Airspace **O**perations **L**aboratory (AOL)
Unmanned Aircraft Systems (UAS)
Service **S**upplier (**AOLUSS**)
for
Scalable Traffic Management for Emergency Response Operations
(**STEReO**)

Connecting Capabilities

George Lawton

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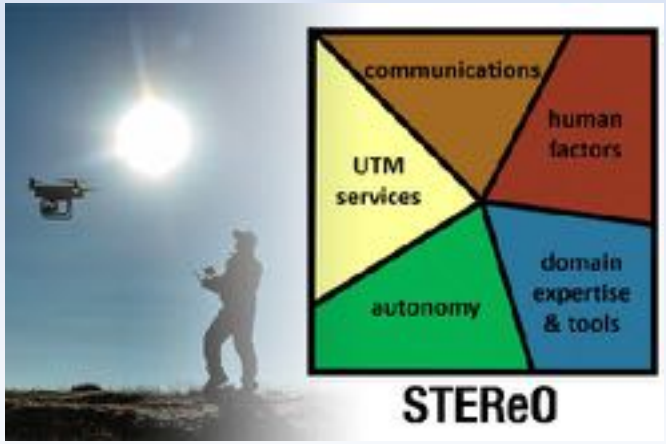
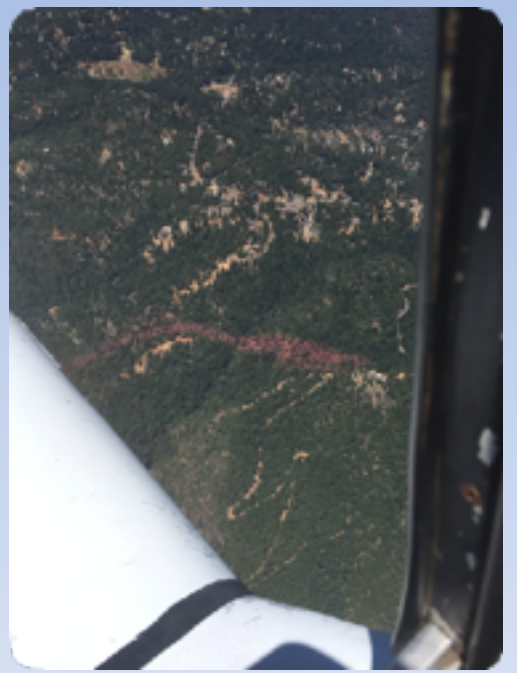


Background / Perspective / Motivation

- Software:
  - Space Shuttle Telemetry and Data Processing 1990’s
  - Army Drone Data Collection / Reduction System 1990’s
  - UTM pre-TCL1
  - Aviation and Vehicle Simulations
  - iOS App, web, and Server Side (full stack)
- Pilot:
  - Commercial, Multi-engine, Instrument Current, 3000+
  - Former Remote Control Aircraft Instructor
  - Close Encounter With Drone



