In-Time System-Wide Safety Assurance

IASMS Data & Architecture

Concept of Operations Development Webinar

October 18th, 2019

Today's Webinar Focus:

Desired Outcomes for today's meeting:

- Share ideas
- Capture thoughts and assumptions
- Document the IASMS data and architecture important to critical safety risks and their causal and contributing factors
- Discuss next steps

IASMS Data and Architecture

- **What data and the associated architecture are needed on critical safety risks and how often?**
  - e.g., aircraft state information for risk of flight outside of approved airspace
- **Who needs the data provided by the services?**
  - e.g., operator, USS, or regulator
- **How important are the data and the associated architecture?**
  - i.e., cost justified by severity and probability of the risk
    - Identifies data to be *monitored and assessed* and…
    - *Interconnectivity recommendations* between agents in the system

Why you should be involved

You have the key knowledge and expertise that we need to:

- Highlight the safety barriers that are limiting UAM operations
- Identify the safety critical risks — *Which safety critical risks could an IASMS help to reduce? How?*
- Define key IASMS services that demonstrate potential to assure safety and enable UAM access to the NAS
- Create the IASMS functional architecture (e.g. service oriented)
- Define the minimum data requirements and sharing concerns

Going in…

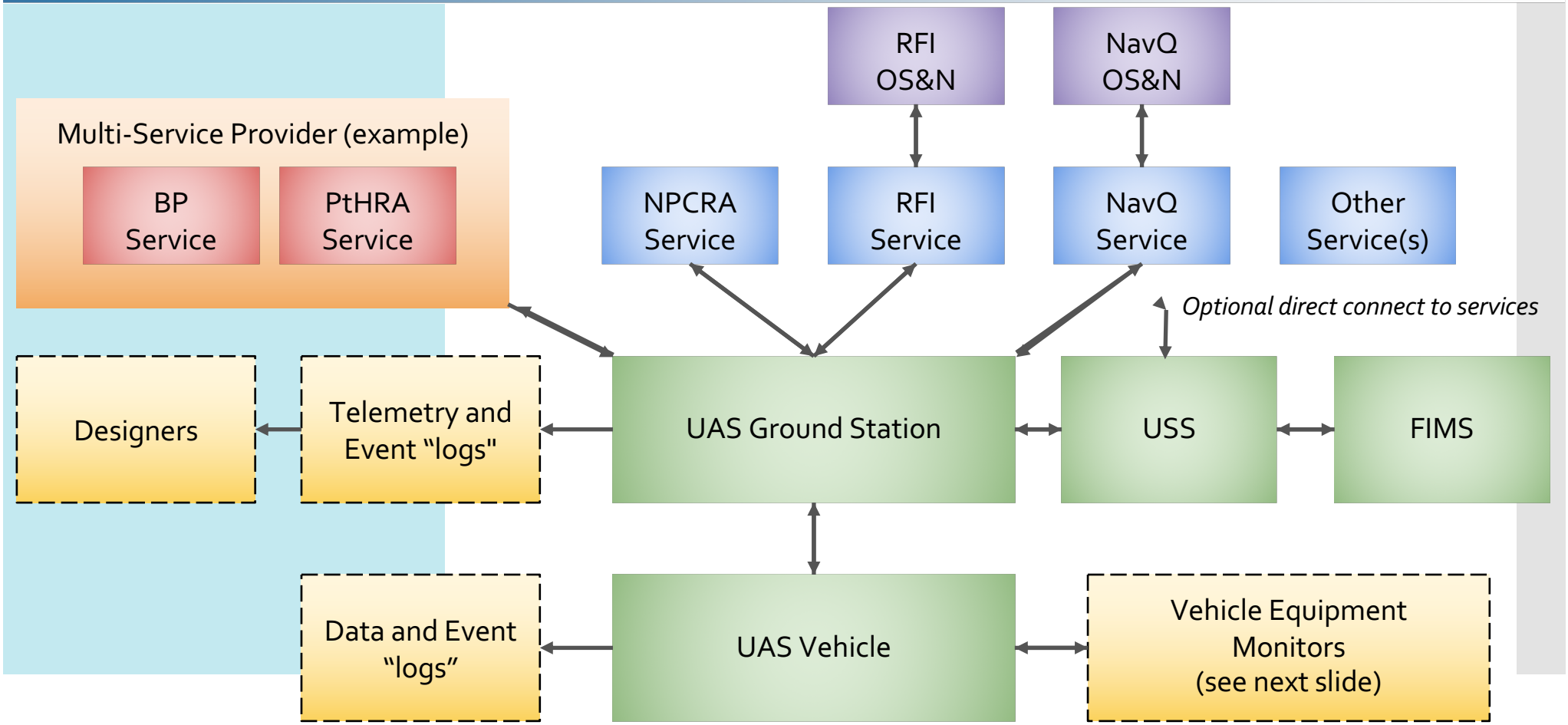
- **Scope**
  - Application of ISSA concept to low altitude urban flight
- **Approach**
  - Leverage existing systems and standards where able
  - Demonstrate solutions for gaps
- **Assumptions**
  - Highly autonomous flight (no pilot)
  - ATM/Airspace functions are separate, but interoperable
  - Reliance on 'connectivity' is ok
  - Identified hazards provide good coverage of the 'waterfront'

