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Agenda Item 18: Future Work Programme

U.S. NEXT GENERATION AIR TRANSPORTATION SYSTEM (NextGen)

(Presented by the United States of America)

SUMMARY

Current demands on the United States of America's national air transportation system are exceeding its ability to provide sufficient system capacity domestically and abroad. Operating and maintenance costs of the air traffic system are outpacing revenues, and the air carrier industry is experiencing a period of dramatic change. Security requirements established in the aftermath of the 11 September 2001 jetliner attacks have significantly impacted 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.

Merely adapting air transportation's current paradigm will not be sufficient to meet its challenges. Instead, transformation of today's system is required to ensure a healthy, environmentally friendly, globally interoperable air transportation system for 2025. In 2003, 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 (NextGen). The NextGen 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 NextGen 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 three times greater than that of current operating levels.

1. Introduction

1.1 As mandated by Congress, the JPDO is a public-private partnership tasked to modernize and transform the national air transportation system by the year 2025, while providing near-term benefits throughout the process. NextGen 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 Federal Aviation Administration (FAA), the National Aeronautics and Space Administration (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 NextGen. 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.

2. NextGen PRINCIPLES

2.1 NextGen 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.

2.2 Safety in NextGen is approached in a prognostic fashion, establishing a new safety culture that assesses risk in a predictive environment, instead of the existing reactive context.

2.3 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 American 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. NextGen CAPABILITIES

3.1 We have defined several key capabilities that denote the major characteristics of NextGen that are currently missing from today's system. As a "total system" concept, there are multiple dependencies among these capabilities.

3.2 These key NextGen capabilities include: Network-Enabled Information Access; Performance-Based Services; Layered, Adaptive Security; Weather Assimilated into Decision-Making; Broad-Area Precision Navigation; Aircraft Trajectory-Based Operations; Equivalent Visual Operations; and Super-Density Operations.

3.3 **Network-Enabled Information Access**

3.3.1 Making information available, securable and usable in real time according to defined “communities of interest” is central to the NextGen 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.

3.3.2 In the NextGen 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 (i.e., pilot licenses or aircraft maintenance records), 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. Providers of the data will ensure appropriate information protection as necessary to address national defense, security, and privacy concerns.

3.3.3 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.

3.4 **Performance-Based Services**

3.4.1 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.

3.4.2 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.

3.5 **Weather Assimilated Into Decision-Making**

3.5.1 Leveraging the benefits of Network-Enabled Information Access, NextGen 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.

3.5.2 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 NextGen use. NextGen will move from weather data dissemination of text and graphical products to ingestion of raw weather information into NextGen decision algorithms and processes – bypassing the need for human interpretation.

3.6 **Layered, Adaptive Security**

3.6.1 Far from the add-on dimension of our current security system, Layered, Adaptive Security will integrate security functions into NextGen 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.

3.6.2 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.

3.7 **Broad-Area Precision Navigation**

3.7.1 Broad-Area Precision Navigation will provide navigation services where and when needed to enable reliable aircraft operations in nearly all conditions¹. 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.

3.7.2 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.

3.7.3 NextGen Broad-Area Precision Navigation (at different required levels of performance) will likely include a next generation of Global Positioning System (GPS) satellites with non-terrestrial navigation augmentation for CAT-I approaches and hybrid Global Navigation Satellite System (GNSS)/inertial avionics for CAT II/III approaches.

3.8 **Aircraft Trajectory-Based Operations**

3.8.1 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.

¹ direct weather hazards to aircraft, such as severe thunderstorms, will affect operations at certain times.

3.8.2 The design must not only improve system efficiency but also meet goals for security, safety and environmental compatibility. NextGen will use four-dimensional (4-D) 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.

3.8.3 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.

3.9 **Equivalent Visual Operations**

3.9.1 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.

3.9.2 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.

3.10 **Super-Density Operations**

3.10.1 Key to the complete success of NextGen 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. NextGen PRODUCTS

4.1 The JPDO has developed technical documentation to bring the 2025 NextGen Operational Vision into much greater definition.

4.2 The NextGen 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 focused 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. The most recent version (Version 2.0) of the ConOps, called “curb to curb,” includes operations that take place before and after a flight. Also, the additional topics of environment and airports are included in this newer version. Version 2.0 of the ConOps was released on 13 June 2007. The JPDO will release an updated ConOps in 2010.

4.3 The NextGen ConOps is being developed concurrently with the NextGen Enterprise Architecture (EA). The NextGen EA represents the actual plan for how NextGen 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 NextGen EA is a recognized tool for re-engineering business practices and the underlying technology that supports them. Version 3.0 of the EA was published in January 2009.

