ORIGINAL

STEPTOE & JOHNSON LLP
ATTORNEYS AT LAW

1330 Connecticut Avenue, NW
Washington, DC 20036-1795

Telephone 202.429.3000
Facsimile 202.429.3902
www.steptoe.com

Philip L. Malet
202.429.6239
pmalet@steptoe.com

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June 29, 2001

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Via HAND DELIVERY

Magalie Roman Salas
Secretary
Federal Communications Commission
445 12th Street, S.W.
Washington, D.C. 20554

Re: **Ex Parte Presentation**
The Boeing Company
IB Docket No. 99-81
FCC File No. 179-SAT-P/L/97(16)

Dear Ms. Salas:

On June 26, 2001, representatives of The Boeing Company ("Boeing") met with Commissioner Tristani and Adam Krinsky to discuss the need for prompt licensing of 2 GHz MSS networks, including Boeing's pending 2 GHz application. In attendance for Boeing were Scott Carson, a Boeing Senior Vice President and President of Connexion by Boeing (sm), Jeffrey Trauberman and Robert Vilhauer, along with the undersigned.

Boeing emphasized that it needed at least 3.88 MHz of service link spectrum (Earth-to-space and space-to-Earth) for its 2 GHz MSS network with a regulatory path for obtaining up to 8.25 MHz in each direction over time. These spectrum requirements will enable Boeing to meet the growing air traffic management ("ATM") needs in the United States and around the world for the next 10 to 20 years. In this regard, Boeing supplied those in attendance with the attached brochures describing Boeing's satellite-based architecture and overall ATM plans. Boeing also explained how its plans were consistent with and complimentary to the FAA's recently announced Operational Evolution Plan.

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If there are any questions regarding this filing please contact the undersigned.

Yours truly,

Philip L. Malet

Attachments

Cc: The Honorable Gloria Tristani
Adam Krinsky, Legal Advisor to Commissioner Tristani
R. Craig Holman, Counsel to The Boeing Company
David A. Nall, Counsel to The Boeing Company

BOEING

Air Traffic Management

Innovations to Move Traffic Without Delay

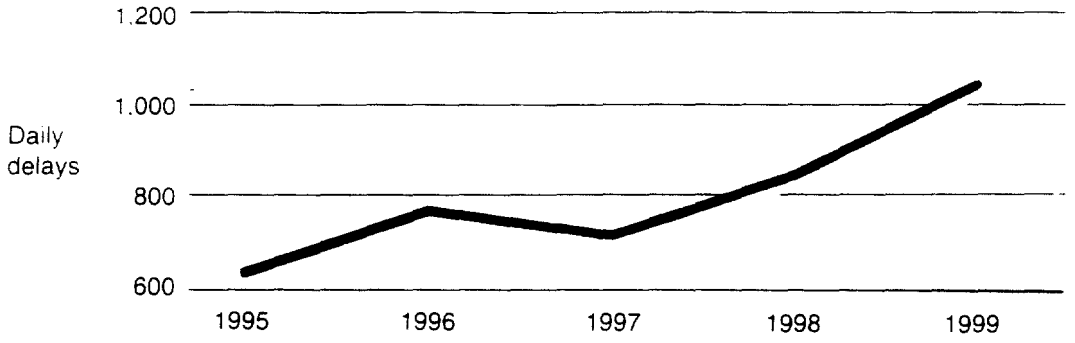
Airspace congestion crowds our way of life.

Air travel has enjoyed phenomenal success. In the 1940s and 1950s, traveling by plane was strictly for the wealthy. But in 1978, the U.S. Government deregulated air travel, and people soon discovered not only that they could afford to fly, but also that airlines were more likely to take them directly to where they wanted to go. Today, flying is a thread that stitches together the pieces of modern life. Indeed, airlines carry 1.8 billion passengers per year. More than 40 percent of worldwide cargo, calculated by value, travels by air. And some 200,000 general aviation aircraft make up the U.S. fleet.

The air traffic system is saturated. Regrettably, the fast, convenient, safe mode of travel that airplanes offer has become bogged down by delays and flight cancellations. Business travelers miss out on meetings, lose clients, break commitments. A family member might have to spend the night at the airport instead of at a vacation resort or send a gift instead of holding a grandchild.

And things won't get better any time soon. Industry experts forecast air traffic volume will more than double by 2020. Neither the current air traffic control system nor existing airports will be able to meet the soaring demand for air travel and commerce. While current air traffic modernization initiatives will improve equipment reliability, it will not increase the capacity of the system to handle projected growth.