Connecting Capabilities

- UTM Background
    - UAS Traffic Management (UTM)
    - NASA Research 2014-2019
    - UTM is an Automated Web-Based Technology
    - Architecture
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    - AOLUSS - Research-based USS
    - AOLUSS Operator Interface
    - AOLUSS Clients
- Future
    - UTM Future
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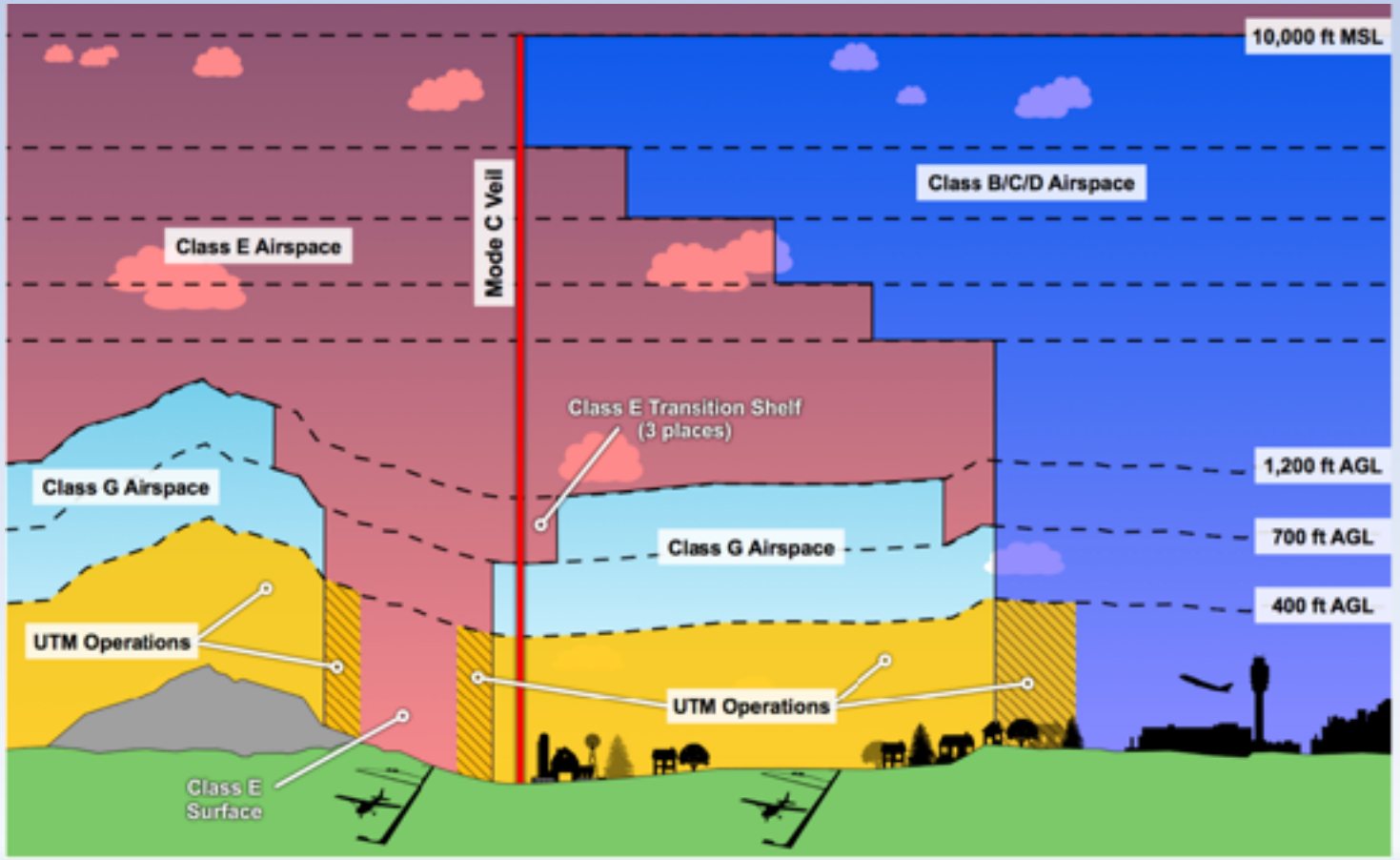
UAS Traffic Management (UTM)

”**70,000 operations by 2035**”

“Building on its legacy of work in air traffic management for crewed aircraft, **NASA is researching** prototype technologies such as airspace design, dynamic geofencing, congestion management and terrain avoidance for a UAS Traffic Management (UTM) system that could enable safe, efficient low-altitude operations“

“**UTM is to enable safe and efficient low-altitude airspace operations**”

Below 400’ Above Ground Level (AGL)



