Federal Aviation Administration

Office of System Capacity
and Requirements

Near Term Capacity Initiatives

- Simultaneous (Independent) Parallel Approaches Utilizing the Precision Runway Monitor (PRM)
- Improved Dependent Parallel Approaches
- Reduced Longitudinal Separation on Wet Runways
- Dependent Converging Instrument Approaches (DCIA)
- Simultaneous Operations on Wet Intersecting Runways
- Simultaneous ILS & LDA Approaches
- Flight Management System (FMS) Transition to Existing Approaches

FORWARD

The capacity initiatives contained herein offer near-term solutions toward improving the nation's aviation system capacity. Based on the application and refinement of new systems and procedures, these initiatives promise an increase in capacity with relatively little financial investment or systems development. Users can look forward to receiving benefits from these procedures within the next year without the requirement for extensive certification of new airborne and ground-based systems.

Two terms which are used in describing some of the procedures need clarification. They are "independent" and "dependent" procedures. "Independent" procedures are so called because aircraft arriving along one flight path do not affect arrivals along another flight path. "Dependent" procedures place restrictions between the various arrival streams of aircraft, because their proximity to each other has the potential for some interference.

This pamphlet offers the reader a description of near-term capacity initiatives, their intended purpose, an indication of which airports may benefit, and the target implementation dates.

Questions or comments concerning these efforts may be directed to:

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Capacity Initiatives

One of the major aviation challenges in recent years has been the increase in the number and duration of flight delays. Aviation industry experts have been seeking ways to keep pace with the operational demand while minimizing delays that can quickly have a domino effect throughout the national airport and airspace system.

While substantial increases in capacity can best be achieved through new airport and runway construction, programs of this type require extensive long-term planning. In an effort to meet the increasing demands on the airport and airspace system in the near-term, the FAA has initiated a capacity enhancement program designed to provide additional capacity at existing airports, while maintaining the level of safety in aircraft separation.

These capacity enhancement programs include improvements in air traffic control procedures, radar systems, high-resolution color displays for controllers, and increased utilization of multiple runways.

The testing of these initiatives has been thorough, involving various validation methods including real-time simulations and live demonstrations at selected airports.

The gains realized from these enhancements range from three additional arrivals per hour to as many as twenty six arrivals per hour. Forecasts suggest that, in the absence of capacity improvements, delay in the system will continue to grow. In 1990, 23 airports each exceeded 20,000 hours of flight delay. Assuming no improvements are made, 40 airports are forecast to each exceed 20,000 hours of flight delay by the year 2000.

The capacity initiatives that are described in this pamphlet are near-term initiatives that have recently become available for use or are targeted to become national procedures within the next 12 months. They continue to be tested thoroughly and are an example of the collective effort within the FAA to enhance operations and improve system performance.

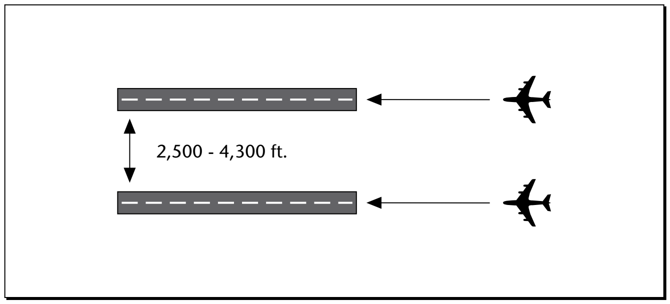
Simultaneous (Independent) Parallel Approaches Utilizing the Precision Runway Monitor (PRM)

Where closely-spaced parallel runways exist, the proximity of arrival paths preclude simultaneous approaches under instrument weather condition. Through implementation of a Precision Runway Monitor system, significant capacity gains can be achieved.

The PRM system consists of an improved monopulse antenna system that provides high azimuth and range accuracy and higher data rates than the current terminal Airport Surveillance Radar (ASR) radars. The PRM processing system allows controllers to monitor the parallel approach courses on high resolution color displays and generates controller alerts when an aircraft appears to be blundering off-course.

