ALPA WHITE PAPER

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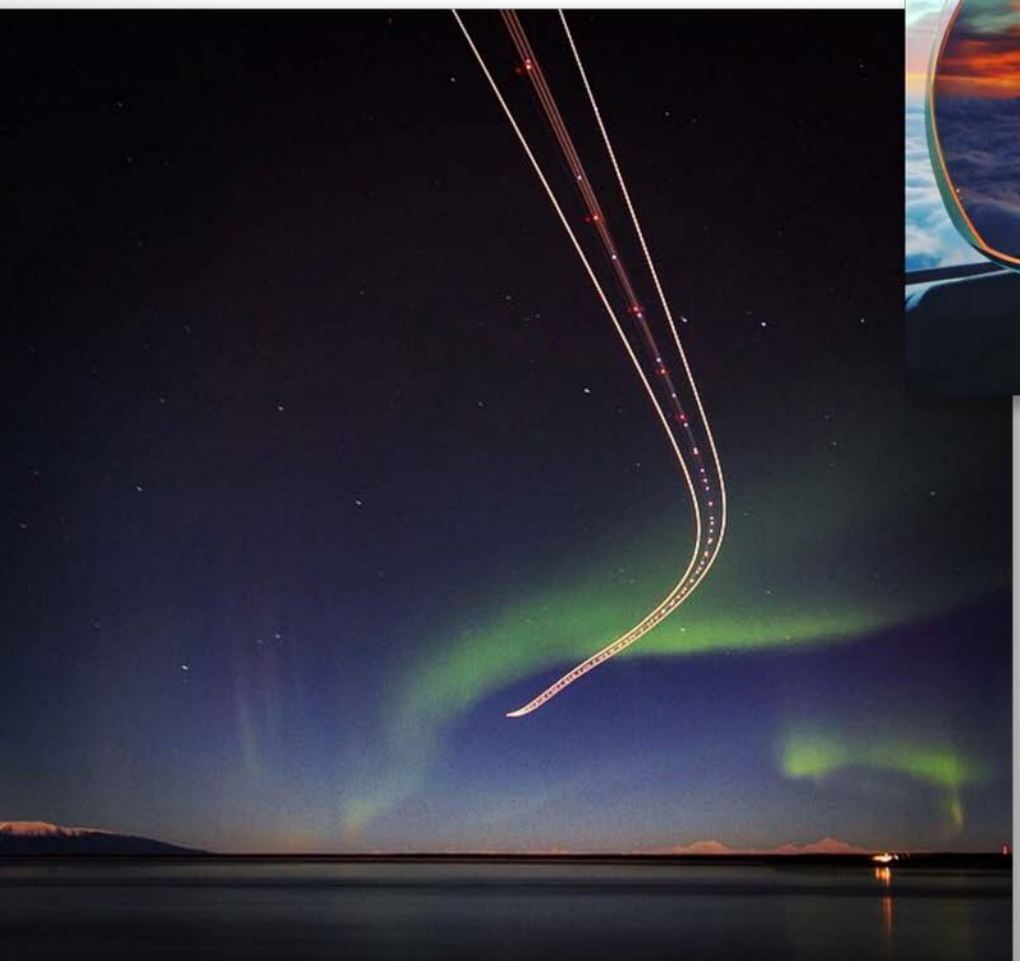
ALPA Perspectives on the Next Generation Air Transportation System

NextGEN



ALPA Perspectives on the Next Generation Air Transportation System (NextGen)

Introduction

The Air Line Pilots Association, International (ALPA) is committed to working with regulators, legislators, and industry partners to modernize the airspace systems in which we operate around the world. In the United States, this effort takes the form of participation at many levels with the FAA's NextGen program. Similar efforts are underway in Canada, and ALPA participates through the International Federation of Air Line Pilots' Associations (IFALPA) in efforts beyond North America. ALPA members, along with our air traffic controller colleagues, represent the professionals on the front line of operations every day and thus possess a unique view of the challenges in safely improving capacity and efficiency. Pilot representatives and ALPA Engineering and Air Safety Department staff are working diligently to ensure the pilots' perspectives are included in the discussion of improvements and that pilots' interests are represented in the process. The overarching goals of our work in that process are:

1. Ensure capacity improvement initiatives maintain or increase the level of safety.
2. Implement pilot-centric solutions.
3. Ensure global standards are developed and utilized to ensure global interoperability.
4. Actively participate in discussions to improve the mechanism and structure used to deliver air navigation services.

