



# EXPLORE FLIGHT

WE'RE WITH YOU WHEN YOU FLY

## Airspace Operations and Safety Program

**Akbar Sultan**

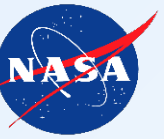
Director, Airspace Operations and Safety Program

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Deputy Director, Airspace Operations and Safety Program

Pre-Decisional: For NASA Internal Use Only





# ATD-2: Objectives<sup>†</sup>

**TC:** Develop and deliver an integrated metroplex traffic manager to the FAA NextGen and Air Traffic Organizations, flight operators, and airport operators, that leverages NASA, FAA and industry technologies to enable simultaneous improvement of the predictability and efficiency of arrival, departure and surface operations

- **DEVELOP** an integrated arrival/departure/surface (IADS) prediction, scheduling and management system for a metroplex environment
- **ENABLE** use of collaborative decision-making that is consistent with FAA's Surface Collaborative Decision Making (CDM) ConOps
  - through increased information sharing of prediction and scheduling information between airport, flight operator, and ATC
- **QUANTIFY** current day shortfalls and evaluate the system-level performance for benefits in terms of *predictability*, *efficiency*, and *throughput*
  - using metrics established by NASA and stakeholders
- **DEMONSTRATE** the ATD-2 technologies in an operationally relevant environment with system capable of performing under continuous daily use
- **TRANSFER** an integrated set of technologies to the FAA, airlines, airports, and suppliers

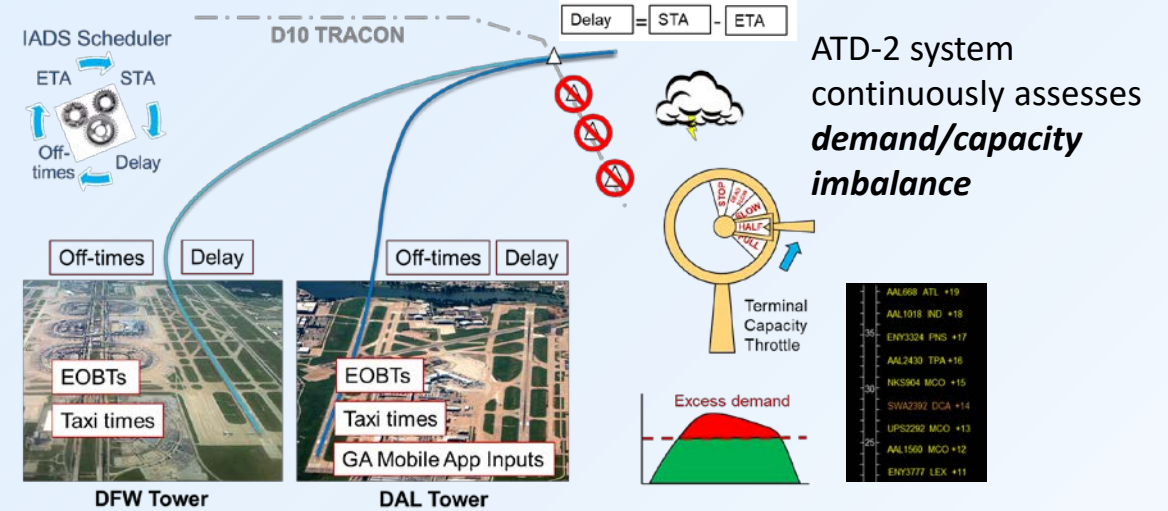
# ATD-2 Phase 3: TOS-based Digital Departure Reroutes

## 1 Preconfigure TOS Parameters

- ATC and operators identify acceptable alternative routes
- Alternative routes codified in ATD-2 system
- Operator-specific Relative Trajectory Cost (RTC) algorithms codified in ATD-2 system

```
<TRAJ_OPTION_LIST>
<TRAJ_OPTION>
  <TRAJ_INDEX>1</TRAJ_INDEX>
  <REL_TRAJ_COST>0</REL_TRAJ_COST>
  <ROUTE>DCT IPL J18 GBN DCT PXR J18 SJN DCT TCC J6 PNH
  <ALT>F320</ALT>
  <SPEED>N0380</SPEED>
</TRAJ_OPTION>
</TRAJ_OPTION_LIST>
```

## 2 Terminal Predictive Engine Monitors Demand & Capacity



## 3 Candidate TOSs are Presented to Operators

- ATD-2 system assesses delay savings on alternative routes
- Candidate TOSs identified when RTC thresholds are met
- Operator selects and submits TOS request to ATC

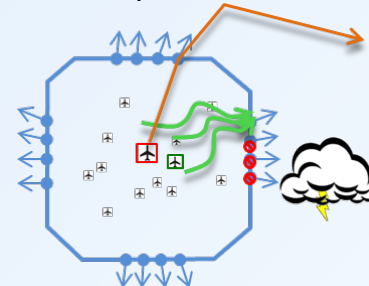


Delay savings > Relative Trajectory Cost ?