There are two versions of the PRM system. One system (E-SCAN) utilizes an electronic scanning antenna which is capable of updating an aircraft's position every half second. This update rate is an order of magnitude greater than the current airport surveillance radars. The other system (MODE-S) utilizes two mechanically rotating antennas mounted back-to-back and provides an update of an aircraft's position every 2.4 seconds.

Demonstrations of PRM technology were conducted at Memphis, TN, and Raleigh-Durham, NC, in 1989 and 1990 and have resulted in the publication of procedures for simultaneous parallel approaches to runways that have centerlines separated by 3,400 feet to 4,300 feet. Application of these procedures is contingent upon the use of PRM technology.



Independent Parallel Approaches Utilizing PRM

Additional simulations are being conducted at the FAA Technical Center to determine the minimum runway spacing (below 3,400 feet) for PRM approaches. The box below lists those airports that have or plan to have parallel runways separated by 2,500 to 4,300 feet and the average capacity gain expected from the use of these approaches.

The first PRM system (E-SCAN) is scheduled to be commissioned in Raleigh-Durham, NC, in June 1993. Additional systems are scheduled for delivery starting the latter part of 1994.

Average Capacity Gain 12 - 17 Arrivals/Hour

Candidates Among Top 100 Airports

Atlanta	Tampa
Baltimore	Denver (DVX)
Detroit	Harlingen
Ft. Lauderdale	Long Beach
Lubbock	Minneapolis, St. Paul
Memphis	Portland
Milwaukee	Philadelphia
Phoenix	Columbus
Pittsburg	Dallas
Raliegh-Durham	Indianapolis
Salt Lake City	New York (JFK)

Note: Some candidates are based on the assumption that proposed runways will be constructed. Other deciding factors include traffic and weather demands.

Improved Dependent Parallel Approaches

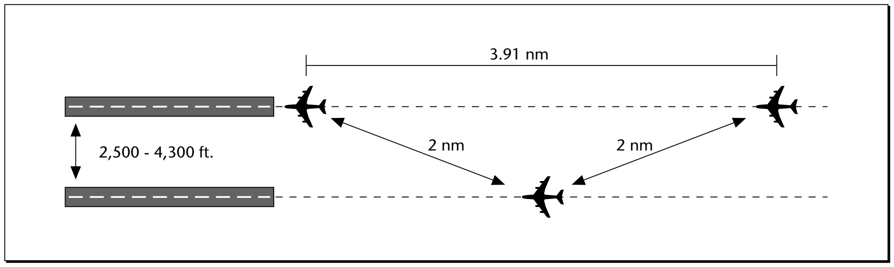
Previous procedures allowed dependent parallel approaches provided that the parallel runways are separated by at least 2,500 feet. A minimum of two nautical miles (nm) diagonal separation is required to be maintained between aircraft on adjacent approaches.

In 1989, the FAA initiated a formal program to study the effects of reducing the diagonal separation from 2 nm to 1.5 nm. This program involved a real-time simulation at the FAA Technical Center, followed by live demonstrations at Salt Lake City, UT, and Minneapolis, MN.

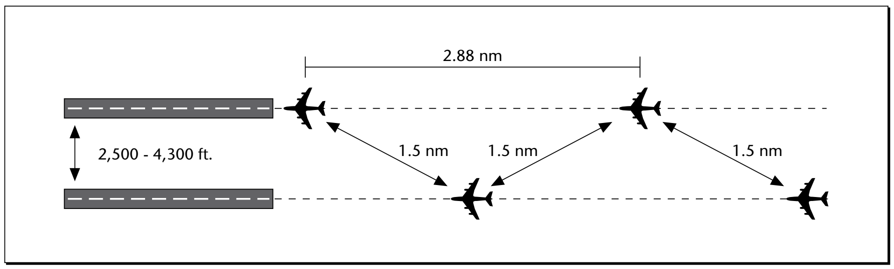
The results of this program indicated that the separation standard of 2 nm could be reduced to 1.5 nm with no degradation of safety. Additionally, there was a marked improvement in terms of capacity. The real-time simulation revealed that controllers were able to accommodate an average of 4 additional arrivals per hour using the 1.5 nm vs. 2 nm separation standard.