For more than a decade, the Federal Aviation Administration (FAA) program to modernize the air traffic control system has been referred to as the Next Generation Air Transportation System (NextGen) initiative. In Canada, Europe, and elsewhere around the world, air navigation service providers (ANSP) are undertaking similar large-scale, long-duration upgrades to their own systems. Although this paper makes frequent reference to FAA's NextGen program, most, if not all, of the issues involved with the NextGen enterprise are present throughout North America and in the areas internationally undertaking similar programs. NextGen and the related international efforts are generally all considered to be comprehensive modernization efforts to maintain historic levels of safety while:

- Increasing airspace and airport capacity.
- Increasing Air Traffic Control (ATC) system efficiency.
- Integrating security enhancements.
- Integrating unmanned aircraft systems operations.
- Reducing aviation's impact on the environment (noise and emissions).

The NextGen initiatives rely on new or improved technologies, new or improved procedures, updated regulations, and supporting policy changes. The FAA's timeline for NextGen implementation spans nearly three decades. The currently envisioned series of enhancements began with a system concept of operations in the early 2000s, but the idea of transforming the nation's airspace and moving

away from traditional ground-based radar control of aircraft goes back much further. However, the combination of technological advancement, national will to change, and the funding needed to make it all happen has only been seen in the last decade. It can be argued that modernization efforts like NextGen in the United States and equivalent enhancements to communications, navigation, surveillance, and air traffic management (CNS-ATM) in Canada will never be complete, not because of any lack of planning or execution, but because, like any project reliant on large advances in technology, some of the enhancements made early in the evolution of these changes will undeniably be replaced by even more efficient, more accurate, and less costly alternatives at some point.

Nevertheless, when the end state currently envisioned is achieved sometime beyond 2025, the national airspace system (NAS) in the United States will have been significantly transformed. Indeed, that dramatic transformation is well underway, leading many

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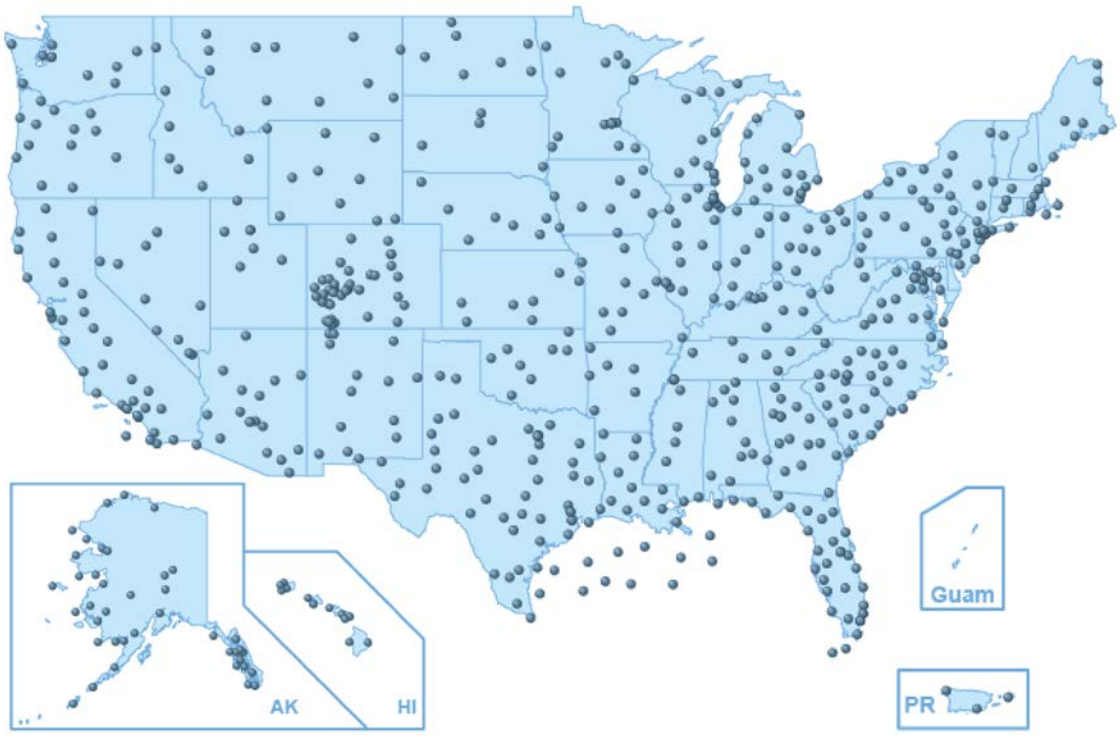
to use the term "NowGen" to describe portions of the overall effort that are already flagged as success stories. Groundbreaking application of GPS-based surveillance technology, ADS-B (considered a key enabler of NextGen), and Controller Pilot Data Link Communications (CPDLC) has shown marked increases in efficiency and safety, especially in remote areas previously beyond coverage of ground-based infrastructure. NextGen initiatives are being implemented in stages, and nearly all are underway to varying degrees. As the programs mature and as more are implemented, they will eventually result in more complex applications with interlinked technologies, highlighting the



