AIRSPACE INTEGRATION

ENABLING SCALABLE, EFFICIENT, AND SAFE ACCESS TO AIRSPACE

Parimal Kopardekar, Ph.D.
NASA Senior Technologist for Air Transportation System

Parimal.H.Kopardekar@nasa.gov
VERTICAL TAKE OFF AND LANDING (VTOLS)
Flight Information Management System (FIMS) - FAA

Constraints, Directives
Requests, Decisions
Operations, Deviations

UAS Service Supplier

National Airspace System - ATM

NAS state
Common data
NAS impacts

Supplemental Data Service Provider

• Terrain
• Weather
• Surveillance
• Performance

UAS/Urban Air Service Supplier (USS)

Inter-data provider communication and coordination

Inter-USS communication and coordination

Color Key:
- ANSP Function
- Operator Function
- Other Stakeholders

Public Safety
Public

Public Safety

Urban air Operator

UAS

Urban Air Operator

UAS

UAS Operator

VTO
URBAN AIR MOBILITY AIRSPACE INTEGRATION
PRINCIPLES

• No burden on current system
• Cooperative and interoperable with other users
• Performance and risk-based
• Efficient
• Safe
• Scalability and sustainability

BUILD ON THE FOUNDATION OF
UNMANNED AIRCRAFT SYSTEM TRAFFIC MANAGEMENT (UTM)
CLOUD-BASED SERVICES (WEATHER, TRACKING, TRAJECTORY)

DEMAND/CAPACITY COORDINATION

SCHEDULING

SPACING

SEPARATION

AIRSPACE AND TRAFFIC CONSTRAINTS

CONNECTED SYSTEM FOR SCALABILITY

AIR NAVIGATION SERVICE PROVIDER

"UTM" SYSTEM

SUPPORT SERVICES SUPPLIER

AIR MOBILITY OPERATIONS CENTER

AIRCRAFT

USER DEMAND
FLEXIBILITY WHERE POSSIBLE, STRUCTURE WHERE NECESSARY

- AIRCRAFT
  - SEPARATION
    - LAST/FIRST 100 FT
    - ENHANCED FLIGHT RULES
- SUPPORT SERVICE SUPPLIERS
  - WEATHER
  - TRACKING
  - SEPARATION
  - 3D MAPS
  - SPACING
  - COMMUNICATION

"UTM" SYSTEM

AIR NAVIGATION SERVICE PROVIDER
- DIRECTIVES
- DEMAND/CAPACITY MANAGEMENT
- AIRSPACE CONSTRAINTS
- MANAGED BY EXCEPTION

OPERATIONS CENTER
- TRAJECTORY PLANNING
- SCHEDULING
- OPERATION
- DYNAMIC ROUTING
- FLIGHT AND FLEET MONITORING
- CONTINGENCY SUPPORT

RESEARCH TO DETERMINE SERVICES, PERFORMANCE NEEDS, AUTOMATION CAPABILITIES FOR SCALED OPERATIONS
CRAWL-WALK-RUN APPROACH

Low-density: Initial Operational Capability
- Helicopter routes using today’s procedures
- Entry into controlled airspace thru UTM
- Users: conflict-free trajectories and own tracking

Medium-density: Interim Operational Capability
- User creates conflict-free trajectories
- Interoperable, cooperative, and intent sharing
- Self-managed operations

High-density: Mature Operational Capability
- Fully-autonomous planning, scheduling, separations, entry/exit controlled airspace, interoperability, and contingency management
- Multiple, simultaneous take-offs and landings

Research needed to identify requirements for scaled operations
• Architecture, roles/responsibilities and technology that allows self-management as much as possible

• Air traffic control interacts indirectly for the majority of flight - for constraints and directives, and airspace changes

• Operator plans and schedules operation through UTM

• Tracking via wireless, satellite, ADS-B, or beacon-based systems connected through UTM

• Air-ground-cloud integrated system for scalability (spacing, separation, flow management, etc)

• Last/first 100 feet for safe and automated take-off and landing

• Vertiport design and operations for multiple simultaneous arrivals and departures
<table>
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<td>High Altitude UTM (upper E)</td>
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<td>Conventional Manned Aviation (Class A, B, C, D, E)</td>
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- Cooperative
- Intent-sharing
- Digital: data exchanges among operators
- Standardized application protocol interfaces
- Air/ground integrated
- Service-oriented architecture
- Role for third parties
Autonomy alone will not lead to efficiency and large-scale disturbance management.

Connectivity is crucial - air/ground/cloud/infrastructure integration will be key.

Connectivity is Key
Scalable en route and arrival/departure operations
Cooperative and interoperable operations
Design of vertiports with multiple vertipads
Weather tolerant operations (75% delays are due to Wx)
Off-nominal conditions and contingency operations
  High winds, wind shears, up drafts, etc.
  Power depletion
  Bird strikes
Requirements (e.g. reserve fuel)
Integrated air/ground/cloud/infrastructure connected system
EMBRACING INNOVATION IN AVIATION WHILE RESPECTING ITS SAFETY TRADITION

Parimal.H.Kopardekar@nasa.gov