BLOCKCHAIN 4 AVIATION OPERATIONS

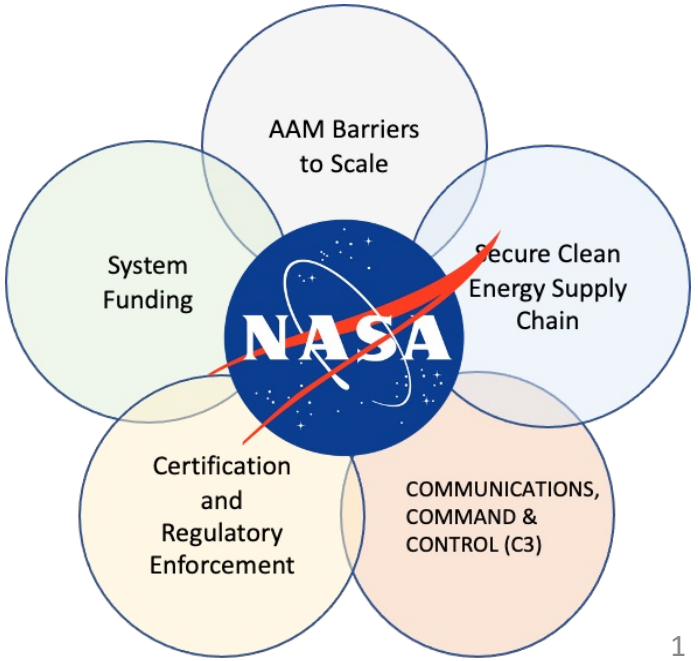
Exploring the revolutionary potential of an info-centric NAS

Capitalizing upon distributed ledger technology (blockchain), assess its applicability toward resolving identified barriers to scale for UAS and AAM

- Richard Walsh
- Andrew Lacher
- Wes Ryan
- Gerard Welch
- Kenneth Freeman

In Memoriam of Ronald J. Reisman, Aero Computer Engineer, Flight Trajectory Dynamics and Controls Branch, M/S 210-10
NASA Ames Research Center

CONVERGENT PROBLEM AREAS



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Wisk/Boeing CONOPS

3.1.7 Cybersecurity (page 23 of 64)

- Uncrewed, highly automated UAM aircraft will encounter ever-increasing cyber threats. To meet these threats, **UAM aircraft will require robust and traceable compliance with airworthiness security regulations**.

3.2.1 Common Operating Picture (page 24 0f 64)

- Common operating pictures (COP) will include a set of **real-time operational information** that will be accessible to UAM operators and Vertiport Managers.

3.2.3.1 Adjusting Mission Intent (page 27 0f 64)

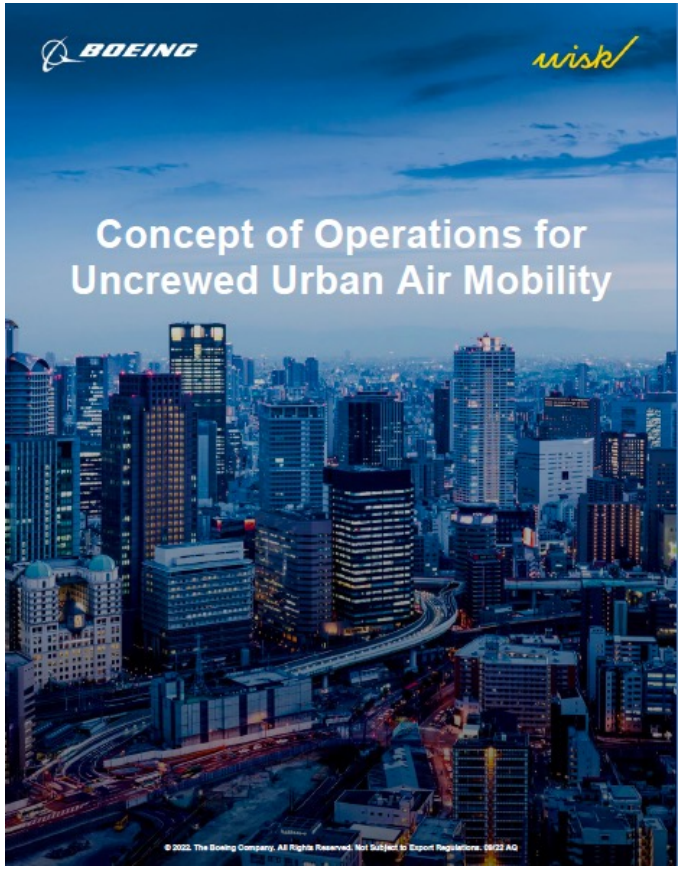
- **DAA resolution advisories: DAA resolution advisories will be automatically executed onboard the aircraft to avoid near-midair collisions**. Return to course may be automatic or commanded by the MVS.

