A variety of aircraft will share the future air transportation system

Chapter 10: Flying Into the Future

Since the Wright brothers' historic flight, aviation has been a vital national resource for the United States — its strategic, economic, and social importance remains unsurpassed. Aviation is critical to our national well-being and interests. It provides invaluable opportunities for travel, for new business, for jobs, and for the general growth and development of the U.S. economy. It serves an important role in attracting investment to local communities and helps stimulate and sustain growth by opening new markets and supply chains, nationally and internationally.

Thanks to the work of FAA, over the past fifty years aviation has become central to the way we live and do business, linking people from coast to coast and connecting America to the world. In fact, FAA has created the safest, most reliable, most efficient, and most productive air transportation system in the world.

Aviation is an integral part of our daily lives. We travel for work and recreation. Airplanes bring us closer to family and friends. They deliver food and consumer goods. They provide emergency transportation and delivery of medical services and supplies. They link us to the world, facilitating the export and import of products and materials. They provide critical safety services. They serve as our first line of defense in an uncertain world.

New frontiers are opening as commercial space transportation becomes more common. Today this generally refers to private companies launching satellites into space. Tomorrow it may mean vehicles that take private citizens on sub-orbital flights and eventually into orbit. To maintain safe and efficient national airspace system (NAS) operations, FAA will need to accommodate the growing demand for commercial space launches.

To ensure aviation's future viability, FAA is working with its federal and industry partners to develop a flexible aerospace system that fully responds to the changing needs of businesses, customers, and the general public. The strength of the future system depends on lower costs, improved service, greater capacity, and smarter security measures. That is why FAA has defined a vision of the future that integrates achievements in safety, security, efficiency, and environmental compatibility. Currently under development, the Next Generation Air Transportation (NextGen) System will:

The NextGen vision involves the entire aviation community

- Enhance economic growth and create jobs,
- Expand system flexibility and deliver greater capacity,
- Tailor services to customer needs,
- Integrate capabilities to ensure national defense,
- Promote aviation safety and environmental stewardship, and
- Retain U.S. leadership and economic competitiveness in global aviation.

A Vision of the Future

Imagine a future where . . .

- Flights cost less and arrive on-time,
- Airport security is fast and non-intrusive,
- Flights depart from and arrive in the communities where we work and live,
- Airplanes are quiet and environmentally friendly,
- Flights are safer and more secure,
- New aircraft types provide flexible transportation solutions,
- The skies are always friendly, and
- Air travel is fun, and getting there is easy.

NextGen requires a global partnership

Achieving this vision involves embracing new ideas and creating new ways for government, industry, and academia to work together. It also requires, according to the "Next Generation Air Transportation System (NextGen) Integrated Plan," the need to:

- Develop airport infrastructure to meet future demand by empowering local communities and regions to create alternative concepts of how airports will be used and managed in the future.
- Establish an effective security system without limiting mobility or civil liberties by embedding security measures throughout the air transportation system — from curb to curb.
- Create a transparent set of security layers that will deliver security without creating undue delays, limiting access, or adding excessive costs and time.
- Create a responsive air traffic system by devising alternative concepts of airspace and airport operations to serve present and future aircraft. As very light jets, unmanned aircraft systems, and other new vehicle classes emerge — and as new business models, such as spaceports and other innovations appear — the safe and efficient operation of all vehicles in the NAS will be increasingly critical to creating new markets in aviation and related industries.
- Provide each traveler and operator in the system with the specific situational awareness they need to reach decisions through the creation of a combined information network. All users of the system will have access to the air transportation system data they require for their operations.
- Manage safety through a comprehensive and proactive approach that can integrate major changes, such as new technologies or procedures. This will be done in a timely manner and without compromising aviation's current superior safety record.
- Introduce new policies, operational procedures, and technologies to minimize the impact of noise and emissions on the environment and eliminate ground contaminants at airports. This effort includes exploration of alternative fuels, engine and aircraft designs. These actions will result in reduced environmental impact and sustained aviation growth.
- Reduce the impact of weather on air travel through the integration of a system-wide capability for enhanced weather observations and forecasts into the the tools used by air system operators. This capability will substantially improve airspace capacity and efficiency while enhancing safety.
- Harmonize equipage and operations globally by developing and employing uniform standards, procedures, and air and space transportation policies worldwide, enhancing safety and efficiency on a global scale.

