



Operation of UAS in the Non-Segregated NAS

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The goal for all Airspace Stakeholders is to achieve safe and seamless integration of unmanned aircraft systems (UAS) into the Global Airspace over land and sea; here are some of the reasons:

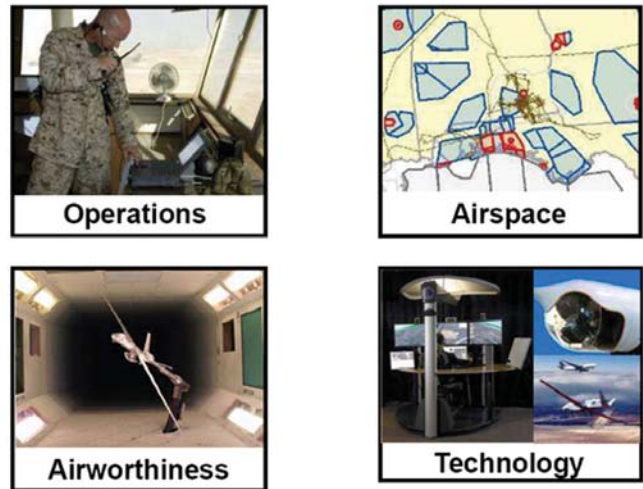
- Public (government owned) Military: training exercises, global access to defend against terrorists, rogue nations and pirates, plus defense of our nation's borders.
- Public Civil: coastal and border patrol, police, fire, search and rescue and help in emergencies and natural disasters.
- Commercial: cargo transport, communications, surveillance for agriculture, fisheries, power/pipe lines, mineral exploration, earth observation, etc

The advantages of a UAS are lower costs (capital and operating), longer endurance, and no pilot in harm's way to name a few. However, without airspace integration, assured separation from other air traffic demands non-standard margins in space and time, consequently, UAS are poor stewards of scarce airspace today. As UAS flying operations increase, their airspace consumption grows disproportionately to growth in flight hours.

This further challenges and complicates an already dense air traffic picture the Federal Aviation Administration (FAA) is managing while ensuring the safety of the airspace. The UAS Air space Integration is needed to restore the principle of maneuver to UAS platforms.

standards for UAS enabling technologies. Military and Civil programs need this information in order to establish a solid safety case specific to their UAS platform and operational concept. The Focus areas for successfully achieving UAS NAS Access are shown in Figure (2).

Figure 2: Focus Areas



The need for these is now and that's the problem. We, all the Stakeholders, have responded slowly, without sufficient funds and in some cases lack of passion!

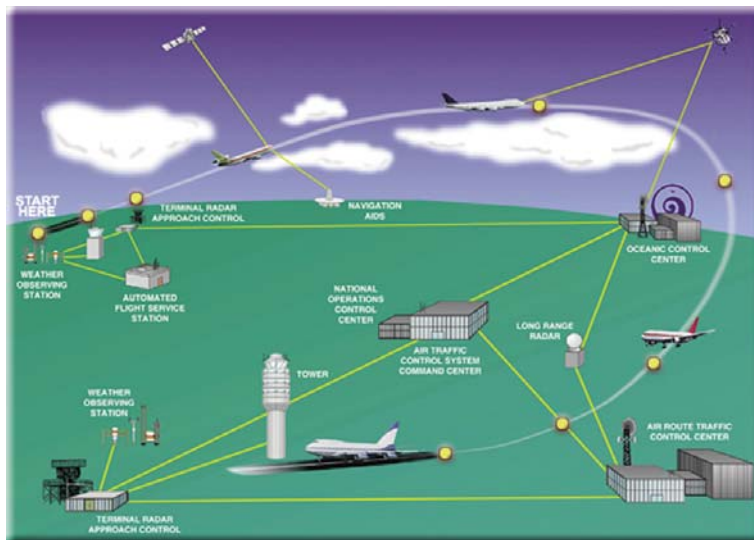
Civil Standards development Organizations are important contributors to this process. These agencies are not only involved in the process of the DOD's timely and routine access of UAS to the NAS, but are also participating in the NEXT GENERATION Air Transportation System (NEXTGEN), which under Section 709 of the Vision 100- Century of Aviation reauthorization Act (Public law 108-176) is to transform (See Figure (3)) manned and unmanned flight seamlessly in the NAS with full implementation by 2025.