4.4 The NextGen Integrated Work Plan (IWP) complements the ConOps and Enterprise Architecture by providing the programmatic and schedule details of the transition to NextGen. The IWP describes the transition from the current air traffic system to the future air transportation system. It is an evolutionary plan that illustrates how NextGen will be researched and developed, what commitments are required from major development partners, what policy actions are required, and what key decisions will be necessary along the way. IWP Version 1.0 was released to the public in September 2008.

4.5 To view a copy of the NextGen ConOps, the NextGen Enterprise Architecture, and the NextGen IWP, please visit the JPDO Web site at <http://www.jpdo.gov>.

4.6 The FAA released a NextGen Implementation Plan (NGIP) which is published annually. The latest implementation plan was published in January 2010 with two primary purposes. The first is to more closely align the plan’s publication with the release of the FAA’s National Airspace System Enterprise Architecture and the budget cycle. The second is to provide a springboard for a new level of engagement with the aviation community on NextGen equipage. This dialog will be critical for achieving benefits and return on investment for both the community and the government.

4.6.1 The FAA outlined six NextGen Transformational Programs in the 2010 NGIP. The programs include; Automatic Dependent Surveillance –Broadcast (ADS-B), System Wide Information Management (SWIM), NextGen Network Enabled Weather (NNEW), NAS Voice Switch (NVS), Data Communications (Data Comm), and Collaborative Air Traffic – Technologies (CATM-T). To read a copy of the FAA’s NextGen Implementation Plan, please visit the FAA website at <http://www.faa.gov/nextgen>.

4.7 The FAA is currently developing the NextGen Segment Implementation Plan (NSIP). The first phase of the NSIP, Segment Alpha, provides the blueprint to implement the mid-term Operational Improvements until 2015. The second phase, Segment Bravo, covers the implementation between 2016 and 2018. The NSIP is organized into functional portfolios, each of which contains a set of capabilities that share a common benefit pool.

4.7.1 The FAA identified eight functional portfolios and one set of common services in NSIP Segment Alpha. The functional portfolios include: Collaborative Air Traffic Management (CATM), Improved Surface Operations, Time-Based Flow Management (TBFM), Closely Spaced, Parallel, Converging, and Intersection Runway Operations, Improved Vertical Profiles and Low Visibility Operations, Performance-Based Navigation (PBN), On-Demand NAS Information, Automation Support for Separation Management.

4.7.2 **Collaborative Air Traffic Management**

4.7.2.1 Collaborative Air Traffic Management (CATM) coordinates flight and flow decision-making by flight planners and the FAA traffic managers to improve overall efficiency, provide greater flexibility to flight planners, and make the best use of available airspace and airport capacity. The overall philosophy driving the delivery of CATM services is to accommodate user preferences to the maximum extent possible. Traffic managers impose Traffic Management Initiatives (TMIs) to account for congestion, weather, special activity airspace, or other constraints. TMIs are the means by which traffic managers enforce a constraint. These initiatives can alter users' flight plans. The impact of TMIs can be reduced by tailoring flow management actions to specific flights. This can be done through a combination of increased information on the users' preferred alternative routes; enhanced tools for assessing the impact of rerouting decisions; and improved communications and display of instructions to the controllers who must implement the initiatives.

4.7.3 **Improved Surface Operations**

4.7.3.1 Improving surface operations involves improving safety, efficiency, and access by implementing new capabilities for both pilots and air traffic management (ATM). Improved runway safety situational awareness for controllers and pilots is brought about through Segment Alpha increments that provide surveillance equipment with automation that displays location and identification of aircraft on busy airport surfaces; basic surface traffic surveillance at medium and small airports; and Runway Status Lights (RWSL) to alert flight crews to risks. Surface traffic operations and management are improved through the Segment Alpha increments providing data communications and automation assistance to ground controllers and flight crews regarding airport movement and departure clearances. An advanced service included in Segment Alpha is improved runway assignments for flights based on their departure routing.

4.7.4 **Time-Based Flow Management**

4.7.4.1 The Time-Based Flow Management Portfolio will enhance system efficiency by leveraging the capabilities of the Traffic Management Advisor (TMA) decision support tool, a system that is already deployed to all contiguous U.S. Air Route Traffic Control Centers (ARTCCs). In particular, improvements in TMA's core Time-Based Metering (TBM) capability and its trajectory modeler, an expansion of TMA and its capabilities to additional locations, and enhancements to TMA's departure capabilities, will enhance efficiency, optimizing demand and capacity well into the mid-term.

