m:N WORKING GROUP

MEETING SUMMARY

MARCH 2024

EXECUTIVE SUMMARY

From March 26th to 28th, 2024 the m:N UAS working group and its subgroups (Evaluation Methodologies, Exceptions/Interventions, and Initial Operating Capability for Airspace Integration) met at SAIC in Washington, D.C. for an in-person meeting. The subgroups meet virtually throughout the year, and twice a year participants from all the subgroups come together to further identify and discuss challenges and paths forward for incorporating UAS into the airspace.

The m:N UAS working group is run by Jay Shively (Adaptive Aerospace) and Andy Thurling (DroneUp) and is comprised of members from government, industry, and academia in an effort to identify and reduce barriers to m:N operations. This includes identifying requirements, use cases, metrics, and the development of white papers to support organizations including the FAA, RTCA, and ASTM. A change from last year, the Large UAS and HAPS sub working groups have disbanded while the sUAS working group continues independently, currently working on a white paper titled Personnel Selection, Roles, and Training for sUAS. For 2024 the m:N sub working groups have been refocused to cover evaluation methodologies, interventions/exceptions, and initial operating capability for airspace integration; with the premise that the outcomes from these subgroups will be white papers. These white papers can inform one another to ultimately become a master whitepaper.

Each subgroup lead is called out below:

Evaluation Methodologies Subgroup
Jay Shively, Adaptive Aerospace

Interventions/Exceptions Subgroup
Andy Thurling, DroneUp (Lead)

Initial Operating Capability for Airspace Integration Subgroup
Andy Lacher, NASA (Lead)

THE CHARGE FOR THE WEEK

This meeting of the m:N UAS working group focused on clarifying the goals and progress of the new subgroups and providing opportunities for cross-pollination of the subgroups through the day 2 breakout sessions.

Day one of the working group focused on presentations from government, academia, and industry. Topics discussed included approaches for measuring situation awareness, recent research about factors impacting multi-UAS deployments, team cognition and performance, and workload measurement for m:N operations. Day one also included briefings and summaries of the focus areas and activities of each subgroup.

Day two of the working group meeting was focused on all-day working session breakouts for each subgroup to take advantage of the opportunities to discuss and collaborate in-person to help shape the white papers from each group.

At the culmination of the three-day meeting each subgroup briefed the larger m:N UAS working group on the status, progress-to-date, and next steps within their working area.

MARCH 26TH BRIEFINGS & DISCUSSIONS

The March 26th briefings included representatives from industry, NASA, and academia.

A summary of the briefings and presentations from the first day of the working group session are included in the following section.

MARCH 26TH PRESENTATIONS AND BRIEFINGS

Introductions & Goals

Vanessa Aubuchon | NASA
Jay Shively | Adaptive Aerospace

The m:N working group meeting was kicked off with around-the-room introductions and an overview of the agenda and goals of the in-person meeting.

Situation Awareness Measurement

Mica Endsley, PhD | SA Technologies, Inc.

Figure 1: Situation Awareness diagram

Dr. Mica Endsley's presentation on Situation Awareness (SA) Measurement summarized the essential aspects of understanding and measuring situation awareness (Figure 1), especially in the context of system design and operation in dynamic environments such as that of remotely operated vehicles. Situation awareness is defined as the *perception of elements in the environment within a volume of time and space, the comprehension of their meaning, and the projection of their future status*. Dr. Endsley outlined the importance of measuring SA, which serves as a critical metric for assessing an operator's capability to synthesize information and maintain performance under challenging conditions. Dr. Endsley also summarized challenges for SA specific to remotely operated vehicles, such as:

- Time Lags
- Intermittent/Noisy data
- Limited transmission of sensory data
- Narrow Field of View
- Sensors Often not Focused in Direction of Movement
- Impoverished Visual Imagery
- Poor User Interfaces for Many Systems
- Little Support for Team Tasks
- Automation, which presents major problems in m:N operations

Dr. Endsley summarized various methods for measuring SA, including direct measures such as the Situation Awareness Global Assessment Technique (SAGAT), which involves pausing a simulation to query participants about their awareness at that moment. This technique is praised as the "gold standard" for its sensitivity and diagnostic capability. Another method discussed is the Situation Awareness Present Technique (SPAM), which allows for real-time queries during operations but has been found to be intrusive and less sensitive compared to SAGAT. The presentation also described pros and cons of different measurement approaches - subjective measures, which gauge confidence rather than objective awareness, process measures such as eye tracking and communication, performance measures which infer SA based on actions taken, and physiological measures, which show potential but require further validation as a true measurement for SA.