Map depicting ADS-B ground station network

need for accurate planning and execution. The real future benefits envisioned will happen as the resulting data is converted to usable information by the pilots and controllers enabling more efficient operational decision-making.

Modernization efforts directly affect every aspect of aviation and are interwoven with many existing and future initiatives for change. Therefore, identifying "the cost" is virtually impossible, but estimates by the FAA and others have put the cost in the United States at about $40 billion, with about half of that borne by the U.S. government and the other half by airlines and other NAS users. Considerable effort is being expended by the FAA and stakeholders to ensure that the planning and execution of this multi-billion dollar enterprise is done efficiently and that a positive business case is achievable for customers. Stakeholder support for the effort is impossible without that assurance that investments of the magnitude required for this change will see a high likelihood of satisfactory returns. Much of the return on investment for the airlines hinges on effective planning, minimizing the time aircraft are out of service for equipage and maximizing the use of equipment once installed. The planning effort is therefore as complex, and as important, as the execution itself.

FAA's NextGen Plan

The driving reference document for the NextGen program is the NextGen Implementation Plan, updated annually. Beyond that, the FAA has developed a significant amount of documentation describing NextGen, available online at *www.faa.gov/nextgen/library*. The FAA, through a variety of collaborative efforts, has involved industry stakeholders in the development of and updates to the NextGen Implementation Plan, which the industry has agreed to use as a basis for the work being done and is the primary reference document for stakeholders' participation.

Why ALPA Supports Modernization

Recognizing that safety and efficiency enhancements are necessary in order to stay ahead of the predicted growth in passenger air travel and the transport of cargo over the next three decades, ALPA stands alongside most of the aviation industry in support of the FAA's efforts to implement NextGen and efforts by Transport Canada and NAV CANADA to implement similar modernization efforts in Canada. Time and again, various experts have documented that the benefits of modernization far outweigh the costs. If implemented correctly, the safety improvements that accompany the gains in capacity and efficiency will greatly benefit ALPA members for the next several decades. Many modernization-related initiatives, when mature, will afford pilots and controllers more timely, accurate, and comprehensive information to use in both strategic and tactical decision-making. Others will allow more accurate, predictable routing in busy terminal areas, reducing cockpit workload and improving situational awareness.

The Safety Benefits of NextGen

Maintaining the highest level of aviation safety has come to be viewed by the public in general as a given. Any modernization efforts must have at their core the fundamental principle that the high level of safety enjoyed in North America cannot be adversely impacted. Safe and efficient change is vital to the continued robustness of the airspace system and specifically to the airports and the ATC system. Modernization programs like NextGen and similar efforts in Canada and elsewhere are vital to the future of aviation safety.

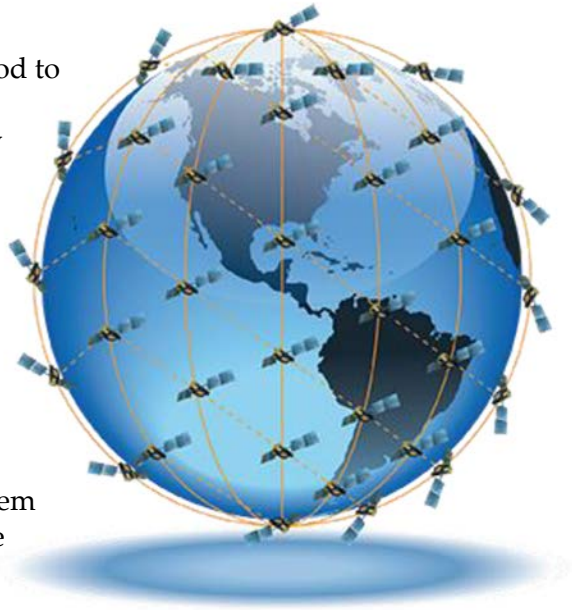
Today's air transportation system is the safest transportation system in the world. Airline passengers are about 40 times safer in an airliner than on the safest highway system in the world. But we are at a crossroads. ATC systems are getting older, and there are many systems on our newer aircraft that are not used to their

fullest capabilities. Where modernization efforts have not yet begun, infrastructure is woefully outdated, the equipment's capabilities are limited, facilities are crumbling, efficiency is decreasing, and capacity is limited. These shortcomings, left unchecked, eventually have the potential to decrease efficiency and even erode safety margins, because our air traffic system and infrastructure have not been kept up to date.