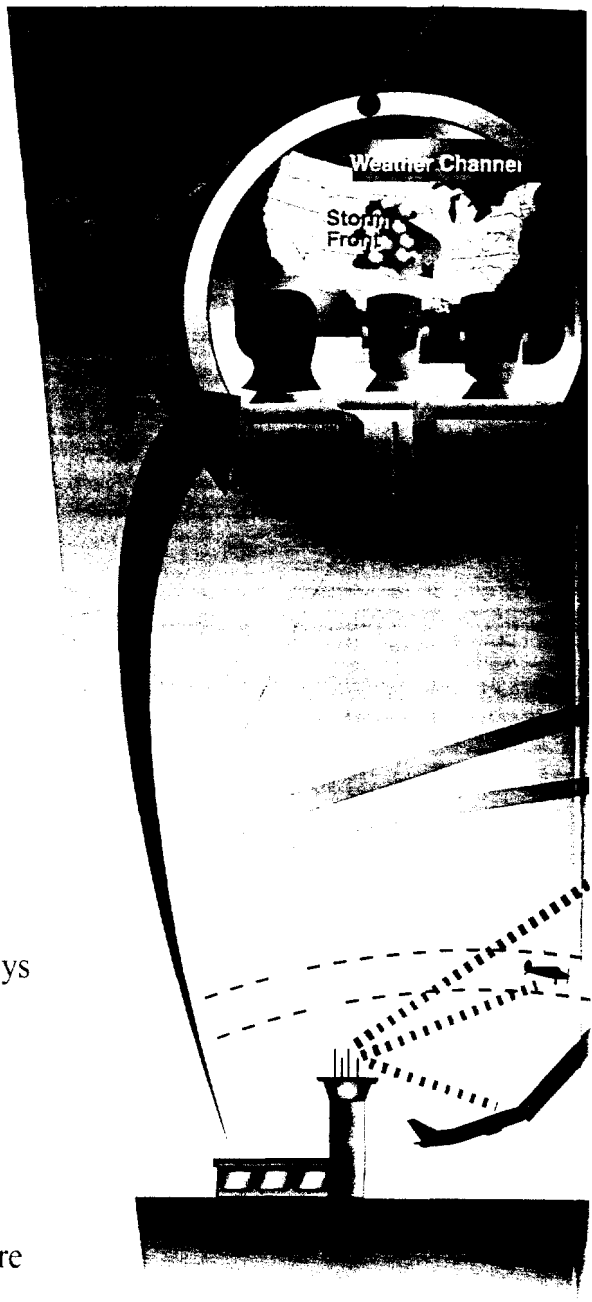
Air Traffic Control System Delays



Data source: Air Transport Association Web Site

Trajectories are the shape of the future.

The ability to confidently predict the three-dimensional path that an aircraft will follow—its trajectory—is the foundation of the Boeing Air Traffic Management concept. Onboard systems will communicate intended flight profiles by two-way data links to air traffic service providers. Accurate space-based navigation and surveillance systems will allow flight crews to maintain extremely precise flight paths.



A new network will give more people better data in real time.

The air traffic system's central control facility will use the new Common Information Network and National System Flow Model to integrate planning information with comprehensive real-time weather, traffic, and system status information. Flight planners and air traffic managers will use the information to avoid conflicts, congestion and ground holds. Flight crews will use continuously updated trajectories to coordinate the optimum route to their destinations. Aircraft equipment requirements will be flexible, according to the level of service the user needs, and will depend on the phase of implementation.

Redesigned airspace will create greater efficiency.

We propose dramatically restructuring airspace to reduce delays and safely increase the number of flights the system can handle. The design would take advantage of the new system's improved planning capabilities. Air traffic managers will be able to plan strategically, contacting a pilot only for exceptions, such as when an airplane requires rerouting from its predetermined flight path. That means that each manager can oversee a sector containing more airplanes than is possible today.

