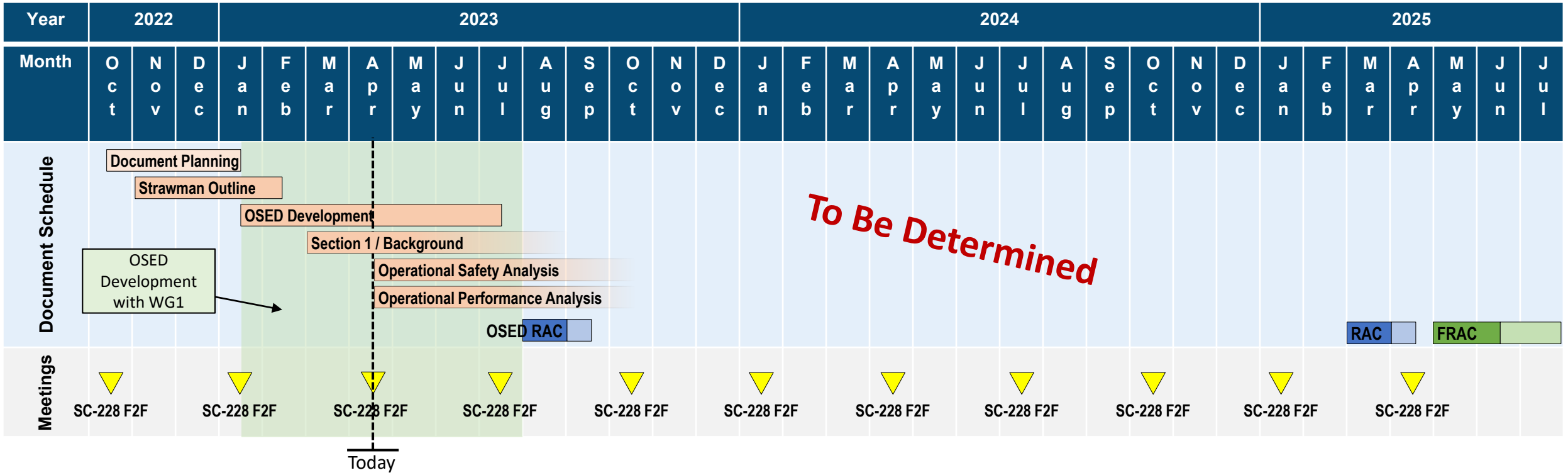
Minimum Aviation Systems Performance Standards (MASPS): Navigation for Automatic Taxi

- The WGs initial document, DO-397, identified a lack of navigation standards to support automatic taxi operations. This document is being developed to fill the identified gap.
- The scope of this document is to define navigation system performance requirements to support automatic taxi operations (traditionally crewed or remotely piloted).

Note: Similar to DO-236(): RNP for Area Navigation, certain requirements defined in this document may go beyond what is typically regarded as a navigation requirement.

Automatic Taxi Nav MASPS Development Timeline

- **Tentative schedule, to be revised and expanded**
  - Estimated FRAC completion date: July 2025
  - Estimated RAC completion date: April 2025



