

# NAS Integration of Transiting and Higher Airspace Operations (NITRO)

## Informational Briefing

Presented to: REDAC

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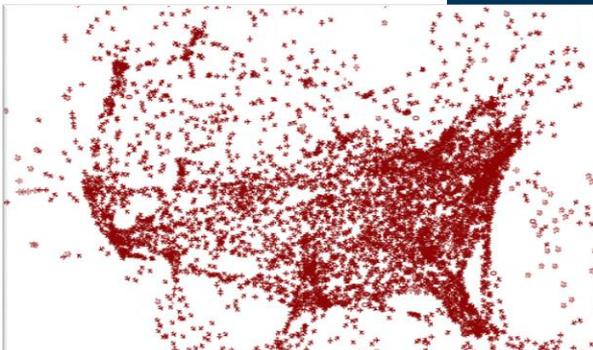
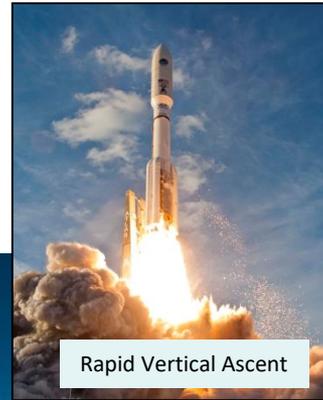
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**Federal Aviation  
Administration**

# Future of the National Airspace is Changing

Increasing diverse users and vehicles operations, with varying demand, and rapid pace of innovation and technology changes



# NAS Current Improvements resulting from previous Research and Analysis

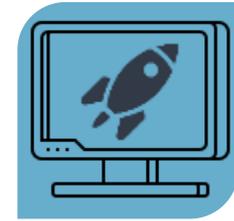
Executing **improvements now** while simultaneously **building for the future**



**Time Based Launch  
Procedures  
(TBLP)**



**Letters of  
Agreement  
(LOAs)**



**Space Data  
Integrator  
Minimum Viable  
Product  
(SDI MVP)**



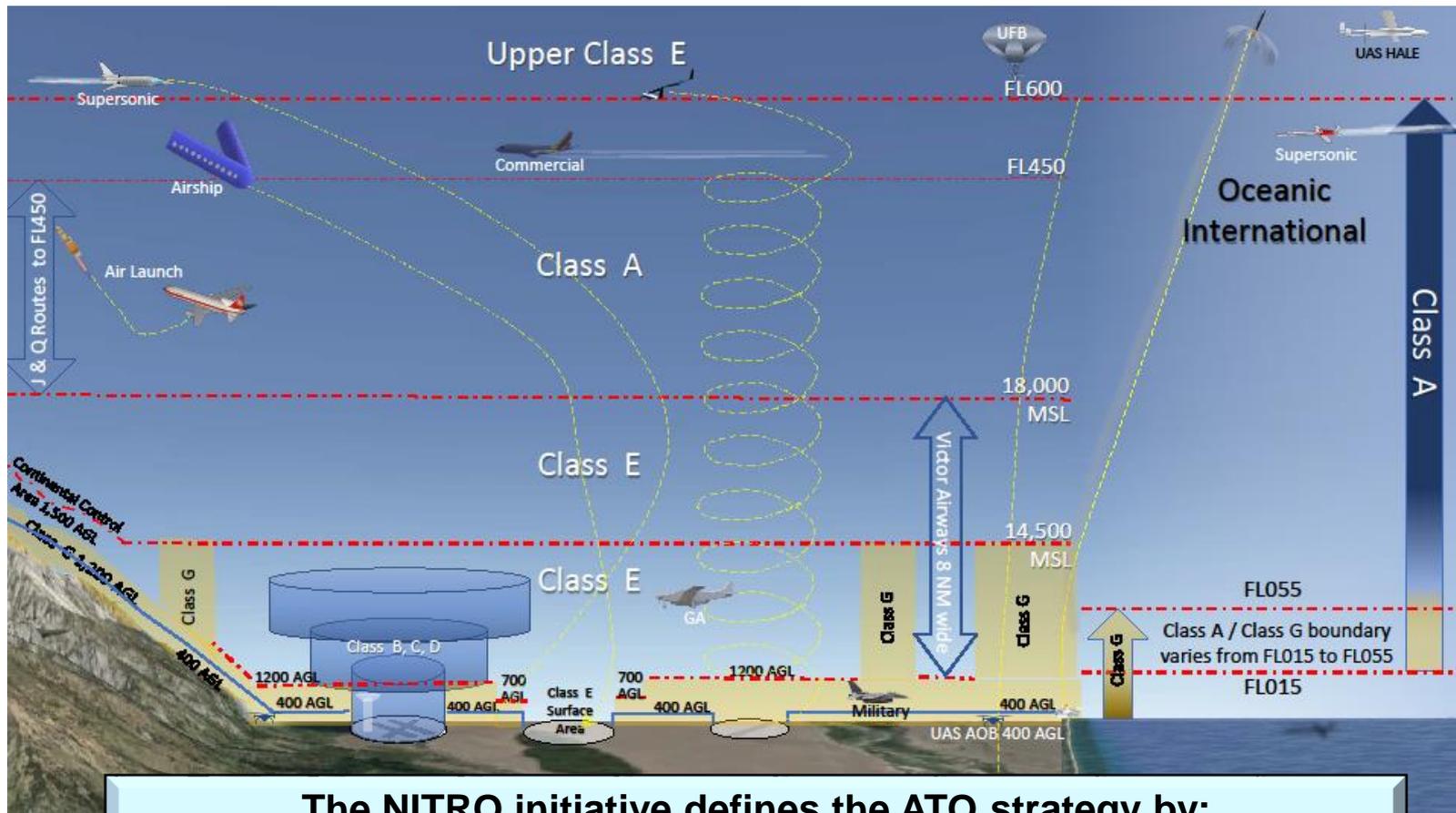
**Dynamic Launch/  
Re-Entry Windows  
(DLRW)**