Despite all that, it is a tribute to the dedication and professionalism of our pilots, controllers, air traffic services employees, and regulators that the system continues to operate safely. Efficiency is another matter entirely. The system generally operates efficiently, but is becoming more and more sensitive to any type of disruption. There is little flexibility and even less capability to accommodate irregularities that inevitably occur. One has only to look at the impact of radar outages, poor weather, or various technological shortcomings to see the mass congestion and delays that result and can persist for hours and even days after any perturbation. The legacy systems we have in place cannot keep going indefinitely and indeed will be unsupportable in the near future.

Airport improvements for NextGen will improve safety and efficiency. Key enhancements include runway(s), taxiways, lighting, signage, and other parts we often take for granted. The layouts at some airports result in high risk of runway incursions while others operate at reduced throughput because of excessive runway occupancy time. Making substantive changes to airport layouts with such things like high speed exits, rerouted taxiways, improved signage, and other "low tech" actions are part of the overall NextGen solution to improve safety and efficiency.

The ATC system has moved from separating flights using radio position reports to positive control using radar in all but the most remote, sparsely populated regions of North America. With the introduction of the Global Positioning System (GPS)—a system originally designed by the U.S. Department of Defense as a precision method to attack targets and adapted by the aviation industry—aircraft navigation is moving from a ground-based navigation system to a satellite-based navigation system and at the same time achieving unprecedented levels of positioning accuracy. GPS technology allows all types of aircraft, both large and small, to fly extremely precise approaches around the world in all types of weather using purely satellite-based navigation systems.



We have a lot of work to do. Despite improvements in technology, a large percentage of the tens of thousands of airline flights a day across North America are controlled much the same as they were in 1960—by ground radar stations using technologies developed in World War II. Modernization efforts like NextGen will completely replace this analog, ground radar-based air traffic control infrastructure with a 21st-century, digital, satellite- based system.

The ever-expanding use of procedures designed to capitalize on satellite-based positioning provides precision surveillance and navigation capability that will give pilots and controllers more accurate and detailed real-time information about aircraft location than is currently possible, increasing situational awareness and making the system safer. As a result, aviation system users will benefit from precision-approach capability at locations and runways where precision approaches do not currently exist.

Pending more widespread implementation of procedures exploiting the improved navigation accuracy possible through NextGen, we are seeing the implementation of nonstandard

procedures in some locations in an attempt to gain capacity and efficiency improvements. While these procedures are compliant with appropriate standards and stakeholders continue efforts to ensure an adequate level of safety, this locally focused strategy adds the potential to introduce procedures that vary between areas, leading to confusion among pilots and controllers, as well as the potential to improve efficiency at one airport in an area at the expense of others. Moving forward on NextGen implementation would mitigate the need for these nonstandard, location-specific applications. Our current system is capacity-limited. Without the improved navigation accuracy possible through NextGen, we risk reducing the current safety margin for that system capacity.

As part of the effort to effectively implement modernization initiatives across the spectrum of North American operations, the FAA, Transport Canada, and NAV CANADA are realizing the advantages of looking at the impacts of change at a "hub" airport on efficiency at nearby airports. In the United States, the FAA has developed the metroplex initiative. This process is intended to evaluate