Dr. Endsley emphasized that while performance measures are commonly used to infer SA, they are affected by numerous other factors such as workload and decision-making strategies, making it difficult to isolate SA's impact, Figure 2. Consequently, Dr. Endsley advocated for a nuanced approach to selecting SA measurement techniques, suggesting that a combination of methods might be necessary to gain a comprehensive understanding of SA in various operational contexts. This includes considering the trade-offs between the intrusiveness, sensitivity, and practicality of each method, particularly in real-world applications where direct measurement can be challenging.

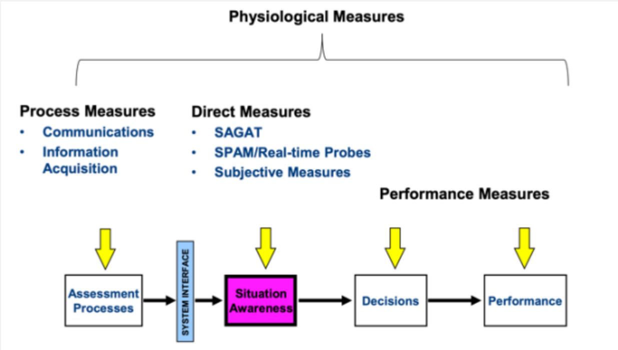


Figure 2: Types of SA measures

m:N is Not the Question

Julie A. Adams, PhD | Collaborative Robotics and Intelligent Systems / Oregon State University

Dr. Julie Adams' presentation discussed the factors and challenges associated with supervising robot swarms. She discussed the critical factors influencing the deployment and management of multiple UAS, which include the human-robot ratio, UAS heterogeneity, the reliability of UAS autonomy, environmental complexity and conditions, and air traffic control communication requirements. These elements directly affect the operational efficiency and the decision-making process in real-time UAS operations.

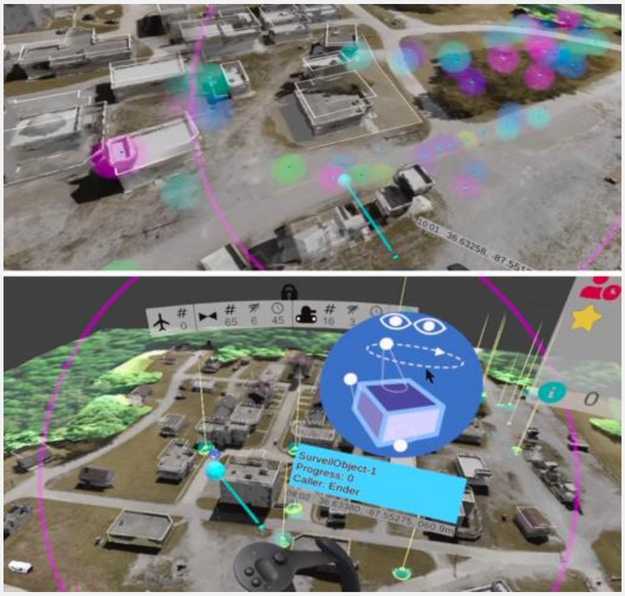


Figure 3: CCAST Swarm Commander Interface

Dr. Adams discussed the above topics within the context of the work and research conducted as part of DARPA's OFFSET program and the associated research that was performed at Fort Campbell, showcasing practical deployments of unmanned system swarms and the development of an immersive interactive interface known as the Swarm Commander Interface, designed to enhance human supervision of robotic swarms (Figure 3). Dr. Adams shared findings on workload estimation, indicating that within the right conditions a single operator can efficiently manage a swarm of over 100 unmanned robots without excessive workload. This is the first known objective workload data set for single human interaction with a real heterogeneous swarm, underscoring advancements in UAS control interfaces and the potential for effectively scaling up human-UAS collaborations.