Architecture

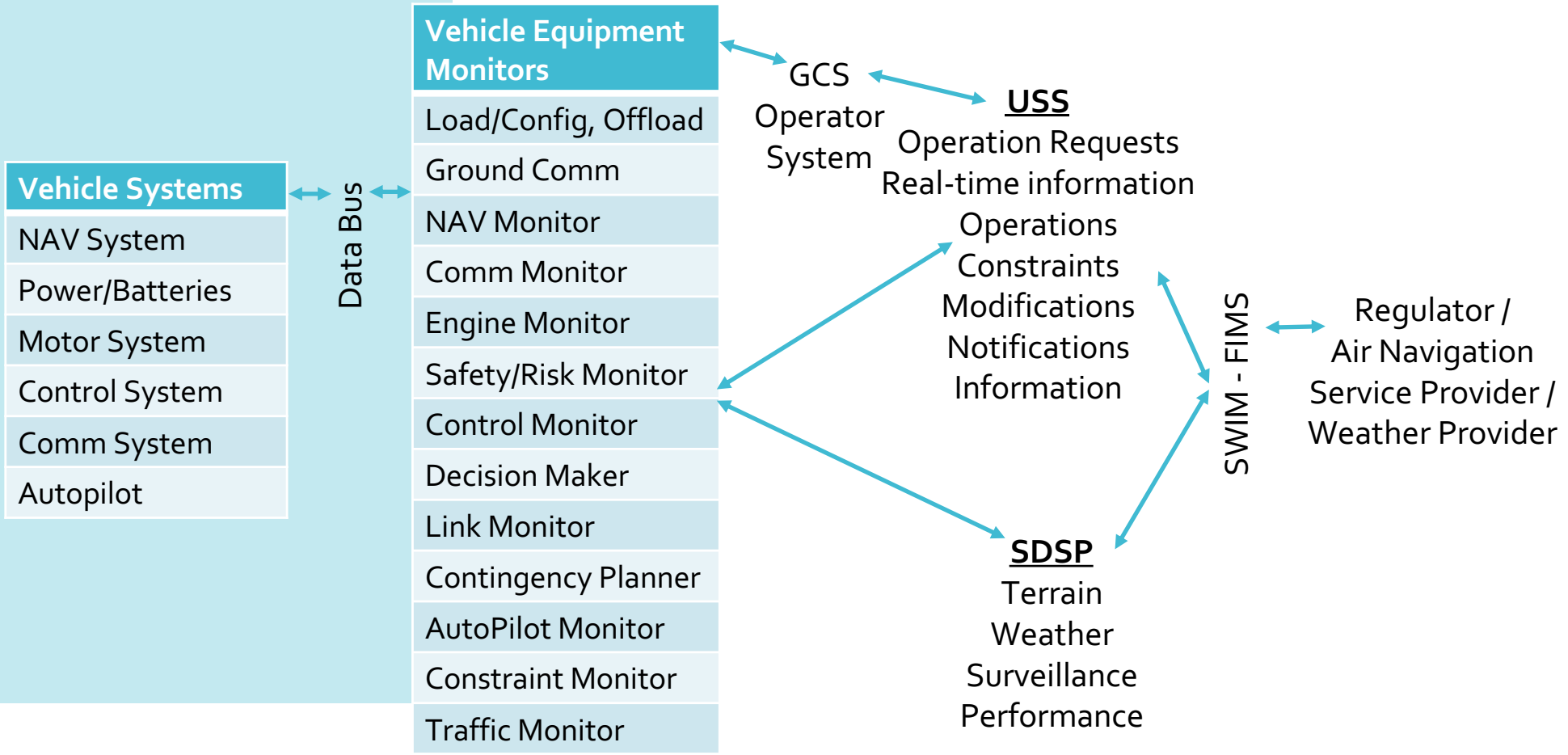
Guiding principles and overarching traits