SC-228 Plenary | RAC Comment Period | FRAC Comment Period

Document Milestone | RAC Resolution Period | FRAC Resolution Period

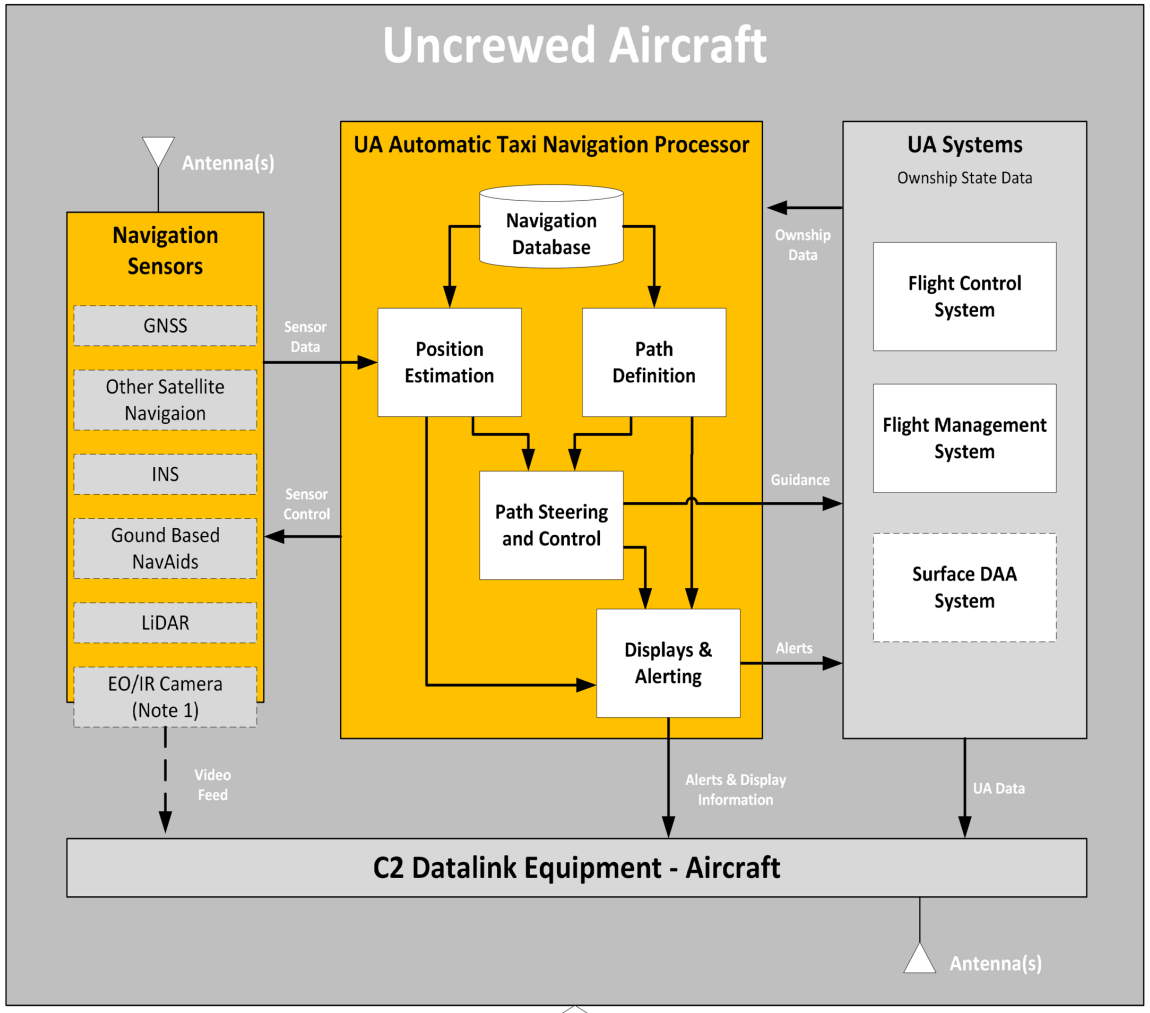
Taxi Authors Meeting

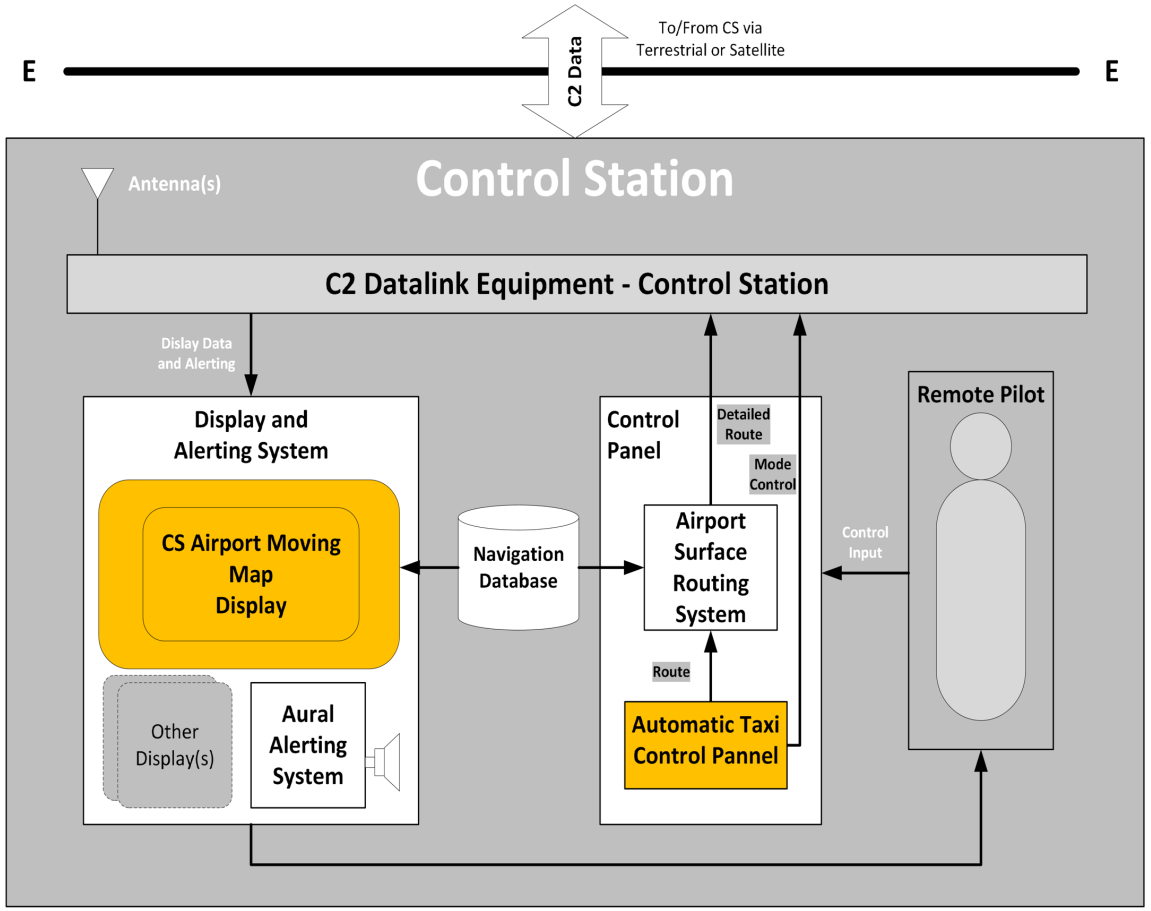
- Bi-Weekly (every other week) on Wednesdays at 12 PT / 3 ET
- Next meeting: Wednesday, May 3rd

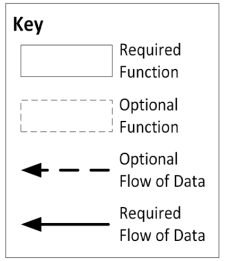
Discussion Topics this Week

- **WG-4 Discussion Topics**
  - Update on other relevant RTCA Special Committees: SC-159
  - MASPS Overview & Structure Review
  - Review of previous working sessions and action items
  - Automatic Taxi Navigation System (ATNS) architecture
  - Potential (ATNS) equipment classes
- **Joint WG-1/WG-4 Discussion Topics**
  - Review of the entire OSED, with focus on:
    - Environment description
    - High level taxi scenario
    - Detailed nominal use cases
    - Assumptions
    - Operational requirements
  - Taxi safety hazard severities
  - Taxi airport efficiency severities

OSED Automatic Taxi Navigation Architecture







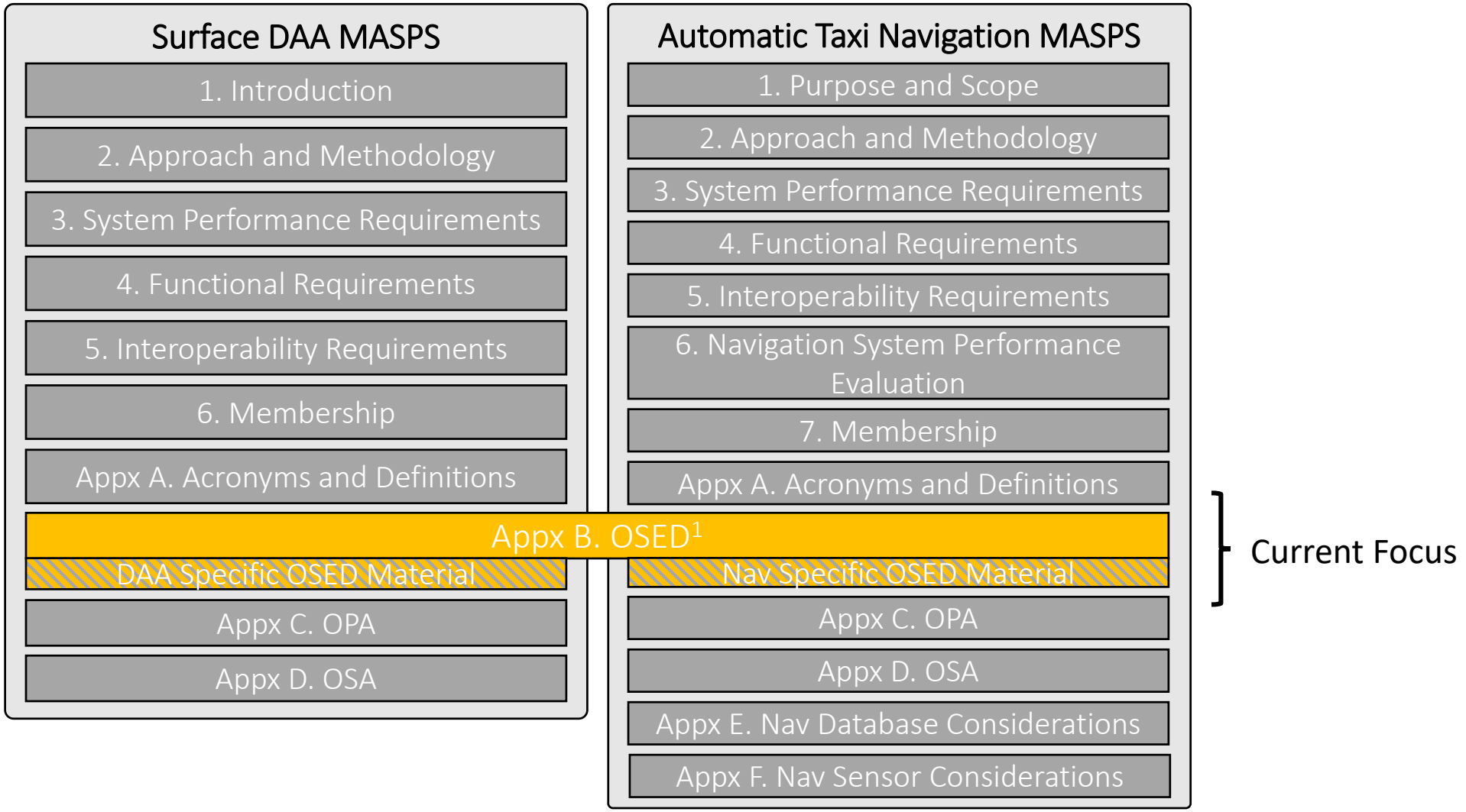
Note 1: EO/IO Camera may be used as a Navigation Sensor as well as Surveillance/Situational Awareness Sensor (video feed) to the PIC.

Joint WG-1/WG-4 Automatic Taxi OSED

- **With WG-1 & WG-4 simultaneously developing MASPS documents related to automatic taxi operations (DAA and Navigation), the decision was made to jointly develop the Operational Services Environment Definition (OSED) together**
  - Both WGs jointly developing the OSED will ensure that the “operational concept” is the same across both documents and that the standards development swim lanes are well defined.
  - Following joint development of the “foundational OSED,” each WG will expand upon the OSED as needed for their standards document.
  - The intent is to finalize the foundational OSED over the next 3 months, with a WG-1 & WG-4 RAC in August.