Interactive Team Cognition for Humans and Machines

Nancy J. Cooke, PhD | Center for Human, AI, and Robot Teaming, Arizona State University

Dr. Nancy Cooke's presentation discussed the nuances of interactive team cognition and its importance in enhancing the effectiveness of teams within sociotechnical systems. Decades of research has explored how teams process information collectively; this has significant implications for designing environments where humans, AI, and robots collaborate (Figure 4). The presentation summarized several discoveries such as the critical role of team interactions, the benefits of introducing perturbations to improve teamwork, and strategies to enhance team player attributes and coordination. These insights are based on empirical studies conducted in synthetic task environments, which simulate complex real-world operations to better understand and improve team dynamics.

Figure 4: Remotely Piloted Aircraft System (ground control station) Synthetic Task Environment used for research

Key to Dr. Cooke's findings is the concept that team cognition evolves from interactions rather than being a static shared knowledge base. In her presentation, Dr. Cooke critiqued the traditional approach of shared cognition, which focuses on aggregating individual knowledge, arguing that it fails to capture the dynamic and context-dependent nature of real team interactions.

Dr. Cooke provided findings that team performance improves through experience and that strategic disruptions or perturbations in team composition can enhance this learning process. This has direct applications in designing training regimes and technological aids that foster more adaptive and efficient human-machine teams, ultimately aiming to optimize team integration and performance in technologically complex settings.

Workload, Automation, and m:N Operations

Scott Scheff | HF Designworks, Inc.

Scott Scheff's presentation discussed the complexities and challenges in managing workload through automation in m:N operations. Mr. Scheff emphasized the necessity for scalable autonomy in today's technology environments. He discussed the growing need to understand and define operator roles in an evolving landscape as we transition from manned aviators to remote operators and ultimately remote supervisors with air traffic control-like taskings. As these roles evolve there will be more technologies imposed on end users as well as the potential for increased demands on operators managing multiple unmanned systems at the same time, Figure 5.

Figure 5: FortiFly Simulation Environment for measuring real-time workload

Mr. Scheff's presentation summarized the nature of workload, distinguishing between physical and mental components, and highlighted the consequences of sustained high mental workloads such as fatigue and decreased performance. The presentation also summarized various methods for measuring workload, including subjective scales such as NASA TLX, modeling and simulation through tools such as IMPRINT and MicroSaint, and physiological measures that include heart rate/heart rate variability and neuroimaging techniques. Each method offers its benefits and limitations, indicating a preference for a mixed-method approach to capture comprehensive workload data accurately (Figure 6).

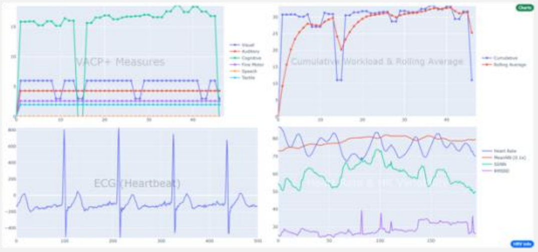


Figure 6: FortiFly real-time workload measurement

To effectively integrate automation, Mr. Scheff highlighted the need to identify high workload drivers early and adjust automation levels dynamically to maintain optimal operator performance. He outlined levels of automation from zero to full automation, noting that there would be different levels of operator support depending on the degree of automation. The briefing concluded with a call for further research into how automation affects workload, the integration of AI and machine learning in workload management, and the importance of building trust in automation and better understanding fatigue in m:N operations. This holistic approach aims to enhance both the effectiveness and efficiency of human-machine teaming in complex operational settings.

Subgroup Briefings & Breakout Assignments

Jay Shively | Adaptive Aerospace Group
Andy Thurling | DroneUp
Andy Lacher | NASA

After morning presentations from industry and academia, the afternoon of the first day of the m:N UAS working group face-to-face meeting focused on briefings from each of the three subgroups. This offered an opportunity for each subgroup to brief the broader working group about the subgroup's purpose and goals, progress, plans for the near future, and other background information. After the subgroup briefings, attendees were provided their breakout group assignments and the day ended with an initial 90-minute breakout group session prior to the full day of breakout sessions for day two.