1. Service-oriented; scalable; building block approach
2. Open and extendible to address new risks or hazards as/if they are discovered
3. Leverages and interoperates with existing relevant systems (e.g. SWIM and ATM/ANSP services)
4. Transformative from the existing NAS (i.e., not a clean-slate design)
5. Applies techniques that assure appropriate levels of data/information integrity
6. Applies run-time assurance techniques; incl. reporting of system failures back to designers
7. Supports isolation of flight-critical functions onboard to meet higher fail-safe assurance levels
8. Supports functions that can bound the behavior of autonomous functions
9. Service providers can be certifiable as "trusted source"
10. Minimizes exposure to cyber threats (e.g., by minimizing in-flight exchanges of critical data)
11. Data exchanges are protected and link agnostic (as long as meeting quality requirements)
12. Combines SWIM-like connectivity/services with ASIAS-like analytics and processes
13. Supported by a safety case for flight-critical elements (e.g. auto-mitigate functions)
14. Provides an incremental step to the larger IASMS concept described in National Academies report
15. Supports current SMS processes

Architecture (Notional)

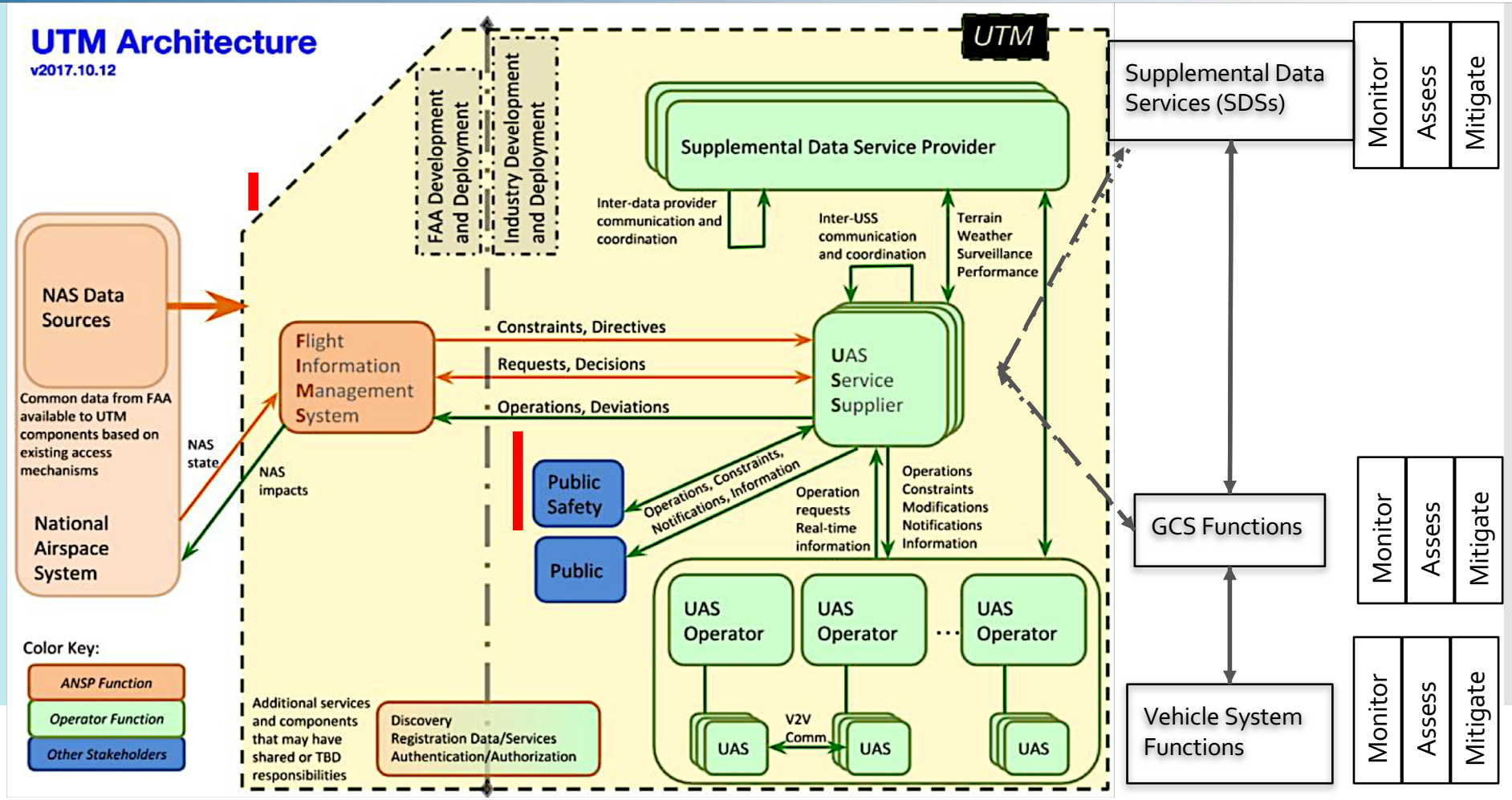


System Interactions



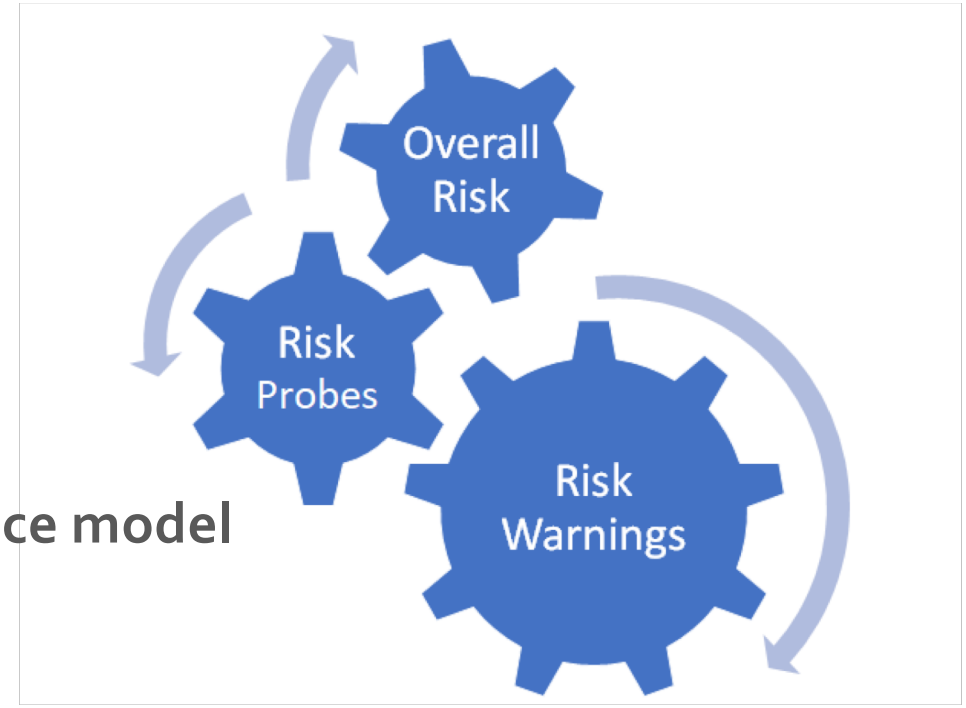
(From Young and others, 2018, Figures 3 & 5)