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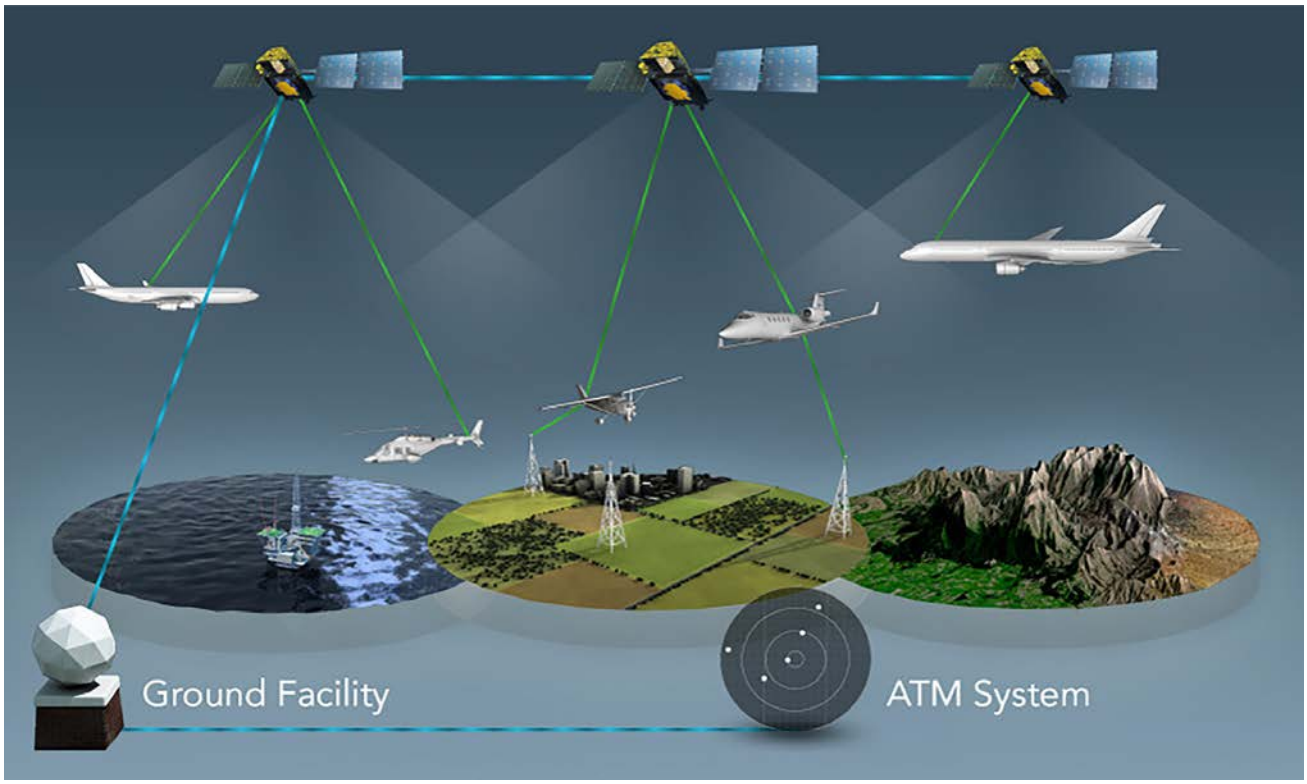
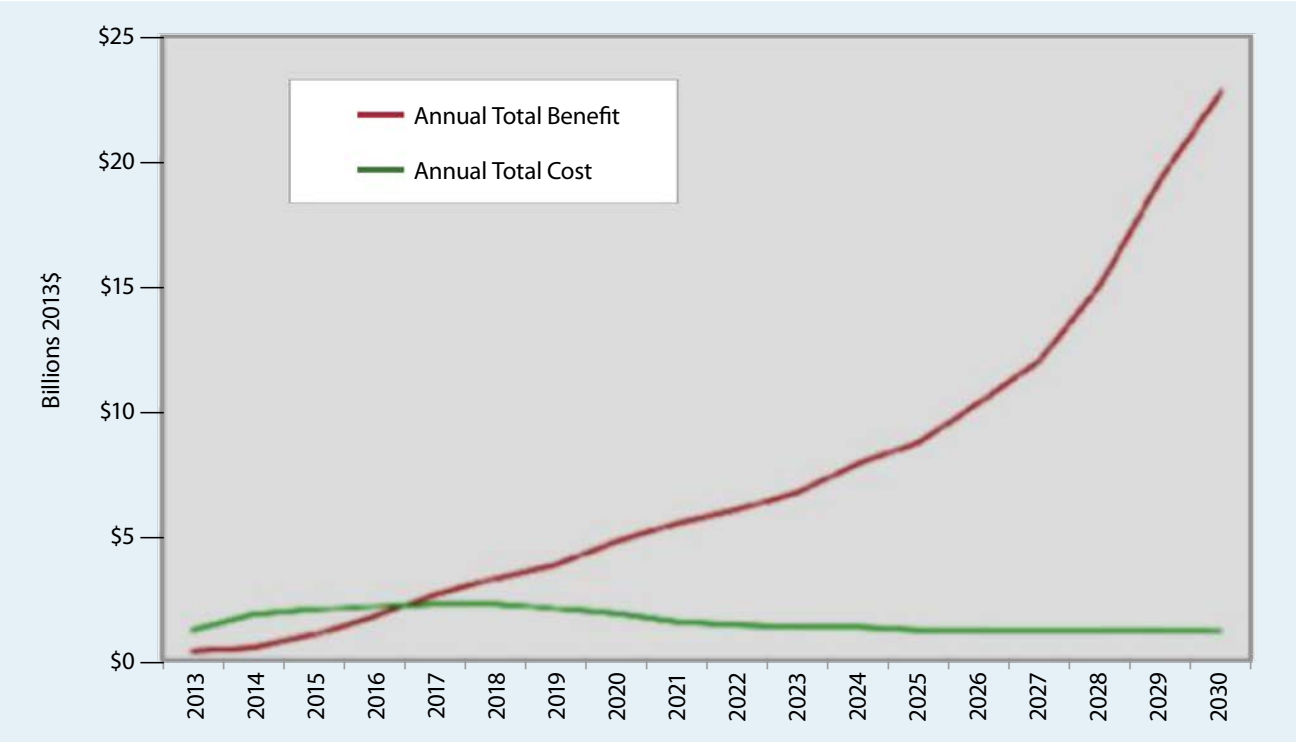
the capacity restrictions and other inefficiencies in a context of all the major airports in an area whose traffic flows impact each other. Major metropolitan areas such as New York, with multiple airports used by both air carriers and high-end general aviation (business) aircraft, are evaluated as an entity. Stakeholders from all affected aviation constituencies, as well as community and airport interests, are involved in identifying areas where efficiency gains can be made in the overall capacity of the entire metroplex area, rather than at a single individual airport. This approach has proved to be successful in several areas and is actively being developed in others. This approach is characteristic of the growing understanding that NextGen is not a single program but rather is a "system of systems" that needs to be viewed in its entirety.