Note that rather than summarize each subgroup's briefing in this section, this content has been combined with the day three updates from each subgroup in the day three section of this document.

MARCH 27th and 28TH SUBGROUP BREAKOUTS, SHAREOUTS, AND NEXT STEPS

Day two of the working group face-to-face meeting was focused on all-day working session breakouts for each subgroup to take advantage of the opportunities to discuss and collaborate in-person to help shape the white papers from each group.

Day three of the working group face-to-face meeting provided an opportunity for each subgroup to report on the status of their focus areas, latest thoughts and concepts, and overall progress-to-date.

Evaluation Methodologies Subgroup

Jay Shively | Adaptive Aerospace

The Evaluation Methodologies Subgroup summarized four primary goals:

- Define evaluation methodologies that can be a standard and used across domains
  - Neglect Time/Service time, Workload, Situation Awareness, Team Performance, Complexity
- Account for CONOPS differences (i.e., aircraft vs. area commands)
- Discuss how the data can be used for safety cases/ risk ratios
- Investigate modeling tools. e.g., Workload prediction

Defining Neglect Time and Service Time

The subgroup identified the need for a consistent definition of Neglect Time and Service Time and has provided the following candidates for definition, along with related concepts that also require definition and future measurement.

Neglect Time: The time an operator can ignore an autonomous system (aircraft) before needing to intervene.
Mean Neglect time: The average time between interventions
Neglect Tolerance: The threshold for a continuously degrading system. This could come into play, but many of our events are discrete – once hitting threshold continuous can be treated as discrete (Figure 7).
Service Time: The time required to resolve an intervention.
Example: OODA loop

- Orient (switching time)
- Observe (build SA)
- Decide on Action
- Action to resolve

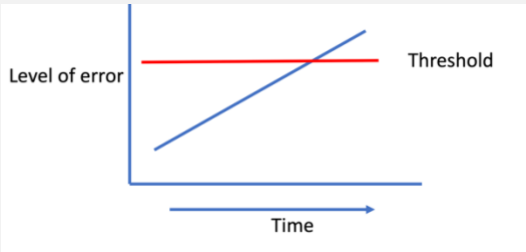


Figure 7: Visual representation of Neglect Tolerance

Simultaneity Metric: Probability of a new event occurring given an event(s) is already occurring.
Simultaneity = P (new event| event is occurring)

The subgroup also emphasized the nascent nature of these definitions with the following questions:

- Are these definitions and thinking off base?
- When do interventions start and stop? Should any simultaneous interventions automatically be an overload condition?
- Some interventions can be delayed (which I think can be captured in neglect time with regard to neglect threshold)
- Some are more important than others and/or more difficult for the operator (i.e., variable workload)
- Interventions can combine is various ways (Conflict, Facilitate)

For next steps, the group emphasized the need for data – from flight, simulations, etc. The following data was highlighted as important for progress, along with the open question of *does enough data exist for meta-analysis*?

- Intervention times and Service times
- Pilot workload
- System performance

In addition to the above progress updates, the subgroup also summarized details of its organizational structure and general logistical updates. The subgroup has met three times this year, developed a participant roster, organized an outline for their work, established section leads, and created a collaborative workspace. The subgroup is currently developing a schedule and review process to efficiently move forward with their objectives.

Interventions/Exceptions Subgroup

Andy Thurling | DroneUp

Recap of formation of new m:N subgroups

The Interventions and Exceptions (I&E) subgroup provided a summary of revelations from the last face-to-face meeting that led to shift in subgroup focus areas amongst the larger working group. These included:

- Focusing on the exceptions instead of the scenario
- The need for a defined Taxonomy - Naming, Describing and Classifying key concepts for m:N
- Other considerations
    - What if the “Exception” is handled by another “layer” of automation?
    - “Workload” becomes computational resource requirements, but much of the taxonomy remains the same
    - What are the “Bandwidth” changes/requirements?