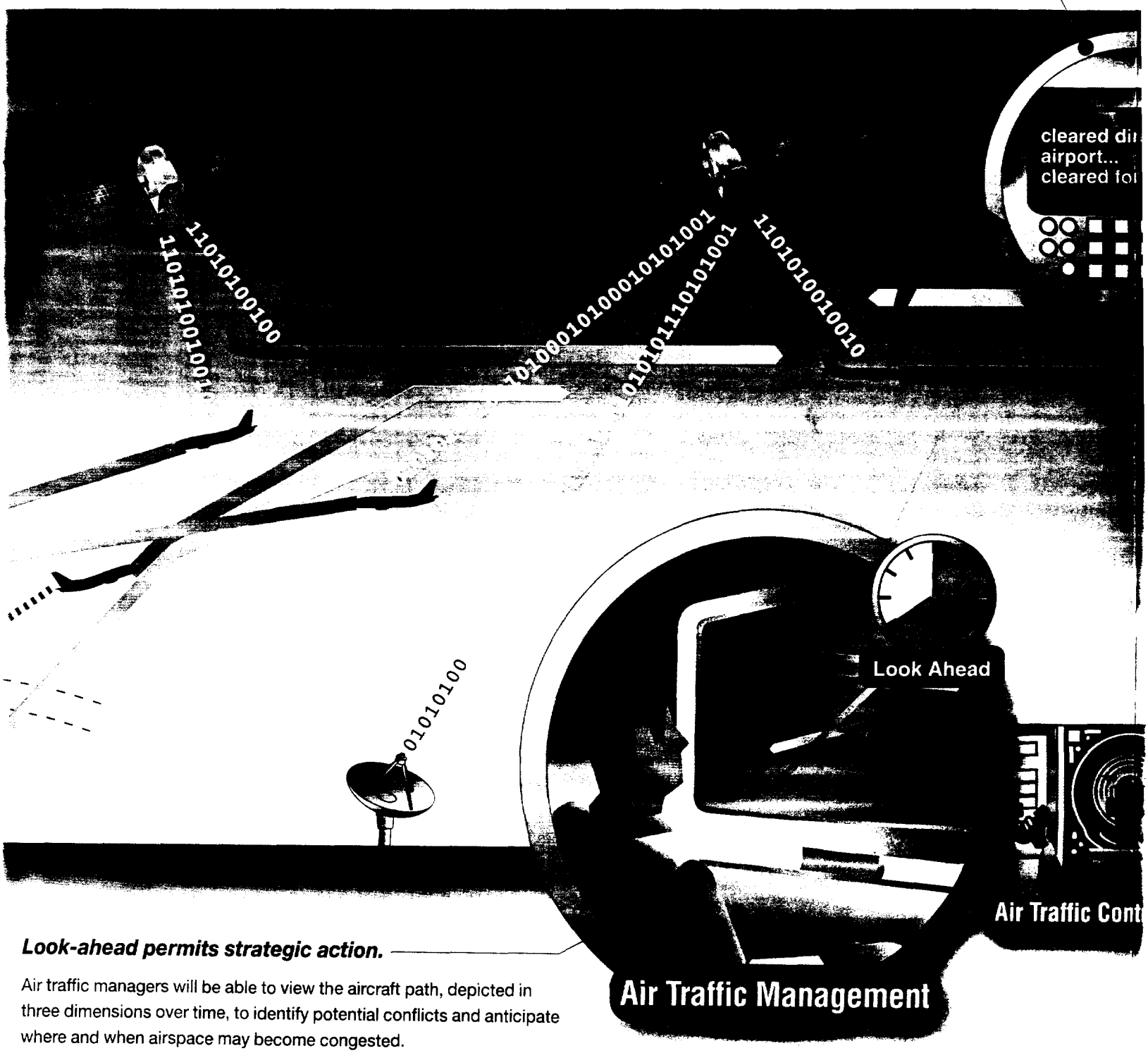
Picture the Next-Generation A

Why the system must be responsive.

Flight plans can quickly become outdated as weather or air traffic control actions force schedule and routing changes.

New system to leverage flight path data.

By linking onboard flight management systems, ultra-precise and reliable satellite communication, navigation and surveillance data, and ground systems, air traffic managers and flight crews can safely coordinate flight path revisions.



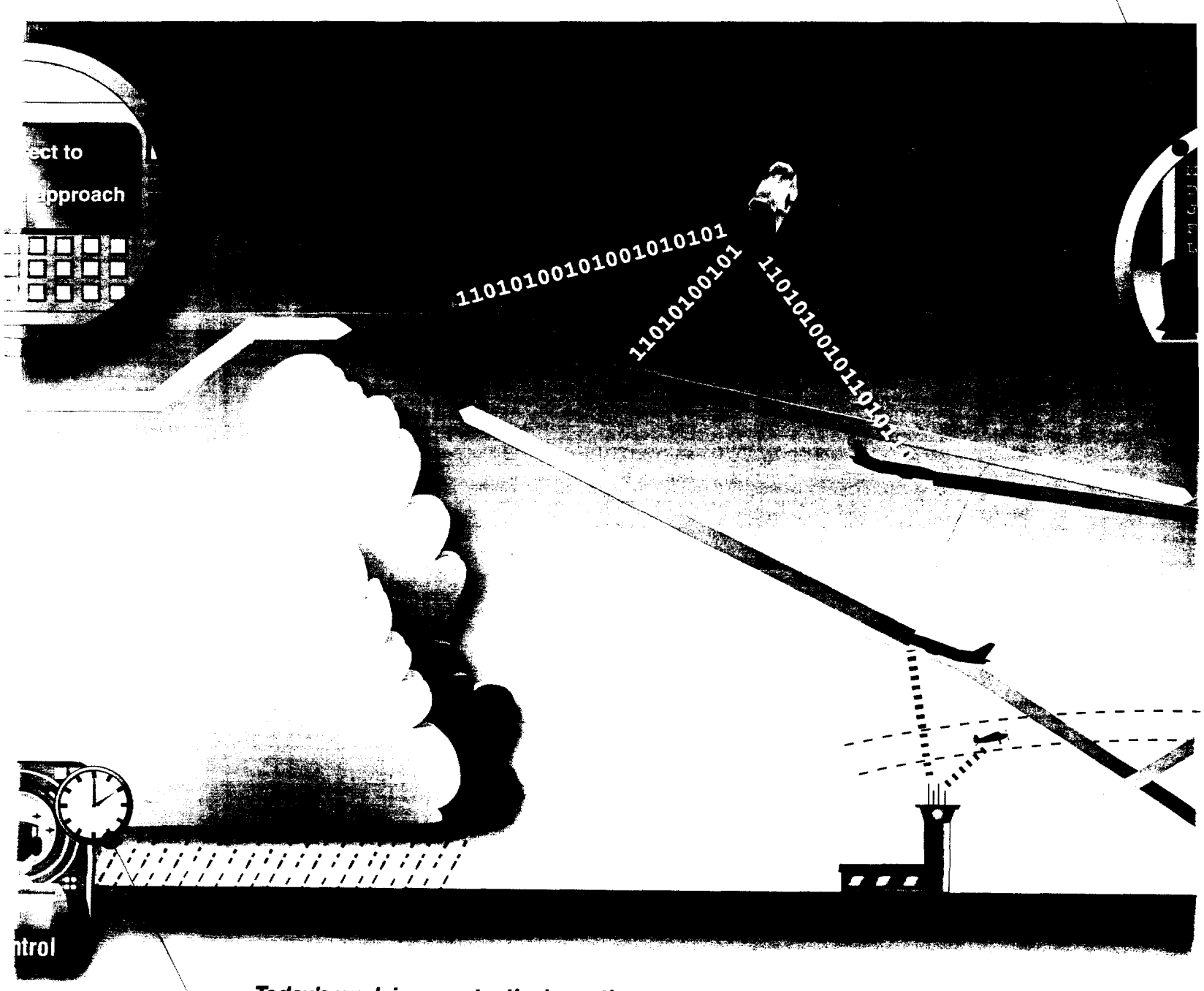
Look-ahead permits strategic action.