**Hotline**



# Strategy for the Integration of Upper E and Space L/R Operations



**The NITRO initiative defines the ATO strategy by:**  
 Identifying and prioritizing operational service gaps and needs  
 Forecasting the timeline to adapt to future demands  
 Ensuring successful operational transition and integration



# ATO Operational Focus Areas

| Focus Area  | Separation   | Demand            | ATO Thrust   |
|---|--|-------------------|--|
| <b>Space Launch/Reentry (L/R) Operations</b>              | Segregated airspace from legacy operations                     | Increasing demand | <ul style="list-style-type: none"> <li>• Identify regulatory needs</li> <li>• Airspace access (e.g., spaceport siting criteria, international considerations)</li> <li>• Operational coordination, automation enhancements to improve efficiency</li> <li>• Maintain flexibility &amp; safety</li> </ul> |
| <b>Vertical Transiting Operations to and From Upper E</b> | Integrated / Segregated airspace with other legacy operations  | Emerging demand   | <ul style="list-style-type: none"> <li>• Policy and procedures research to support safe and increased access</li> </ul>  |
| <b>Upper E Operations</b>                                 | Integrated / Segregated airspace with other Upper E operations | Emerging demand   | <ul style="list-style-type: none"> <li>• Establishing safety requirements</li> <li>• Solidify the concept of operations with stakeholders</li> <li>• International coordination, identifying policy and procedures solutions</li> </ul>  |