Update on Taxonomy and definitions

The push toward the creation of a taxonomy has focused on several key concepts and open questions:

- Nature of human intervention
    - Supervisory – additional guidance for automation
    - “Skip” out of one loop becomes an “Exception” the level higher
    - Triggering events could cause a control mode change
    - Similar to ASTM WK76044 “state transition” concepts
- IF automated, how does the human maintain SA?
    - Displayed? Yes/no, how?
    - Transparency? Trust?
- Relevant to Operational Impacts as well, not confined to “Safety”
    - Now the Operational Impact is a new “exception” to handle!
    - How does one aircraft impact the execution of the mission strategic plan?
- Construct table of “parameters” defined in the “Taxonomy”
- Pass the “Taxonomy” description in a machine-readable structure
- Exceptions can then be analyzed to see how they should “Sequence” or “Stack” and wait to be “Serviced” by “m” humans
- This also allows us to evaluate the m:N problem in an m to “Managed Area” fashion instead of against the number of aircraft

Creation of four task groups within the Interventions/Exceptions Subgroup

The Interventions/Exceptions subgroup has divided their focus into four main task groups: Graphics, ASTM WK76044 Review, Writing, and Queuing Theory/Algorithms. Each focus group has had marching orders to prepare for the face-to-face meeting to review progress, capture feedback from the other m:N subgroups, refine the evaluation process, and make progress toward a more ready to use taxonomy “tool” for describing exceptions.

The Graphics task group, led by Mehrnaz Sabet (Cornell University) has been focused on creating graphical tools/representations that will help the working group analyze generic Interventions and Exceptions, Figure 8. Examples of these graphical representations include:

- Exception Curves, which visually represent Exception Severity and progression over time
- Service Levels for exception recovery, which visually represent how the Max Queue time shifts as an exception is serviced by various levels of automation or human intervention
- How Exception Curves and Service levels translate into “blocks” – summarized chart-like columns (or rows) that visually represent how Max Queue time is impacted by severity and level of automation