Air traffic managers will be able to view the aircraft path, depicted in three dimensions over time, to identify potential conflicts and anticipate where and when airspace may become congested.

ir Traffic Management System

Dependable on-time arrivals—will this new system deliver?

A disciplined endeavor such as this one requires performance objectives and measurable outcomes. Sophisticated simulation and unique modeling tools will help quantify benefits derived from these or other concepts.

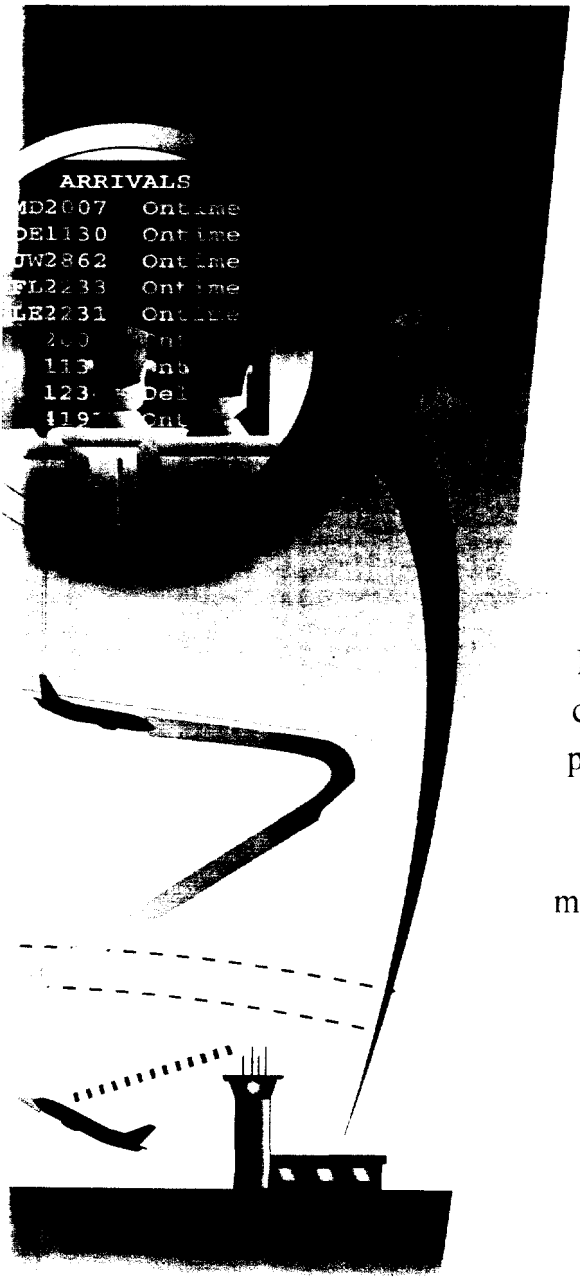


Today's work is more tactical reaction.

Currently, air traffic controllers track aircraft as moving dots on a flat display, each labeled with flight number, altitude, and ground speed. The controller must create a three-dimensional mental picture of the complex, changing airspace, projected in time.

What the next-generation system will bring.

Expand capacity and reduce delays. This new air traffic system builds on and enhances the current modernization plans of the FAA, which Boeing supports. Once fully implemented, this new system, in combination with FAA modernization plans, will create capacity for 15 to 17 years of growth.[1] This improvement is equivalent to a 45 percent reduction in delays.



Further increase capacity as new runways are built. As new runways and improvements to airport infrastructure relieve congestion on the ground, the envisioned system will accommodate air traffic growth for the next 25 years, with no increase in delays.

Enhance the inherent safety of flight. A common, more precise view of where airplanes are and where they are going significantly raises awareness of the many system participants to the air traffic state.

Working with all stakeholders is the next step.

The Federal Aviation Administration (FAA) Operational Evolution Plan accomplishes much needed near-term improvements. The Boeing concept goes much further, however, allowing system capacity to keep pace with predicted growth without resorting to re-regulation.

Boeing will work with the FAA and other stakeholders to establish more detailed requirements of the next-generation air traffic system.