# Goal: Foster growth and expansion of Space L/R operations with safety and efficiency for all NAS users

| Objective   | Outcomes  |  |  | Initiatives/Completion   |
|---|---|--|--|--|
|   | 0-3-year  | 5-year   | 7-year   |  |
| Ensure safety via improved situational awareness of L/R nominal and off-nominal operations                            | Expedited sharing and response to Space L/R nominal and off-nominal operations              | Expedited Air Traffic Management response to separate aircraft from hazardous airspace                   | More decision support capabilities for resolution of conflicts in off-nominal events                       | <ul style="list-style-type: none"> <li>Hotline (0-3)</li> <li>SDI Phase 1 (0-3)*</li> <li>NSIC (5)* / NSIC-E (7)</li> <li>Hazard Area Needs Analysis (HANA) (5)*</li> <li>Establish telemetry guidelines</li> </ul>  |
| Establish a Collaboration Forum with L/R operators, ANSP, and flight operators, and identify data sharing initiatives | Existing mechanisms and processes such as LOAs and MOUs provide foundation for data sharing | Standard and repeatable data sharing procedures are tailored to operation/operator                       | A mature information infrastructure (e.g., SWIM, EIM platform) meets evolving data exchange needs          | <ul style="list-style-type: none"> <li>DLRW (0-3)*</li> <li>NOTAM improvement (0-3)</li> <li>PERTI Planning (0-3)</li> <li>NOD (0-3)</li> <li>Information Portal</li> <li>Collaboration forum*</li> <li>Common Weather Picture</li> </ul>                    |
| Develop and implement procedures and separation methods to safely tailor to vehicle / operation                       | Modified procedures take advantage of existing capabilities to manage segregated airspace   | Procedures and capabilities allow for more dynamic airspace use  | Procedures and capabilities allow for vehicle - airspace separation; and Vehicle - Vehicle (when possible) | <ul style="list-style-type: none"> <li>TBLP/DLRW (0-3)*</li> <li>Safety/risk (0-3)</li> <li>Captive-carry rules</li> <li>Airspace protections (corridors, adaptive volumes) - some research areas</li> <li>Support AST and ARP spaceport planning</li> </ul> |
| Establish data requirements to make data-driven decisions that optimize support of NAS and user objectives            | Traffic management decisions based on metrics using existing data collection and analysis   | Community-based operational performance and optimization metrics involve stakeholders in decision-making | Robust data and processes routinely measure operational performance  | <ul style="list-style-type: none"> <li>NEAP (0-3)*</li> <li>PERTI Planning (0-3)</li> <li>Post analysis tools</li> <li>Baseline data</li> <li>Metrics development</li> </ul>   |

Green indicates active initiatives and completion timeframe

DRAFT – Work in Progress

\* = ARC Recommendation

ANSP = Air Navigation Service Provider  
 ARC = Aviation Rulemaking Committee  
 FAA Office of Airports  
 AST = FAA Office of Commercial Space Transportation  
 DLRW = Dynamic Launch and Reentry Window  
 EIM = Enterprise Information Management

LOA = Letter of Agreement  
 MOU = Memorandum of Understanding  
 NAS = National Airspace System  
 NEAP = NAS Effects Analysis Prototype  
 NOD = National Operations Dashboard  
 NOTAM = Notice to Airman

NSIC = NAS Space Integration Capability  
 PERTI = Plan/Execute/Review/Train/Improve  
 SDI = Space Data Integrator  
 SWIM = System Wide Information Management  
 TBLP = Time based Launch Procedures



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# Goal: Increase access for vertical operations transiting to and from Upper E with safety and efficiency for all NAS users

