

Future Airspace Operations

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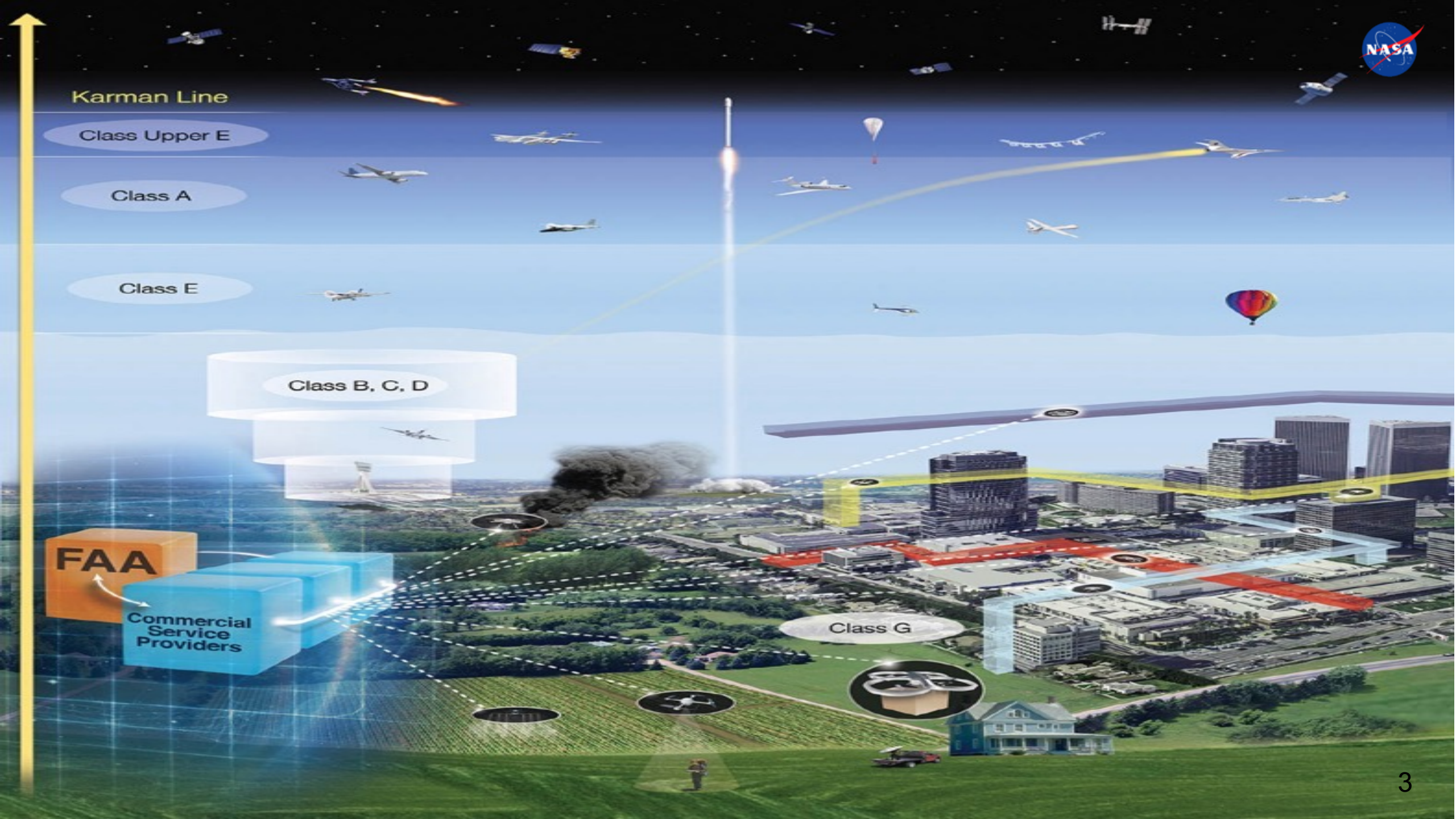
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Airspace “System”
Should be Ready
when Vehicles
are Ready

Need



Big Picture

One mile of surface transportation takes you one mile, whereas one mile of aviation land can take you *anywhere*



Society and transportation could change

- Quieter, faster, and farther
- No need to congregate into higher density geographical areas
- Connects businesses without congestion
- More integrated living: business, residential, and recreational



Big Picture

One mile of surface transportation takes you one mile, whereas one mile of aviation land can take you *anywhere*

Vector 2: Enablers

New technology needs to be embraced

- IOT, Digitization, Electrification, autonomy, and AI/ML

Vector 3: Drivers/Need

Diversity, density, volume, complexity will continue to increase

- Commercial space
- UAS of all sizes
- Self-flying aircraft
- UAM/AAM
- Current aviation operators