The Economic Importance of NextGen

As the budget debate rages in Washington, the public and our political representatives should agree that we need to make acceptable return on our investments. That is to support the ones that bring back more benefits than the cost of what we put in—those that grow the economy and create jobs. These are decisions that businessmen and women make in companies large and small every day. It is fundamental to long-term success.

There is no serious disagreement on the need for a smart investment in NextGen—it's plain that funding NextGen will bring enormous returns to the U.S. economy for years to come and equally clear that funding must continue and be guaranteed for the duration of the effort with strong oversight. This also means that the services promised by the FAA for investing in the technologies and programs must be delivered, and the benefits must be realized.

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The civil aviation industry has a critical role in ensuring a robust, growing economy in North America and, in fact, the rest of the world. Civil aviation, directly and indirectly, contributes more than $1.3 trillion to the U.S. economy each year. It is a driving force of the economy of North America at 5.2 percent of the U.S. gross domestic product and nearly 3 percent of Canada's. The value of air travel—leisure and business—is a critical pillar of the economy. Hotels and resorts, conference centers, rental car companies, tourist attractions, logistics management (such as just-in-time delivery), and other global business industries are not nearly as viable without reliable, efficient, and affordable air travel. In today's economy—and even more so in tomorrow's—millions of jobs depend on keeping the air travel system healthy. NextGen and similar modernization efforts across North America will increase capacity and efficiency while generating growth in airlines, aviation companies, and suppliers. This will lead to job growth at a time when it is needed most.

Aircraft Technology Upgrades

Key technical parts such as communication, navigation, and surveillance systems are integrated into aircraft cockpits and optimized by using technological advances to address future air traffic control and user community needs.

The specific aircraft technologies enabling NextGen include:

Domain	Function	Technology
Navigation	Performance-Based Navigation	Global Navigation Satellite System (GNSS)
Surveillance	Ground-Based ATC In Flight Trail Procedures Interval Management	Automatic Dependent Surveillance-Broadcast (ADS-B)
Communications	DCL Data Clearance D-Taxi Frequency Change	Controller Pilot Data Link Communications (CPDLC)

The technologies introduced above are capable of operating individually but become most effective when operating in concert with air traffic management (ATM) systems used by controllers and traffic-flow management experts. The ATM systems:

1. Ensure safe separation of aircraft,
2. Manage *four* dimensional aircraft flight paths (laterally, vertically, and temporally), and
3. Plan efficient flow.

NextGen technologies will likely integrate aircraft capabilities and ground automation to a much deeper level than the systems in use today. The avionics system installation and upgrades intended for airline aircraft will likely require operators to develop implementation plans that establish timelines for installing new hardware on their aircraft and training flightcrews to effectively use the new technology.