FAA understands that building the NextGen system depends on a clear understanding today of what that system will look like. As we look to the future it is easy to imagine the revolutionary advances that will occur in aviation technology, because many of those advances are already on the drawing board. By 2025 technological advances in the use of satellite-based communications and computer technology will work together to keep air traffic moving safely along more efficient routes than are presently available. There will be a steady stream of information flowing from digital computers onboard the aircraft.

Researchers are working today to understand tomorrow's needs

These powerful computers will monitor or control virtually every function of the plane, often with very little interaction by the cockpit crew. The flight crew and the air traffic controller will exchange information over high-speed digital data links. Airline and air traffic control computers on the ground will relay weather updates and safety alerts quickly and accurately to the pilot. Onboard collision avoidance and advanced traffic display systems will allow the pilot be an active participant with the controller in ensuring the safe separation of aircraft. The cockpit will be so information-rich pilots will be able to operate their aircraft under conditions where long-term route, speed, or altitude clearances are no longer necessary.

As the U.S. transitions to this future high-tech system, FAA is examining how innovations such as technology improvements, system integration, human-computer interface, and other factors will affect the course of modernization. Research teams at FAA know that even the most advanced technology cannot be effective if it is not integrated carefully into the system and properly used. These professionals are working hard to ensure the NextGen system employs a proactive approach to safety impacts fixing problems before they cause accidents, identifying trends, and using information more powerfully, more creatively, and more collaboratively than ever before.

FAA NextGen Planning Documents

- *NextGen Implementation Plan (OEP version 1)*
- *NAS Enterprise Architecture*

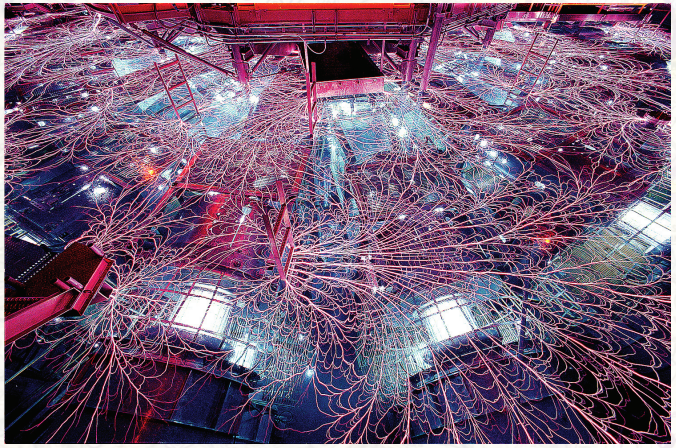
See www.faa.gov/programs/oep and www.nas-architecture.faa.gov

An Information-Rich Environment

As the future data driven environment evolves, it is vitally important to ensure the integrity of the data as well as its secure, reliable transmission between aircraft and ground computers. These systems will deliver a higher quality and quantity of information than presently available and will facilitate an:

- Awareness of FAA and NAS users of the need for the efficient, real-time exchange of vital operational data,
- Demand for improved data services in specific operational areas such as evolving weather conditions, and
- Emphasis on informed and collaborative decision making among service providers and users.

In the years ahead, aviation systems will become more complex than they are today. It is imperative FAA and industry find ways to ensure that these systems are as robust and fail-safe as possible. To do this, FAA needs new kinds of data, more powerful analytical tools, and a greater pooling of intellectual resources around the world. Most of all, the agency needs a broad-based partnership committed to the principle of shared knowledge.



The future aerospace system will be data driven

As the aviation community moves toward NextGen, it is also critical for FAA to coordinate an industry-wide safety strategy and plan to ensure future aviation investment is focused on the most effective means of lowering an already historically low accident rate. This is not an easy task. The worldwide commercial aviation accident rate, after having declined steadily for many years, now remains fairly constant. Many believe that for the accident rate to decrease even further, the worldwide aviation community must continue all of the positive steps that have worked so well for so long. It will, however, also have to revitalize another activity — collecting, analyzing, and sharing aviation safety information. The challenge is to discover problems and fix them before they cause an accident or incident, especially as we move to a highly sophisticated, and technology-driven aviation system.