4.2.3 Aeronautical Data Service (page 35 of 64)

- **UAM aircraft operations will require a wide variety of validated, high-integrity data to ensure safe operations.** These data will include: Geospatial information, Terrain and obstacle information, Micro and macro weather information, Codified route and RNP NavSpec information, Aviation map information, NOTAM information, and Temporary flight restriction information.

4.3.4 Communication, Navigation, and Surveillance Equipment (page 42 of 64)

- TSPs will provide the C2 and DAA functions required to meet the performance requirements (including operations around a vertiport) along flight routes. The services provided by TSPs at vertiports will be **required to ensure safe takeoff and landing operations.**
- **To meet PNT accuracy, integrity, and availability requirements for precision landing of UAM aircraft, GNSS PNT may be augmented with the Ground Based Augmentation System or an alternate PNT solution.**



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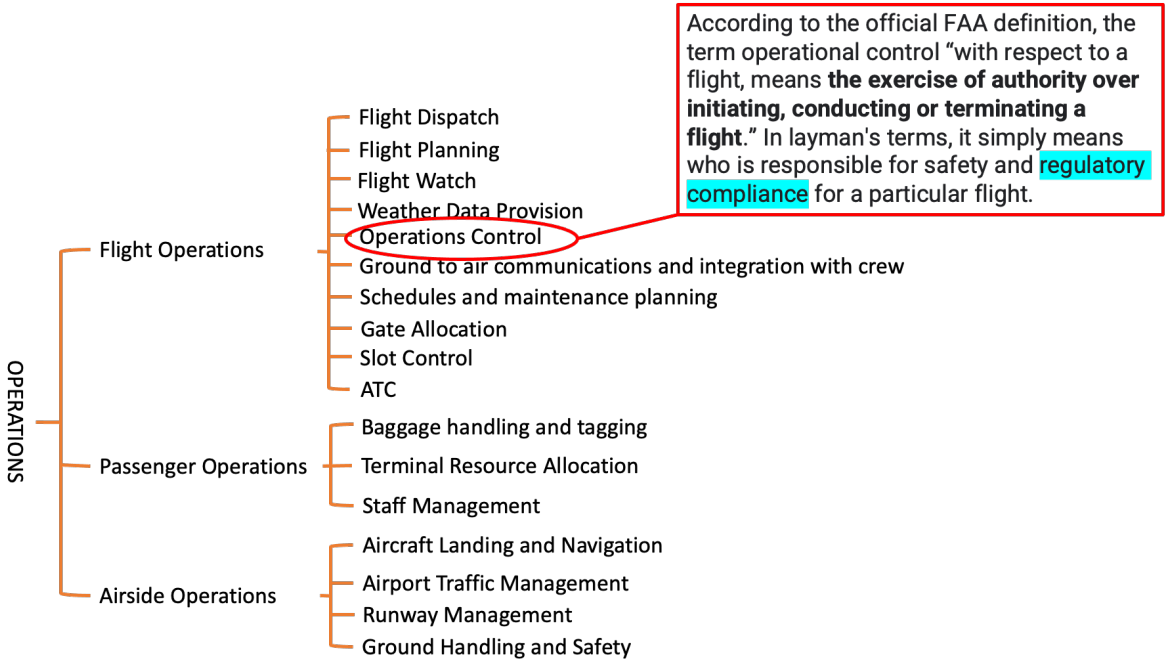

Flight Counts by Operating Rules

Operating Rules	Flight Count
Airspace	931
BVLOS w/o VO	110
BVLOS w/VO	25,373
Multiple UA	57
Night Operations	101
OOP	3,365
OOP; OOMV	187
VLOS	2,223
UNK*	4,502
Grand Total	**36,849**

*UNK: Not documented/Not reported

Total Flight Counts by Geographic Locations and Use of Airspaces

Airspace Classes	Assembly	Rural	Suburban	Urban	Grand Total
Class B	50	65		1,233	1,348
Class B, Class G		50			50
Class C, Class G		1		1	2
Class D	3	534	1,816	2	2,355
Class D, Class G				486	486
Class G	28	11,618	10,102	5,463	27,211
Class G, SUA				1	1
NA		1,867	3,529		5,396
Grand Total	**81**	**14,135**	**15,447**	**7,186**	**36,849**