Another important component of NextGen implementation is to determine how the airspace and ground infrastructures are coordinated and redesigned to optimize our flight operations for the future and the predicted traffic volumes. Potential benefits of this design may permit safely reduced separation between aircraft, reduced flight times between cities enabled by optimized flight path management, and efficient ground operations. Newer aircraft in the airline fleet are establishing improved engine and airframe designs that result in better fuel efficiency that, coupled with optimized flight paths made possible by NextGen initiatives, will allow for greater capacity at both airports and in en route airspace.

In addition to the operational efficiencies that can be achieved through integrated implementation, the combination of the ability to precisely determine aircraft location and move vast amounts of information to and from aircraft provides additional security to flight operations. Ultimately, with the inclusion of a space-based infrastructure, aircraft will be able to be in constant contact with ground facilities anywhere on the planet. Along with normal operational information, aircraft can be quickly notified of potential threats to the operation or the airline when operating in or near areas of political unrest or hostilities. This same "everywhere all the time" capability will also provide airlines and ATC the ability to track the position of flights from start to finish regardless of routing. While this capability represents an operational improvement, it also introduces risk that must be managed. The ability to pinpoint the location of every airborne aircraft is a potential security vulnerability that would need to be addressed as these technologies are integrated into operations.

> NextGen deployment must result in increased levels of safety, while also adding capacity and efficiency gains for the operators in all airspace and surface operating environments.

Harmonization and Interoperability—Key Elements of Success

As noted above, efforts to modernize the infrastructure, technology, and procedures involved in the provision of air traffic services is underway globally. At the same time, aviation continues to become ever more international and global in scope. Advances in aircraft and engine design now make it possible for airlines to operate in every corner of the globe. Clearly, if the air traffic management system in one part of the world undergoes a dramatic change, such as NextGen in the United States, the means by which capacity and efficiency are safely improved must be compatible with similar efforts worldwide in order to take full advantage of the change. It serves no purpose to efficiently deliver more aircraft safely across vast distances if they cannot be just as efficiently accommodated in the destination airspace. Similarly, from the pilots' viewpoint, we need to minimize the number of differences in local procedures that can lead to confusion, higher workload, and loss of situational awareness. The key to safety and efficiency in provision of air traffic services is, like all of aviation, standardization down to the smallest detail. Technologies must work together seamlessly, pilot-controller communication must be independent of regional variations, and the process of getting from an en route structure to the terminal area needs to be the same, whether the terminal area is Houston, Montreal, Beijing, or Frankfurt.

What Are ALPA's Goals in NextGen?

NextGen deployment must result in increased levels of safety, while also adding capacity and efficiency gains for the operators in all airspace and surface operating environments. As NextGen is deployed, ALPA members should experience improved operating conditions in the following ways:

1. Improve safety by modernizing the air traffic control system through increased information sharing, improved pilot situational awareness, and access to better tools for decision making that ultimately enable a more efficient flight operation. The outcome must increase the safety of the current operation to maintain overall safety levels in light of forecast flight volume increases.

2. Implement pilot-centric solutions. ALPA's participation in NextGen will emphasize pilot-centric solutions and closely monitor activities that affect the conduct and outcome of flights. Humans must remain centric in the decision processes affecting our flights. The decision process should never be contradictory to the captain's authority. New procedures must be developed, and effective training must be put in place prior to deployment of these systems. Some of the work can be automated, and even some of the workload may be slightly increased if the results appropriately increase safety.

3. Ensure global standards are utilized and ensure global interoperability. ALPA believes a key to successful NextGen development must be implementation of global standards that allow for a single set of procedures and rules to accomplish the flight globally. Different geographical regions are implementing their future aviation systems, but it is unclear whether all systems are harmonized adequately. ALPA members have experience in airline operations and ATC procedures

Potomac Consolidated TRACON, FAA, Warrenton, VA.

throughout the world and share that global perspective with stakeholders and national authorities to facilitate harmonization. ALPA sits on the NextGen Advisory Committee and other coordinating bodies in the United States developing national and international policy that must include the need for harmonization. In addition, ALPA, through our membership in IFALPA, brings the pilot perspective to development of harmonized standards at the International Civil Aviation Organization.