WG-1 / WG-4 Document Relationship

Note: Open discussion considering if OSED should be essentially the same in both the Taxi DAA and Auto Taxi Navigation MASPS document, or if a single integrated OSED should be in a new separate RTCA document approved at the same time (or slightly after) both MASPS are completed.



[1]Baseline OSED developed jointly between WG-1 & WG-4, each WG with then expand upon the baseline OSED as needed.

Automatic Taxi OSED Structure and Status

B.1 Introduction [In-Progress]
B.2 Environment [In-Progress]
- B.2.1 Airport and Terminal Environment
- B.2.2 Airport Traffic Density
- B.2.3 Flight and Right of Way Rules
- B.2.4 Traffic (Intruders)
- B.2.5 Meteorological, Topographical, and Environmental Conditions
- B.2.6 Equipment Environment

B.3 Surface Obstacle Avoidance System Description [In-Progress]
B.4 Surface Operations Navigation System Description [In-Progress]
B.5 Surface Operations Actors and Activities [In-Progress]
B.6 Automatic Operations Overview [In-Progress]
B.7 High Level Nominal Automated Surface Taxi Scenario [In-Progress]
B.8 Detailed Nominal Automatic Taxi Scenarios [In-Progress]
B.9 Detailed Off-Nominal Taxi Scenarios [Not Started]
B.10 OSED Assumptions [In-Progress]
B.11 OSED Operational Requirements [In-Progress]

Heavily based on the SC-228 WG-2 ”Advanced” Taxi OSED

Automatic Taxi Navigation MASPS Authors Subgroup

- **An authors group has been stood up to lead the development of the Taxi Navigation MASPS**
  - Small focused group of relevant stakeholders
- **This group meeting nominally bi-weekly (every other week) to provide updates on the status of the document and discuss document content**
  - Bi-Weekly (every other week) on Wednesdays at 12:00pm Pacific / 3:00pm Eastern
  - Next meeting is Wednesday, May 3rd
- **We are seeking authors who wish to join this subgroup**
  - UAS OEMs, avionics OEMs, navigation system OEMs, certification authorities (e.g., FAA, EASA, etc.)
- **Current authors group members:**
  - A3 by Airbus, Aura Network Systems, Boeing, Collins Aerospace, FAA, Reliable Robotics

Agenda 12:
FAA MASPS/MOPS Usage Update

Steve Van Trees, SC-228 Government Authorized Representative

GAR Report - WG1 Regulatory Material

- SC-228 has completed original TOR from 2013
- SC-228 focus is large UAS in controlled airspace
  - FAA addressing smaller drones at low altitude as a priority
- FAA addressing changes to regulatory structure for next phase of UAS implementation
  - Rulemaking upon BVLOS ARC report
- FAA will entertain exemption/waiver proposals to operate UA in the interim, and applicants may leverage SC-228 products
  - FAA/AIR does not intend to update TSOs for TSO-C211 DAA, and TSO-C212 ATAR, or develop a TSO for EO/IR
- FAA has noted interest from international (UK MOD) and military (USN) partners in TSO

WG2 – Advisory Circular

- AIR has an ongoing obligation to work with applicants and stakeholders to develop and refine means of compliance for UAS C2 projects to meet expectations of aviation safety based on kinds and types of UAS designs and conops.
  - DO-377A has been noted as MoC
- AIR will work on new ideas to improve the MoC concepts currently in the draft AC.
  - Approval methodology material to be added in DO-377A
- Any decision to restart work on this AC would be guided by input from industry and other stakeholders on the need for an AC
  - E.g., clarification of regulatory role in ICAO RLP performance, and its relation to DO-377A work.
- Such decision would be made in coordination between AIR-626D, AIR-660 Standards Management branch, and Emerging Technology shop. Final decision would probably rest with PMC member.

Agenda 13: Zipline V2V Prototype

Eric Watson, Zipline

Kevin Kellar, Zipline

Anne Hilby, Zipline

Aircraft to Aircraft Communications for Deconfliction

A2X or V2V

Eric Watson

April 21, 2023

Zipline

1. Zipline Intro
2. Our experience with V2V
3. Vision / End State
4. A phased implementation for small UAS
5. V2V prototype

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Our Mission

Create the first logistics system that serves all humans equally.

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Drone Delivery

+

Long range

<55 pound fixed wing

Since 2016

High accuracy

<55 pound eVTOL

Starting 2023

500,000+ flight hours in delivery operations with **zero** midair collisions

High Density

40 Zips in 0.2 km^2 ≈
200 UA per km^2 ≈
500 UA per $mile^2$

Distributed

Decentralized algorithms and peer-to-peer comms are robust.

Tactical and Strategic

Strategic mitigations to reduce density and intersections.
Tactical to maintain real-time separation.

Available Spectrum

Unprotected ISM (Industrial, Scientific, Medical) band works well.

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Vision

- Aircraft directly communicate for **deconfliction and collision avoidance**
  - Per industry defined standard
  - Utilizing licensed spectrum
  - Not just identification and state but also near-term intent

- Hardware that is cost effective for sUAS
  - Likely via effective use of consumer-grade electronics

- The wider the adoption the better. Not just sUAS but ideally UAM, etc

Why tactical deconfliction helps?

Strategic mitigations work best when flight plans and connectivity are guaranteed, but..

Maintaining desired separation may require **quick flight plan changes…**

Even where **connectivity** is challenged.

Why tactical deconfliction helps?

Strategic mitigations are challenged when flight plans change quickly

or without connectivity

Why tactical deconfliction helps?

Strategic mitigations are challenged when flight plans change **quickly**

or without connectivity

Maintaining separation with non-cooperative crewed traffic

Why tactical deconfliction helps?

Strategic mitigations are challenged when flight plans change quickly

or **without connectivity**

Autonomy leads to less strict connectivity requirements

Phase 0

Today

>Only communications within Operator

>Proprietary implementation

>ISM band (2.4 GHz)

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Phase 1

Late 2023

>Support for inter-Operator communications

>Open implementation extending Remote ID hardware and standards… Requirements for Remote ID are a subset of V2V

>Still ISM

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Phase 0

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Phase 1

Late 2023

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>Open implementation extending Remote ID hardware and standards… Requirements for Remote ID are a subset of V2V

>Still ISM

Phase 2

2024-2025

>V2V beyond small low altitude UAS

>Licensed and protected spectrum

Zipline

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Phase 0 – Link Performance on unlicensed ISM

- With both aircraft avoiding, generally robust to one direction dropouts
- With range margin compared to maneuverability, robust to single / short term dropouts
- Total comms loss still has relatively low probability of collision due to strategic mitigations

	Range between UA	
	~300 m	~ 1 km
Probability of bi-directional comms loss in two consecutive attempts (one attempt per second)	1E-6	1E-5

*values are order of magnitude estimates from flight log analysis

Phase 1 – Requirements

Design tenets / constraints

1. Safe, autonomous operations at scale
2. Only add hardware if absolutely needed
3. Aircraft mass <55 pounds (25 kg)
4. Efficient aircraft cost
5. Serving customers soon

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No human oversight required → fast response times → relatively low range requirements

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Broadcast Remote ID is required and is a subset of V2V requirements → try to use same hardware if possible!

Budget ~10's of grams

Budget ~10's of dollars

Phase 1 – Requirements

Design tenets / constraints

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2. Only add hardware if absolutely needed
3. Aircraft mass <55 pounds (25 kg)
4. Efficient aircraft cost
5. Serving customers soon

No human oversight required → fast response times → relatively low range requirements

Broadcast Remote ID is required and is a subset of V2V requirements → try to use same hardware if possible!

Budget ~10's of grams

Budget ~10's of dollars

Available spectrum

Low risk development and integration

Phase 1 – Extend Remote ID Hardware/Standard for V2V?