The list below indicates the average arrival capacity gain and the airports that may be able to use the proposed procedures.

The national standards for these revised approach procedures were published in June 1992.



Previous Separation for Dependent Parallel ILS Operations



Improved Separation for Dependent Parallel ILS Operations

Average Capacity Gain
4 Arrivals/Hour

Candidates Among Top 100 Airports

Atlanta	Tampa
Baltimore	Denver (DVX)
Detroit	Harlingen
Ft. Lauderdale	Long Beach
Lubbock	Minneapolis, St. Paul
Memphis	Portland
Milwaukee	Philadelphia
Phoenix	Columbus
Pittsburg	Dallas
Raliegh-Durham	Indianapolis
Salt Lake City	New York (JFK)

Note: Some candidates are based on the assumption that proposed runways will be constructed.

Reduced Longitudinal Separation on Wet Runways

In 1986, the FAA implemented a procedure that allowed a reduction of separation inside the final approach fix (FAF) from 3 nm to 2.5 nm provided certain requirements were met. Two of those requirements were: 1) that the runways be clear and dry, and 2) that runway occupancy time be 50 seconds or less. An effort then was undertaken to determine if the procedure could be used for arrivals to wet runways.

Studies conducted in 1989 at Atlanta Hartsfield International Airport (ATL) and Dallas Fort-Worth International Airport (DFW) indicate that wet runway occupancy times are the same or less than dry runway occupancy times.

As a result of the ATL and DFW studies, the FAA initiated demonstrations at selected airports to determine the feasibility of allowing reduced longitudinal separation inside the FAF when the runways are wet.

Average Capacity Gain
3 - 5 Arrivals/Hour

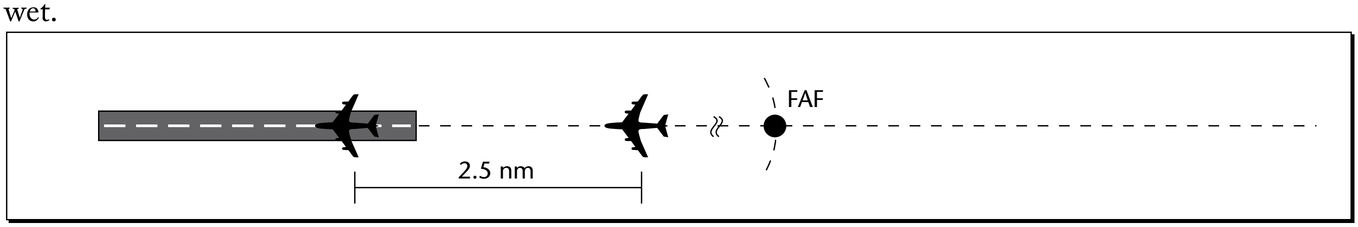
Candidates Among Top 100 Airports

Atlanta	New York (JFK)
Baltimore	New York (LGA)
Boston	Newark
Chicago	Norfolk
Charlotte	Orlando
Cincinnati	Philadelphia
Dallas	Pittsburgh
Denver	Salt Lake City
Houston	Tampa
Los Angeles	Washington-National
Nashville	Washington-Dulles

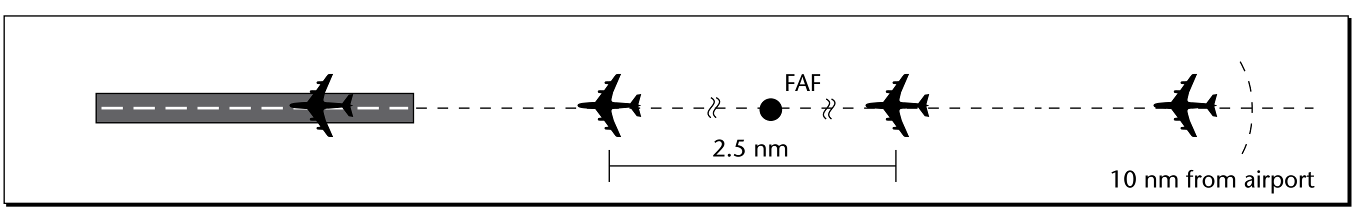
Due to the success of those demonstrations, the FAA amended the national standards to allow reduced in-trail separation when runways are wet. In addition, 2.5 nm in-trail spacing, which may be used inside the final approach fix, will be extended out to a point 10 nm from the airport. This is expected to further smooth the overall arrival flow.