Flight TOS													X
Callsign	Dest	Route	CDR	Dist	+nm	Terminal Gate	RTC	Delay	Delay Savings	Eligibility State	Coordination State	Scratch pad	
AAL1560	MCO	KDFW MRSSH2 ZALEA CREAM CEW J2 QJHAP OTK PIGLT4 KMCO	--	880	--	EAST	--	+18	0	N/A	Filed Route	Crew time out 18:10	
AAL1560	MCO	KDFW FORCK2 FORCK ELD MEI OTK PIGLT4 KMCO	DFWM CO0P	885	+5	EAST	+1	+18	0	Potential	Not Submitted		
AAL1560	MCO	KDFW AKUNA7 MLC RZC ARG MEM J41 SZW OTK PIGLT4 KMCO	DFWM CO1N	1112	+232	NORTH	+15	+0	-18	Candidate	Not Submitted	Coordination	
AAL1560	MCO	KDFW DARTZ7 TNV IAH LCH J2 SZW OTK PIGLT4 KMCO	DFWM CO1S	998	+118	SOUTH	+30	+2	-16	Potential	Not Submitted	Op. Submit	
													Undo

## 4 Operator Submitted TOSs Presented to ATC

- ATC is notified of the Operator submitted TOS route
- ATC evaluates the TOS routes for operational feasibility
- If approved, all users are notified, the filed route is amended, and pilots are cleared on the TOS route



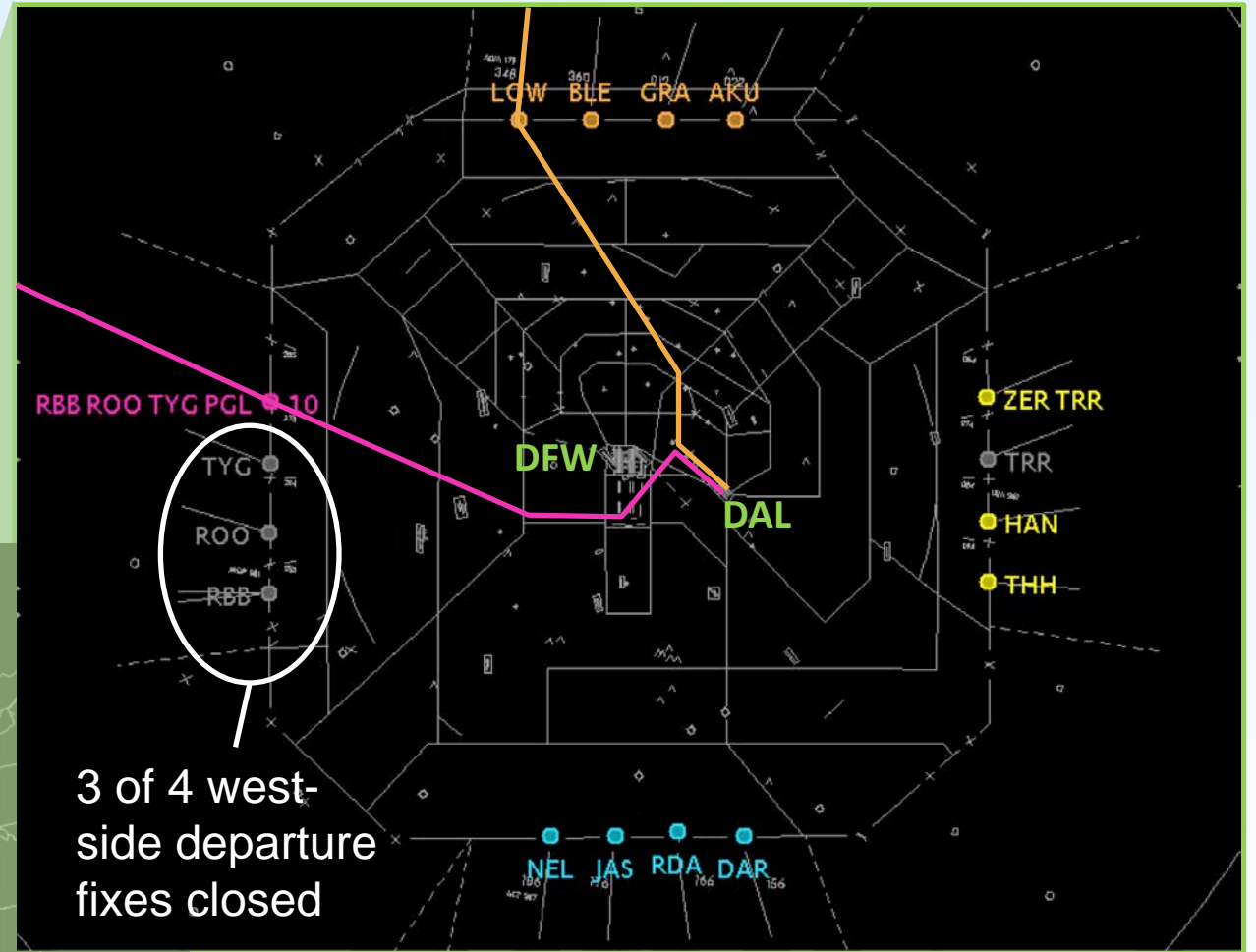
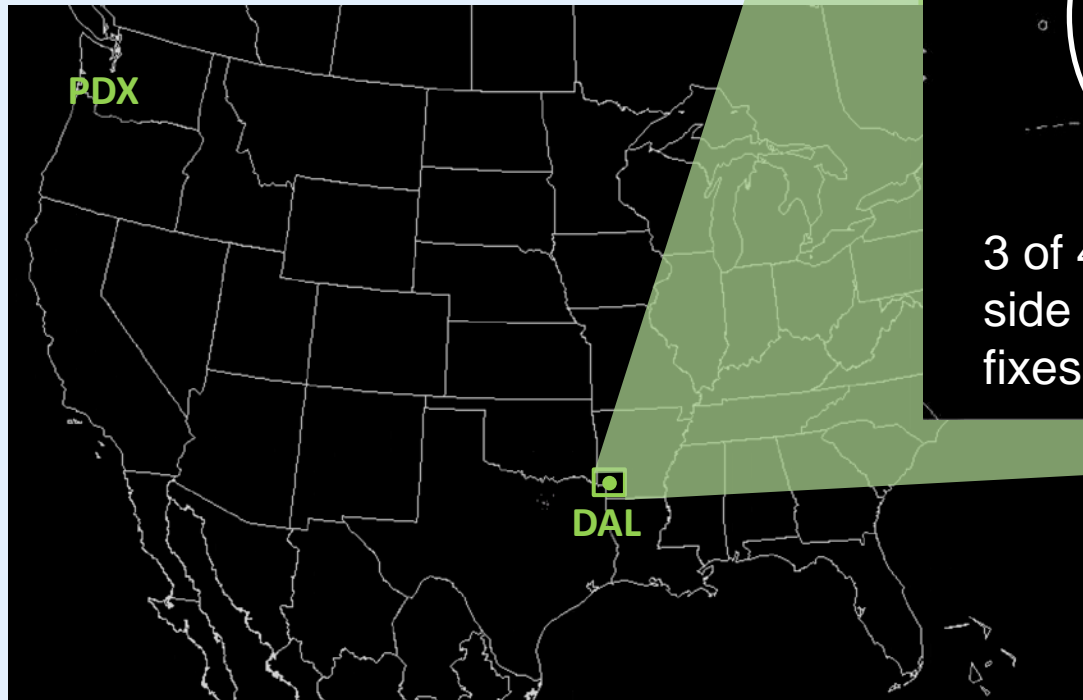
## 5 Post Ops Eval