| Objective   | Outcomes  |   |   | Initiatives/Completion   |
|---|---|---|---|--|
|   | 0–3-year  | 5-year  | 7-year  |  |
| Identify policy barriers and mitigations to safely improve access (e.g., lost C2 link, detect-and-avoid, certification) | Identify research and policy decisions and priorities (e.g., surveillance and see-and-avoid alternatives from ARCs) | Use of safety mitigations and updated procedures expand access to unmanned vehicles<br><br>Use LOAs and MOUs to establish roles and responsibilities related to unmanned vehicles, enabling access to the NAS | Access is normalized via procedures, policies and methods including support for vehicle-to-vehicle separation | <ul style="list-style-type: none"> <li>• NOTAM standardized practices (0-3)*</li> <li>• Implement updated Safety Risk Management solutions*</li> <li>• Expedited COAs and waivers*</li> <li>• Implement airspace, vehicle &amp; equipment certification, separation regulations and guidance (as appropriate), policies, and standardized procedures*</li> <li>• Advisory Circular of safety and equipage best practices*</li> <li>• Implement training</li> </ul> |
| Standardize ATC procedures to ensure operations are managed safely and consistently across the NAS                      | Understand and analyze current operational practices then implement best practices                                  | Standardized procedures across ATC facilities tailored to each vehicle type   | Update and add standardized procedures as new vehicle types are introduced                                    | <ul style="list-style-type: none"> <li>• Implement airspace, policies, and standardized procedures</li> <li>• Implement training</li> </ul>  |
| Implement a collaboration forum to reduce impact on all NAS users   | Communicate, partner with, and establish collaboration mechanisms   | Collaboration leads to improved mission planning reducing impact on NAS   | Community-based performance metrics are routinely applied   | <ul style="list-style-type: none"> <li>• FEAs for monitoring airspace demand (0-3)</li> <li>• NEAP for evaluating historical airspace demand (0-3)</li> <li>• Establish collaboration forum</li> <li>• Industry use of impact assessment tools for mission planning (e.g., RIA)</li> <li>• Establish guidelines to support departure and landing sites</li> </ul>  |
| Use automation to improve safety and efficiently manage operations  | Identify the automation framework   | Improved situational awareness allows ATC to handle increased demand  | Additional decision support tailored to vehicle performance supports increased traffic density                | <ul style="list-style-type: none"> <li>• Concept exploration in accordance with ARC recommendations*</li> <li>• Add automation functionality (i.e., ERAM)*</li> </ul>  |

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ARC Aviation Rulemaking Committee  
 ATC = Air Traffic Control  
 COA = Certificate of Authorization  
 ERAM En Route Modernization  
 FEA Flow Evaluation Area  
 LOA Letter of Agreement

MOU = Memorandum of Understanding  
 NAS National Airspace System  
 NEAP NAS Effects Analysis Prototype  
 NOTAM Notice to Airman  
 RIA = Rapid Impact Assessment



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# Goal: Enable Upper E operations with safety and efficiency for all NAS users

| Objective  | Outcomes   |   |  | Initiatives/Completion   |
|--|--|---|--|--|
|  | 0-3-year   | 5-year  | 7-year   |  |
| Establish safety requirements (based on Target Level of Safety), and risk-based conflict management procedures       | Existing capabilities and procedures are adapted to provide strategic deconfliction        | ALTRVs evolve to better address Higher Airspace strategic deconfliction         | Initial vehicle - vehicle deconfliction framework for achieving TLS                    | <ul style="list-style-type: none"> <li>CARF automation and procedures (0-3)</li> <li>ANG, NASA, and industry RTT (0-3)</li> <li>Safety Risk Management solutions to meet TLS</li> <li>Airspace access priority guidance, safety-risk metrics</li> <li>Implement policies, and standardized deconfliction procedures</li> </ul> |
| Make needed policy changes and procedures to support diverse operations in Upper E                                   | Identify CNS and interoperability needs (e.g., geometric vs barometric altitude reporting) | Prioritized regulatory roadmap aligned with industry and ANG concepts           | Guidance for implementing community-based flight rules                                 | <ul style="list-style-type: none"> <li>Assess matured ETM CONOPS (0-3)</li> <li>Pursue regulations</li> <li>Implement policies, and standardized procedures</li> <li>Research associated CNS needs and requirements, implement guidance</li> </ul>   |
| Collaborate and partnering with industry   | Establish interoperability standards for vehicle trajectory and performance                | LOAs and MOUs establish data sharing mechanisms                                 | Initial infrastructure supporting interoperable information sharing and negotiation    | <ul style="list-style-type: none"> <li>NOTAM standardized use (0-3)*</li> <li>Policies, and standardized procedures to support data sharing</li> <li>Implement collaboration forum</li> <li>International collaboration &amp; harmonization</li> </ul>   |
| Implement decision support to enable interoperability among traffic management environments (strategic and tactical) | LOAs and MOUs clarify roles and responsibilities of operators and FAA                      | Expedited sharing of status and off-nominal situation assistance via automation | Maturing decision support for off-nominal events and automated resolution of conflicts | <ul style="list-style-type: none"> <li>CARF automation and procedures (0-3)</li> <li>Policies and standardized procedures to support off nominal (including loss of C2 link*)</li> <li>Enhanced automation*</li> </ul>   |