The average capacity gain expected from this initiative is 3 to 5 arrivals per hour.

The national standards for implementation of reduced in-trail separation were published in June 1992.



Previous In-Trail Separation to 2.5 nm (inside Final Approach Fix)



Improved In-Trail Separation to 2.5 nm with an Extended Final Approach Course

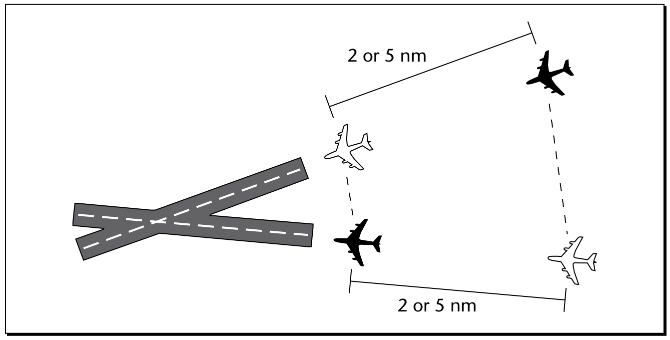
Dependent Converging Instrument Approaches (DCIA)

Approaches to converging runways can be conducted simultaneously (independently) utilizing current separation standards. However, to do so requires that visual separation must be provided by the tower controller before radar separation criteria are violated. Further, there is a requirement to ensure that the missed approach protection area surfaces do not overlap. To con-duct such approaches the meteorological minima are usually held to values near a 700 feet ceiling and 2 miles visibility.

The primary issue in extending converging runway operations into low Instrument Meteorological Conditions (IMC) is the ability to ensure aircraft separation in the event of simultaneous missed approaches.

In an effort to reconcile this problem, the FAA has developed DCIAs which provide a stagger between aircraft approaching the converging runways. When the leading aircraft is over the threshold, the succeeding aircraft on the converging runway is staggered at a distance of 2 nm if the lead aircraft is a non-heavy, or 5 nm if the lead aircraft is a heavy. This stagger provides separation in the event of a simultaneous missed approach.

A converging runway display aid (CRDA) has been developed to assist the controller in achieving the necessary stagger. The CRDA projects electronic "ghost" images of aircraft on converging arrival paths so that the separation between aircraft can be verified during the arrival spacing. The controller will then apply the requisite 2 nm or 5 nm as appropriate.



Dependent Converging IFR Approaches Using CRDA (Ghosting Techniques)

Because of the stagger and the separation it affords, controllers will be able to conduct DCIAs safely to Category I minima (200 feet ceiling, 1/2 nm visibility). Since this should increase the amount of time converging approaches can be conducted, an average capacity gain of 10 arrivals per hour is expected through use of this procedure. A demonstration at St. Louis International Airport