- Benefits
- Lessons
- Refinements
- Analyses
- Reports



# Example of ATD-2 Phase 3 TOS Digital Reroute

- Southwest 2230 was initially filed on the **magenta route**
- ATD-2 projected surface delay due to constraints on the west departure gate
- Based on Southwest's TOS preferences, ATD-2 recommended the **orange re-route** out the north gate
- Even though the orange route is 37nm longer, Southwest 2230 flight saved 7 minutes of surface delay by taking the alternate reroute

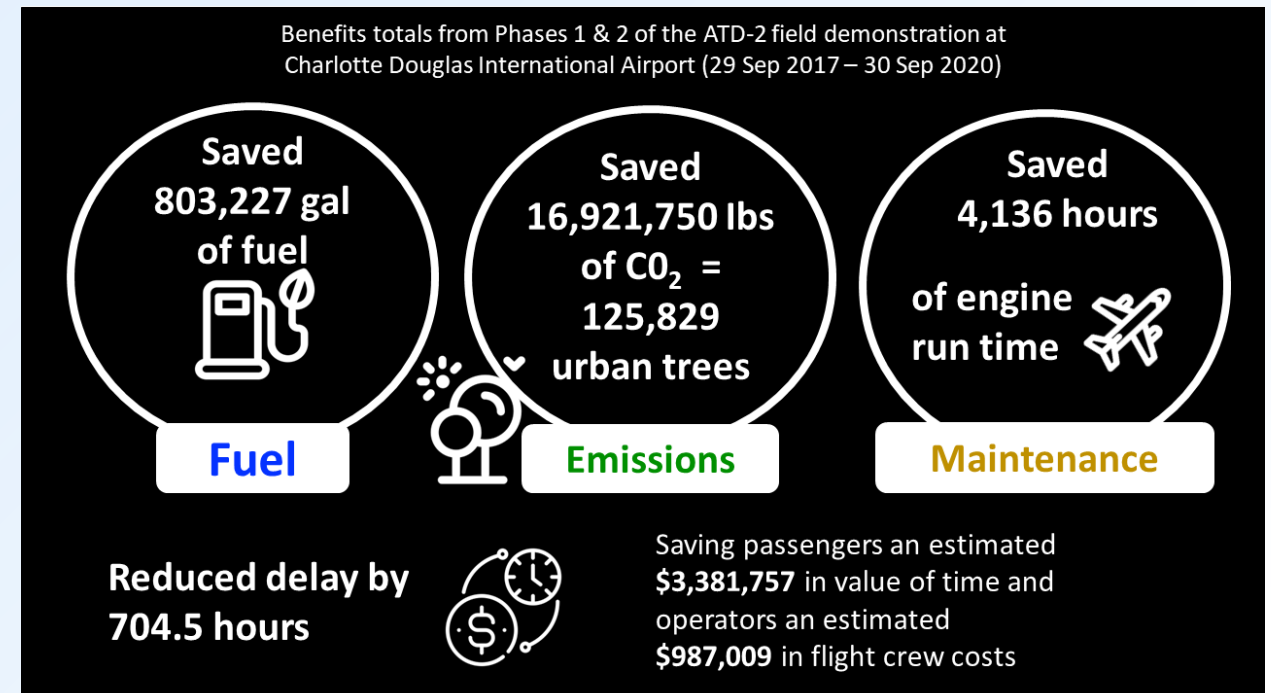


On July 22, 2019, Southwest 2230 flew Dallas (DAL) to Portland (PDX) on the first reroute approved using the ATD-2 Phase 3 system.

# ATD-2 Phase 3 – Status

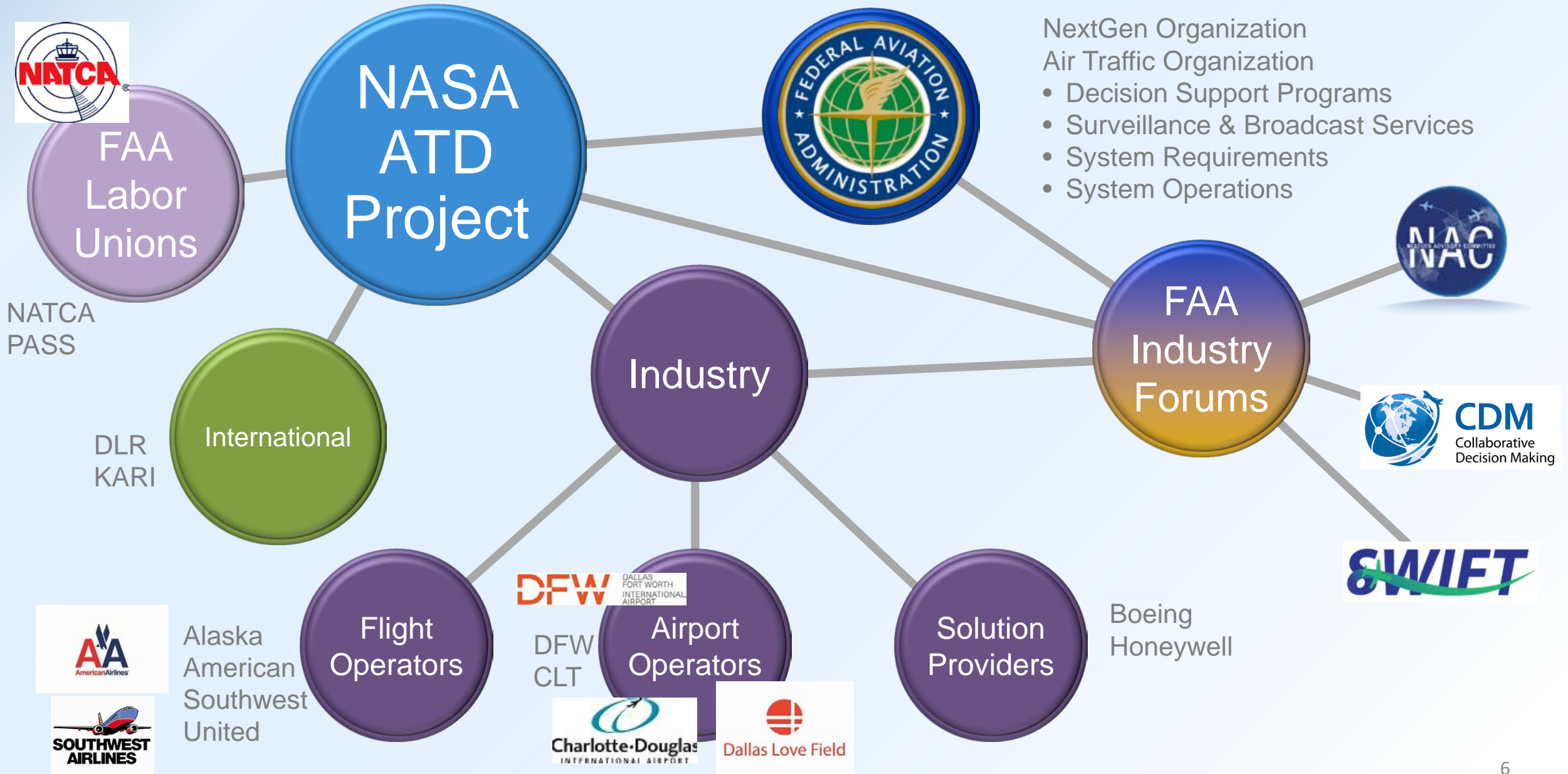
Develop an integrated arrival/departure/surface (IADS) prediction, scheduling and management system for a metroplex environment