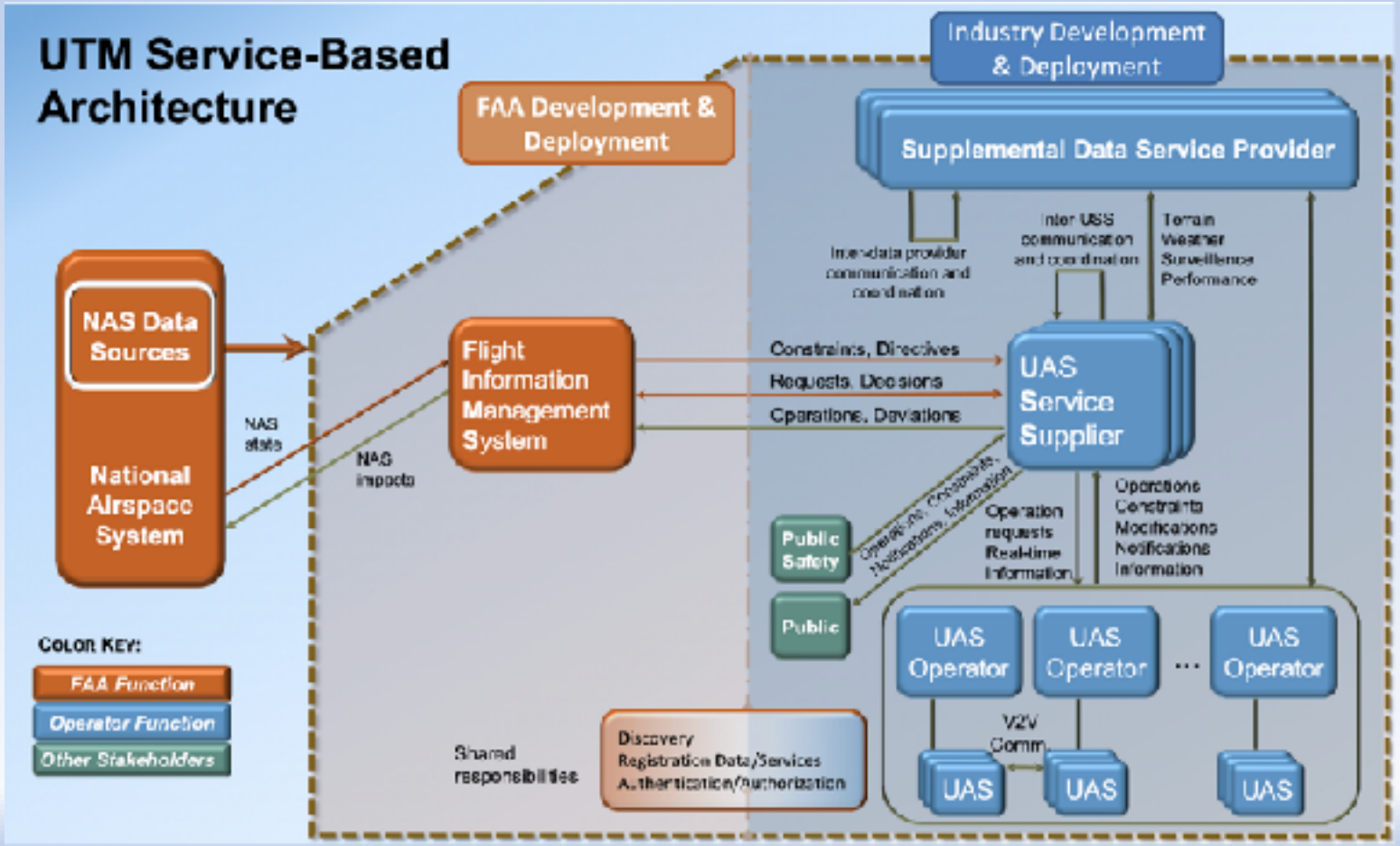
Reference: https://ntrs.nasa.gov/archive/nasa/casi.ntrs.nasa.gov/20140013436.pdf; https://utm.arc.nasa.gov/docs/2018-UTM-ConOps-v1.0.pdf; https://www.nasa.gov/sites/default/files/atoms/files/utm-factsheet-09-06-16.pdf

UTM NASA Research 2014-2019

Reference: https://utm.arc.nasa.gov/docs/2018-June-UTM-Media-Day.pdf ; https://www.nasa.gov/sites/default/files/atoms/files/utm-factsheet-09-06-16.pdf

UTM is an Automated Web-Based Technology

- "The primary means of communication and coordination between Operators, the FAA, and other stakeholders is through a **distributed network of highly automated systems**, and *not* between pilots and air traffic controllers via voice."
- RESTful Hypertext Transport Protocol (HTTP) Application Programming Interface (API)