Figure (4) presents a comparison between today's NAS and that of NEXTGEN's.

This is a massive undertaking led by the FAA Air Traffic management. The FAA's Joint Programming and Development Office (JPDO) released in 2008 an Integrated Work Plan (IWP) with a five section phased timeline for NEXTGEN enabling concepts to achieve UAS NAS integration; including 4DTrajectory (4DT) management and performance based operations and support. These concepts will enable UAS operations within the newly defined 4DT airspace by allowing electronic negotiation of altitude, trajectory, and automated trajectory management.

The DOD and the FAA are working together as directed by the National Defense Authorization Act (2009 NDAA-Public Law 119-417) Section 1036 to establish a joint FAA/DOD executive committee for UAS NAS integration that would:

- Act on conflict/dispute resolution of pertinent UAS issues between the two organizations and as a focal point for airspace, aircraft certifications, aircrew training and other



UAS in the NAS

UAS operations will continue to be restricted until the full spectrum of Standards, Procedures, Policy, Performance Specifications, M&S, Human Factors and Enabling Technologies including Sense and Avoid are developed, validated and demonstrated to provide an acceptable level of safety for unmanned/manned flight operations. The inadequate funding of the UAS Standards effort impacts the Regulatory Authorities who need this information to develop the appropriate regulations and procedures needed for UAS to routinely operate in the NAS without a waiver. Standard Development Organizations need this information to create

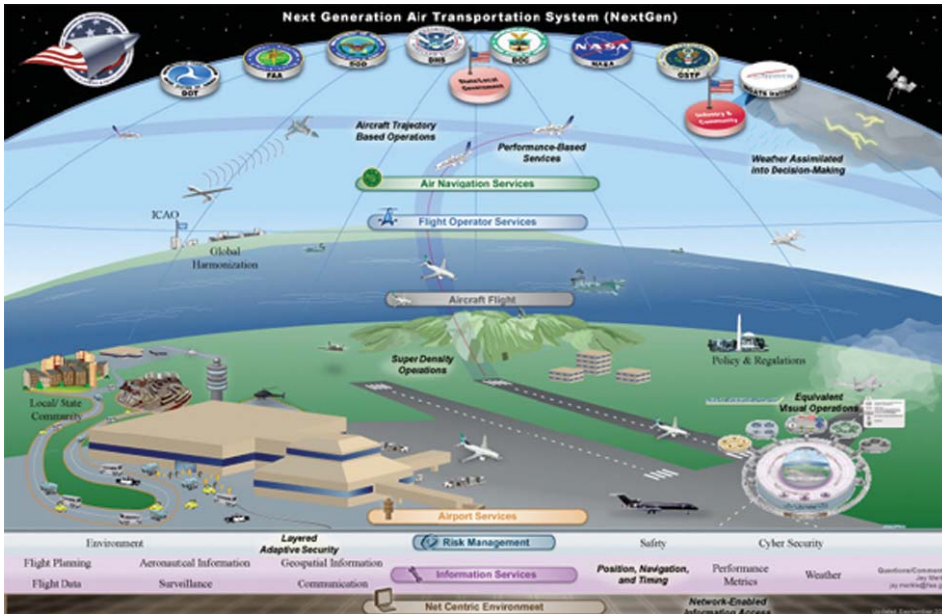


Figure 3: Next Generation Air Transport System (NEXTGEN)

