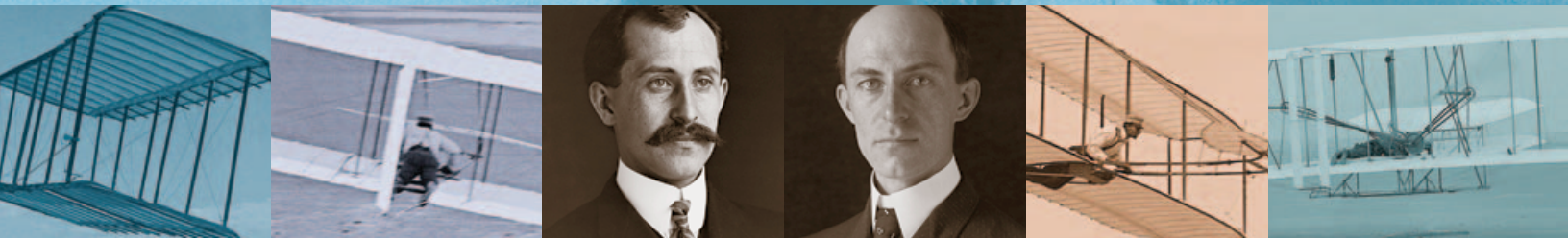


# 2003

## ACE PLAN

Aviation Capacity Enhancement Plan



*Centennial of flight 1903-2003*



U.S. Department of Transportation  
**Federal Aviation Administration**

**2003 ACE PLAN**  
Aviation Capacity Enhancement Plan

*Centennial of flight 1903-2003*

BUILDING CAPACITY TODAY  
FOR THE SKIES OF TOMORROW

Federal Aviation Administration

**December 2003**

Prepared jointly by the Federal Aviation Administration  
and ARP Consulting, L.L.C.

Visit us at [www.faa.gov](http://www.faa.gov)

The Aviation Capacity Enhancement (ACE) Plan is published annually by the Federal Aviation Administration's (FAA) Office of System Capacity. It contains a summary of the significant accomplishments and near-term goals of FAA-related programs, technologies, and initiatives affecting the capacity of the National Airspace System (NAS). Airports, airlines and aviation organizations use the ACE Plan. In addition to the U.S. and international aviation industry stakeholders, academia and members of the U.S. Congress are also part of its audience.

The ACE Plan discusses various approaches to enhancing airport and airspace capacity. The FAA relies on procedural and technological investments to increase airspace capacity, and while those approaches are also useful in the airport environment, airport capacity is most directly enhanced by building new runways or other airfield infrastructure.

## **Introduction**

Summarizes the challenges that continue for the aviation industry. Features selected milestones in aviation history and technological development affecting the NAS.

## **Chapter 1 – Aviation Activity in the National Airspace System**

Contains a summary of activity by user groups during 2003 and discusses the revised FAA forecasts for aviation activity to FY 2014.

## **Chapter 2 – National Airspace System Performance and Airport Capacity Analysis**

Reports new NAS performance measures. Summarizes recent delays, trends in delays, and the data systems that assist in analysis.

## **Chapter 3 – Development of Airport Capacity**

Summarizes various programs that increase airport capacity. Reports on the progress of capacity analysis projects and runway construction projects.

## **Chapter 4 – Operational Procedures**

Provides new, updated and modified operational procedures. Topics include air traffic management during convective weather (the Spring/Summer Plan), reduced separation minima, the development of RNAV approaches, and simultaneous approaches to closely-spaced parallel runways.

## **Chapter 5 – Airspace Redesign**

Contains program updates to redesign airspace and maximize efficiencies in air traffic flow. Reports on various elements of the National Airspace Redesign Plan, including high-altitude redesign and regional airspace redesign initiatives.

## **Chapter 6 – Air Traffic Control System Modernization**

Contains an overview of the FAA's air traffic control NAS modernization efforts.

These chapters are supported by additional information on aviation activity and construction projects at the busiest 100 U.S. airports in the following appendices:

**Appendix A**

Provides historical, current, and forecast information on passenger enplanements and aircraft operations.

**Appendix B**

Summarizes the status of the recommendations for completed Capacity Enhancement Plans.

**Appendix C**

Summarizes runway construction projects that are proposed for 2009 and beyond.

**Appendix D**

Presents airport layouts with an update of current and proposed capacity enhancement projects.

**Appendix E**

Defines acronyms used in this plan.

**Appendix F**

Lists the references used to prepare the ACE Plan and credits materials from FAA and other sources.