Average Capacity Gain
10 Arrivals/Hour

Candidates Among Top 100 Airports

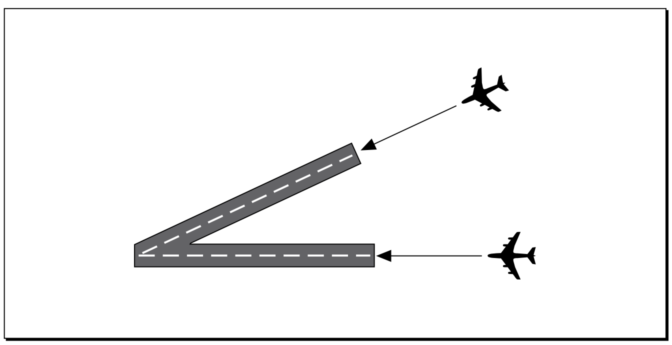
Baltimore	Houston Intrc.	Omaha
Boston	Jacksonville	Philadelphia
Charlotte	Kansas City Int'l	Pittsburgh
Chicago O'Hare	Louisville	Portland
Chicago Midway	Miami	Providence
Cincinati	Milwaukee	Rochester
Dallas/Ft. Worth	Minneapolis	San Antonio
Dayton	Nashville	San Francisco
Denver	Indianapolis	Seattle (SEA)
Detroit	New York (JFK)	Seattle (BFI)
Ft. Lauderdale	New York (LGA)	St. Louis
Honolulu	New Orleans	Washington-Dulles
Houston Hobby	Newark	Windsor Locks
	Oakland	

has validated the use of CRDA and this procedure under actual operational conditions. Initial results indicate an increase in airport acceptance rates better than originally expected.

The national standards for DCIAs will be issued in September 1992. The CRDA software will be available for installation in the ARTS IIIA prior to the release of the DCIA National Standards.

Current procedures governing simultaneous operations on intersecting runways (SOIR) require that the runways be dry. This requirement was to ensure that the pilot could hold short of an intersecting runway and not be adversely affected by a wet surface.

As a result of recommendations made in the mid-1980's, the FAA initiated an effort to develop procedures that would allow SOIR operations on wet runways while maintaining the level of safety experienced on dry runways. Research has found that the addition of stringent runway surface standards and increased minimum stopping distances would achieve an equivalent level of safety.



Simultaneous Operations on Wet Intersecting Run-

Top 14 Candidate Airports

Boston	New York (JFK)
Chartlotte	St. Louis
Chicago O'Hare	Philadelphia
Detroit	Pittsburgh
Miami	San Francisco
Minneapolis, St. Paul	Washington-National
New York (LGA)	

Demonstrations utilizing the new procedures began in 1987 at Boston's Logan International Airport for propeller-driven aircraft only and in 1988 and 1989 at Greater Pittsburgh International Airport and Chicago O'Hare International Airport, respectively, for operations including jet aircraft.

Due to the successful nature of these demonstrations, the FAA has taken action to permit simultaneous operations on wet intersecting runways. Capacity gains will be achieved through increased use of this procedure during wet runway conditions.

The national standards for simultaneous operations on wet intersecting runways will be issued in December 1992.

Of the top 100 airports in the continental United States, a total of 60 currently conduct hold-short operations and could receive an additional capacity benefit from this procedure. At O'Hare, increases of up to 25% have been experienced during wet runway operations.

Simultaneous ILS & LDA Approaches

Localizer Type Directional Aids (LDAs) are used for non-precision instrument approaches. Although they offer the utility and accuracy of a localizer course, LDAs are not aligned with the runway nor do they provide any vertical guidance. The use of LDA approaches in conjunction with an ILS on adjacent, very closely-spaced (700 feet to 2,500 feet) parallel runways allows an additional arrival stream in weather minima lower than those required for visual approaches. The procedures for use of ILS and LDA approaches are the same as those used for simultaneous approaches to parallel runways separated by 4,300 feet or more, with the additional requirement that visual separation must exist at the point where lateral separation between the final approach courses decreases to 4,300 feet.

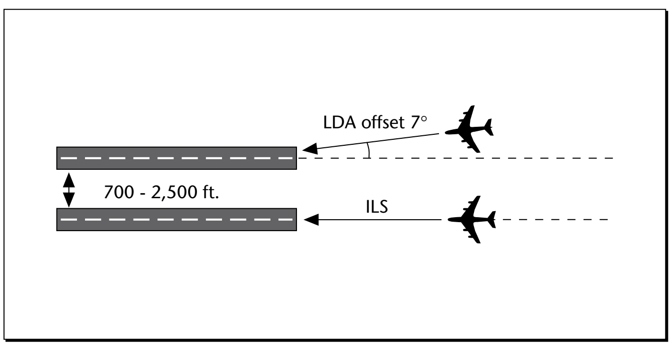
Simultaneous ILS and LDA approaches have been in use at St. Louis' Lambert Field (STL) for several years. The weather minima at STL are a ceiling of 1,200 feet and a visibility of 4 miles. A capacity gain of approximately 18 arrivals per hour has been achieved at STL during use of the procedure.