4.7.5 Closely Spaced, Parallel, Converging, and Intersecting Runway Operations

4.7.5.1 The FAA will enhance access to converging, intersecting, and closely spaced parallel runways by making the following incremental changes to use improved technology, updated standards, safety analysis, modifications to air traffic monitoring tools, and new operating procedures that will enable more arrival and departure operations, and field integrated airport surface decision-support tools, standards, and processes via Tower Flight Data Manager (TFDM).

4.7.6 Improved Vertical Profiles and Low-Visibility Operations

4.7.6.1 The FAA will improve vertical profiles and increase access to airports and runways during low-visibility operations through a combination of procedural changes, improved aircraft capabilities, and improved precision approach guidance. The procedural changes provide more efficient profiles. The improved aircraft capabilities include vertical navigation. Improved precision approach guidance leads to improved flight accuracy and reliability, and leverages satellite navigation (SATNAV) augmentation.

4.7.7 Performance Based Navigation

4.7.7.1 Performance-Based Navigation (PBN) is a framework for defining navigation performance specifications for an aircraft along a route, during a procedure, or in airspace. These navigation performance specifications have been defined and have specific operational performance requirements. PBN provides a simple basis for the design and implementation of automated flight paths, as well as for airspace design, aircraft separation, and obstacle clearance. PBN comprises both Area Navigation (RNAV) and Required Navigation Performance (RNP).

4.7.8 On-Demand NAS Information

4.7.8.1 The On-Demand National Airspace System (NAS) Information Portfolio will implement programs and processes to ensure that the NAS and aeronautical information is consistent across applications and locations, and is available to authorized subscribers and equipped aircraft. The initial Segment Alpha capabilities will focus on providing pilots and Flight and Airline Operations Centers (FOCs/AOCs) with reliable and relevant Special Activity Airspace (SAA) status and NOTAM constraints. This information will be disseminated over System-Wide Information Management (SWIM) and Traffic Information Service-Broadcast (TIS-B) and Flight Information Services-Broadcast (FIS-B).

4.7.9 Automation Support for Separation Management

4.7.9.1 This portfolio includes changes to the En Route and Oceanic automation systems to support the en route and oceanic controllers in performing separation management. Separation management is performed in a different way in each of the domains (i.e., oceanic versus en route). The automation changes required will vary based on the needs of the respective controller in the domain. The main automation systems that support the en route and oceanic controllers are En Route Automation Modernization program (ERAM) and Ocean21, respectively.

5. NextGen EARLY OPPORTUNITIES

5.1 The JPDO and its partner departments and agencies are focused on objectives for near-term benefits. On 16 January 2008, the US Transportation Secretary challenged the Senior Policy Committee (SPC) to develop an acceleration plan for NextGen. At its May 2008 meeting, based on collaboration between its agencies, the SPC agreed to move forward on a set of near-term activities. Among examples of the acceleration plan is the FAA's sponsoring Integrated Test Bed Demonstrations to develop a prototype "Airport of the Future." Over a three-year period, the project will demonstrate emerging technologies in safety, security, capacity and overall efficiency, including up-linking weather data directly to the aircraft which will enable real-time decision making and improved safety.

5.2 Similarly, the Department of Defense (DoD) will explore the use of continuous descent arrivals at dual-use airfields and is working with the FAA to implement one Federal Notice to Airmen (NOTAM) system. The DoD is committed to the joint use of Special Use Airspace to the maximum extent practicable.

5.3 The Weather Working Group Policy Team, consisting of members from DoD, the US National Oceanic and Atmospheric Administration, FAA and Industry, completed the definition for the Single Authoritative Source (SAS) that provides sufficient guidance for the development of detailed specifications at the weather element level by the Initial Operational Capability (IOC) Team. The SAS at IOC will be the starting point for evolution toward Final Operational Capability (FOC) over the life of NextGen. A coordinated multi-agency weather 4D Cube Plan for IOC and an ATM-Weather Integration Plan (version 2) have been completed and will be presented to the SPC in September. These Plans describe actions/milestones for agency implementation and will be folded into the JPDO Integrated Work Plan.

5.4 The acceleration plan is designed to test technical feasibility and operational viability in localized geographic zones, with the intention of expanding to locations throughout the United States.

6. Conclusion

6.1 The strategy for NextGen is to define what the future system will look like, knowing that it is unlikely that the concept presented here will emerge exactly as the NextGen 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 NextGen, we are also taking a global perspective. We cannot build a harmonized system without partnerships with our domestic stakeholders and international counterparts. We invite all interested States to learn more about NextGen and how this process can assist other States in the development of their future air transportation systems.

6.2 For more information, please contact David S. Burkholder, Acting Director, Air Traffic Organization (ATO) International Office, at david.s.burkholder@faa.gov.