**About the Data**

Each year the airports that constitute the busiest 100 will slightly change as traffic at some of the airports grow more rapidly. Often several airports near the bottom of the list will be dropped off and replaced by others.

The 2003 ACE Plan contains data for both calendar years (CY) 2002 and fiscal years (FY) 2002. Since FAA forecasts are available only for fiscal years, all data relating to those forecasts are for fiscal years. Other data, such as delays, are presented for relevant calendar years.

Forecasting future aviation activity is always difficult and the further in the future these projections are made, the greater their uncertainty. Therefore, please use these forecasts with the knowledge that they may be significantly adjusted, both up and down.



**INTRODUCTION** CHARTING THE NEXT CENTURY OF FLIGHT

*“Whether outwardly or inwardly, whether in space or time, the farther we penetrate the unknown, the vaster and more marvelous it becomes.”*

~ Charles A. Lindbergh

## Challenges Continue for the Aviation Industry

In 2003, the aviation industry and the U.S. economy as a whole continued a steady but uneven recovery. The recovery of U.S. aviation has been slower than expected, largely resulting from the impact of the war in Iraq and airline industry restructuring. The demand for air travel both within the U.S. and between the U.S. and other world travel regions declined sharply in 2002, resulting in a reduction of scheduled flight, or less system capacity, reflecting an 8.6 percent decline in available seat miles (ASMs) from 2001.

The ripple effect of troubled finances for the airlines continues to impact the nation's airports. Relationships between airlines and airports are changing, as hub airports are most vulnerable when major capital plans rely on one or more of the major carriers as tenants, and lower air traffic has a negative impact on Passenger Facility Charges (PFC) revenue. However, less capacity has not proportionately reduced the demand on air traffic management resources. The complexity of air traffic has increased at many large hub airports because of the increase in regional jets. Low-cost carriers continue to expand point-to-point service as opportunities result from the route consolidations of the larger carriers. Smaller regional jets that require greater separation will operate a greater proportion of flights in the future. Most large air carrier schedule reductions at large hub airports occurred during off-peak periods, and at some airports, peak-period activity levels have increased over pre-September 11th levels. These complexities make the FAA's job more challenging even with less overall traffic.

For commercial aviation to recover its traffic and profitability, business travel must return to pre-2001 levels, currently FAA forecasts this to occur in 2006. The resumption of business travel depends on the recovery and strength of future U.S. and world economic activity. It is also too early to assess whether or not increased security measures at airports may have contributed to the permanent or temporary shift of passengers, particularly higher-yield business travelers, to other modes of transportation. The FAA, along with the stakeholders of the aviation industry, are using this period of traffic recovery to apply measurement systems supportive of a performance-based organization, and to implement new planning initiatives, such as the FAA Flight Plan 2004-2008 and update the FAA's Operational Evolution Plan.

The FAA expects that the Nation's invaluable air transportation system will remain the most popular transportation mode throughout the foreseeable future. The following summary and chapter divider graphics of the 2003 ACE Plan commemorate a century of powered flight, as the FAA continues to operate with an indomitable spirit of dedication and commitment, to "Chart the Next Century of Flight" for the world's largest, busiest and safest aviation system.

## Highlights from a Century of Powered Flight

On December 17, 1903, Wilbur and Orville Wright launched the world's first successful flight of a powered, heavier-than-air machine, and went on to perfect a controllable aircraft by 1905. The Wright brothers, pursuing their passions and applying their ingenuity, gave birth to the dynamic aviation industry that continues to succeed through the most trying of times, driven by men and women exhibiting a similar indomitable spirit and love of flight.

The first flight took place in Kill Devil Hills, North Carolina, piloted by Orville, lasted 12 seconds and went a distance of 37 meters. In 2002, the U.S. commercial air carrier passenger fleet reached an inventory of 5,156 aircraft. While the Introduction for the 2003 ACE Plan contains highlights from "A Century of Powered Flight," the chapter dividers will include famous quotations

about aviation, to recognize the inspiration that aviation provides, affecting all aspects of our culture. As the FAA and its stakeholders work together to chart the next century of flight, imagine the magnitude of changes that will occur in the aviation and aerospace industry by 2103.