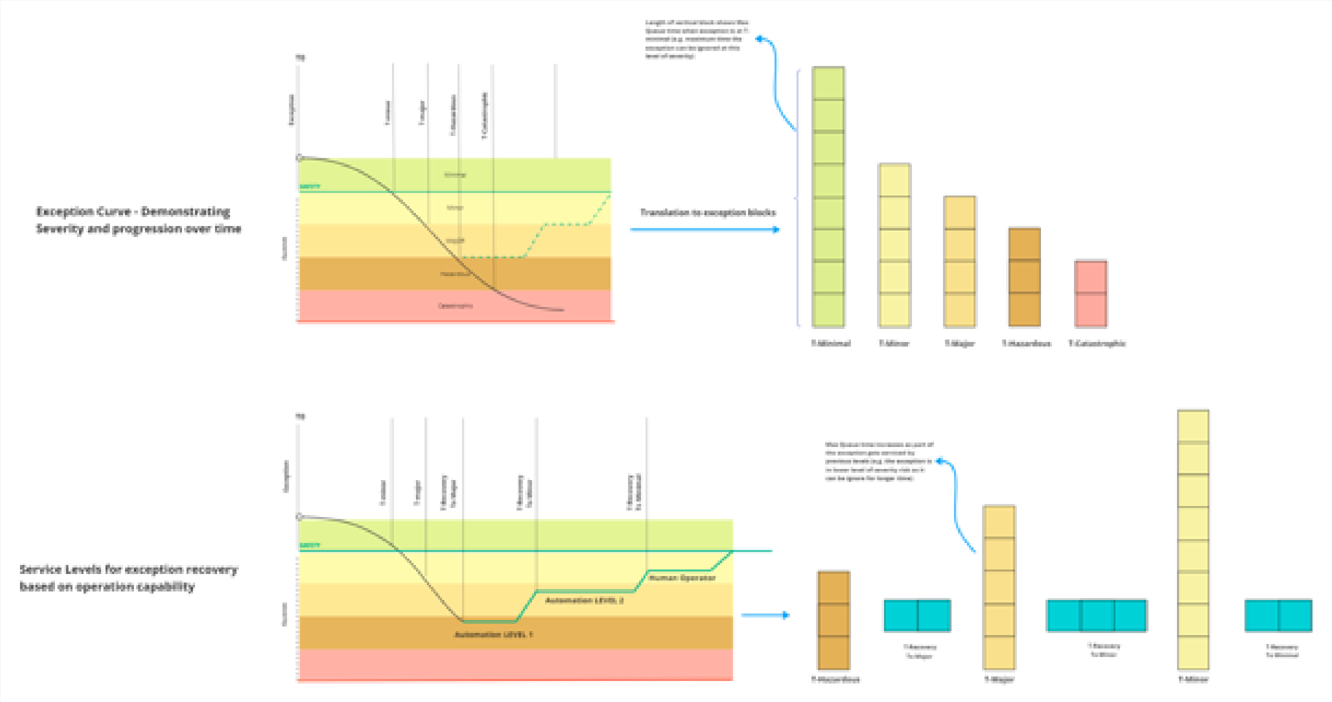


Figure 8: Exception Curves & Service Levels

The ASTM WK76044 task group, led by Andy Thurling (DroneUp) and Wendy Ljungren (Anzen Unmanned), has focused on having draft 76044 material reviewed for relevance to the Interventions/Exceptions subgroups. The goals are to prepare to lead discussions related to this at the face-to-face meeting.

The Writing task group has been awaiting marching orders and is on-hold for the time being.

The Queuing Theory/Algorithms task group, led by Garrett Sadler (NASA) and co-lead by Mehrnaz Sabet (Cornell University); has been focused on conducting a literature search to prepare discussion options and examples for the face-to-face meeting.

Interventions/Exceptions subgroup Day 1 and Day 2 activities

Day 1 Activities

- Briefly reviewed Task Group progress
- Briefly reviewed outcome of the WK76044 evaluation
- Used Graphics Groups’ Miro tools to refine evaluation process
- Feedback from Queuing Group regarding how they may “ingest” tools’ output

- Discussion that we now have a “tool” ready to use

Day 2 Activities

Interventions/Exceptions Subgroup

- Use Tool refined on Day 1 to describe the Taxonomy of some practice “exceptions”
- Develop a “data structure” that could provide the Taxonomy in a machine-readable format to the queuing algorithm group
- Review the Queueing Theory/Algorithm work
- Develop an outline for the whitepaper for which the writing group can start developing content

Joint Meeting - Methodologies for Evaluation & Interventions/Exceptions

- Look at “Methodologies” “reference scenario” with our newly developed tools
- Goal is to have our practice “exceptions” be relevant to the Reference Scenario
- Discuss transitioning our work to working group 1 (Evaluation Methodologies) to help compile a master white paper

Initial Operating Capability for Airspace Integration Subgroup

Andy Lacher | NASA

The Initial Operating Capability subgroup briefed the broader group in the following areas:

- Motivation/Scope
- Why Airspace Integration
- Assumptions
- Strategy

Motivation and need for addressing airspace integration

The subgroup outlined the core purpose and need for addressing airspace integration and the motivation and scope driving the subgroup’s initiative. A top priority for airspace integration is to reduce the dependency on voice communications for interactions with air traffic control (ATC), which is seen as a major bottleneck for scaling multi-vehicle operations under instrument flight rules (IFR). The subgroup made several key points toward this need:

- Pilot performance limitation is not necessarily an ATC performance limitation
- Timely communications and timely compliance with instructions with ATC could be an obstacle for IFR operations
- Increased latency in communications, response, and action due to multiple responsibilities and additional draws on attention could have a cascading effect on traffic efficiencies

The future vision

The strategy consists of three primary focus areas for minimizing routing interactions with ATC:

1. Authorizing digitally-enabled VFR-like operations where we have VFR operations today (e.g., Class E)
2. Expanding Class E-like airspace operations into Class B, C, and D where feasible (ATC/ATM preapproved airspace), Figure 9
3. Leveraging ability to transition from m:N to 1:1 as needed