1. Downselect to 802.11 Beacon Frame implementation
2. Receive Beacons Frames
3. Add intent
4. Add security

Phase 1 – Analyze Performance

Analyze Performance of Remote ID Beacon Frames on ISM band considering:

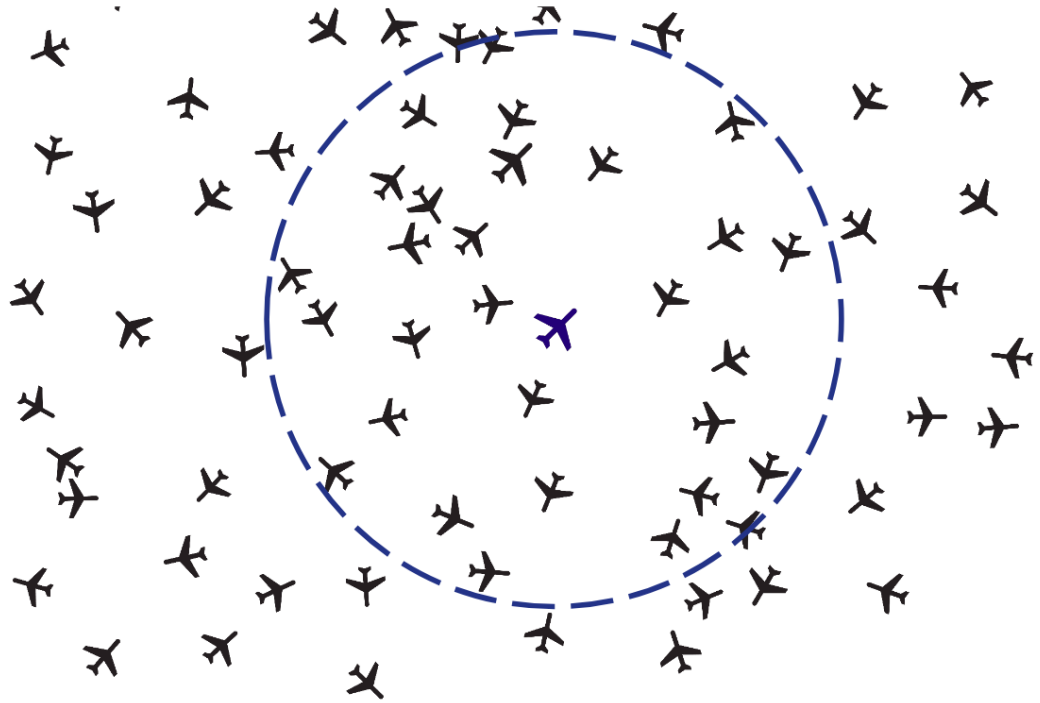
- 802.11 Medium Access Control
- Antenna Performance
- Transmit Power
- Channel Noise Floor
- Modulation
- Data Rate
- Carrier-Sense Multiple Access (CSMA) Sensitivity Threshold
- Message Size

Phase 1 – Selecting a Configuration

Select: power level, antenna design, data rate, modulation, and message size

Trading: range, density, message receive frequency

Landed on: ~1 km range supporting ~30 UA per sq km in challenging environment



Phase 1 – Extension to Other Operators

Higher range may be needed if:

- Higher speed
- Less autonomy
- Less maneuverable
- Higher risk

Can achieve higher range via different tradeoffs such as higher power, notably with lower density.

Still interoperable.

Phase 2 – Extension to Licensed Spectrum

- Approach generalizable to licensed spectrum

- 5030-5091 MHz would be great!
  - Higher power offsets higher frequency
  - Same approach can be used in this band

Questions?

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Anne Hilby
anne.hilby@flyzipline.com

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Agenda 14: Industry progress on MOPS-compliant equipment

1. Tim Bleakley, GA-ASI
2. Jim Davis, uAvionix

Development of Certified Detect and Avoid (DAA) and Air-to-Air Radar (ATAR) Systems

Outline

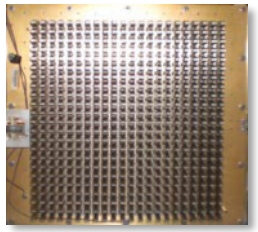
- **GA-ASI DAA/ATAR History**
  - R&D
  - Baseline (non cert) DAA System Testing, Operation, Approvals
- **TSO DAA Program Review**
  - TSO Articles
  - Objectives
  - Accomplishments
  - Schedule
- **Post TSOA Plan**

GA-ASI DAA Radar Development

Baseline DAA System

Breadboard (4Q11)

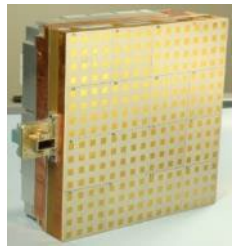
AESA



REA

Prototype (4Q13)

AESA



REA

EDM
Pilot Prod (4Q16)

AESA

REA

TSO Compliant ATAR (4Q24)

New AESA

Mini REA

Sense & Avoid Processor

TCAS (TPA-100C)

EDM – Engineering Development Model
AESA – Active Electronically Scanned Array
REA – Radar Electronics Assembly

Baseline DAA System Testing, Demonstration and Operation

Testing formed basis for RTCA MOPS/FAA TSO

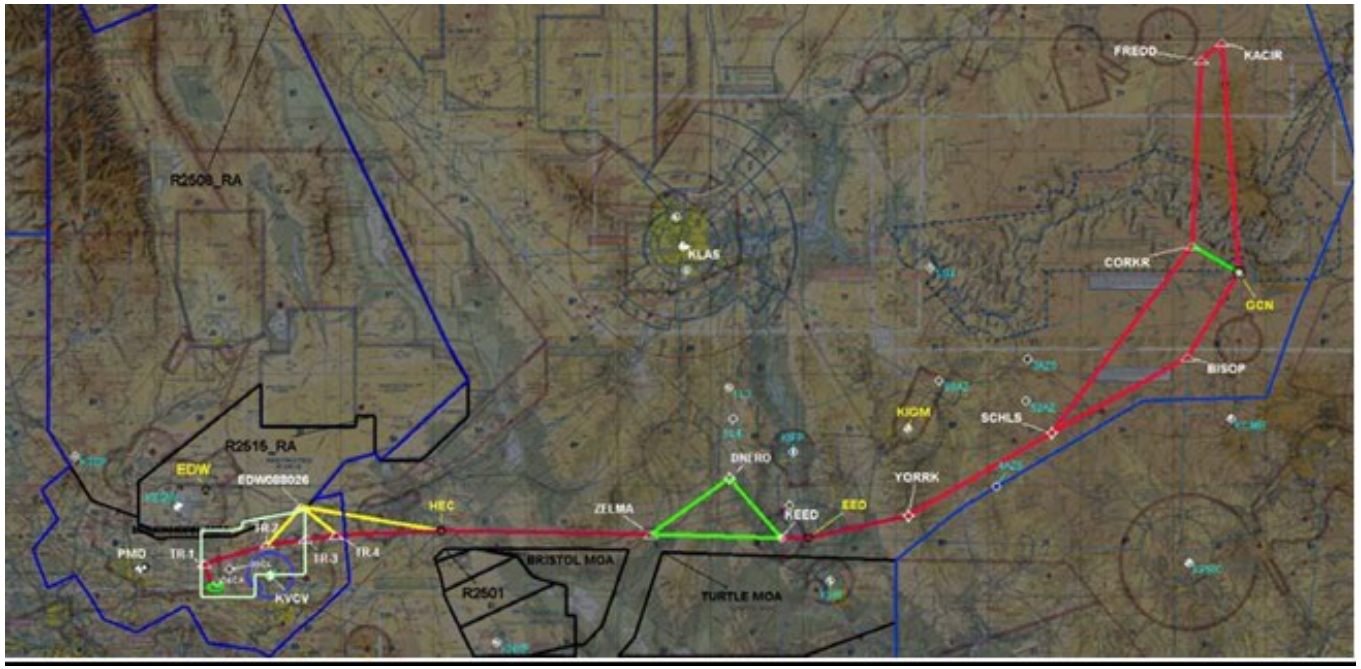
Fielded since 2016 – Over 12,000 operational hours and growing