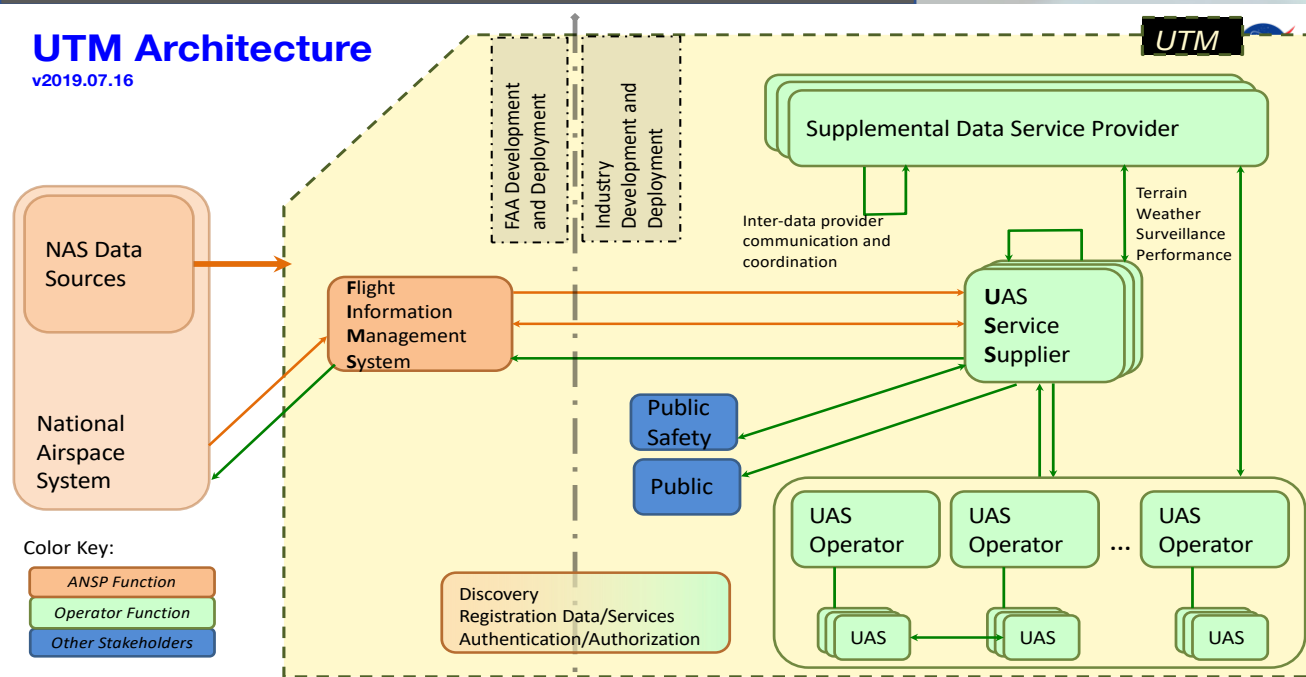


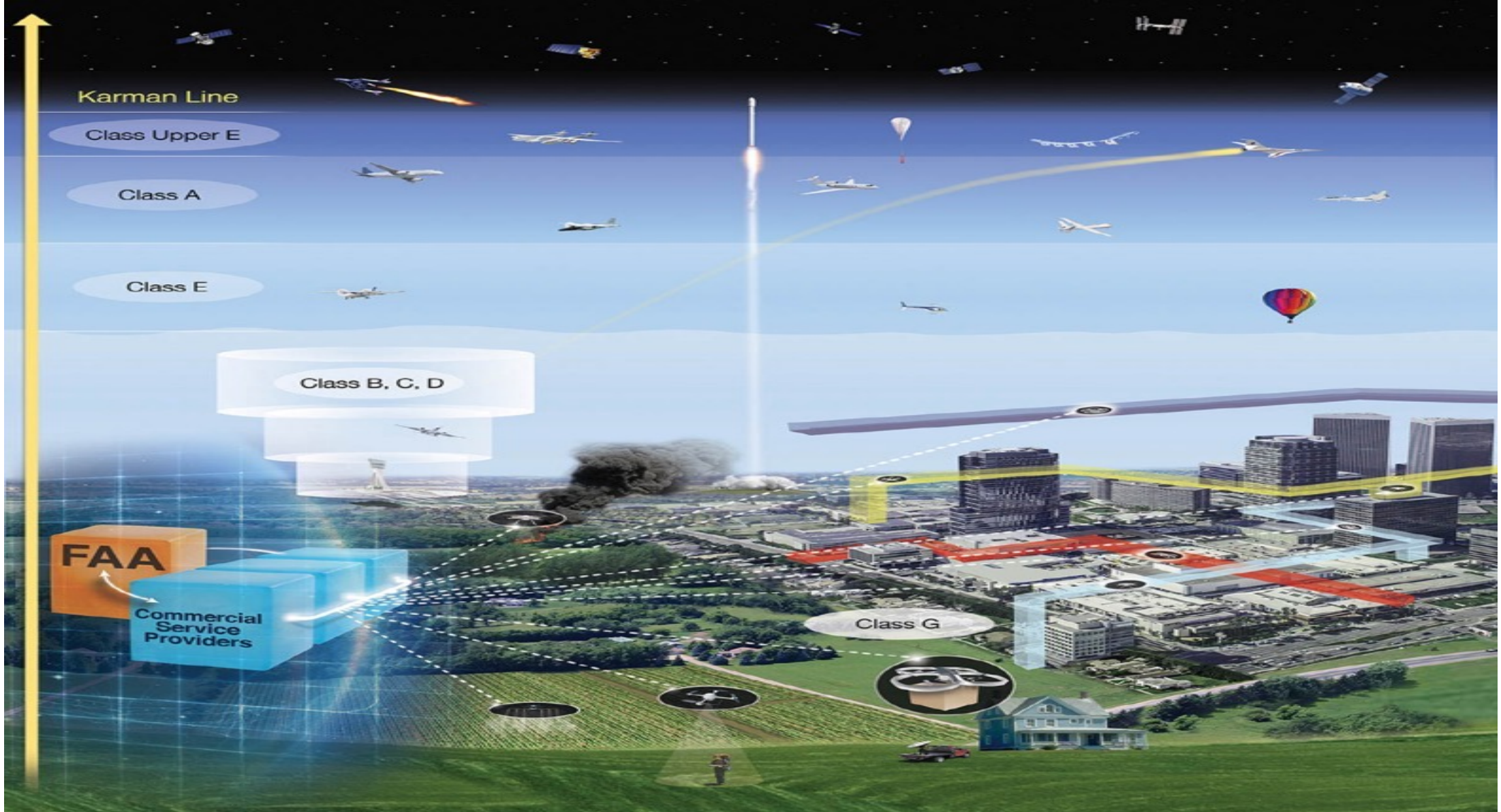


Lessons Learned from Successful Unmanned Aircraft System Traffic Management

Unmanned Aircraft System Traffic Management (UTM) - Attributes

- Cooperative (share and care)
- Intent-sharing
- Digital: data exchanges among operators
- Standardized application protocol interfaces
- Air/ground integrated
- Service-oriented architecture
- Role for third-parties
- Management by exception





Next Steps

Enabling Future Airspace Operations



Planning for future

UTM-inspired-ATM (digital, cooperative, intent sharing, service-oriented architecture, etc.)



Revisiting flight rules

Digital, intent sharing, CNS, etc.



Revisiting roles and responsibilities

federated, management by exception



Revisiting separation minima

new technology with higher precision

Enabling Future Airspace Operations



Using technologies to reduce weather induced delays
Machine learning and artificial intelligence



