International Civil Aviation Organization
NORTH AMERICAN, CENTRAL AMERICAN AND CARIBBEAN OFFICE
Twentieth Meeting of Directors of Civil Aviation of the Eastern Caribbean (20th E/CAR DCA)
Miami, Florida, United States 4 to 7 December 2006

Agenda Item 3: Air Navigation Matters
3.6 Other Air Navigation issues

NEXT GENERATION AIR TRANSPORTATION SYSTEM (NGATS)

(Presented by the United States of America)

SUMMARY

Today's U.S. air transportation system[1] is under stress. The demands on air transportation are outpacing our ability to increase system capacity. Operating and maintenance costs of the air traffic system are outpacing revenues and the air carrier industry is going through a period of dramatic change. Security requirements established in the wake of the September 11 attacks significantly impact costs and the ability to efficiently move people and cargo. In addition, growth in air transportation is provoking community concerns over aircraft noise, pollution, and congestion. Adapting our current air transportation paradigm will not be sufficient to meet these challenges. Instead, transformation of today's system is required to ensure a healthy, environmentally friendly, globally interoperable air transportation system for 2025. In 2002, the U.S. Congress established the Joint Planning and Development Office (JPDO) to define a national strategy for developing the Next Generation Air Transportation System (NGATS). The NGATS vision for 2025 enables the safe, efficient and reliable movement of large numbers of people and goods throughout the air transportation system in a way that is consistent with national security objectives. Our NGATS vision is founded upon an underlying set of principles and enabled by a series of key capabilities that will free the U.S of many current system constraints, support a wider range of operations, and deliver an overall system capacity up to 3 times current operating levels.

1. Introduction

1.1 The JPDO is a public-private partnership directed by Congress to transform the national air transportation system to meet the needs of the year 2025 while providing near-term benefits. NGATS will address critical safety and economic needs while fully integrating national defense and homeland security improvements into this future system. Along with the private sector, the FAA, NASA, the Departments of Commerce, Defense, Homeland Security, Transportation, and the White House Office of Science and Technology Policy are working together to design and build the Next Generation Air Transportation System. Overseeing the work of the JPDO is a Senior Policy Committee chaired by the Secretary of Transportation and comprised of senior representatives from each partner agency, including the FAA Administrator.

[1] The current air transportation system is a complex array of systems and services used by an ever broadening collection of stakeholders. The term "the air transportation system" means all activities and components related to the safe passage of people and goods by air. This includes related federal lines of business, as well as private industry, state, and local activities.

2. NGATS Principles

2.1 NGATS is about the customers – the users of the air transportation system. It fosters a shift in the historical focus of air transportation from a system constrained by physical/technical infrastructure and the ability of the service providers, to a system focused on and responsive to the "user." The concept is multi-dimensional in scope—incorporating technological innovation, but also addressing the critical aspects of change and innovation in organization, culture, and policy. Safety in the NGATS is approached in a prognostic fashion, establishing a new safety culture that assesses risk in a predictive environment, instead of the existing reactive context. The system will enable integrated management of environmental performance to foster continued growth of aircraft operations in an expected future where the environmental impacts of aviation are increasingly scrutinized. International harmonization accommodates both the demands of U.S. users to operate globally without unnecessary constraint, and similarly, to embrace the needs of non-U.S. users to operate in the United States.

3. NGATS Capabilities

3.1 We have defined several key capabilities that denote the major characteristics of the NGATS that are currently missing from today's system. As a "total system" concept, there are multiple dependencies among these capabilities. These key NGATS capabilities include: Network-Enabled Information Access; Performance-Based Services; Weather Assimilated into Decision Making; Broad-Area Precision Navigation; Aircraft Trajectory-Based Operations; Equivalent Visual Operations; and Super Density Operations.

3.2 *Network-Enabled Information Access*

3.2.1 Making information available, securable and usable in real time according to defined "communities of interest" is central to the NGATS vision. Information will be used to distribute decision-making appropriately during normal operations, abnormal events, and system- wide crises -- improving the speed, efficiency, and quality of decisions. Aircraft will become mobile "nodes" integral to this information network, not only using and providing information, but also routing messages or information being sent from another aircraft or a ground source.

3.2.2 In the NGATS context, data encompasses all relevant information forms—flight plan information; pilot, passenger and cargo data; aircraft telemetry; surveillance information; weather data, etc. Information might be in the form of records, databases (pilots licenses, aircraft maintenance records, etc), voice communications, images, etc. Information will be both "pushed" to known users and available to be "pulled" by other users including clients not previously identified as needing that data. Data providers will ensure appropriate information protection as necessary to address national defense, security, and privacy concerns.