Baseline DAA System Operating Approvals
All supported by DO-365x/DO-366x Gap Analysis

Customer/Operation/Aircraft	Operating Approval
DHS Guardian (~MQ-9A Block 1)	DHS authorized Due Regard
NASA Ikhana – No Chase COA flight	FAA 91.113 waiver / Public COA
MQ-9B Demos (N190TC)	FAA 91.113 waiver / Civil COA Recognized by JCAB
SOUTHCOM COCO (Block 1)	SOUTHCOM DRAMOC
India COCO (Block 5)	Indian Navy authorized Due Regard
Japan Coastguard COCO (MQ-9B)	JCAB recognition of FAA SAC-EC and similarity to N190TC's 91.113 waiver
US Navy Ex Northern Edge 23 (MQ-9B N390MC)	FAA 91.113 Waiver, NAVAIR DAA Limited Cert*, FAA Public COA*

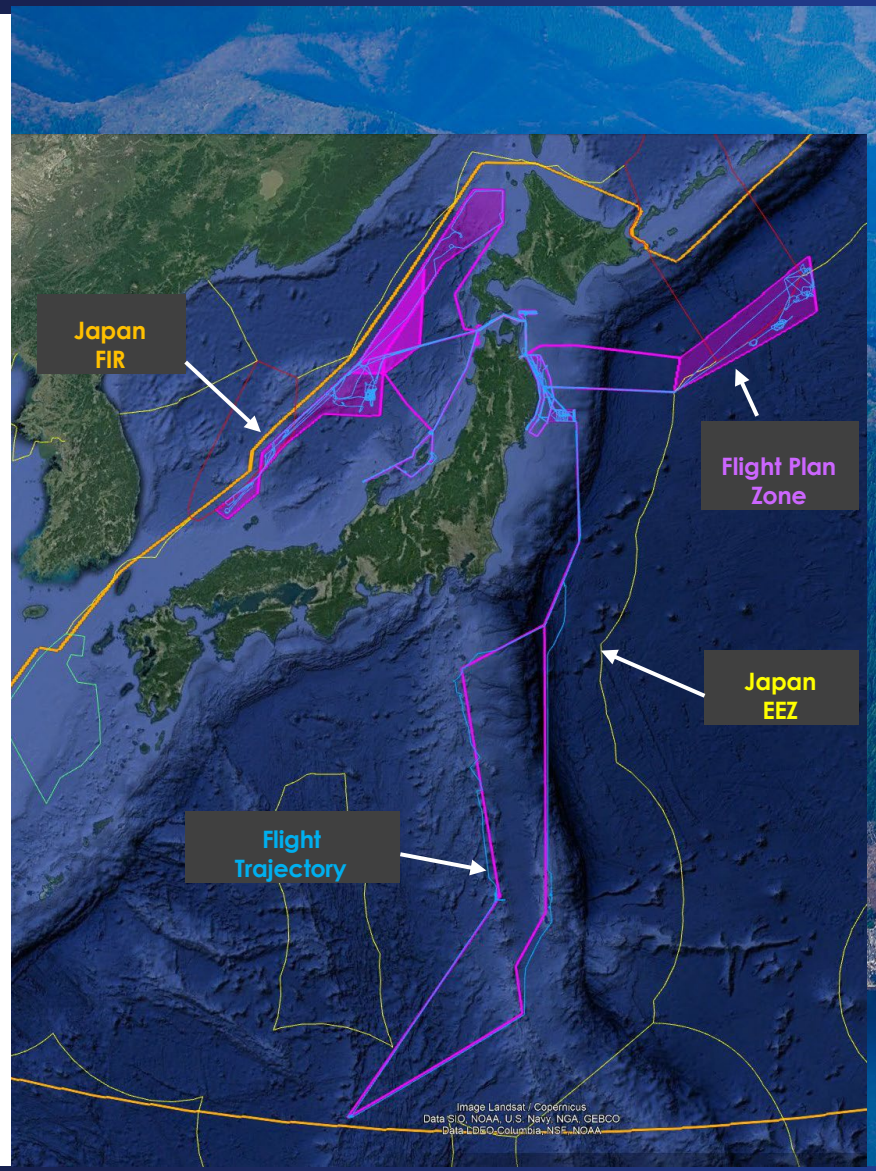
*Approvals pending

SkyGuardian Approval – FAA Experimental Cert COA with BVLOS Waiver (2020)

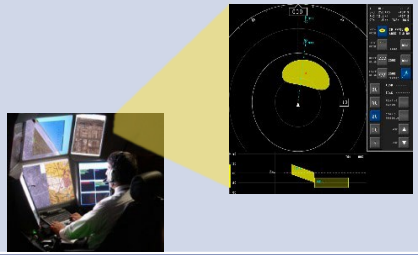


- **Surface to 3,000 ft AGL: Visual Observer**
- **3,000 ft AGL to FL 100: Climb/descend expeditiously**
- **FL100 to FL 180: En-route flight (no loitering)**
- **Contingencies, climb above FL 180:**
  - Loss of C2 link
  - Loss of DAA function

Japan Coast Guard



DAA/ATAR Configurations

	Non-cert DAA/DRR	Certified Class 2 DAA/ATAR
Readiness	Already Fielded	TSO Authorization ECD 2025
Air-To-Air Radar (ATAR)	  Gen 3 Due Regard Radar (DRR)	Gen 4 ATAR (TSO-C212)  
TCAS	Honeywell TPA-100 (TSO) 	ACSS T³CAS Airborne Processor (TSO-C211) 
Airborne DAA Processor	 Sense and Avoid Processor (Ballard computer + Honeywell Sensor Track Module)	Integrated with ACSS T³CAS
Control Station Processor and Display	CPDS on CGCS Wing Monitor 	Smart display (TSO-C211) 

Certified DAA System

IR&D Program Objectives

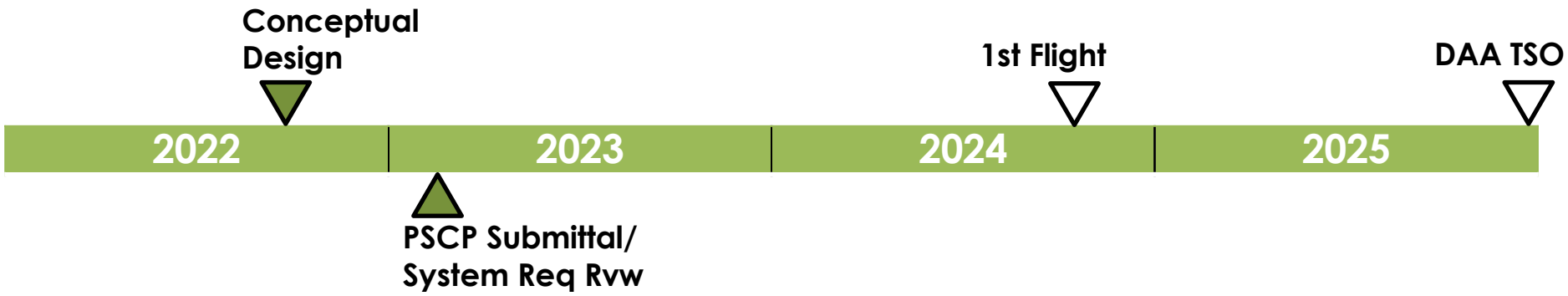
- **Air-to-Air Radar Component TSO Authorization**
  - TSO-C212
- **Airborne Processor Component TSO Authorization**
  - TSO-C211, Class 2, Articles A & B (i.a.w. DO-365B)
- **Control Station Processor & Display TSO Authorization**
  - TSO-C211, Class 2, Articles C, D, & E (i.a.w. DO-365B)
- **Prototype Release of UA and CS Integration Kits**
  - Mechanical, Electrical, Digital Integration
  - Flight Control/Ground Control Software
- **Flight Test Campaign on SeaGuardian Platform**

Program Accomplishments to Date

- **ATAR**
  - PSCP Approval
  - Prototype manufacturing
  - King Air flight demo/test
- **DAA**
  - PSCP Submittal (TSO with DO-365B as deviation)
  - System Requirements Review complete
  - Concept design/architecture/HMI definition complete

DAA/ATAR IR&D Program Schedule

Detect and Avoid Development



Air-to-Air Radar Development

Post-TSO Authorization DAA Usage

- U.K. Royal Air Force (RAF) Protector Program
- Canada Remotely Piloted Aircraft System (RPAS) Program
- + Other MQ-9B customers

uAvionix Leveraging of DO-362A and DO-377A

James Davis

uAvionix Corporation

Director, Policy and Regulatory Affairs

jim.davis@uavionix.com

Background

- Initially tried to get certification under DO-362 and TSO-C213 using L-Band
  - Hit a wall!
- To satisfy customers, implemented a Plan B
  - Quickly developed and sold microLink – an ISM band 1- Watt MIMO radio
  - 902 to 928 MHz, frequency-hopping
  - Not aviation-protected spectrum, making BVLOS permission a challenge!