Enabling increased local and regional operations
Benefits societal change

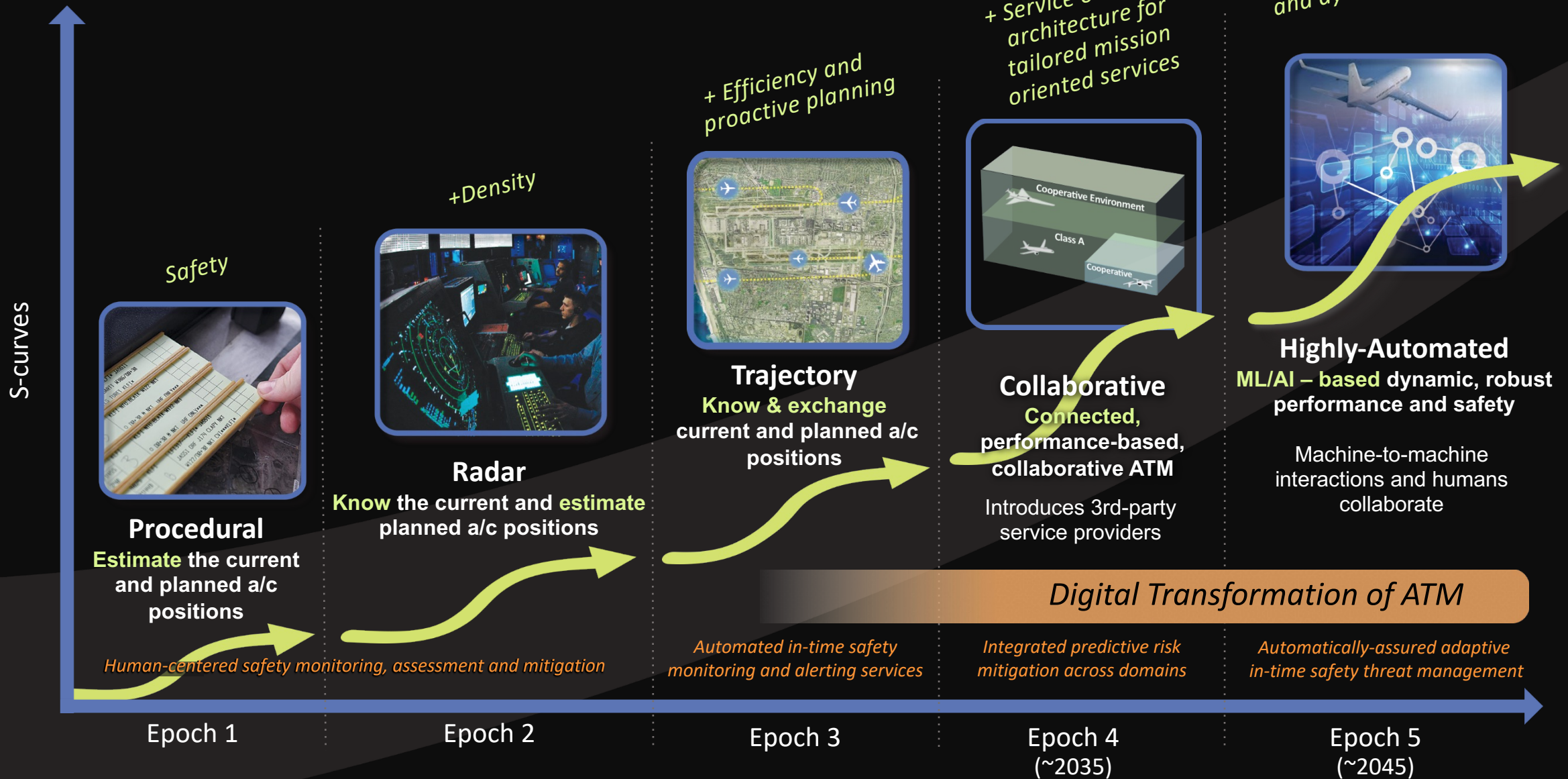


Enabling better disruption management
Primary focus on large-scale disruptions



Developing architecture, information integration, automation and roles and responsibilities
Dynamic: Performance, risk, and demand based

Evolution of Airspace Operations and Safety



Transition to UTM-inspired Airspace Traffic Management



Current ATM

All services are provided by FAA

Human address off-nominal situations and contingencies to ensure safety

Very little interaction among users and third parties

- Human at the epicenter of information integration
- Every data for every vehicle moves through FAA systems
- Management by clearances
- Each change is focused on domain-specific system



UTM-inspired-ATM

Services are provided FAA and third parties

Automation addressed off-nominal situations and contingencies to ensure scalability while maintaining safety

Users collaborate/cooperate for efficiency, preferences for flights into constraints resources

- Automation at the epicenter of information integration
- New paradigm: Digital, connected ecosystems, third-party applications, service-oriented architecture
- **Management by exception**
- Focus on **Total System Performance**



Embracing Innovation in Aviation while Respecting its Safety Tradition

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Manage by Exception Everywhere

- Performance-based
- Leverages UTM paradigm in entire airspace—from ground to heavens!
- Scalability everywhere

Airspace Operations Transformation Approach

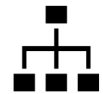
Question current assumptions – which limit user flexibility and system capacity, and conduct research to set system characteristics and requirements



Revisit visual and instrument flight rules: electronic/digital flight rules to promote cooperative traffic management



Revisit separation minima as "track and locate" accuracy is consistent and more precise with GPS instead of radar



Revisit architecture, and roles and responsibilities to move towards federated, service-oriented, manage by exception system for scalability



Revisit management of large-scale disruptions: use more data driven, integrated, machine learning based approaches



Revisit how routine weather-related delays are managed: use predictive and machine learning based algorithms



Enable regional and local operations by accommodating local considerations about vertiports and surroundings



Revisit integrated arrival/departure/surface movement, runway lengths and flows in/out of airports/vertiports with increasingly quieter electrified aircraft

Airspace System Must Continue to Evolve with Relatively Quicker Cycles

- Integrated, service-oriented architecture with modular implementation for real-time use to serve users
- Disruptions, off-nominal conditions, and contingencies managed by automation
- Automation to create solutions for Total System Performance (e.g., safety, risk, efficiency, resiliency, scalability)
- Continuous common situation awareness for all users and providers by going digital