*NA: Not Available or Reported

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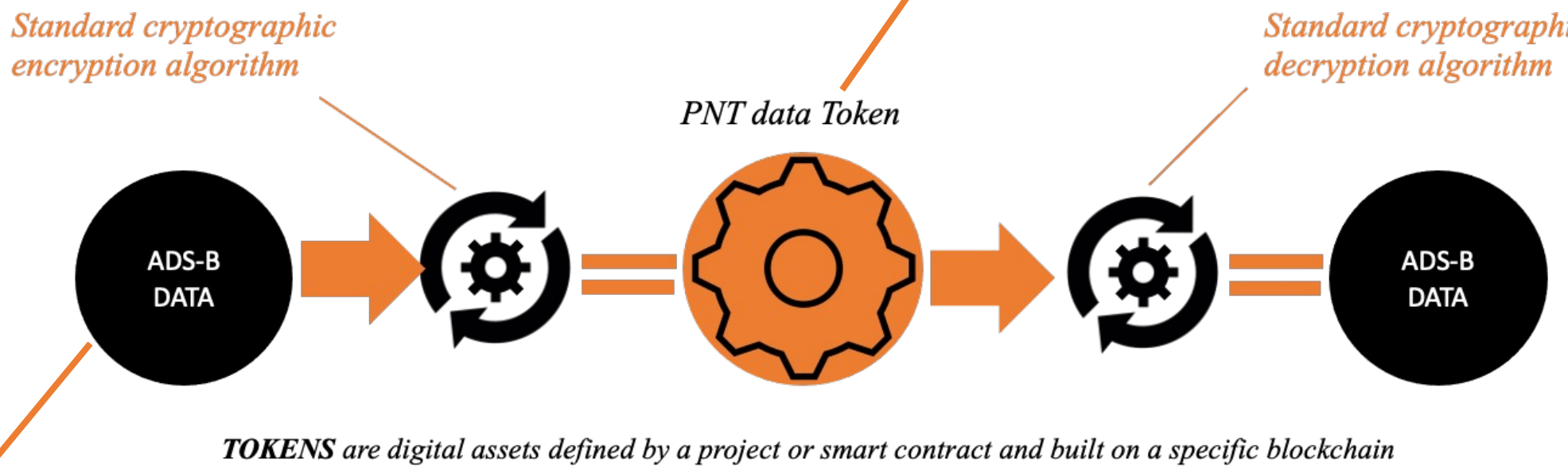
"Positioning, Navigation, and Timing (PNT) is fundamental to enabling UAS communications, navigation, surveillance, automation, safety systems, and mission applications"

Ken Alexander, FAA Chief Scientist for Satellite Navigation Systems



Automatic Dependent Surveillance-Broadcast (ADS-B) works by broadcasting information about an aircraft's GPS location, altitude, ground speed and other data to ground stations and other aircraft, once per second

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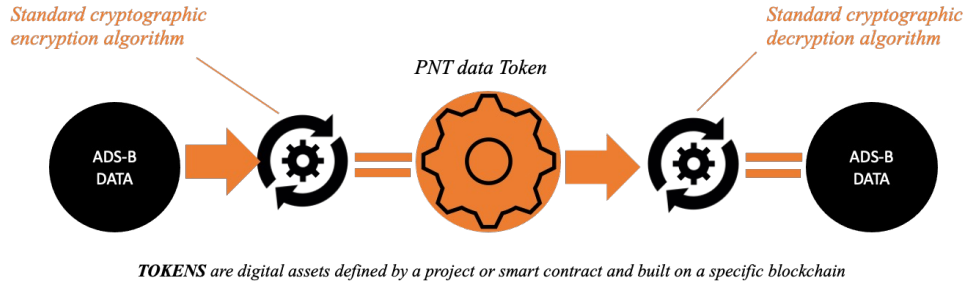
A



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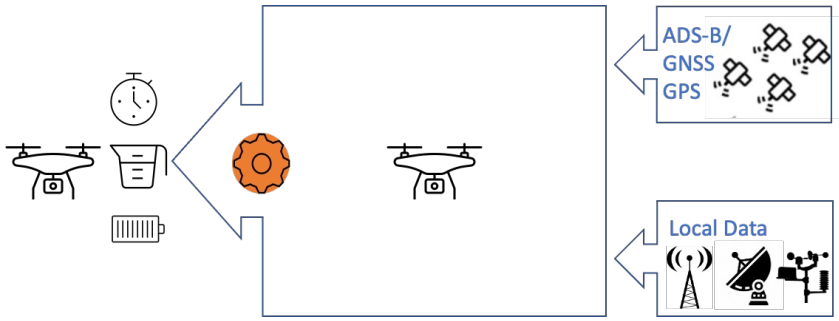