Please call us at Boeing Air Traffic Management. We would be glad to answer any questions and hear your ideas.

John Hayhurst, President
(253) 657-3600

[1] This preliminary assessment assumes 3.7 percent annual growth in delay through 2012, uses the Boeing *Current Market Outlook* passenger growth rates and other data, and incorporates a range of weather conditions.

Imagine facing a predicted storm... yet arriving on time.

The Boeing vision revolutionizes air traffic management. We will

- Make flying even safer.
- Dramatically reduce congestion and delays.
- Keep aviation affordable and accessible for all users—commercial, military, business, and general aviation operators.

The proposed concept has three defining features:

- Aircraft trajectory—or "look-ahead" capability, will enable air traffic managers to predict where an airplane will be, further into the future and with more precision than ever before.
- Common information network—will allow dynamic revision of flight paths, even after airplane departure, when unexpected weather or other developments threaten schedules.
- Airspace redesign—restructured airspace sectors will enable development of more strategic, less repetitive operating procedures.

Advanced satellites will enable the largest improvements. Satellite-based communication, navigation and surveillance (CNS) will integrate the entire National Airspace System (NAS). This capability, together with new operational procedures, will provide the most significant system capacity gains.

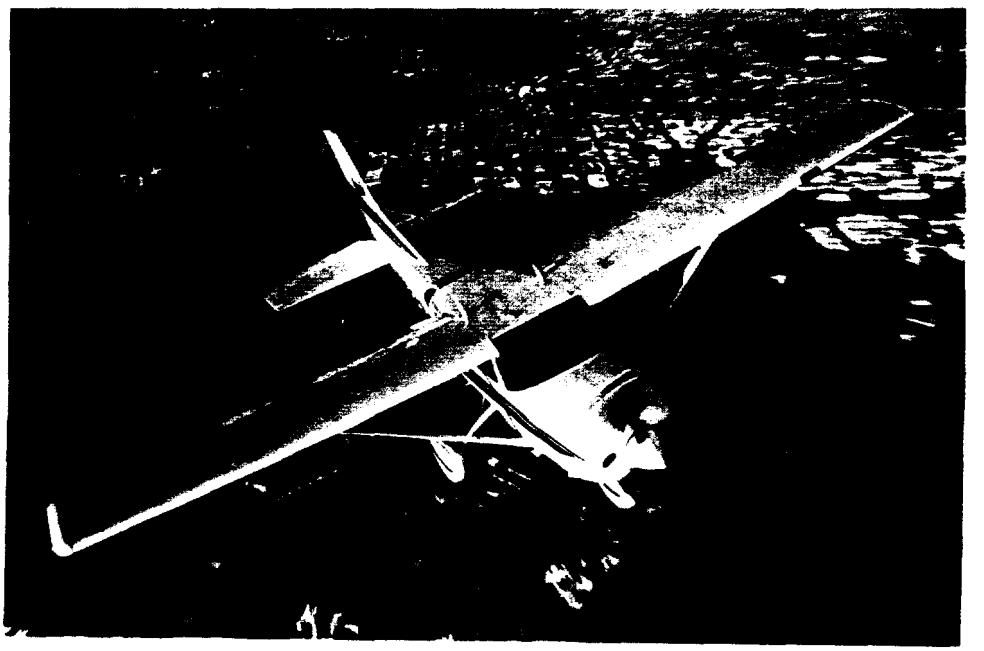


Photo courtesy of the Cessna Aircraft Company, 2001

Real near-term improvements if change is initiated now.

The National Airspace System will be upgraded in three achievable stages. The biggest challenge will be choreographing the complex set of airspace system changes to allow an orderly and affordable transition to new capabilities and procedures. Recognizing how needs change over time, Boeing is using an open system architecture design to readily accommodate future technology developments.

Proposed schedule — Establish stakeholder requirements — Complete operational implementation: Phase 1, Phase 2, Phase 3

Year	0	1	2	3	4	5	6	7
	Current Situation		**Program Phase 1**		**Program Phase 2**		**Program Phase 3**	
Trajectory-Based Air Traffic Management	Radar- and flight plan-based tactical air traffic control		Trajectory-based flow management • Integrated national and regional flow planning system • Dynamic replanning consistent with airline planning		Trajectory-based flight planning • Integrated national and regional flow and flight planning • Trajectory for individual flight plans		Trajectory-based separation management • Strategic separation assurance • Trajectory conformance monitoring • Dynamic flight replanning	
Common Information Network	Numerous data sources (e.g. radar, flight strips) Limited data connectivity CNS environment • Voice for ATC • Land-based navigation aids, GPS backup • Radar-based surveillance		Common traffic flow planning database Flow planning data connectivity CNS environment • Initial data link • Increased GPS use • Radar-based surveillance		Common traffic flow and flight-planning database Flow and flight data connectivity CNS environment • Data link, voice backup • GPS primary navigation • Radar and data fusion		Common NAS database Systemwide connectivity Global CNS satellite services	
Airspace Redesign			See FAA OEP		Transition to new airspace design		Implement new sector, en route, and terminal airspace	
Satellite Enabled System	—		—		Partial		Full	
FAA Operational Evolution Plan (OEP)	**Resolve choke points** **Collaboration and information sharing**		**Optimize airspace design** **Widespread use of Free Flight tools** **Reduced vertical separation** **Enhanced navigation procedures**		**Data communications** **Satellite navigation** **Enhanced surveillance**			

This plan is technically feasible, requiring extensive collaborative action among stakeholders, industry, and policy makers.