Selected Milestones In Aviation History and Technological Developments Affecting Demand and Capacity in the National Airspace System\*

Year	Event
1903	Wright Flyer First powered airplane
1926	Goddard Rockets First liquid propellant rocket
1926	Western Air Express One of the first U.S. airlines to offer regular passenger service
1926	Varney Speed Lines Carrier established that eventually became Continental Airlines in 1937
1927	Spirit of St. Louis First solo transatlantic flight
1927	Pitcairn Aviation Established, 3 years later became Eastern Air Transport operating through its shutdown in 1991
1928	Commerce Department A partial radio navigation beacon system was developed; teletype machines usage began to transmit aviation weather information
1928	Delta Air Services Carrier established that became Delta Air Corp in 1930
1929	NY-2 Biplane (Lt. James Doolittle) First flight guided entirely by instruments
1930	Air Traffic Control (ATC) First radio equipped ATC tower in Cleveland
1930	American Airways Formed and changed to American Airlines in 1934
1930	Transcontinental and Western Air First merger, for the companies that became Trans World Airlines (TWA) in 1950
1930	Cleveland Municipal Airport First establishment of radio control of airport traffic
1932	Amelia Earhart First woman to fly solo across the Atlantic Ocean
1938	Civil Aeronautics Authority CAA created to manage Air Route Traffic Control Centers (ARTCCs)
1942	Bell XP-59A Airacomet First American turbojet
1942	Tuskegee Airmen First Group of African American aviators earn their wings
1942	VS-300 (Igor Sikorsky) First flight of the modern helicopter
1946	Civil Aeronautics Authority First radar-equipped control tower at Indianapolis
1946	FAAP Act Established the Federal-aid Airport Program
1947	Bell X-1 aka Glamorous Glennis First aircraft to travel the speed of sound at a speed of Mach 1.06 or 670 mph
1949	Chicago O'Hare ARTCC First radiotelephone communications with pilots
1949	Civil Aeronautics Authority Authorized commercial planes to use Ground Control Approach (GCA) radar for bad weather landings
1951	U.S. Aviation Industry First time air passenger miles passed train passenger miles
1954	Boeing 707 First U.S. jet transport tested. Speed 550 mph, range: 3,500 mi., passenger capacity: 150
1957	Civil Aeronautics Authority Establishes control of continental airspace at or above 24,000 ft. via 12 super skyways
1958	Explorer First successful U.S. satellite launched
1958	FAA FAA formed by the Federal Aviation Act
1958	NASA Formation of the civilian space agency
1961	FAA First national standards for air traffic rules for flights on and around all controlled airports went into effect
1962	Mariner 2 First interplanetary probe
1962	Mercury (John Glenn) First American in earth orbit
1962	FAA At Chicago O'Hare, simultaneous instrument approaches on parallel runways was approved to relieve traffic delays at peak periods
1964	XB-70A First flight of Air Force supersonic aircraft
1965	Gemini IV First American space walk

\* For a more detailed summary of milestones in aviation history, see [www.centennialofflight.gov](http://www.centennialofflight.gov); The FAA web site offers its historic summary for the period 1926-1996 on [www.faa.gov](http://www.faa.gov).

*continued from page v*

Year		Event
1967	American X-15	First hypersonic, high altitude aircraft
1968	U.S. Congress	Established the Aviation Trust Fund for funding FAA programs and operations
1969	Apollo 11 Command Module	First manned lunar landing
1970	FAA	Established the Air Traffic Control Systems Command Center
1976	Concorde	First supersonic passenger flight approved at New York JFK and Washington Dulles airports for Anglo French SST Concorde operation
1978	President Carter	Signed the Airline Deregulation Act that resulted in applications for 248 new airline routes and special provisions boosting commuter airline growth
1981	Columbia (OV-102)	First U.S. space shuttle to fly into orbit
1981	FAA	Adopted a reduced interim air traffic control operations plan "Flow Control 50" due to dismissal of 11,400 controllers
1983	Global Positioning System (GPS)	First aircraft navigated across the Atlantic entirely using GPS cited by the FAA for future civil aviation use
2001	FAA	September 11th terrorist attacks forces the unprecedented 2-day shutdown of U.S. airspace