- ATD-2 Phase 3 system was ready for 2020 stormy season operational evaluation despite COVID-19 constraints
  - Software development, checkout, deployment and user training completed on schedule
  - Novel approach to deliver training and end-user tech support remotely
- Due to the COVID-19 pandemic, FY2020 air traffic volume was dramatically reduced such that there was insufficient data to demonstrate the ATD-2 Phase 3 Technologies
  - Project was extended for one year to collect data in summer 2021
  - FAA ZFW ARTCC/D10 TRACON/DFW Tower/DAL Tower, DFW Airport, DAL Airport, American Airlines, Envoy Air, Southwest Airlines, and NATCA ready and prepared for 2021 operational evaluation



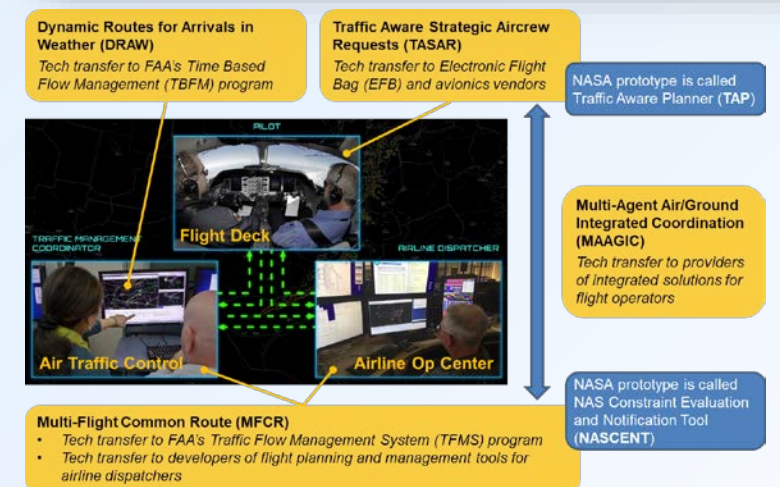


# ATD2 Partnerships / Stakeholders



# Additional NextGen Accomplishments

- **Terminal Sequencing and Spacing (TSAS) and Flight Deck Interval Management (FIM) – ATD1**
  - Forecast \$500 million national fuel savings
  - FAA national deployment in Time Based Flow Management (TBFM) starting with Denver in 2020
- **Efficient re-routes around weather which are more direct, fuel-efficient, wind optimal, conflict free, and avoid congested airspace – ATD3**
  - Multi-flight Common Routes (MFCR) and Dynamic Routing Around Weather (DRAW) informing FAA Traffic Flow Management System (TFMS)
- **Low-altitude small UAS operations in dense urban environments**
  - Reno, NV, June 17-28, 2019 and Corpus Christi, TX, August 12-23, 2019
  - Enable FAA's UTM Pilot Program and UAS Integration Pilot Program





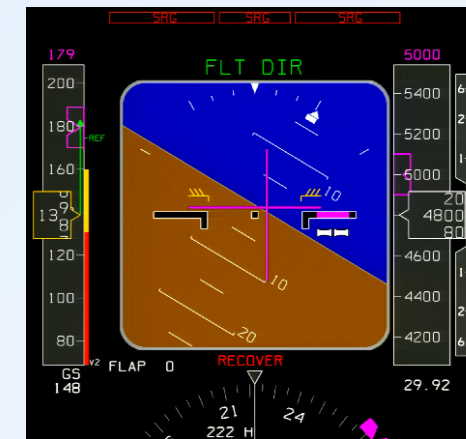
# Flight Deck and Pilot Safety Technologies