SkyLink-915 Micro

SkyLink-915

Current Status

- DO-362A published, but…
  - DO-362B a WIP to accommodate SATCOM in C-Band (5030-5091 MHz)
  - Impact: Change in TDD interval and data rates
- TSO-c213a drafted, released December 2022
  - Caution: DO-362B and TSO-C213b releases will sunset existing TSO’d radios
- FCC rulemaking out for public comment, but not yet implemented
  - Result is that even TSO’d radios will be operating experimentally.
  - Users will need to obtain experimental transmit authorizations from the FCC
    - Dealing with STAs or Form 442s on the FCC’s OET Electronic Licensing System (ELS)

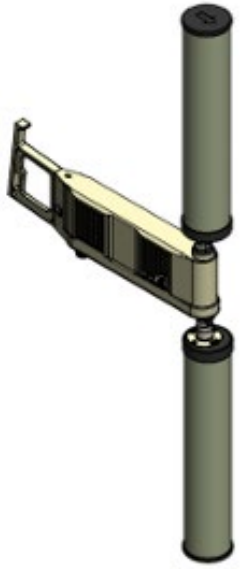
uAvionix's Plan C – Compliance with DO-362A

- SkyLink-5060 Airborne Radio
  - GMSK modulation
  - Emission Designator 175KG1D
  - Nominally uses a ½-Wave Dipole Antenna
  - Tx power = 10 W / 100 mW

SkyLink-5060 Micro

SkyLink-5060

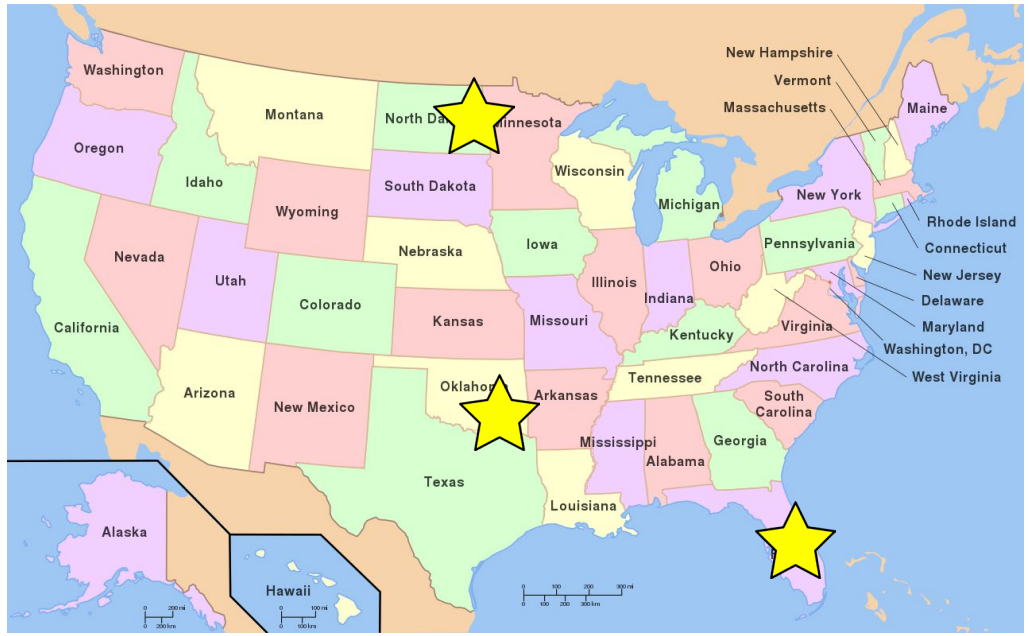
- SkyStation-5060 Ground Radio
  - GMSK Modulation
  - Emission Designator 175G1D
  - Uses a directional antenna: 12 dB gain; 111º beam width
  - Tx power = 10 W



SkyLStation-5060

Examples of Customer Use

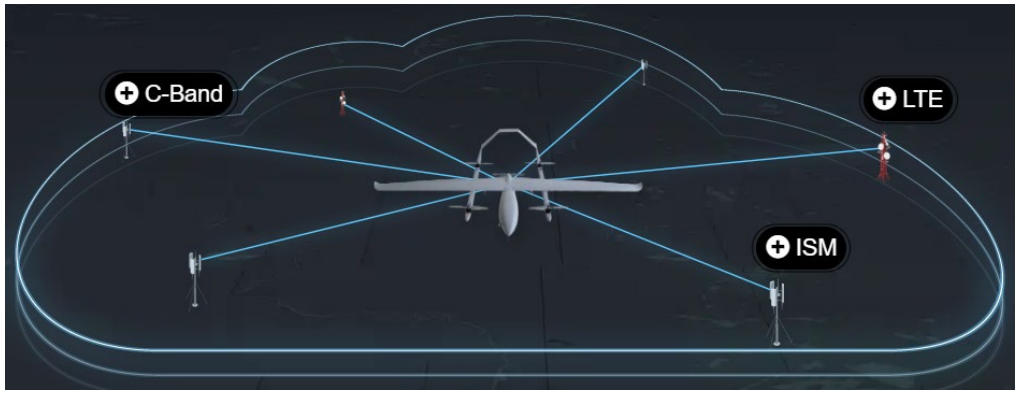
- Choctaw nation (Oklahoma) Test Site
  - BVLOS operations
- Grand Forks, ND – FAA Contract
  - Frequency Management Organization
- Florida Power and Light
  - State-wide infrastructure inspection



- Nb. All operations require:
  - First, obtaining FAA concurrence (WebFCR)
  - Second: Obtaining experimental Tx permission from the FCC (OET ELS)

Adopting Principals of DO-377A

- uAvionix SkyLine architecture for large area C2 management
  - Used to obtain two (2) BVLOS waivers
  - Used in Vantis (ThalesUSA) in N. Dakota using MicroLink (ISM Band)
- What is SkyLine?
  - Provides mission assurance via cloud-based centralized management of C2 infrastructure and assets
    - For diverse frequencies and radios
    - Purpose-built to support BVLOS safety cases
  - Combines:
    - Fleet management
    - Network health monitoring
    - Detect & Avoid
    - Seamless make-before-break roaming