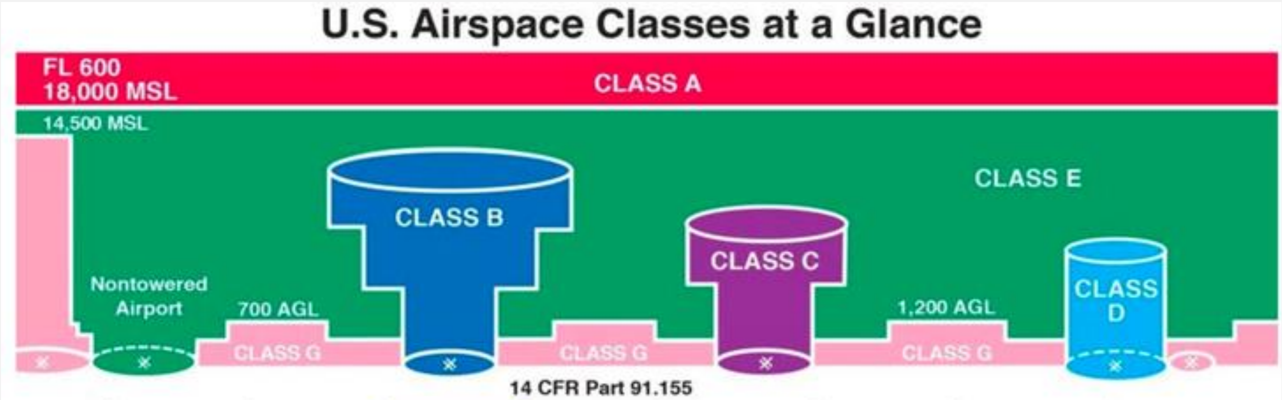
This strategy assumes that technology will enable unmanned aircraft to be able to comply with the intent of visual flight rules procedures and that M:N operations will need to be interoperable with incumbent piloted and remotely piloted operations.

Authorizing digitally-enabled VFR-like operations

- Highly automated operations minimize the need for direct human oversight of each action
- Highly advanced electronic navigation
  - GPS, GBAS, NAVAIDS
  - Obstacle and terrain databases
  - Potentially machine vision
- Detect and Avoid for maintaining well clear and collision avoidance
  - Operator is responsible for conflict detection and resolution using an automated capability
  - With other VFR, IFR, and eVFR traffic and other hazards (e.g., obstacles)
  - Ground-based and aircraft based cooperative and non-cooperative traffic surveillance
- Cloud Clearance – Not a requirement – Assumes DAA meets safety requirements
- Ordinal Altitudes (14 CFR Part 91.159)
- Not constrained to VMC
- Electronically conspicuous – ATC will have the same situation awareness of eVFR flights as they do VFR

ATC/ATM Preapproved Airspace

- Where feasible (each facility is different)
- Under-utilized areas
- Airspace class remains unchanged
- Not exclusive airspace
- ATC does not provide separation services to eVFR (similar to Class E)
- Rescindable by ATC as needed
- Preapproved, Analogous to LAANC and Facility Map areas
- Nominally, no further ATC communications required



Airspace Class	Entry Requirement	Pilot Certificate or Rating	Two-Way Communication	Altitude Decoding Transponder	VFR Min. Visibility Below 10,000 MSL	VFR Min. Visibility 10,000 MSL and Above	VFR Cloud Clearance Below 10,000 MSL	VFR Cloud Clearance 10,000 MSL and Above
A	ATC Clearance	Instrument	Yes	Yes	N/A	N/A	N/A	N/A
B	ATC Clearance	Private Certificate or student with endorsement	Yes	Yes within 30 nm of the class B primary airport[1]	3 miles	3 miles	Clear of Clouds	Clear of Clouds
C	VFR: Radio Contact IFR: Clearance	Student Certificate	Yes	Yes within C space and above lateral limits of C space[1]	3 miles	3 miles	500 below 1,000 above 2,000 horizontal	500 below 1,000 above 2,000 horizontal
D	VFR: Radio Contact IFR: Clearance	Student Certificate	Yes	No unless required by other airspace	3 miles	3 miles	500 below 1,000 above 2,000 horizontal	500 below 1,000 above 2,000 horizontal
E	VFR: None IFR: Clearance	Student Certificate	IFR only	No unless required by other airspace	3 miles	5 miles	500 below 1,000 above 2,000 horizontal	1,000 below 1,000 above 1 mile horizontal
G	None	Student Certificate	No	No unless required by other airspace	Day: 1 mile Night: 3 miles	5 miles[2]	500 below 1,000 above 2,000 horizontal [2]	1,000 below 1,000 above 1 mile horizontal [2]

[1] An altitude decoding transponder is required above 10,000 MSL.
[2] When flying 1,200 AGL or below: DAY: 1 mile visibility clear of clouds; NIGHT: 3 miles visibility, 500 below, 1,000 above, 2,000 horizontal.