3.2.3 Real-time access will enable system operators and users to exploit risk-management practices to enhance safety. The capability provides a "cooperative surveillance" model for civil aircraft operations, where aircraft will be constantly transmitting aircraft status (including position) and flight path intent. This information will be used together with a separate sensor-based non-cooperative surveillance system as part of an integrated federal surveillance approach for national security purposes.

3.3 ***Performance-Based Services***

3.3.1 Today's system is based on "binary access" (where users meet all of the requirements for access or are denied admission), one level of service (first come, first served), and a regulatory structure largely built around specific equipment types. Performance Based Services will enable a definition of service tiers and allow the government to move from equipment-based regulations to performance-based regulations. Multiple service levels will allow service to a wider range of users and better tailor services to individual needs. As an example, the busiest airspace will have the highest air traffic service level -- thus requiring the highest level of user avionics performance. Implementation of performance-based services will enable a more cost-effective service provider maintenance framework and will encourage private sector innovation. Clearly defined service tiers will allow the service provider to create service guarantees for given performance levels so that users can determine appropriate investments to meet their needs.

3.4 ***Weather Assimilated Into Decision Making***

3.4.1 Leveraging the benefits of *Network-Enabled Information Access*, NGATS will provide a "common" weather "picture" to support decision-making. Thousands of global weather observations - from ground, airborne, and space-based sources - will be used to determine real-time weather status and to feed multiple weather forecast models. Information will be fused into a single, constantly updated, national (eventually global) weather database. Differences between forecasts and actual conditions will be measured and analyzed. Analysis tools will examine how well information was used in past decision-making and use this knowledge to improve future performance, making more airspace available for NGATS use. NGATS will move from weather data dissemination of text and graphical products to ingestion of raw weather information into NGATS decision algorithms and processes - bypassing the need for human interpretation.

3.5 ***Layered, Adaptive Security***

3.5.1 Far from the "add-on" dimension of our current security system, layered, adaptive security will integrate security functions into NGATS in a manner that increases security while moving more people/goods and requiring proportionally fewer resources to do it. Building on *Network-Enabled Information Access* and *Performance-Based Services*, security will exist in "layers of defense" designed to detect threats early. Risk assessments will begin before each flight, so that people and goods are appropriately screened as they move from the "air portal" curb to the aircraft, or as they work to support airport and aircraft operations. As technology matures, screening will be unobtrusive and increasingly transparent to the individual. Security changes will be assessed in terms of impacts to and effects from other aspects of the system, such as safety, to ensure they are implemented in a complementary, synergistic way.

3.6 ***Broad-Area Precision Navigation***

3.6.1 Broad-Area Precision Navigation will provide navigation services where and when needed to enable reliable aircraft operations in nearly all conditions[2]. Today's U.S. navigation infrastructure includes over 5,000 FAA operated ground-based navigation aids to support both en-route navigation and precision approaches to airports. The airspace structure and approach/departure procedures are constrained by this navigation infrastructure. When this localized-service model is replaced by a broad-area service, "instrument" landings will be possible at any "air portal" or location within the coverage area. NGATS Broad-Area Precision Navigation (at different required levels of performance) will likely include a next generation of GPS satellites with non-terrestrial navigation augmentation for CAT-I approaches and hybrid GNSS/inertial avionics for CAT II/III approaches. NGATS may also take advantage of other GNSS systems and broad-area navigation services such as enhanced LORAN. Elimination of multiple legacy systems will reduce FAA infrastructure costs and reduce user costs associated with maintaining proficiency over multiple navigation systems.

3.7 ***Aircraft Trajectory-Based Operations***

3.7.1 To accommodate the projected doubling or tripling of system demand by 2025, today's flight planning and air traffic paradigms must be transformed to a system that manages operations based on aircraft trajectories, regularly adjusts the airspace structure to best meet user and security/defense needs, and relies on automation for trajectory analysis and separation assurance. This capability builds on the *Network-Enabled Information Access*, *Performance-Based Services*, *Weather Assimilated into Decision Making*, and *Broad-Area Precision Navigation* capabilities. The design must not only improve system efficiency but also meet goals for security, safety and environmental compatibility. NGATS will use 4D trajectories (time-based paths from block-to-block, including ground segments) as the basis for planning and executing system operations. The planned trajectories will be exchanged among system participants, with automation continuously analyzing trajectories in a framework that accounts for operational uncertainties, to develop constantly updated trajectory plans that keep aircraft safely separated. The airspace structure will be matched dynamically (both daily and within the operational day) using a framework that seeks to allocate/configure airspace as a resource to meet demand from user operations, while meeting safety requirements, environmental requirements, etc. This airspace framework will consolidate today's disparate mechanisms for segregating and managing airspace into a single mechanism for implementing Temporary Flight Restrictions, Special Use Airspace, and other requirements. The airspace framework will seek to both provide the maximum available airspace to all users while meeting national security needs for airspace restrictions.