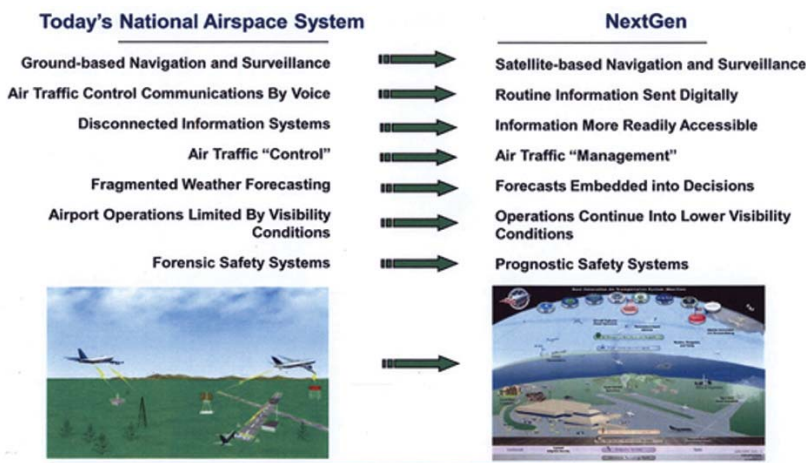
issues that arise.

- Identify solutions to the range of technical, procedural and policy concerns arising in the increasing and ultimately routine access of such systems of DOD UAS into the NAS.

The end state is to acquire a synthesized set of UAS Airspace Integration performance based requirements, translated into DOD Policy and Airspace Regulatory terms that will enable routine, global DOD UAS operations while preserving airspace safety. The Services will increasingly need that admittance both for training and operational missions. By 2013, the DOD services estimate that UAV missions will consume more than one million flight hours, the majority of which will occur outside of restricted air space. The purpose of the airspace integration enterprise is to restore the principal of maneuver to projected military operations by integrating Unmanned Aircraft into the civil airspace. The demand for UAS airspace access will only increase with time and currently their airspace consumption grows disproportionately to growth in flight hours. This further challenges and complicates an already dense air traffic picture.

The challenge for the DOD is to develop airworthy platforms, properly trained UAS crew and operating procedures that can meet the intent of the FAA's goal. In order to satisfy the FAA requirements, five primary capability gaps must be addressed

Figure 4: Today's NAS / NEXTGEN Comparison



The transition to NextGen has begun

in order to achieve a «file and fly» capability.

The following are required for routine UAS operations in the NAS:

Airworthiness Certification

For unmanned aircraft systems, the certification process must include the whole system which includes the aircraft, ground station, communications systems (data links) and software/firmware where the flight critical software should be separated. The UAS System is defined in Figure (5). UAS communication links must be secure and reliable from bad source data, spurious or degradation, intermittency and latency. At the World Radio Communications Conference in 2011 a decision is to be announced

regarding the UAS civil spectrum for Command and Control. The ground station also needs to be protected from damage natural or otherwise. While the DOD Services have been self certifying /flying manned aircraft for decades, UAS require an expanded airworthiness process due to the additional equipment needed.

On September 24, 2007 Memorandum of Agreement, the FAA and the DOD agreed that DOD UAS operated outside of Restricted Areas and Warning Areas shall be certified by one of the military departments as airworthy to operate at the appropriate level in accordance with applicable DOD and Military Department standards. DOD self certifies its aircraft with intent to meet FAA requirements. Although there currently exists a DOD airworthiness statement /certificate for several of the Program of Record UAS operating in support of the War Fighters they are limited in scope and applicability. None have airworthiness certifications sufficient for routine access to the NAS. Additionally guidance does not currently exist for UAV specifics in MIL HDBK 516, Airworthiness Certification Criteria. Therefore, no civil or military standards exist for UAS aircraft and other system elements.

Sense and Avoid

14 CFR, Part 91.113, requires that vigilance shall be maintained by each person operating an aircraft so as to see and avoid other aircraft. Currently, the FAA does not recognize DOD UAS operating in the NAS as having this capability. The FAA currently ensures safety and mitigates the risk through exceptions to policy via Certificates of waiver or authorization (COA) or Temporary Flight Restrictions (TFR). Exceptions to policy are unsustainable as UAS proliferate in the NAS. The nonmaterial and material solutions to Sense and Avoid (SAA) are urgently needed, particularly for the Groups 4 and 5 UAS. Currently no accepted standard of «UAS Sense and Avoid» exists. Ground Based Sense and Avoid (GBSAA) is being explored as an interim solution, while ABSAA solutions are being pursued by many Stakeholders.