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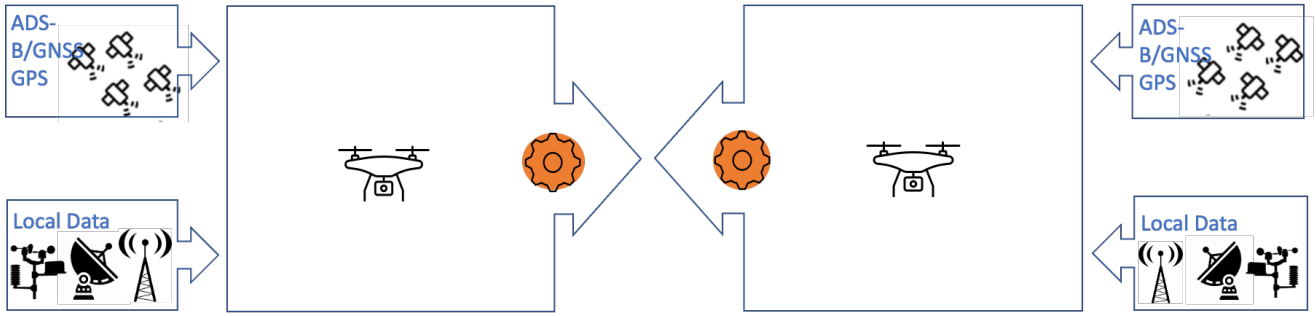
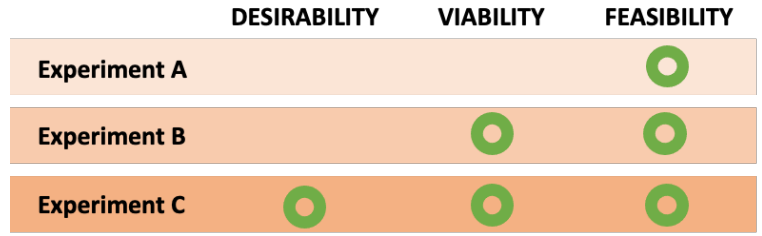


Aviation Operations	Blockchain Benefits
Barrier 1	1. Immutability 2. Digital Identification 3. Data Provenance
Barrier 2	1. Tokenization 2. Immutability 3. Smart Contracts
Barrier 3	1. Smart Contracts 2. Decentralized/Democratized – No Central Authority 3. Shared Situational Awareness



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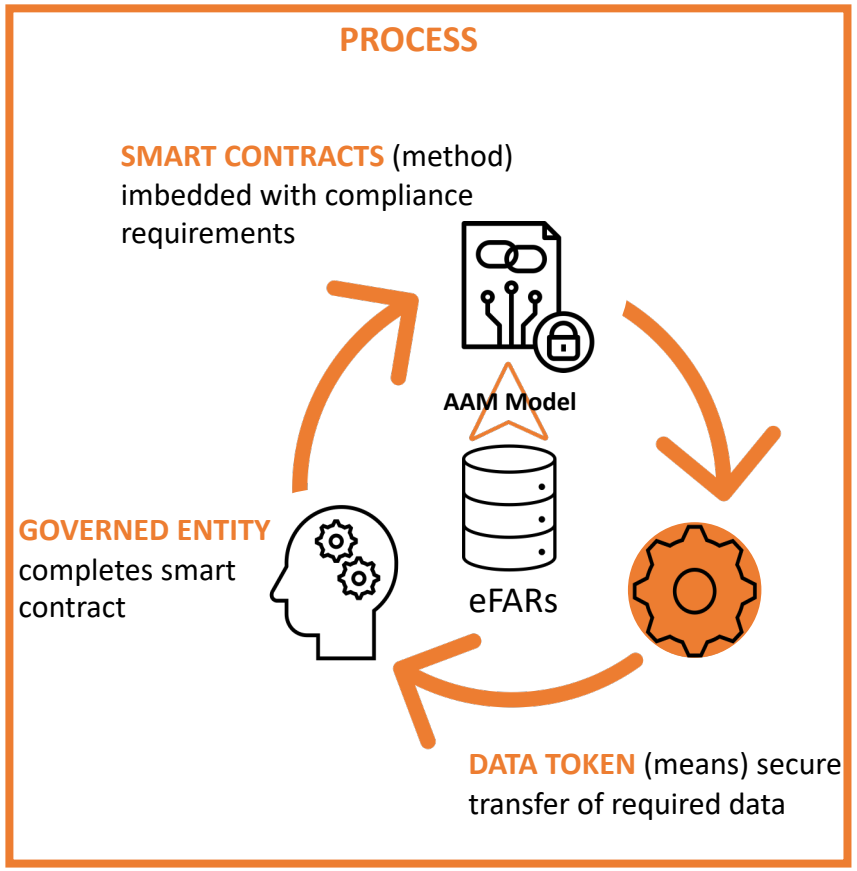
USE CASE - REGULATORY

REGULATORY

TYPE	REGULATOR
MEANS-BASED	Methods
	Materials
	Processes
PERFORMANCE-BASED	Standards
MANAGEMENT-BASED	Process (self regulated)



GOVERNING ENTITY (autonomous) BLOCKCHAIN REQUIREMENTS

observe, **evaluate**, and **enforce** compliance

observe, **evaluate**, and **enforce** compliance

review and **evaluate** plans against established criteria

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