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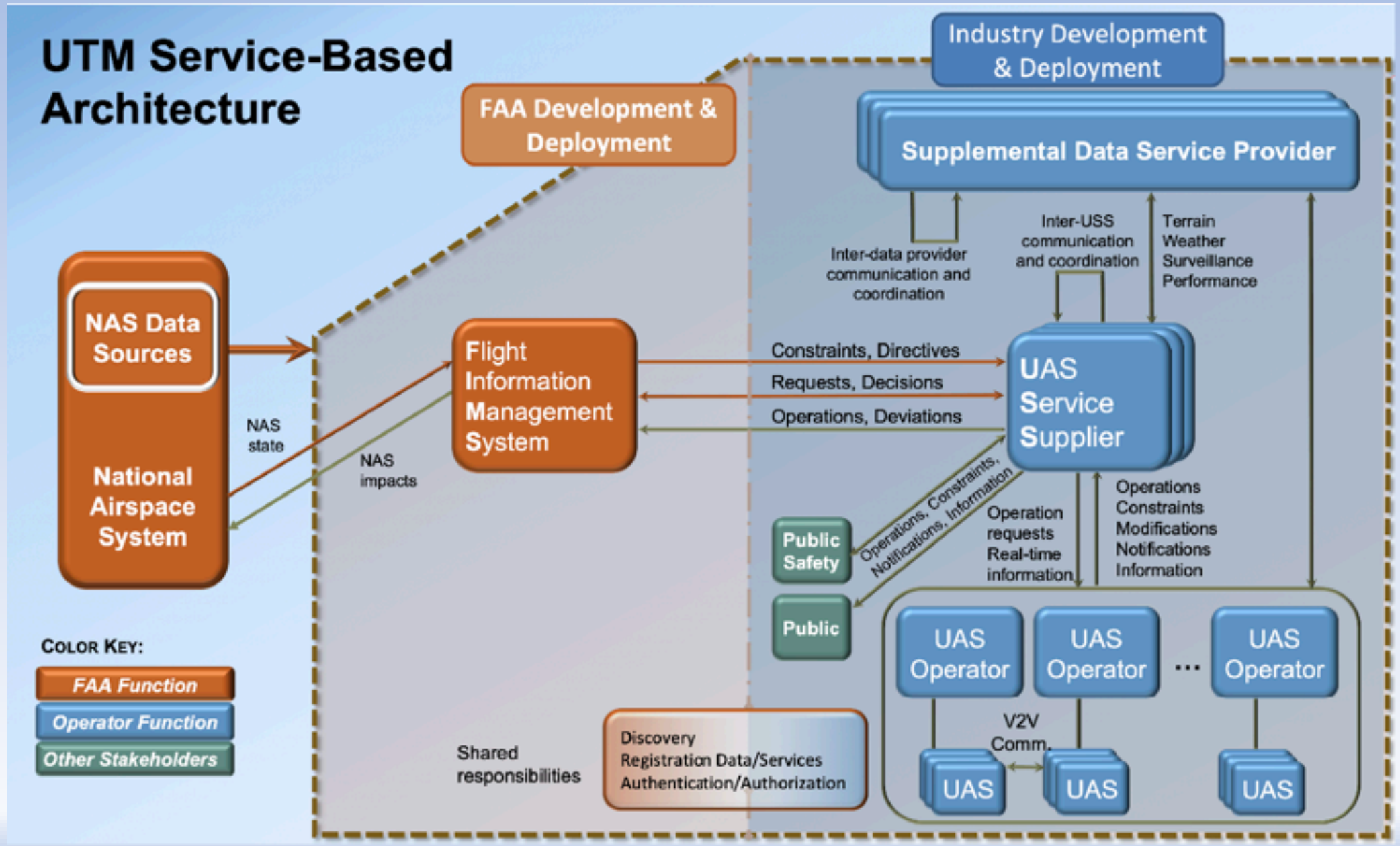

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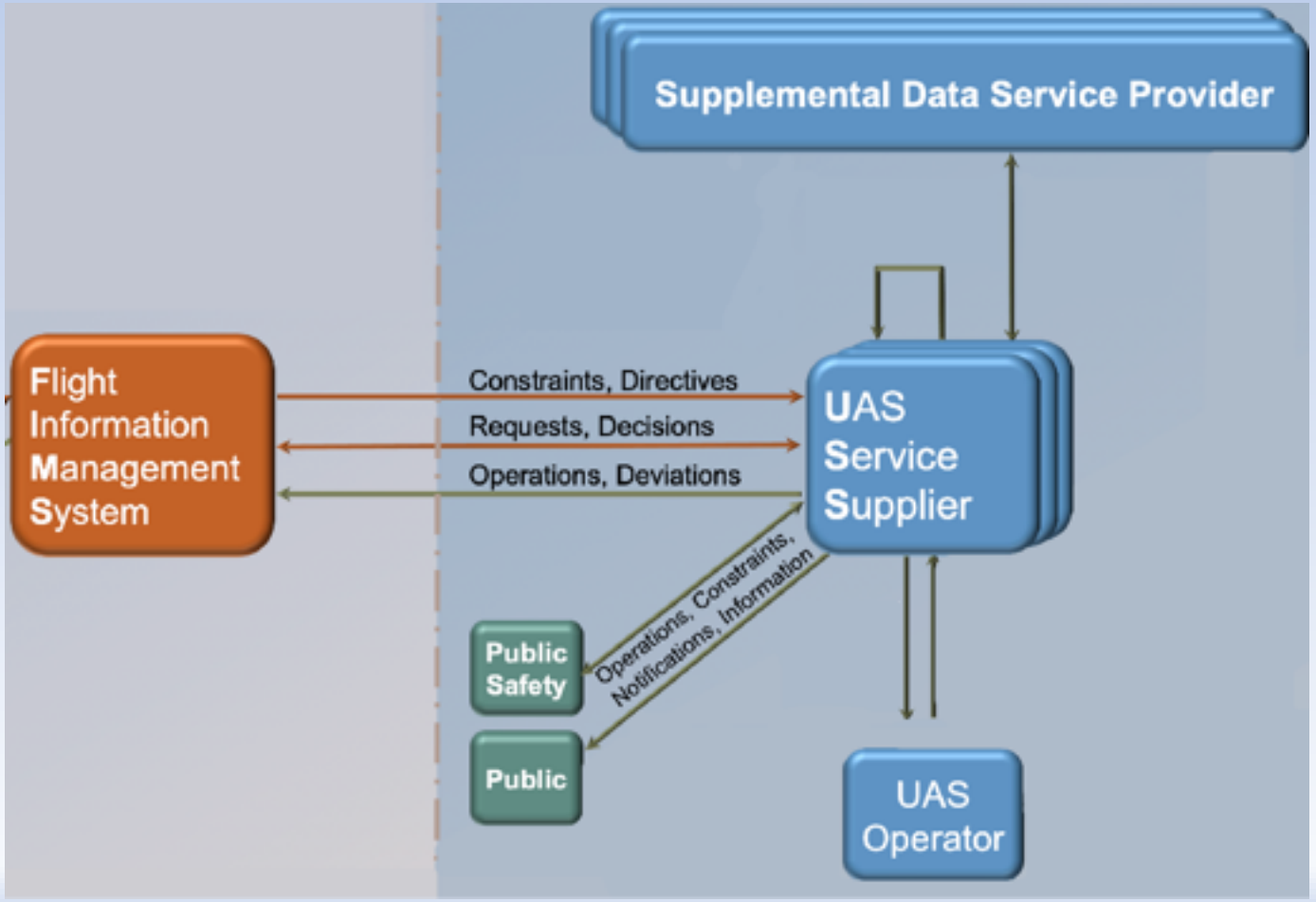
UAS Service Supplier (USS)