The Boeing Company, Air Traffic Management, P.O. Box 3707
MC 80-RP, Seattle, WA 98124-2207 www.boeing.com/atm

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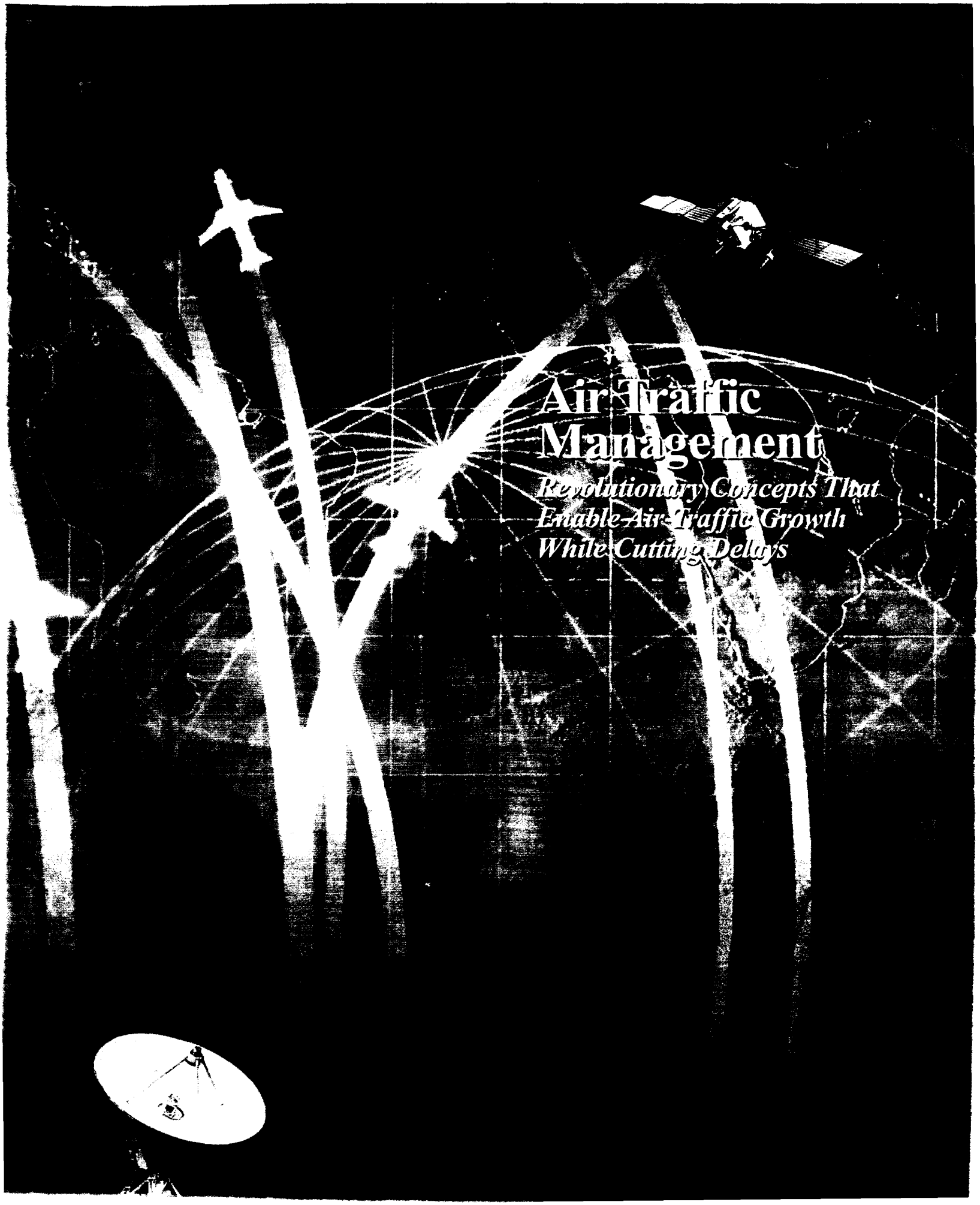

Air Traffic Management

Revolutionary Concepts That Enable Air Traffic Growth While Cutting Delays

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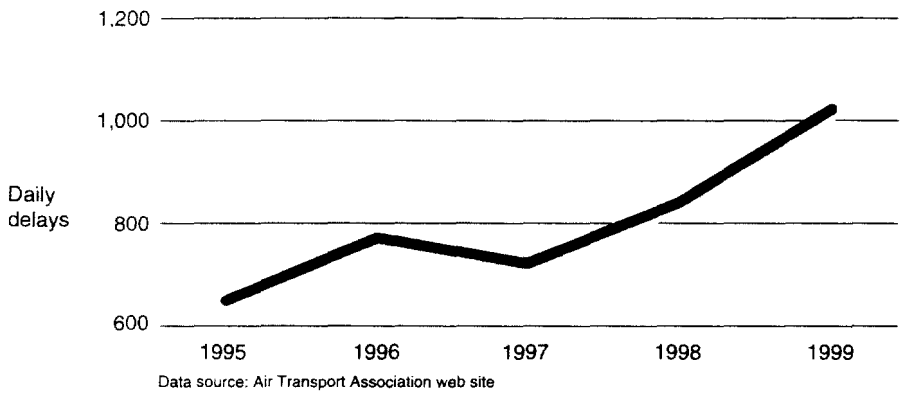
The World's Most Advanced Air Transportation System at the Cross Roads