Architecture
(image from March 15, 2018 UPP Workshop)



Databases and Models

- Aircraft aerodynamic model
- Geo-spatial feature model
- Weather forecast model
- Population density model
- Link performance model
- Navigation system performance model
- Battery performance model
- Engine performance model



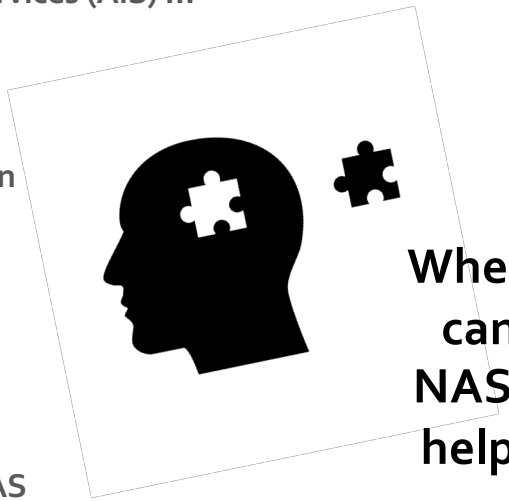
Information Requirements

Data Quality (and other relevant standards)

- DO-200B, Standards for Processing Aeronautical Data
- DO-201B, User Requirements for Navigation Data
- DO-272D, User Requirements for Aerodrome Mapping Data
- DO-276C, User Requirements for Terrain and Obstacle Data
- DO-291C, Exchange Requirements for Terrain, Obstacle, and Mapping Data
- DO-324, Safety and Performance Requirements (SPR) for Aeronautical Information Services (AIS) …
- DO-349, Architecture Recommendations for AIS and MET Services
- DO-364, Minimum Aviation System Performance Standards for AIS and MET Services
- DO-369, Guidance for the Usage of Data Linked Forecast and Current Wind Information
- FAA Advisory Circular, AC 00-45H, Aviation Weather Services
- ICAO Annex 3, Meteorological Service for International Air Navigation
- ICAO Annex 15, Aeronautical Information Services
- ISO-9000 series, Quality Management Systems
- ASTM, F3269-17, Standard Practice for Methods to Safely Bound Flight Behavior of UAS
- [Others from FAA, ASTM, EASA, OGC, and ARINC}

Groups and Committees…

Others?



Where can NASA help?

Next Steps

In-Person Workshop: Oct 23rd, 2019 – IASMS Use Cases at National Institute of Aerospace. Day prior to AUVSI Hampton Roads Symposium @ Hampton, VA Convention Center, 24th-25th October 2019

Future Interaction:

- Additional Outreach – November schedule TBD at In-Person Workshop

Final: AIAA SciTech @ Orlando, FL – January 2020 – Final Socialization and Stakeholder vetting of ConOps

Thanks for Attending!