"USSs provide UTM services to support the UAS community, to **connect Operators** and other entities to enable information flow across the USS network, and to **promote shared situational awareness** among UTM participants."

Flight Information Management System (FIMS) Authentication and Data Sharing (FAA)



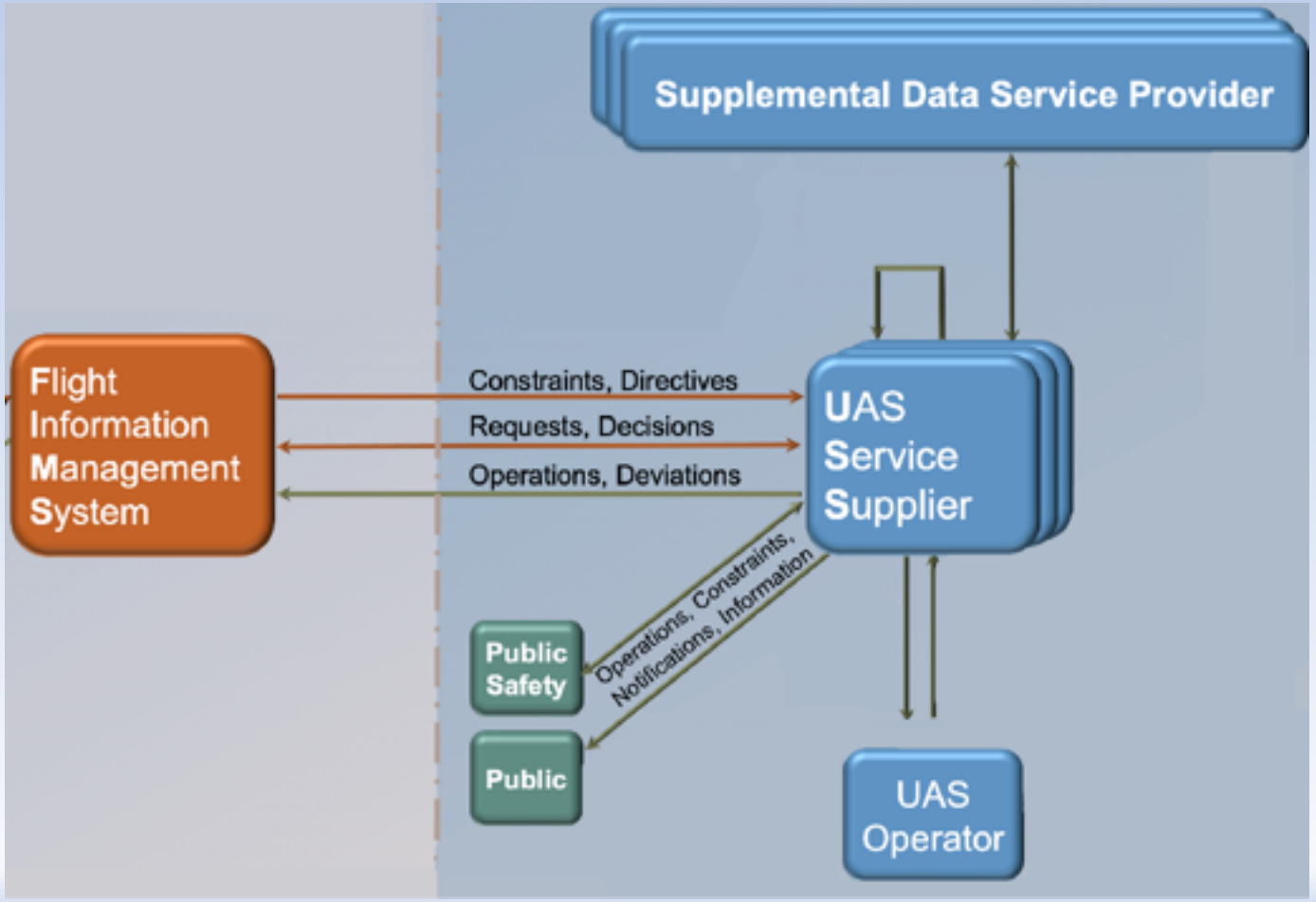
Reference: https://utm.arc.nasa.gov/docs/2018-UTM-ConOps-v1.0.pdf ; https://utm.arc.nasa.gov/docs/2018-June-UTM-Media-Day.pdf