In 1978 the U.S. Government took a bold step and deregulated commercial air travel. The objective was to allow the marketplace to determine how the industry should grow. By every measure, the experiment has been a phenomenal success. Ticket prices declined and continue to be affordable. The number of passengers has steadily risen. The number of cities served by commercial flights continues to expand. Schedules and routes are becoming ever more convenient.



The rising trend of air traffic delays shows no sign of abating.

The deregulated air transportation industry has become a powerful economic engine driving a wide variety of other industries, from tourism and leisure travel to heavy manufacturing, which depends on rapid, dependable air freight for just-in-time inventory management and logistics. Today, commerce in perishable and high-value goods depends heavily on air transportation. In fact, 40 percent of worldwide cargo, calculated by value, travels by air.

Ironically, as countries throughout the world embrace deregulation to gain the advantages of a market-driven air transportation system, our own advances in deregulation are imperiled by the inability of the current system to accommodate future demand. Desperate measures have been suggested, including curtailment of growth to hold traffic volumes within system capabilities.

Failure to fundamentally change the air traffic system now, may leave few alternatives to such draconian market restrictions in the future. It is time to address this crisis in airspace capacity.

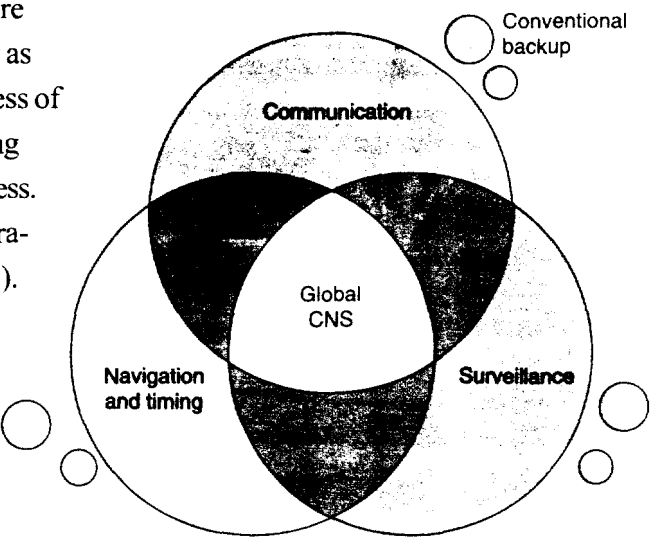
2.0 The Demand-Driven Vision

An Air Transportation System With Room to Grow

Boeing envisions a dramatically new way to manage air traffic. The new concept will accommodate future air traffic growth and preserve the successful vision of a demand-driven air transport system. If the program were initiated today, we could begin to see results in as early as three years. This document is an initial step in the process of fostering discussion, listening to stakeholders, addressing feedback, and launching a formal Working Together process.

The Boeing concept provides unprecedented integration of the entire U.S. National Airspace System (NAS). For the first time

- All participants—flight crews, flight planners, regional and local air traffic service providers, and the national air traffic command center—will have access to the same data for heightened collaboration, negotiation, and strategic planning.
- Precise data regarding the location and intended flight path of an airplane will be accessible to air traffic service providers, airline dispatchers, and airport operators to promote more efficient operations.
- Air traffic controllers will be able to manage more traffic in larger sectors because they will have strategic tools, and there will be substantial automation of routine and repetitive tasks.



Integration of CNS will enable creation of a common, robust air traffic information network for all system users.

These improvements are enabled by advanced satellite-based communications, navigation, and surveillance (CNS) services. Appendix A compares the Boeing integrated upgrade approach to autonomous upgrades of the three service segments. These services, together with new operational procedures, will greatly increase NAS capacity.

Boeing proposes to upgrade the NAS in three achievable stages that build on the Operational Evolution Plan (OEP) of the Federal Aviation Adminstration (FAA) for an orderly and affordable transition to new capabilities and procedures. Recognizing that needs change over time, we will use an open architecture design to readily accommodate future technologies.[1] The technology integration prescribed in our concept will make flying even safer than it is today, dramatically reduce air traffic congestion and delays, and keep aviation affordable and accessible for all users—commercial, military, business, and general aviation operators.

1. This proposal focuses on the U.S. NAS. During the requirements definition stage of the program, we will collaborate with air traffic service providers outside the United States to develop a solution that is compatible with global applications.