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\* = ARC Recommendation

ALTRV = Altitude reservation  
 ANG = FAA Office of NextGen  
 ANSP = Air navigation Service Provider  
 C2 = Command and Control  
 CARF = Central Altitude Reservation Function  
 CNS = Communication, Navigation and Surveillance  
 ETM = Upper Class E Traffic Management

FAA = Federal Aviation Administration  
 LOA = Letter of Agreement  
 MOU = Memorandum of Understanding  
 NASA = National Aeronautics and Space Administration  
 NOTAM = Notice to Airman  
 RTT = Research Transition Team  
 TLS = Target Level of Safety



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# Potential Research Areas

- **NAS integration and strategic/tactical deconfliction**
  - Target level of safety, policy, and procedures
  - CNS and interoperability needs
  - Surveillance alternatives, e.g., Space-based ADS-B for Upper E, transiting, and some space operations
- **Collaboration with industries beyond aviation**
  - Policy, regulations, potential rule-making
  - Data sharing, automation, including 3<sup>rd</sup> party service providers



# Backup



# Transiting Operations Mapped to Current ATM Services

| Vehicle Category   | Current ATM Services |  |                              |                                    |                                   |                        |            |                                |                            |
|--|----------------------|--|------------------------------|------------------------------------|-----------------------------------|------------------------|------------|--------------------------------|----------------------------|
|  | Flight Planning      | Air Traffic Control Separation Assurance | Air Traffic Control Advisory | Traffic Management Synchronization | Traffic Management Strategic Flow | Emergency and Alerting | Navigation | Airspace Design and Management | Government/ Agency Support |
| <b>Aircraft</b>  |                      |  |                              |                                    |                                   |                        |            |                                |                            |
| • Subsonic   | Y                    | Y  | Y                            | Y                                  | Y                                 | Y                      | Y          | Y                              | Y                          |
| • Supersonic   | Y                    | Y  | Y                            | Y                                  | Y                                 | Y                      | P          | Y                              | Y                          |
| <b>Hypersonic vehicles</b>   | N                    | N  | N                            | N                                  | N                                 | N                      | N          | P                              | TBD                        |
| <b>Lighter-than-Air</b>  |                      |  |                              |                                    |                                   |                        |            |                                |                            |
| • High-Altitude Balloons   | N                    | N  | N                            | N                                  | N                                 | TBD                    | N          | N                              | Y                          |
| • Airships (Blimps)  | Y                    | Y  | P                            | N                                  | N                                 | Y                      | Y          | Y                              | Y                          |
| <b>Space L/R Vehicles</b>  |                      |  |                              |                                    |                                   |                        |            |                                |                            |
| • Vertical Launch  | N                    | Y  | N                            | N                                  | N                                 | Y                      | N          | Y                              | Y                          |
| • Horizontal Take Off and Launch   | P                    | Y  | P                            | N                                  | N                                 | Y                      | Y          | Y                              | Y                          |
| • Captive-Carry Launch   | Y/N                  | Y  | Y/N                          | Y/N                                | Y/N                               | Y                      | Y/N        | Y                              | Y                          |
| • Capsule Reentry  | N                    | Y  | N                            | N                                  | N                                 | N                      | N          | Y                              | Y                          |
| • Winged Reentry/Winged Suborbital Landing   | N                    | Y  | P                            | N                                  | N                                 | N                      | P          | Y                              | Y                          |
| • Fly-backs (Rocket Stages)  | N                    | Y  | N                            | N                                  | N                                 | N                      | N          | Y                              | Y                          |
| <b>Unmanned Aerial Vehicles</b>  |                      |  |                              |                                    |                                   |                        |            |                                |                            |
| • HALE   | Y                    | Y  | P                            | N                                  | N                                 | Y                      | Y          | Y                              | Y                          |
| • Unmanned Fixed Wing (e.g., Global Hawk)  | Y                    | Y  | Y                            | N                                  | N                                 | Y                      | Y          | Y                              | Y                          |
| <b>Other Vehicles:</b>   |                      |  |                              |                                    |                                   |                        |            |                                |                            |
| • Hybrids (rocket launched from High-Altitude Balloon), Unmanned Gliders, Parafoils, Ultralights, Parachutes, Lasers, etc. | TBD                  | TBD                                      | TBD                          | TBD                                | N                                 | TBD                    | TBD        | Y                              | Y                          |