UAS Service Supplier (USS)

"USSs act as a real-time or near–real time communications bridge between UAS Operators, the FAA (via FIMS), SDSPs, public entities, and other stakeholders to share information required to manage nominal and off-nominal operations. […]

strategic de-confliction, notifications of priority services (temporary flight restrictions) […]

USSs must have discovery to FIMS, other USSs, Operators, SDSPs, and public entities (e.g., law enforcement, emergency services, Department of Defense) either directly or via a central inter-USS communication and coordination capability"



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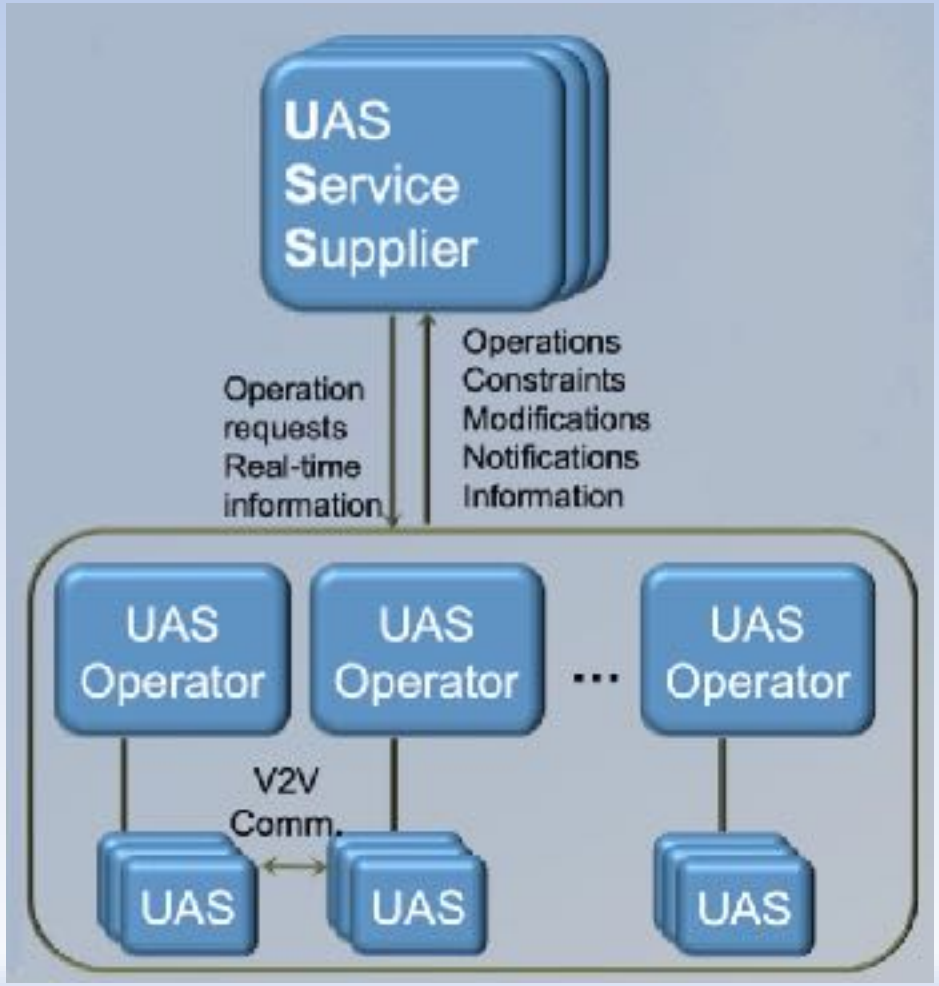
Airspace Operations Lab USS (AOLUSS) - Research-based USS