Agenda 15: FAA A2X (V2V) R&D Project Update

Neal Suchy, FAA

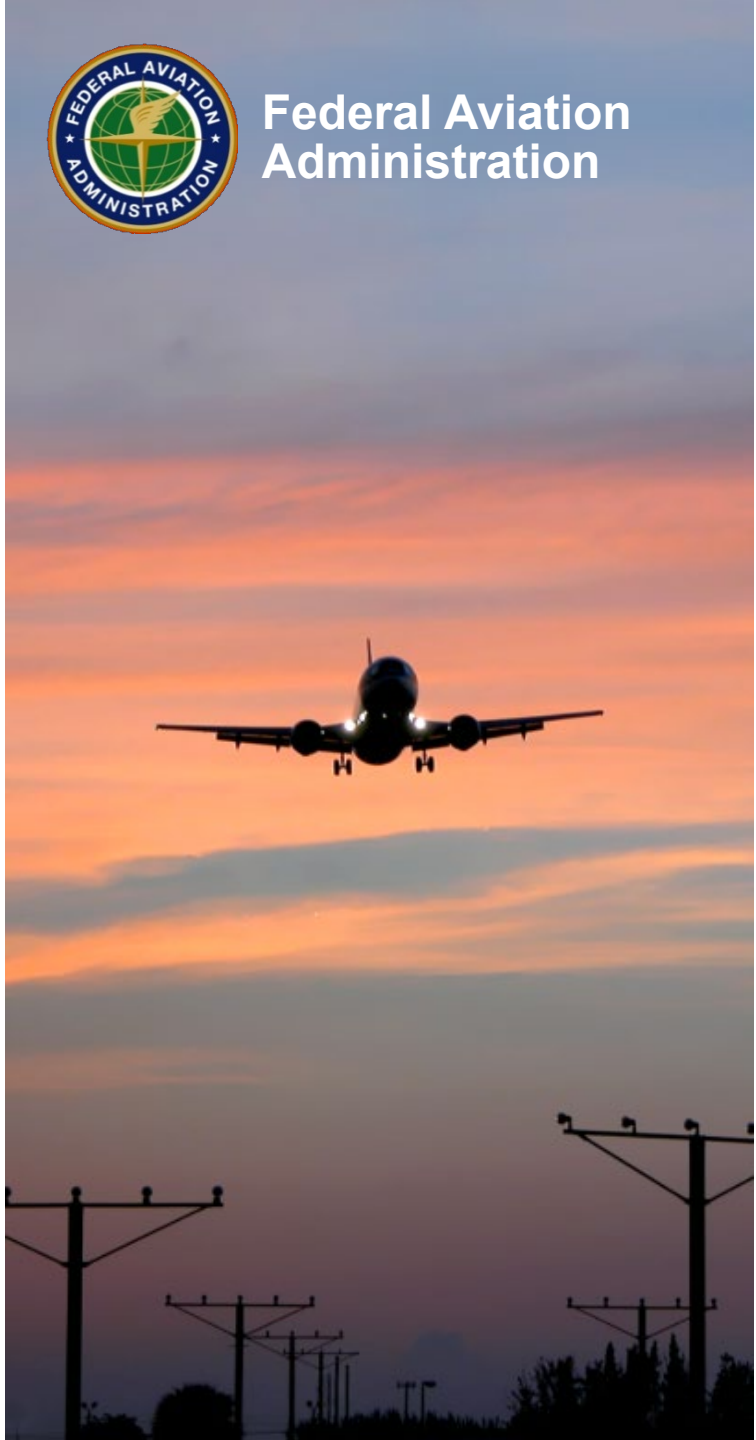
Ian Jessen, MIT Lincoln Laboratory

Federal Aviation Administration

UAS & AAM A2X Concept Maturation Roadmap

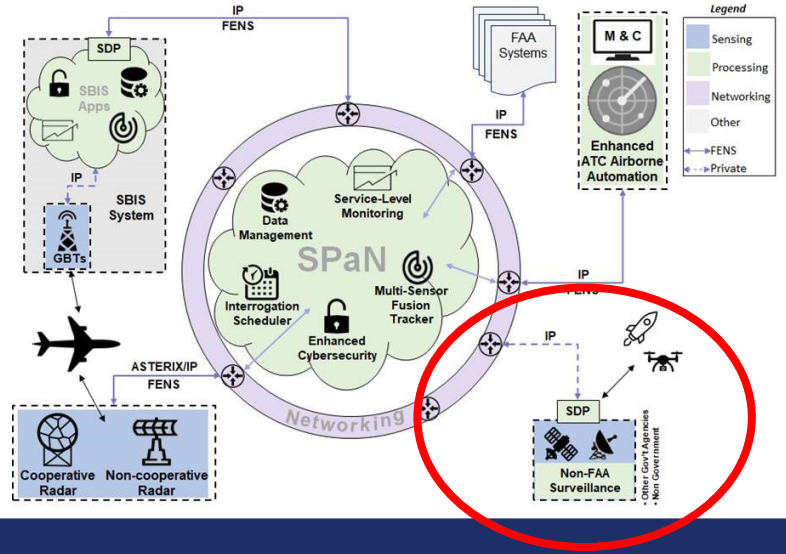
SC-228 Update

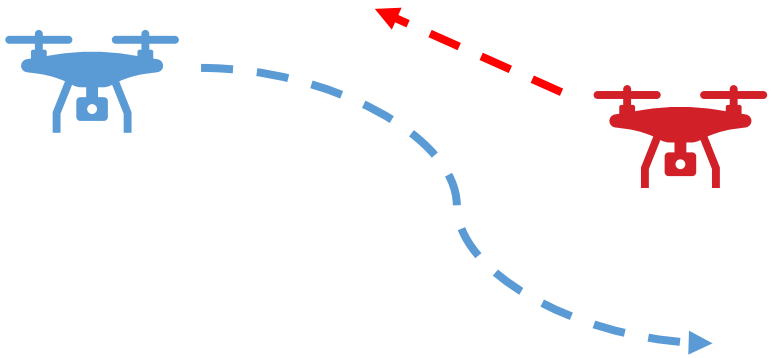
April 21, 2023

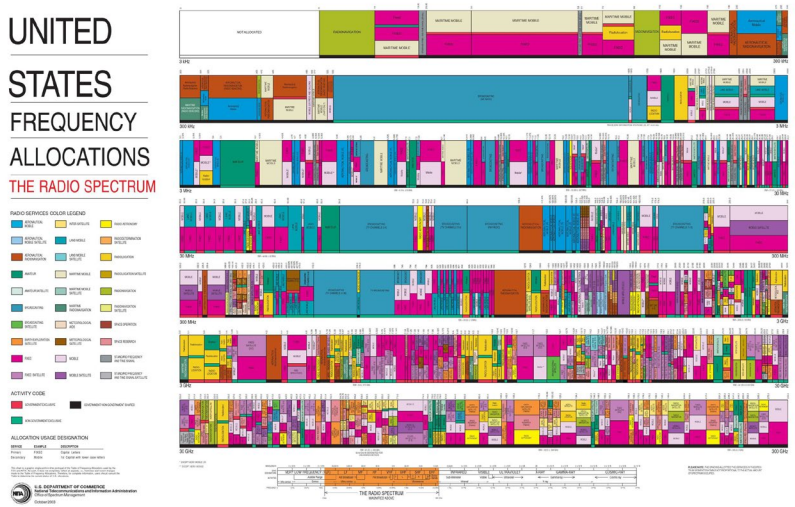


Introduction

- **The FAA aims to enable and accelerate industry towards the formalization of an emerging NAS entrants' (UAS, UAM, & AAM) surveillance & data communications link concept that supports:**
  - the evolving air traffic management system
  - new entrant Detect and Avoid (DAA) capabilities
  - future airspace interoperability in protected spectrum







ENABLES INDUSTRY

Goals of Oct 3 A2X Industry Roundtable with FAA

1. **Understand and collect use cases and need statements from industry to validate the potential need for a A2X communication link**

2. **From these use cases and need statements, develop capability needs to inform FAA decisions**

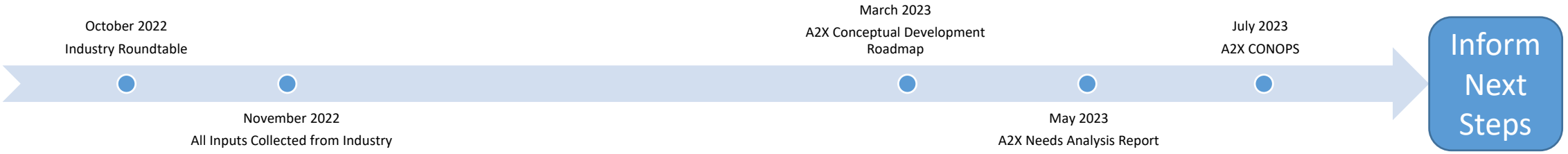
3. **Utilize these inputs to drive the scope & the role FAA should take to accelerate the concept of a A2X link in appropriate spectrum**