## TABLE OF CONTENTS

**Preface** . . . . . **i**

**Introduction** . . . . . **iv**

    Challenges Continue for the Aviation Industry . . . . . iv

    Highlights from a Century of Powered Flight . . . . . iv

**1 Aviation Activity in the National Airspace System** . . . . . **2**

    1.1 Aviation Activity . . . . . 2

        1.1.1 Commercial Passenger Activity . . . . . 3

            1.1.1.1 Passenger Enplanements . . . . . 3

            1.1.1.2 Aircraft Operations . . . . . 4

        1.1.2 Air Cargo Activity . . . . . 5

        1.1.3 Changes in the Commercial Sector . . . . . 6

    1.2 Non-Commercial Aviation Activity and Commercial Space Transportation . . . . . 7

        1.2.1 General Aviation Activity . . . . . 7

        1.2.2 Military Activity . . . . . 9

        1.2.3 Commercial Space Transportation . . . . . 9

**2 System Performance Goals and Measurements** . . . . . **12**

    2.1 The Air Traffic Organization . . . . . 12

    2.2 The FAA Flight Plan 2004-2008 . . . . . 12

    2.3 The Operational Evolution Plan (OEP) . . . . . 13

        2.3.1 The Greater Capacity Goal of the OEP . . . . . 13

    2.4 Performance Data Analysis and Reporting System (PDARS) . . . . . 13

        2.4.1 Jacksonville/Atlanta (LOA) . . . . . 14

        2.4.2 Ontario Class C Airspace Study . . . . . 15

        2.4.3 SFO MOLEN Departure Procedure Analysis . . . . . 16

    2.5 Delays in the National Airspace System . . . . . 18

        2.5.1 Delays Reported by the Operations Network . . . . . 19

        2.5.2 The Aviation System Performance Metrics System . . . . . 21

**3 Development of Airport Capacity** . . . . . **24**

    3.1 Capacity Enhancement Through Airport Construction Projects . . . . . 24

        3.1.1 Capacity Enhancement Through Construction of New Runways  
                and Extensions . . . . . 24

    3.2 Other Strategies For Improving Airport Capacity . . . . . 26

        3.2.1 Airport Design Team Studies . . . . . 27

            3.2.1.1 The Dallas/Ft. Worth International Airport Perimeter  
                        Taxiway Demonstration . . . . . 27

            3.2.1.2 The Portland International Airport Study . . . . . 27

            3.2.1.3 Baltimore-Washington International Airport Study . . . . . 28

            3.2.1.4 Philadelphia International Airport Simulation Study . . . . . 28

        3.2.2 Capacity Benchmark Analysis Continues . . . . . 28

        3.2.3 International Initiatives Address Global Capacity Enhancement . . . . . 30

        3.2.4 Future Airport Capacity Studies . . . . . 31

3.3	Resources Affecting Airport Development	31
3.3.1	Airport Improvement Program	32
3.3.2	Passenger Facility Charges	33
3.3.3	User Charges	33
3.3.4	Airport Bonds	33
3.3.5	Other Sources of Funding	34
3.4	Other Airport Development Activities	34
3.4.1	The Military Airport Program	34
3.4.2	The Essential Air Service Program	34
3.4.3	Impact of New Transport Aircraft	34
3.4.3.1	Aircraft Design Impacts Airport Design	35
3.4.3.2	Airbus and Boeing's Perspectives of the Future	36
<b>4</b>	<b>Operational Procedures</b>	<b>38</b>
4.1	Spring/Summer 2003	38
4.2	Area Navigation Procedures	39
4.2.1	Required Navigational Performance	39
4.2.2	Area Navigation Approaches	40
4.2.3	RNAV Arrivals and Departures	41
4.3	Reduced Separation Minimum	41
4.3.1	Reduced Vertical Separation Minimum	41
4.3.1.1	World-Wide Implementation of the Reduced Vertical Separation Minimum	42
4.3.2	U.S. Domestic Reduced Vertical Separation Minimum	42
4.3.3	Reduced Oceanic Horizontal Separation Minimums	42
4.4	Approaches to Closely-Spaced Parallel Runways	43
4.4.1	Approaches Using a Precision Runway Monitor	43
4.4.2	RNP Approaches to Closely Spaced Parallel Runways	44
<b>5</b>	<b>Airspace Redesign</b>	<b>46</b>
5.1	High Altitude Redesign	46
5.1.2	Navigation Reference System Waypoints	47
5.1.2.1	Waypoints for Navigating Around Special Use Airspace	49
5.1.3	High Altitude RNAV Routes	49
5.2	Terminal Area Airspace Redesign	50
5.2.1	New York/New Jersey/Philadelphia Metropolitan Redesign Project	50
5.2.2	Potomac Consolidated TRACON	51
5.2.3	Northern California TRACON	52
<b>6</b>	<b>Transformation of the Air Traffic Control System</b>	<b>54</b>
6.1	Free Flight and The National Airspace System	54
6.2	Major Developments in Navigation Systems	55
6.2.1	Wide Area Augmentation Systems	55
6.2.2	Local Area Augmentation Systems	56
6.2.3	Automatic Dependent Surveillance – Broadcast	57
6.2.3.1	Alaska Capstone Program	58
6.2.3.2	Ohio River Valley Project	59