Work is underway on the development of this procedure for San Francisco International Airport. The scheduled commissioning date is August 1992.

Average Capacity Gain
12 - 16 Arrivals/Hour

Candidates Among Top 100 Airports

Boise	Omaha
Boston	Ontario
Chicago Midway	Orlando
Denver	Palm Beach
Des Moines	Philadelphia
El Paso	Providence
Houston (both)	Reno
Islip	San Antonio
Knoxville	San Francisco
Las Vegas	San Jose
Los Angeles	Seattle
Midland	St. Louis
Milwaukee	Tucson
Newark	Washington-Dulles
Oakland	

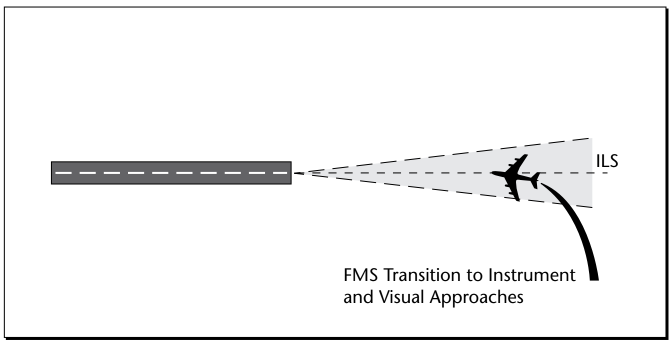


Simultaneous ILS & LDA Approaches

Flight Management System (FMS) Transition to Existing Approaches

Many of the newer generation aircraft are delivered with on board Flight Management System (FMS) computers that are capable of efficiently performing various navigation functions. Utilizing their full abilities, these systems may provide near-term enhancements to operations throughout the National Airspace System.

The FAA has developed a capacity initiative to demonstrate the use of Flight Management System computers as a means of transitioning aircraft from the en route phase of flight to existing charted visual flight procedures (CVFP) and instrument landing system (ILS) approaches. The initial demonstration began in December 1991 at San Francisco International Airport where the Quiet Bridge CVFP to Runway 28R was flown by FMS-equipped aircraft. The demonstration phase has been completed, and the procedure is now being used on a regular basis at San Francisco International.



FMS Transition to Existing Approaches

FMS procedures are expected to allow the reduction of minimums for CVFP and offer alternative arrival paths for FMS-equipped aircraft. FMS capability could offer: a reduction in procedural and airspace conflicts; a reduction in controller vectoring and radio transmissions; increased opportunities for controllers to maximize traffic flow; a reduction in fuel consumption; adherence to and a possible reduction in noise sensitive routings; and availability of alternative arrival, departure, and missed approach procedures.

Implementation of FMS CVFP presently is being expanded to include other airports which can benefit from FMS-assisted flight path navigation. National standards will be issued in December 1992.

Summary

In FY1990, more than half of all delay was attributed to adverse weather conditions. Many of these delays can be reduced if the approach procedures used during IFR operations are able to approximate the operational capacity of those used during visual meteorological conditions.

The focus of these near-term initiatives is to meet the following objectives:

- The use of parallel runways spaced closely together for simultaneous or near-simultaneous arrival operations;
- More efficient spacing along the final approach course;
- Increased arrival rates to converging and intersecting runways;
- A reduction in the airspace needed to transition to and execute an approach; and
- A reduction in the weather minima for arriving aircraft.

For the aviation industry, implementation of these initiatives directly translates into increased operating efficiency. Substantial cost savings through a significant reduction in fuel usage will be complemented by the more efficient utilization of airframes and airport and airline personnel.

For the foreseeable future these capacity initiatives will help to set the standard for enhancing aviation system capacity and will stimulate future developments in advanced surveillance, communication, and automation systems.

U.S. Department
of Transportation

**Federal Aviation
Administration**

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