**Table 1. Transiting and Upper Airspace Vehicle Categories, Industry Leader Status, Operational Maturity Level Assumptions**

| Vehicle Categories  | Conceptual  | Prototype                      | Test and/or Gov't Certified Operations                     | Govt-Licensed/Govt-Certified Operations | Initial Operations | Expanding Operations   | Routine Operations                     |
|---|---|--------------------------------|--|---|--------------------|--|--|
| <b>Aircraft</b>   |   |                                |  |   |                    |  |  |
| • Subsonic  |   |                                |  |   |                    |  | DoD: U2, NASA: ER2                     |
| • Supersonic  |   | Boom, Aerion, Spike            |  | DoD                                     | None currently     | ~5 Years   | Retired: Concorde, SR71                |
| <b>Hypersonic Vehicles</b>  | Boeing, Hermeus, Lockheed Martin, Raytheon              | Aevum                          | Aerojet Rocketdyne, Generation Orbit, HyperSpace           |   |                    |  |  |
| <b>Lighter-than-Air</b>   |   |                                |  |   |                    |  |  |
| • High-Altitude Balloons  |   |                                | Worldview  | No vehicle certification required       |                    | Loon   | Near Space Corporation, NOAA/NWS, AFRL |
| • Airships (Blimps)   | Lockheed Martin Corporation, Sceye, Thales Alenia Space |                                |  |   |                    |  |  |
| <b>Space L/R Vehicles</b>   |   |                                |  |   |                    |  |  |
| • Vertical Launch   | Relativity Space  | Astra                          | Blue Origin, Firefly Aerospace, NASA (Space Launch System) |   |                    | Northrup Grumman, Rocket Lab, SpaceX, United Launch Alliance |  |
| • Captive-Carry Launch  |   |                                | Virgin Orbit and Virgin Galactic                           | Northrup Grumman                        | ~5 Years           |  |  |
| • Horizontal Take Off and Launch  | XCOR Lynx Mk I, Mk II, Mk III                           | XCOR Lynx Mk I, None currently |  |   |                    |  |  |
| • Capsule Reentry   |   | Blue Origin                    | Boeing   |   |                    | SpaceX   |  |
| • Winged Reentry/Winged Suborbital Landing  |   |                                | Sierra Nevada Corp, USAF X-37B                             | Space Shuttle ~5 Years                  | ~5 Years           |  |  |
| • Fly-back Rocket Stages  |   |                                |  |   |                    | SpaceX   |  |
| <b>Unmanned Aerial Vehicles</b>   |   |                                |  |   |                    |  |  |
| • High altitude long endurance (HALE)   |   |                                | AeroVironment, Airbus, Aurora                              |   |                    |  |  |
| • Unmanned Fixed Wing (e.g., Global Hawk)   |   |                                |  |   |                    |  | General Atomics, Northrup Grumman      |
| • <b>Other Vehicles:</b> Hybrids (rocket launched from High-Altitude Balloon), Unmanned Gliders, <sup>3</sup> Parafoils, <sup>4</sup> Ultralights, Parachutes, <sup>5</sup> Lasers, <sup>6</sup> etc. | DoD, NASA, Worldview                                    |                                |  |   |                    |  |  |

Green = Maturity Level in Year 3 (2024), Light Green = Vehicle/Concept No Longer Exists, Blue = Maturity Level in Year 5 (2026)

Table from Business Outlook for reference in developing Needed ATM Services Timeline



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