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*** AGL = above ground level | FL = flight level | MSL = mean sea level ***

www.FAASafety.gov

Figure 9: Us Airspace Classes

Transition from m:N to 1:1 as needed

- For IOC, entire operation does not need to be m:N
- Approach, take-off, and landing could be 1:1 (remotely piloted) IFR operations with direct ATC communications
  - Enables landing at airports in Class D, C, and perhaps even B airspace
  - Builds trust
- During an aircraft emergency or other aircraft contingency revert to IFR and 1:1 remote operations

Subgroup next steps

The Initial Operating Capability for the Airspace Integration Subgroup noted that a clear next step is to develop a white paper that documents thinking and identifies potential activities.

Next Steps

Next steps include each subgroup continuing to evolve and progress their individual whitepapers in order to work toward a master whitepaper summarizing progress for the entire m:N working group.

A summary briefing along with subgroup Q&A will be held at AUVSI's Xponential Conference in San Diego, CA April 25, 2024.

The next face-to-face working group meeting will be held at the FAA facility in Dallas Texas, October 22-24, 2024.

For additional information, or to join the m:N working group or its subgroups, please reach out to the individuals listed below.

m:N Working Group
Jay Shively jshively@adaptiveaero.com
Andy Thurling andy.thurling@droneup.com

m:N WORKING GROUP

A central goal of this working group is to bring together a broad collective of interested stakeholders from government, industry, and academia to identify and reduce barriers to m:N operations, an operational configuration that envisions a ratio of multiple operators (m) controlling multiple vehicles (N) between them. Barriers addressed by this working group are considered across a variety of multi-vehicle control contexts (e.g., Urban/Advanced Air Mobility, drone delivery, infrastructure inspection, disaster response and recovery, and high-altitude platform systems operations) and form the bases for future research to confront operational, technical, and regulatory gaps.

https://nari.arc.nasa.gov/ttt-ram/multi-vehicle

Appendix A: Attendee List

Aaron Casey	LS Technologies
Adam Hendrickson	FAA
Adan Vela	University of Central Florida
Anahita Jain	The University of Texas at Austin
Andy Lacher	NASA Langley Research Center
Andy Thurling	DroneUp
Anna Weigel	Aerial Vantage
Anoop Kiran	Brown University
Ashira Beutler-Greene	AIAA
Barry Jenkins	Primal Space Systems
Benjamin Hargis	NASA Langley Research Center
Bill Kaliardos	FAA
Brittany Duncan	University of Nebraska-Lincoln
Bryan Petty	NASA Langley
Carl King	Northrop Grumman
Carl Pankok	Merlin Labs
Gregory Blaize	The Boston Drone School
Husni Idris	NASA
James Eanes	Daniel H. Wagner Associates, Inc.
James Smith	NATCA
Jay Shively	Adaptive Aero Group
Jimmy Smith	NATCA
Josh Noble	Mosaic ATM
Justine Hong	Global Aerial Management Group
Katie Constant-Coup	FAA
Kelley Hashemi	AOSP
Lisa Kerr	Grants for Good
Marc Compere	Embry-Riddle Aeronautical University
Marilyn Pearson	CAE
Mark Blanks	Wing
Mark Reed	ALPA
Mark Shikerman	Wisk Aero
Mike Politowicz	NASA
Mykyta Zhyla	Wisk
Nancy Cooke	Arizona State University

Paul Albuquerque	Federal Aviation Administration
Radhika Bhopatkar	Purdue University
Raymond Adams	Airde Elevated Thinking LLC
Rese Drucker	DroneUp
Rob Knochenhauer	Censys Technologies Corporation
Scott Swanson	Parallax Advanced Research
Tim Skutt	Anzen Unmanned
Timothy Beglau	FAA-AFS-740
Timothy Bleakley	General Atomics Aeronautical Systems, Inc
Vaslav Patterson	ALPA
Walter Jones	SAIC
Walter Waltz	NASA
Waseem Naqvi	Collins Aerospace
Wendy Ljungren	Anzen Unmanned
William Keating	Metron Aviation