- UTM TCL4 Certified USS
- AOL Video Wall Data Feed
- Cloud Ready Container (docker)
- AOLUSS variations
  - Standalone
  - Discovery (legacy or grid)
  - Urban Air Mobility (UAM)
  - Upper-E Traffic Management (ETM)
  - Japan Aerospace Exploration Agency (JAXA)
  - Trajectory based research

Reference: https://humansystems.arc.nasa.gov/groups/aol/research/utm.php ; https://ntrs.nasa.gov/archive/nasa/casi.ntrs.nasa.gov/20190033109.pdf ;
https://utm.arc.nasa.gov/docs/2018-Homola-Aviation2018-Jun.pdf

AOLUSS Operator Interface

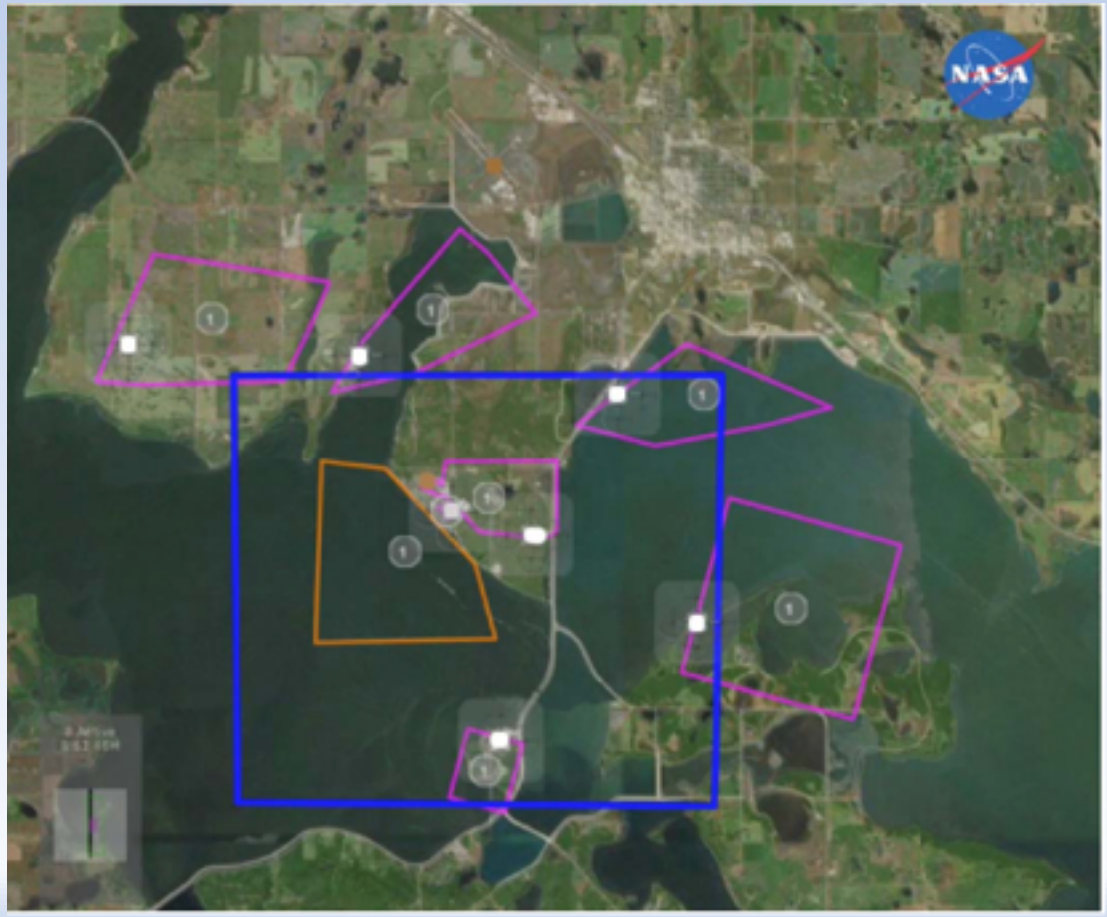
- Operations Specification
  - 4D Trajectory (converted to Volumes)
  - 4D Volumes
- Operation Approval Processes
  - Standalone
    - Local USS Operation intersections
  - Discovery (Legacy or Grid)
    1. Local USS Operation intersections
    2. Full LUN/Grid Operation intersections
- TFR Constraints (FIMS)
- Surveillance Radar Injection (SDSP)
- Common Lab Display API