In partnership with industry, FAA has embarked on a major new initiative expected to improve aviation safety by the exchange of information among all segments of government and the civil aviation industry. The Aviation Safety Information Analysis and Sharing (ASIAS) program will enable government and industry to identify and address proactively safety issues. ASIAS will provide safety experts a better understanding of the factors that contribute to incidents and anomalies, and it will also facilitate the formation of conclusions about causal relationships. Ultimately, ASIAS will allow government and industry to identify and address hazards in aviation before they cause accidents or incidents.

Improving Weather Systems

One of the biggest challenges FAA faces now and in the future is how to collect, process, transmit, and display weather information to users and service providers, both during flight planning and in flight. Weather is one of the leading causes or factors cited in aviation accidents. National aviation forums have repeatedly identified improved weather information in the cockpit, especially

in a graphical format, as a key strategy to reduce weather-related accidents.

FAA is currently developing key NextGen technologies that will reduce the number of weather-related accidents by improving decision making through increased exchange of timely information. When these innovations are fully implemented in the NAS, service providers and users will receive real-time depictions of hazardous weather simultaneously, enhancing common situational awareness. FAA's current aviation weather architecture is evolving from present-day separate, stand-alone systems to weather systems that are an integral part of the airspace system.

NextGen cockpits will be information rich

Almost all in-flight weather information is presently obtained via voice radio. Many weather situations, however, are extremely complex, making them difficult to convey effectively to the cockpit over voice radio. The ability to provide graphical products — reaching pilots over a data link to a cockpit display — will simplify and enhance this information transfer. In addition, improved forecasting in areas critical to safe operations, such as icing, turbulence, visibility, and thunderstorm activity, will provide pilots better information for making better decisions.

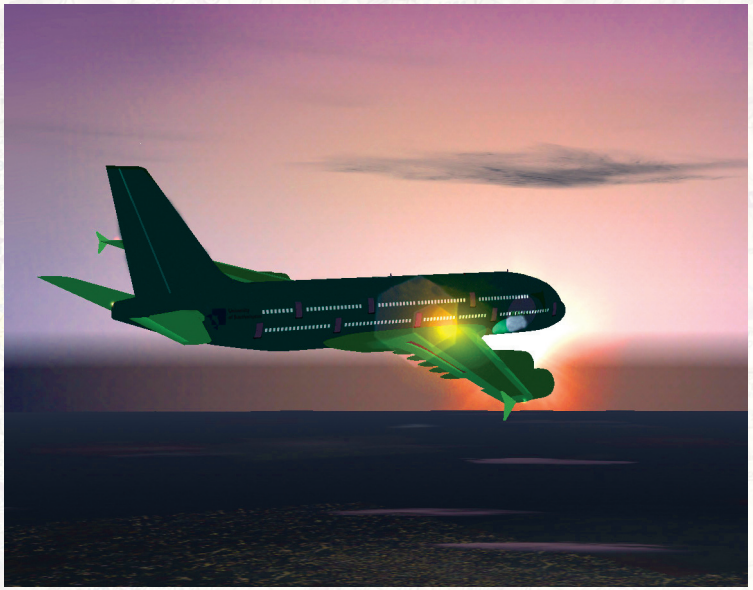
Enhancing Human Performance

Providing key information to pilots and controllers in real-time, however, is just one part of ensuring safety into the future. Aviation safety improvements are also dependent on developing an aviation system that is not only technically sophisticated, but also one that responds well to the humans who give it direction. As FAA develops and deploys a variety of new automated technologies, it is important to understand how users will react to that equipment.

It is essential that human factors specialists remain full partners in the development and deployment of advanced aviation technologies. The future NextGen environment will depend heavily on the enhanced exchange of information between people and between people and systems. It will also depend on a greater understanding of how machines and people, on the ground and in the air, work together under normal and critical situations. To ensure safety in this new environment, FAA human factors specialists now are working to identify the most efficient and reliable ways to display and exchange information; determine when, and how particular information can best be displayed and transferred; design the system to reduce the frequency of information transfer errors and misinterpretations; and minimize the impact of errors.