Discussions of the goals of efforts toward a modernized ATC system inevitably lead to the issue of how a state and its air navigation service provider (ANSP) can best provide the capabilities listed above and achieve those goals. There has been considerable discussion in the United States about various ways to improve the U.S. ATC system while maintaining the characteristics of a safe, efficient ATC system. Various examples of government and nongovernment structures of regulator and ANSP in use in other countries have been proposed or discussed, as have hybrids of those models, modified to best suit the National Airspace System scope of operations in the U.S. At the same time, the aviation industry has come to realize the value of "performance-based" standards intended to specify a desired performance of a system or procedure without explicitly defining how that performance is to be achieved, thereby allowing room for innovative approaches. ALPA, as a key stakeholder, has participated actively in discussions about the characteristics of the future air traffic management (ATM) system.

In that context, ALPA has developed a high level description of what we believe to be characteristics of a well-designed system for the provision of air traffic services (communications, navigation, and surveillance), regardless of whether the organization providing those services is a government department, private business, or some other business model. This is consistent with the role that ALPA plays as a stakeholder in the management and oversight of NAV CANADA and addresses funding, performance, and structure.

ALPA believes that a safe, efficient, effective ATC system must have certain characteristics in order to function in a dynamic ATC

environment. These characteristics should include, as a minimum, the following:

1. The ATC system economic model should be a not-for-profit entity. The financing method of that entity shall be (i) fair and equitable based on use of the system and (ii) take into account commercial aviation's benefit to the nation's economy.

2. Funding for the ATC system must ensure that reliable, predictable, and sufficient long-term funding is available for the sustained development and continuous modernization of an extremely complex system.

3. The ATC system governance should be structured in a way that ensures involvement in decision-making by ALPA (representing commercial airline pilots), the National Air Traffic Controllers Association (representing air traffic controllers), and all other stakeholders.

4. The ATC system must be agile enough to adapt to technological advancement in a timely manner and robust enough to ensure that thorough, timely safety analyses of key programs and procedures are completed.

5. The ATC system must ensure staffing is sufficient to maintain safe operations in any airspace or airport used by air carriers and other aviation system users.

6. Any shift in responsibilities for providing ATC services from a government agency to another not-for-profit model (e.g., "private," "corporate," or "federal corporation") must not disrupt or disturb the employer–employee relationship in an adverse way. Any shift must continue to provide a stable and secure working environment for all employees of the agency including the continuity of the collective bargaining relationships and processes for the employees represented.

ALPA Involvement in NextGen

Flight operations around the world will be affected by the deployment of NextGen and similar modernization initiatives. As the domestic and international airspace undergoes this transformation, pilots will likewise experience changes to their flight operations. Some changes will be transparent, and some will be revolutionary. These changes dictate that the airlines develop effective training in new navigation systems, flight management systems, and pilot-to-controller communications. Again some change will be simple and some complex—it depends on the component being changed and its effect on the other pieces.

Pilots will have the tools to safely operate aircraft in closer proximity and with increased precision in the future, and pilots will be expected to proactively operate their aircraft in order to maintain the highest levels of safety in that environment just as they are today. Fortunately, ALPA is recognized as a key stakeholder and has been invited to participate extensively in all aspects of NextGen design, development, and deployment. ALPA safety representatives provide the industry with a much needed cockpit-oriented operator's perspective. In this key stakeholder role, ALPA participates on several government and industry advisory groups as pilot subject-matter experts. Among these are the FAA's NextGen Advisory Committee (NAC) and the NAC Sub-Committee, both of which are executive-level strategic planning bodies and conduct a wide variety of technical NextGen projects where industry stakeholders propose standards for implementing new technology. The breadth and scope of the work underway by ALPA requires broad coordination from the executive level, the technical groups, and specific committees. This work is frequently reviewed for applicability and effectiveness in carrying out ALPA's strategic safety priorities.

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Conclusions

NextGen and its companion modernization efforts in Canada and elsewhere are in full swing. Much of the technology needed for the ultimate goals is already being used. Pilots and controllers are providing valuable operational experience and channeling that experience to improve both ongoing and developmental efforts. This is no longer an academic planning exercise intended for future use. It is here now. The costs and benefits are enormous, with far-reaching impacts on national and global economies. In the midst of all this revolutionary change, the enviable safety record built by aviation over decades must be jealously guarded. And all this must be done while the existing systems are in full operation. Long-term commitment and involvement by key stakeholders, including ALPA, long-term commitment for strong financial support by legislators, and long-term commitment and leadership by regulators are all critical to the success of these efforts—modernization is vital and has to be done right the first time ▲

Cockpit, Boeing 757.


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