Reference: https://utm.arc.nasa.gov/docs/2018-June-UTM-Media-Day.pdf

AOLUSS Clients

- Common Operator Interface
- Existing Clients
  - GCS:MACS (Java)
  - GCS:Mission Planner Plugin (C#)
  - GCS/Hololens/Google Earth (C++)
  - Displays (JavaScript)
  - iUTM iOS native App (Swift)
  - Metric Analytics (Grafana)
- Publish/Subscribe Architecture
- Demo MP plugin / AOLUSS / iUTM



Reference: https://utm.arc.nasa.gov/docs/2019_Homola_TCL3_DASC.pdf

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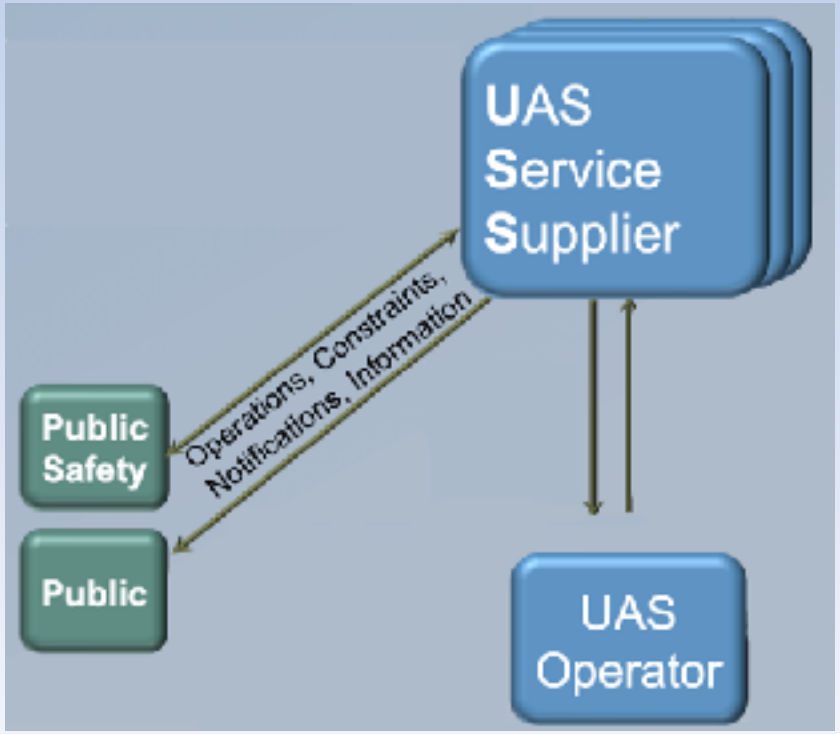
UTM Future

Parimal Kopardekar [PK 2017]: “[…] we see the UAS Traffic Management as **collaborative**. Basically, the **traffic management**, **airspace management** kind of approach could be used for all uncontrolled airspace, regardless of the size of the vehicle, the weight of the vehicle, or the height or altitude they operate. It could be 60,000 feet and up, where the Facebook and Google's Loon, and other vehicles will operate, you could possibly think about using this approach of **exchanging information to each other about areas of operation**, and staying clear, and managing by contingencies rather than in usual vehicles.”

Reference: https://www.nasa.gov/ames/nisv-podcast-Parimal-Kopardekar

UTM for STEReO

- Possible Fusion of USS/NICS/SCOUT/RadioMobile data
- Possible Injection of Real-Time ArcGIS map updates
  - Dynamic Real-Time Picture of Aviation/Pilot Map
  - UTM Data
  - Surveillance Data
  - Autonomous Web Scraping (TFR, MODIS, Wx, &c)
  - Real-Time Public Portal (Evacuation/fire parameter)
- Possible Research Alternatives to UTM Operations Approval
  - ICS Approval Chain
  - FAA SOSC Approval Chain



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Thank you.

Acronyms

Above Ground Level (AGL)
Application Programming Interface (API)
Airspace Operations Laboratory USS (AOLUSS)
Flight Information Management System (FIMS)
Ground Control Station(GCS)
Hypertext Transport Protocol (HTTP)
Incident Command System (ICS)
Japan Aerospace Exploration Agency (JAXA)
Multi-Aircraft Control Simulator (MACS)
Moderate Resolution Imaging SpectroradioMeter (MODIS)
National Airspace System (NAS)
Next-Generation Incident Command System (NICS)
Representational State Transfer (RESTful)
Situation Awareness and Collaboration Tool (SCOUT)
Supplemental Data Service Provider (SDSP)
Situation Unit Leader (SITL)
Scalable Traffic Management for Emergency Response Operations (**STEReO**)
System Operations Support Center (SOSC)
Technology Capability Level (TCL)
Temporary Flight Restriction (TFR)
Urban Air Mobility (UAM)
UAS Service Supplier (USS)
UAS Traffic Management (UTM)