New airport technologies will enhance visibility

FAA realizes that, while it is vital to understand how pilots and flight crews will react to a new information rich environment, its own researchers also must explore how steady advances in automation will change the role and impact of air traffic controllers. The ongoing development and use of decision support tools will help key agency professionals to work smarter while allowing pilots to fly their preferred routings. New NextGen tools will combine the desirable with the efficient while never sacrificing what is safe. For flight crews and controllers alike, NextGen tools will provide computer assistance in identifying potential conflicts of one aircraft with other, prevent entry into restricted military airspace or adverse weather, and help identify trajectories that will more safely maneuver aircraft. Other decision aids will help controllers to expedite the efficient arrival of aircraft during rush periods at busy airports – helping them to determine the landing sequence of particular aircraft and assign them to land on the safest, most efficient choice of runways.



Safety, as it is today, will be tomorrow's mission

Safety First, Foremost, and Always

Eliminating human error is just one part of an integrated research and development (R&D) program designed to anticipate potential accidents and prevent them from happening. Other FAA research projects are focusing on things such as aircraft structural integrity, propulsion systems, flight safety, and mechanical and electrical system reliability and integrity. In addition, knowing that preventive measures cannot avert all accidents and incidents, the agency actively supports an R&D program that concentrates on decreasing fatalities of accidents. Scientist working in these activities continually focus on finding new ways to enhance passenger and crew survivability, crash and rescue, and firefighting in the increasingly less likely event of an accident.

FAA safety research and its implementation of promising initiatives is dependent on a network of partnerships with industry, government, and academia to undertake its critical R&D activities. One of FAA's oldest partnerships has been with the National Aeronautics and Space Administration (NASA). Even as this exciting new century unfolds, FAA and NASA are working together with industry and academia in the area of aging aircraft systems research. Continued development of advanced aircraft inspection technologies will prove to be a critical safety resource in the future as the world's airline fleets get older. Cooperative projects are also developing improved technologies for detecting aircraft icing, and for predicting wind shear and clear air turbulence (in combination the number one cause of injuries in non-fatal accidents), and on noise mitigation. FAA and NASA have also created an even larger partnership to research and develop new air traffic management technologies necessary for NextGen.

Together with industry, FAA is steadily working to prevent runway incursions and related surface incidents and to ensure safety at NextGen airports. Working with its partners, the agency is providing heightened situational awareness for pilots, controllers, and vehicle operators; mandating specific recurring training for controllers regarding surface operations; implementing a range of procedural initiatives; and improving airport signs, lighting, and surface marking standards. Its research teams are using more sophisticated statistical and trend analysis to identify and correct those factors contributing to runway incursion incidents. It also is implementing new technologies that will help minimize the chance of injury, death, damage, or loss of property due to unavoidable runway accidents.

A Global Partnership

Over the past fifty years, FAA has come a long way in creating a safe and efficient aviation system. Ensuring aviation's viability well into the future, however, requires partnerships with the national and international aviation community. The aviation community has shown that by staying with a problem, doing whatever is possible at the moment, and constantly looking for better approaches, it can improve safety and efficiency of the NAS. The partnership has also proved to be flexible enough to allow market forces to shape the direction of growth in the industry. At the same time, though, it has assured that this growth occurs within a regulatory framework that demands the highest possible level of safety. This spirit of cooperation has proven effective in the past, and will help lead us into the future as FAA rallies its partners to pursue the domestic and international agreements that ensure the creation and success of the NextGen system. Enhancing safety and efficiency requires a global effort — one that standardizes procedures, technology, and regulations. Only through international cooperation can NextGen and FAA's vision of the future become reality.

FAA is building tomorrow's system in cooperation with its international partners

Orville and Wilbur Wright could not have imagined the impact their invention would have on the world. Aviation has grown at an exponential rate since that first flight, and FAA has been there to ensure aviation safety, efficiency, and environmental compatibility. The Wright brothers fostered aviation's growth in the 20th Century, now FAA, through its NextGen system, will ensure aviation's growth for the future.

NextGen incorporates new aircraft, manned and unmanned, in the aerospace system