6.3 Replacement and Modernization of Air Traffic Control Equipment . . . . . 59

6.3.1 Standard Terminal Automation Replacement System . . . . . 60

6.3.2 En Route Automation Modernization Program . . . . . 60

6.3.3 Advanced Technologies and Oceanic Procedures System . . . . . 61

**A Aviation Statistics . . . . . 64**

**B Capacity Enhancement Plan Update . . . . . 84**

**C Runway Projects 2009 and Beyond . . . . . 92**

**D Airport Layouts for the Top 100 Airports . . . . . 96**

**E Acronym Listing . . . . . 198**

**F Credits . . . . . 202**

## TABLE OF FIGURES

Selected Milestones In Aviation History and Technological Developments Affecting Demand and Capacity in the National Airspace System . . . . . v

**Figure 1-1** Aircraft Operations by User Type for FY 2002 . . . . . 3

**Figure 1-2** FAA Forecasts of Passenger Enplanements . . . . . 4

**Figure 1-3** FAA Forecasts of Air Carrier and Air Taxi and Commuter Operations . . . . . 5

**Figure 1-4** Airports with the Most Air Cargo Activity for CY 2002 . . . . . 6

**Figure 1-5** General Aviation Operations at the OEP Airports . . . . . 8

**Figure 2-1** PDARS Deployment Locations . . . . . 14

**Figure 2-2** Proposed Arrival Procedure Modification – Pretest. . . . . 15

**Figure 2-3** Proposed Arrival Procedure Modification – Test. . . . . 15

**Figure 2-4** Ontario International Airport Arrivals Exiting . . . . . 16

**Figure 2-5** SFO MOLEN . . . . . 17

**Figure 2-6** PDARs Deployment Timeline . . . . . 18

**Figure 2-7** Annual Flight Delays CY 1991-CY 2003 . . . . . 19

**Figure 2-8** Flight Delays by Month, CY 2002 and CY 2003 . . . . . 19

**Figure 2-9** Flight Delays per 1,000 Operations by Month, CY 2002 and 2003 . . . . . 20

**Figure 2-10** Flight Delays by Cause CY 2003 . . . . . 20

**Figure 3-1** Completed Runway Construction Projects January 1998 to October 2003 . . . . . 25

**Figure 3-2** Runway Construction Projects November 2003 to December 2008 . . . . . 26

**Figure 3-3** Capacity Benchmark Pacing Airports Delay Rate (2000 through 2002) . . . . . 29

**Figure 3-4** OPSNET Delay Data for the Pacing Airports . . . . . 30

**Figure 3-5** Airport Improvement Program Funding History (\$ in Billions) . . . . . 32

**Figure 3-6** FAA Design Group Aircraft Comparison by Wing Span Length . . . . . 36

**Figure 4-1** Potential Arrival Rates . . . . . 44

**Figure 5-1** Initial Implementation of High Altitude Redesigns . . . . . 46

**Figure 5-2** High Altitude Airspace Redesign, Phase I Design Concepts . . . . . 47

**Figure 5-3** Navigation Reference System . . . . . 48

**Figure 5-4** Weather Reroute with NRS . . . . . 48

**Figure 5-5** Jet Routes and High Altitude Q-Routes on the West Coast . . . . . 49

**Table A-1** Passenger Enplanements, by Fiscal and Calendar Years  
(2000, 2001, and 2002) . . . . . 64

**Table A-2** Aircraft Operations, by Fiscal and Calendar Years  
(2000, 2001, and 2002) . . . . . 67

**Table A-3** Passenger Enplanements, 2002 and Forecast 2014 . . . . . 70

**Table A-4** Aircraft Operations, 2002 and Forecast 2014 . . . . . 73

**Table A-5** Change in Enplanements from 2001 to 2002 . . . . . 76

**Table A-6** Change in Operations from 2001 to 2002 . . . . . 79

**Table B-1** Airport Capacity Recommendations – Airfield . . . . . 84

**Table B-2** Airport Capacity Recommendations – Facilities and  
Equipment Improvements . . . . . 86

**Table B-3** Airport Capacity Recommendations – Operational Improvements . . . . . 88

**Table C-1** Runways Planned, Proposed, or Currently Under Construction  
at the 100 Busiest Airports for 2009 and Beyond . . . . . 92