UAS Pilot Qualification

UAS pilots must understand not only their system's capabilities, but also how manned

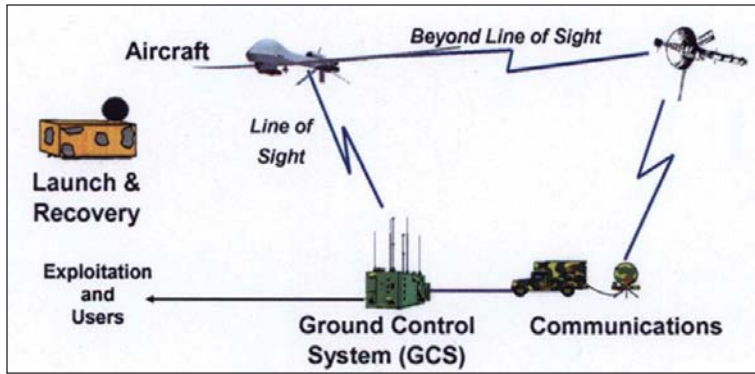


Figure: 5 UAS System

aircraft operate in the same airspace in order to effectively and safely integrate UAS flight operations. UAS pilots are accountable for operating their aircraft to the same standard as the pilots of manned aircraft. The FAA directs that UAS pilots will understand federal aviation regulations applicable to the airspace where the UAV will operate. Currently there are gaps in UAS pilot training for UAS Groups 1-4 across the Services to operate to FAA standards (FARs) required for NAS access. Each Service has UAS Air Crew basic qualifications it certifies to. The FAA required skills align with those in NATO STANAG 4670.

Operating Standards and Procedures (OSP)

The OSP pillar derives its requirements from: -14CFR, Subchapter A- General, 91.1 General Operating and Flight - Interim Operational Approval Guidance 08-01.

These regulatory guidelines ensure both manned and unmanned aircraft systems safely operate in the national airspace. Currently UAS cannot meet all current FAR standards, in fact, unique UAS standards and procedures need to be developed.

Equipage

This pillar derives its requirements from:

- 14 CFR, Subchapter A- General, Part 91- General Operating and Flight Rules;
- Interim Operational Approval Guidance 08-01;
- No comprehensive Civil or DOD UAS equipage standards exist;
- No comprehensive evaluation/analysis of Civil/DOD UAS NAS Spectrum issues has been undertaken.

These regulatory guidelines ensure both manned and unmanned aircraft systems safely operate in the national airspace. All powered aircraft (91.205), with a standard category U. S. airworthiness certificate, must have installed and functional the equipment for the airspace class and meteorological conditions in which the mission is being flown. A System Safety Analysis is required to verify that an appropriate level of safety is met «DO NO HARM.» The FAA's authority for U.S. Airspace Safety comes from Title 49 of the United States Code.

Of course other UAS Stakeholders worldwide are pursuing solution to achieve routine access to the NAS for UAS for Military and Civil needs and applications. Organizational cooperation and funding are key to solving the Airspace Integration Challenge, as it is a long term process.

Air Traffic Management for UAS must consider the principals for deconfliction or conflict management. Unfortunately Part

91 of Title 14 of CFRs (91.11 and 91.113) is qualitative in nature and presents no quantitative measures against which to evaluate an SAA system. Basically, a SAA System must provide both Separation Assurance and Collision Avoidance where the principle difference between the two intended functions is the response time to prevent a collision. Soon Automatic Dependent Surveillance-Broadcast (ADS-B) combined with GPS will provide the appropriate separation bubble. Collision avoidance has to be a separate function which operates at all times, in all airspace classes and under existing flight rules. These two systems must be separate so failure, of one, doesn't void both.

There is much to do to arrive at the desired end state:

- Full access to the NAS;
- Integrated operations with manned aircraft;
- Transparent to Air Traffic Management;
- UAS operations are routine, file and fly everyday Safety track record is equal to or better than manned;
- UAS mission has full advantage of maneuver.

Our Global Family is at the dawn of a new era in aviation where everyone [government (civil and military), commercial/industry and regulatory authorities] must cooperate to make routine operation of UAS in the World's Airspace a reality!

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