4. **Industry can execute on a A2X link**
   – FAA hopes to best enable and aid industry

Supporting Goal 2: FAA Products

Collected use cases and need statements to determine what role FAA has in assisting A2X link development, informed by three products:

- A2X Conceptual Development Roadmap (March 2023)
- A2X Needs Analysis (May 2023)
- A2X Concept of Operations (CONOPS) (July 2023)



A2X Supporting BVLOS DAA

- **Aircraft are required to maintain well-clear of each other**
  - 14 CFR 91.111 & 14 CFR 91.113
- **UAS and AAM will depend on cooperative (e.g., A2X and ADS-B In) and non-cooperative sensors (e.g., radar, acoustic, electro-optic) to detect aircraft nearby to avoid maintain well-clear**
- **ADS-B In is the FAA's prime surveillance source for UAS to avoid crewed aircraft**
  - !! UAS are not allowed to equip with ADS-B to inform others of their position (i.e., other crewed or uncrewed aircraft) !!
- **A2X would enable the trusted surveillance communication for DAA for uncrewed aircraft**

A2X Supporting FAA Missions

- **A2X enables the exchange of surveillance and safety information from the aircraft to traffic management services (ATM & UTM services)**
  - Coexistence (through xTM) will be enabled by sharing fully integrated and interoperable information (A2X data) across traffic management services
    - Allowing interoperation without each xTM operation imposing a burden on ATC services
    - Enabling affordable scalability of xTM operations
- **These traffic management services, approved by the FAA, will be supported by private entities applying new methods, new technologies (such as A2X), and rapidly evolving commercial infrastructure**

Review of Initial Findings – Use Case of A2X

- **Application of a link favored air-to-air (A2A) and air-to-air & ground (A2X), over air-to-ground (A2I) alone**
  - Suggesting a non-interrogating broadcast method of communications
    - Many brought up IPv6 addressing, especially with A2I, but still leaned toward broadcast methods for most use cases

- **Use priority favored:**
  - DAA & SA
  - Air Traffic Management (e.g., SA, Prioritization, Emergency awareness)
  - Unmanned Traffic Management (e.g., DAA, SA, Prioritization, Emergency awareness)
  - Hazard Sharing (i.e., C2 status, Emergency (7700-like), Weather, Terrain, Infrastructure, RF interference)
  - Data relay (often paired with SUAS, low altitude ops)

Informs ConOps

Review of Initial Findings – Needs

- **Priorities around:**
  - Spectrum (aeronautical licensed)
  - ID, State Vector, Measure Performance, and general Intent
  - DAA avoidance state and maneuver Active Intent
  - Hazard awareness connections
    - Aircraft-based:
      - C2 status, Weather, Equipage failures, Malicious intent
    - Ground-based:
      - Weather, Vertiport status, Surveillance uplink

Informs Needs Assessment

Concept Maturation Roadmap

Purpose

- Guide the maturation process of the A2X link concept
- Intended to be a living document with an annual update cycle

What does the Roadmap Provide?

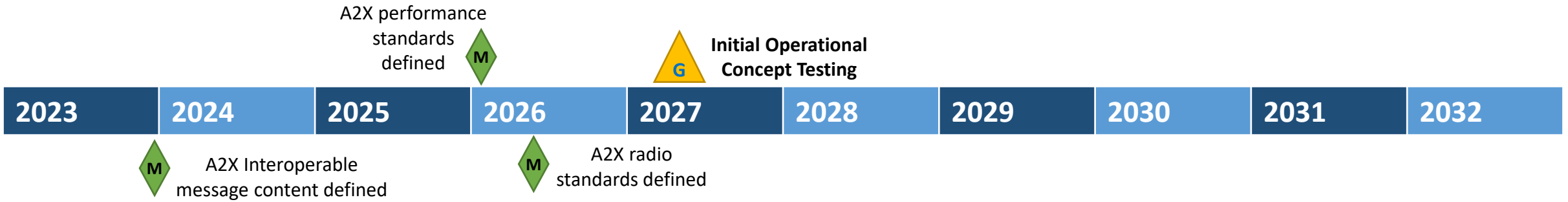
1. **Identify initial concept needs to enable A2X**
2. **Define Industry stakeholder role**
   - Background on Need
   - Identify current bodies of work in Industry
3. **Define FAA stakeholder role**
   - Identify current bodies of work with FAA
   - Identify risks if no FAA participation
4. **Opportunities and challenges**
5. **Key milestones for concept development**
6. **Initial goal timelines**

Initial Concept Needs

- Standards Development
- Spectrum
- Cybersecurity
- Technical Testing and Simulation
- Avionics Development
- Policy Development
- Ground Infrastructure
- Air Traffic Management
- Uncrewed Traffic Management

Standards Development

- **Industry Role**
  - Define interoperable message content that supports DAA, air traffic services, and safety information
  - Define A2X performance standards to support DAA, air traffic services, and safety information sharing
  - Define A2X radio standards to inform manufacturers of system needs to meet desired performance
- **FAA Role**
  - Support industry consensus standards development
  - Define A2X OPR's
  - Provide guidance on current regulation and policy
  - Develop Technical Standards Order (TSO) draft based on standards for future certification of A2X

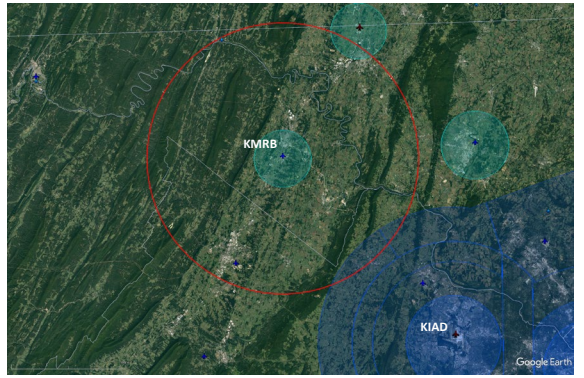


Consolidation of FAA & Industry Efforts and Potential Level of Effort

A2X Concept Need	FAA Stake	Industry Stake
Standards Development	Yes, Moderate	Yes, Major
Technical Testing and Simulation	No, Minor	Yes, Major
Ground Infrastructure	No, Minor	Yes, Major
Cybersecurity	Yes, Moderate	Yes, Major
Avionics Development	Yes, Major	Yes, Major
Spectrum	Yes, Major	Yes, Major
Air Traffic Management	Yes, Major	Yes, Major
Uncrewed Traffic Management	Yes, Moderate	Yes, Major
Policy Development	Yes, Major	No, Minor
TBD	…	…
TBD	…	…

Key Next Steps

- **To define RF spectrum necessary, message content and content structures need to be defined**
  - Prioritization of content is needed
    - Aircraft Identification
    - State Vector (SV)
    - SV Measure Qualities
    - Intent
    - Message Security Elements (e.g., Auth ID)
    - Hazard Safety Data (e.g., TFRs, Weather, C2 status, RF interference zone)
  - Alternative content structures based on prioritization
    - For example:
      - A1: ID, SV, Qual, Intent
      - A2: ID, SV, Qual, Intent, Security
  - Calculated bandwidth and aggregated operational airspace scenario
    - For example: 20nmi from KMRB



Agenda 16: New Business

Jim Williams, SC-228 Co-Chair

Brandon Suarez, SC-228 Co-Chair

Upcoming Meetings

- July 18-21, 2023 Face to Face Meetings at RTCA in Washington, D.C. Plenary #38 on Friday morning July 21.
- October 16-20, 2023 Face to Face Meetings at RTCA in Washington, D.C. Plenary #39 on Friday morning October 20.
- January 2024 TBD

Agenda 17: Adjourn

Jim Williams, SC-228 Co-Chair

Brandon Suarez, SC-228 Co-Chair

Thanks to all for your active participation and commitment to advancing the technical standards basis to support certification and integration of Uncrewed Aircraft Systems into the National Airspace System in a safe, timely and efficient manner.