## Technologies for Airplane State Awareness



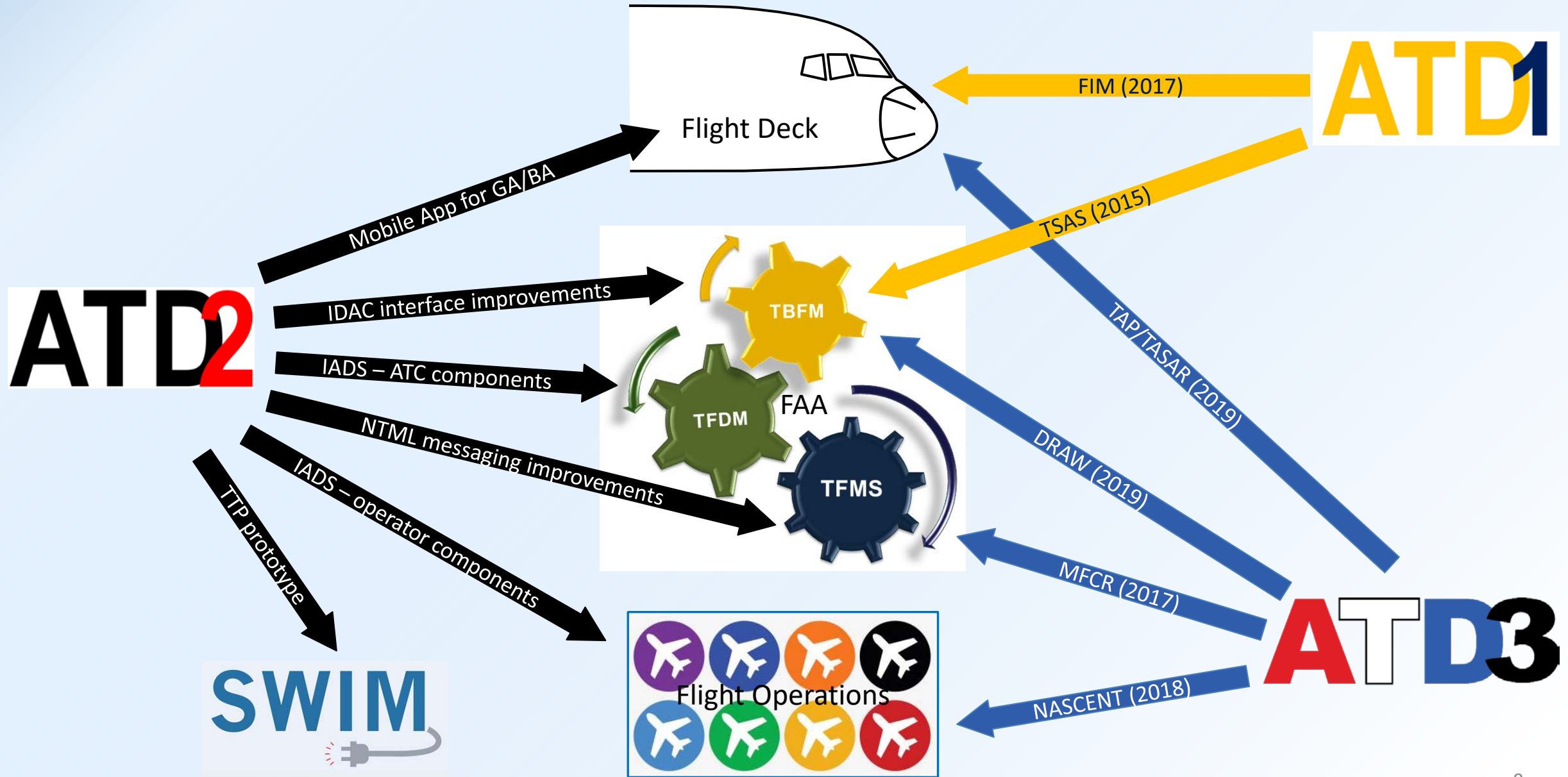
Complete research specified for six Commercial Aviation Safety Team (CAST)  
Safety Enhancements to reduce loss-of-control events

CAST SE	TASA Technical Area
207 Attitude & Energy State Awareness	<b>State and Prediction Technologies</b> <ul style="list-style-type: none"> <li>Prediction and alerting for loss of control and spatial disorientation</li> <li>Crew and system interactions</li> </ul>
208 Airplane Systems Awareness	
209 Simulator Fidelity	<b>Simulator Fidelity</b> <ul style="list-style-type: none"> <li>Refine simulator modeling requirements for stall training</li> </ul>
210 Flight Crew Performance Data	<b>Flight Crew Performance</b> <ul style="list-style-type: none"> <li>Tools and methods to collect and analyze flight crew performance</li> </ul>
211 Training for Attention Management	<b>Training for Attention Management</b> <ul style="list-style-type: none"> <li>Detect and measure attention limitations</li> <li>Develop methods and guidelines for training scenarios</li> </ul>
200 Virtual Day-VMC Displays	<b>Virtual Day-VMC Displays</b> <ul style="list-style-type: none"> <li>Technologies and standards for displays under upset or loss of control conditions</li> </ul>