3.8 ***Equivalent Visual Operations***

3.8.1 *Network-Enabled Information Access*, certain aspects of *Performance-Based Services*, and *Broad-Area Precision Navigation* will provide aircraft with the critical information needed to navigate without visual references and maintain safe distances from other aircraft during non-visual conditions. We expect that the Equivalent Visual Operations capability will be operational in the mid-term, with controllers delegating responsibility to aircraft to "maintain separation" when the aircraft is in the airport area. The ability to conduct Equivalent Visual Operations at all "air portals," combined with appropriately capable landside services (including security) will permit more airports to reliably serve their community or region, whether for commercial service, business aviation, air taxi services, air cargo, or general aviation. The ability to conduct Equivalent Visual Operations at busier airports will also provide greater, more predictable operating levels (equivalent to those experienced under visual operations) and lead to improved performance of the commercial service network.

[2] direct weather hazards to aircraft, such as severe thunderstorms, will effect operations at certain times.

3.9 ***Super Density Operations***

3.9.1 Key to the complete success of NGATS is our ability to match land and airside throughputs of an airport in order to meet future demand. The realization of the previously described capabilities will enable peak throughput performance at the busiest airports while protecting the environment of the surrounding communities. Airport taxiway and runway configuration requirements will be specified to enable high capacity traffic operations on the airport surface. Arrival and departure spacing will be reduced, as a result of enhanced surveillance and navigation performance and the development and integration of tools to detect and avoid wake vortices. Capacity will be increased with closely-spaced and converging approaches at distances closer than currently allowed and through simultaneous operations on a single runway. The airport "landside" (including security systems) will be sized to match the passenger and cargo flow to the airside throughput.

4. NGATS Products

4.1 The JPDO is currently developing technical documentation to bring the 2025 NGATS Operational Vision into much greater definition. The NGATS Concept of Operations (CONOPS) is a document that provides a basic operational description of how the Next Generation Air Transportation System will function. The first CONOPS draft focuses on what is called "block to block," referring to all segments of a flight, from the time an aircraft departs until it arrives at its destination. A future version of the CONOPS, called "Curb to curb," will include operations that take place before and after a flight. Also, the additional topics of environment and airports will be included in future versions. The first CONOPS draft has been released for review by the aviation stakeholder community. Completion of this document is expected in 2007. However, this document is iterative and will continue to evolve. To view a copy, please go to the JPDO website at http://www.jpdo.aero and click on "Tech Hangar".

4.2 The NGATS CONOPS is being developed concurrently with the NGATS Enterprise Architecture (EA). The NGATS EA represents the actual plan for how the Next Generation Air Transportation System will be developed, much like a set of blueprints. This includes the systems that will be needed, the timing for their development, and how they will work together. The Next Generation Air Transportation System EA is a recognized tool for re-engineering business practices and the underlying technology that supports them. Full approval of this document is also expected in 2007.

4.3 The NGATS Operational Improvements (OI) Roadmap is a document that shows how current and near-term transformational activities such as Automatic Dependent Surveillance-Broadcast (ADS-B), cooperative surveillance and satellite navigation will be aligned with the planned future system. The Next Generation Air Transportation OI Roadmap is divided into distinct but interrelated operational improvements, and breaks down the evolution path of the Next Generation Air Transportation System into seven 4-year segments. The Next Generation Air Transportation OI Roadmap was originally released in the spring of 2006, but it is a "living document" and subject to future revisions. This document can also be accessed through the "Tech Hangar" website.

5. Early Opportunities

5.1 In its FY 2007 budget request, the U.S. government proposed targeted investments to accelerate the development of key Next Generation Air Transportation System projects, such as ADS-B which will replace ground-based radar systems and revolutionize air navigation and surveillance and System Wide Information Management (SWIM), which will help make a network-enabled air traffic system possible, improving safety, efficiency, and security.

6. Conclusion

6.1 The strategy for NGATS is to define, as best we can, what the future system will look like, knowing full well that it is highly unlikely that the concept presented here will emerge exactly as the NGATS of 2025; rather, this vision of the future allows us to define a target direction and continue to develop the scope and depth of the elements of the future system. In the development of NGATS, we are also taking a global perspective. We are fully aware that we cannot build a harmonized system without partnerships with our domestic stakeholders and international counterparts. We invite all interested States to learn more about NGATS and how this process can assist other States in the development of their future air transportation systems.

6.2 Please contact Ms. Carey Fagan, Director, JPDO Global Harmonization Integrated Product Team (carey.fagan@faa.gov, phone: 202-385-8965), for more information. Additional information on this initiative can be found on the JPDO website at http://www.jpdo.aero.

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