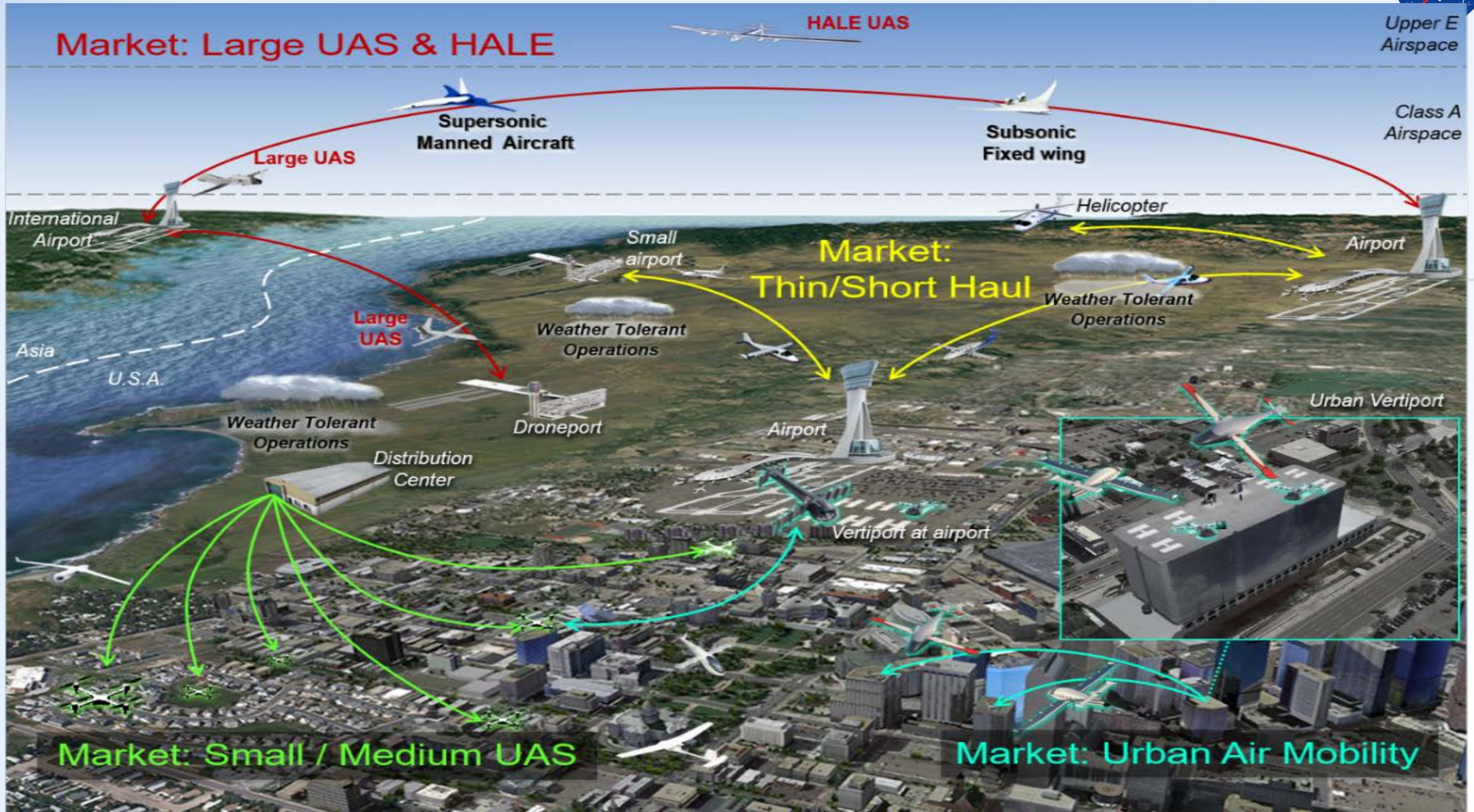


# ATD Technology & Knowledge Transfers



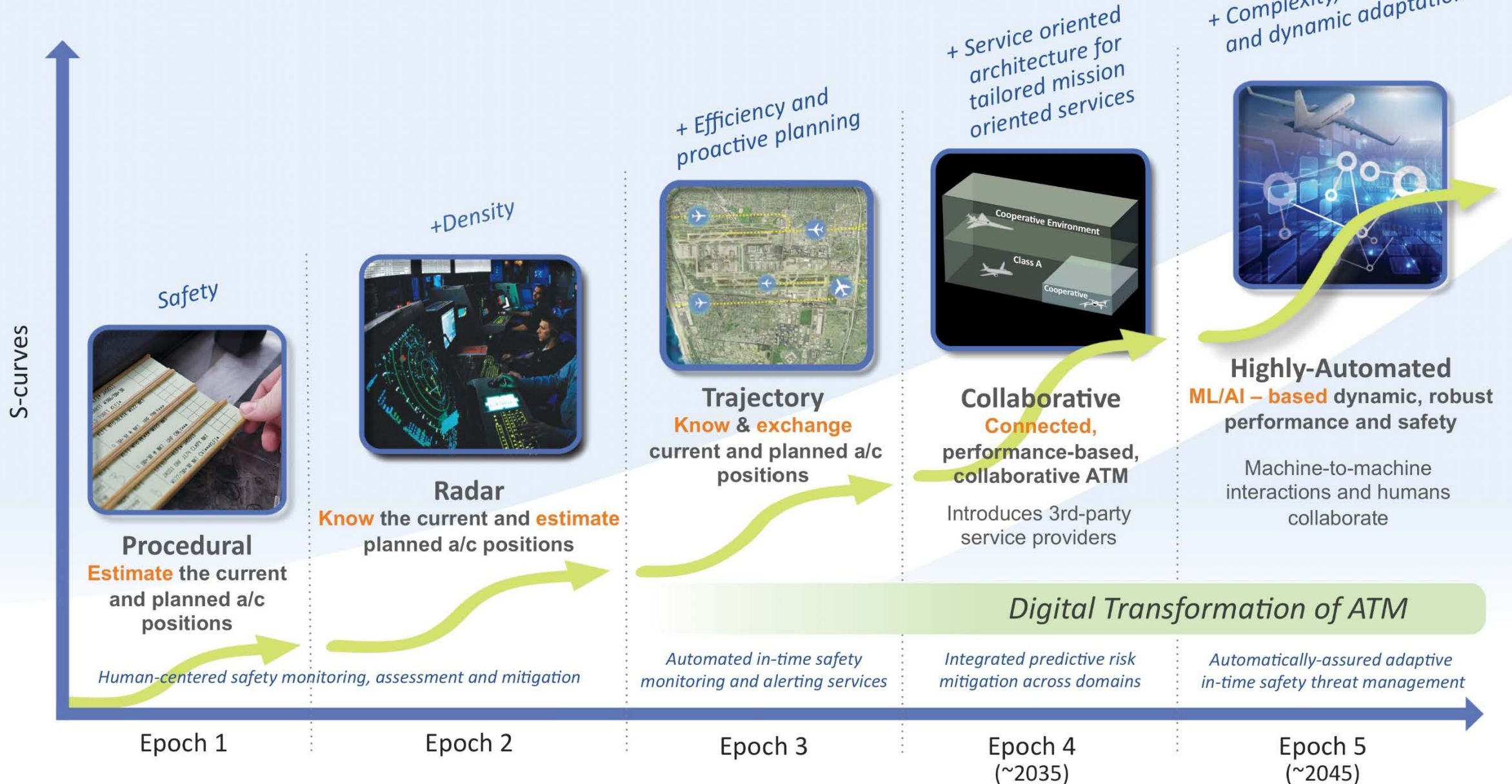


# Future Airspace with Dramatically Varied Users

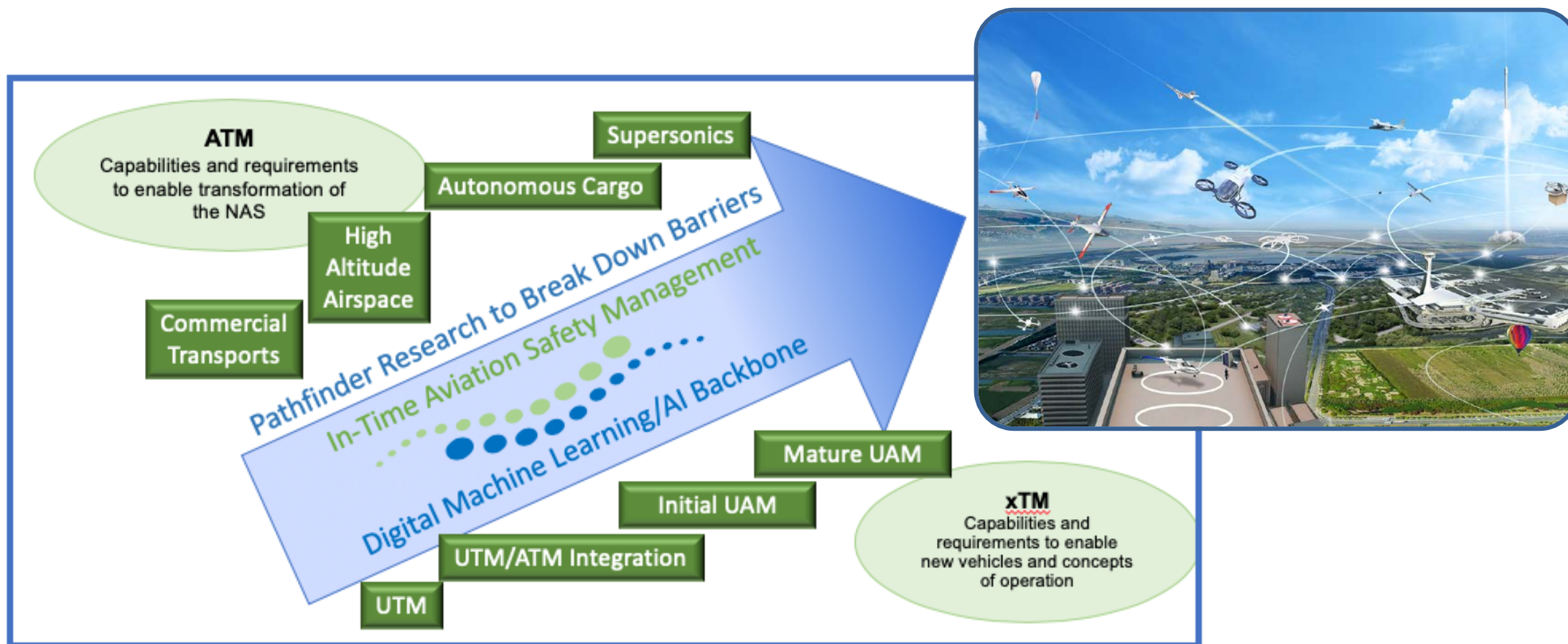




# Evolution of Airspace Operations and Safety



# Enabling Safe, Scalable Airspace Access for Diverse Mobility Solutions



## In-time Aviation Safety Management System Safety Demonstrators:

- Airline Operations Center Integrated Multi-Parameter Safety Dashboard
- Disaster Monitoring and First Responder
- Urban to Rural Medical Emergencies and Forest Fires
- Urban emergency response in a major disaster