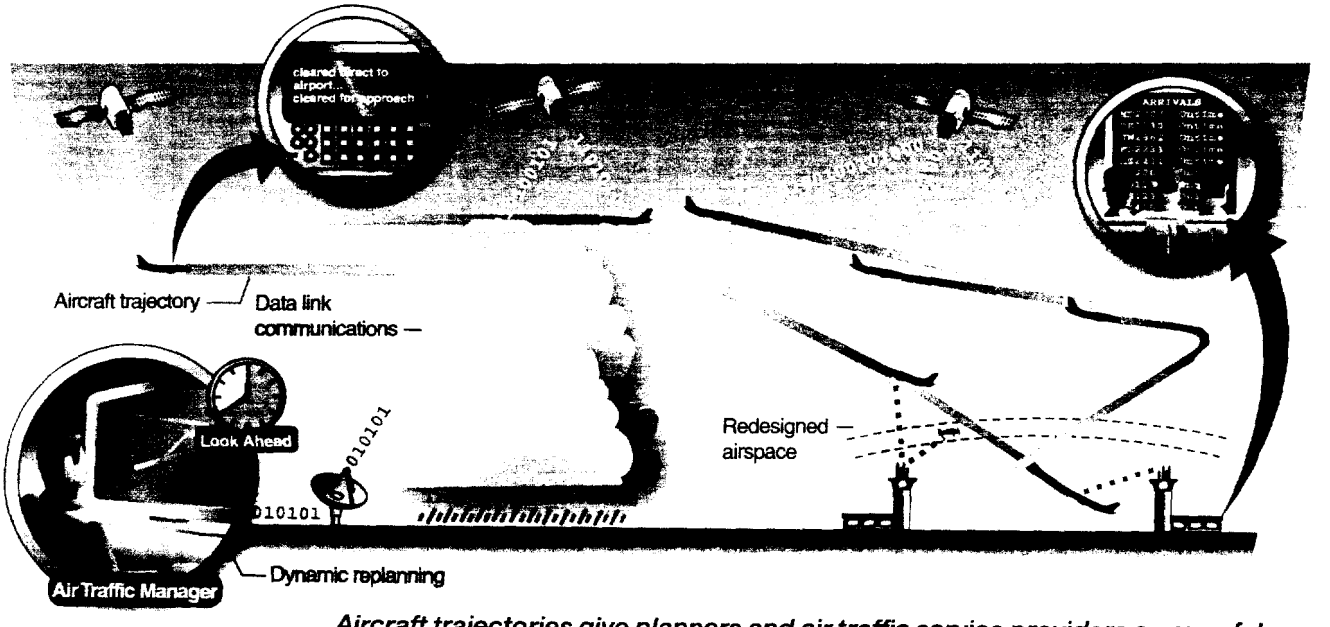
A New Way to Manage Air Traffic

Three definitive features are central to the Boeing air traffic management concept:

- **Aircraft trajectory**—the synthesis of a variety of information about an airplane's position, altitude, speed, and intended flight path into a unified, easy-to-interpret graphical representation. Trajectory-based applications let users confidently predict where an airplane will be at some future time.
- **Common Information Network**—a central airspace information resource that links system users and operators to real-time information about aircraft trajectories, weather, air traffic flow, and other air traffic system conditions.
- **Redesigned airspace**—replacement of the complex, outmoded system of control sectors and segregated flow zones with a simpler, more open, managed-flow configuration.

Innovative Satellite System

An innovative system of CNS satellites (app. A) will unify and enhance air traffic management capability, adding real-time information network functions and enabling the airspace and procedural changes that result in the greatest capacity gains in the later phases of program implementation.



Aircraft trajectories give planners and air traffic service providers a powerful look-ahead capability. The Common Information Network links users to the same trajectory-based information resource, enabling development of simplified air traffic procedures and more efficient use of the airspace.

3.1 Aircraft trajectories give a new dimension to traffic flow management.

Look-Ahead Capability.

The look-ahead capability provided by the aircraft trajectory feature will enable air traffic service providers to accurately forecast system loading. Currently, service providers must base their forecasts on flight plans submitted by operators at the beginning of the day. These flight plans are little more than two-dimensional maps of the waypoints that flights will follow.

Scheduled flight times will decrease as variables and uncertainty are removed from the flight planning process.

It is not possible, using only these plans and currently available analysis tools, to foresee more than a few minutes into the future conflicts between individual flights. Moreover, it is extremely difficult to adjust air traffic flows in response to operator-originated flight plan changes or weather-related disturbances that occur throughout the day.

As a result, air traffic system loads must be estimated very conservatively. When unexpected conditions arise, the primary flow management strategy of the current system is to adjust aircraft departure times—in other words, to delay flights. Airplanes scheduled to take off for affected regions are held on the ground until they will not contribute to the disruption. Faced with the prospect of lengthy or extensive delays, airlines often find it necessary to cancel some flights.

Aircraft trajectory visualization tools will enable operators and air traffic service providers to foresee how the aggregate of flight plans will affect system loading. Together they will be able to revise flight plans before departure to avoid congestion and eliminate resulting delays and cancellations.

When weather disrupts air traffic flow or when airlines must revise flight plans because of problems with equipment or crew, trajectory visualization will help air traffic managers agree on a solution that results in minimum delay and gives optimum choice of routing to affected flights.

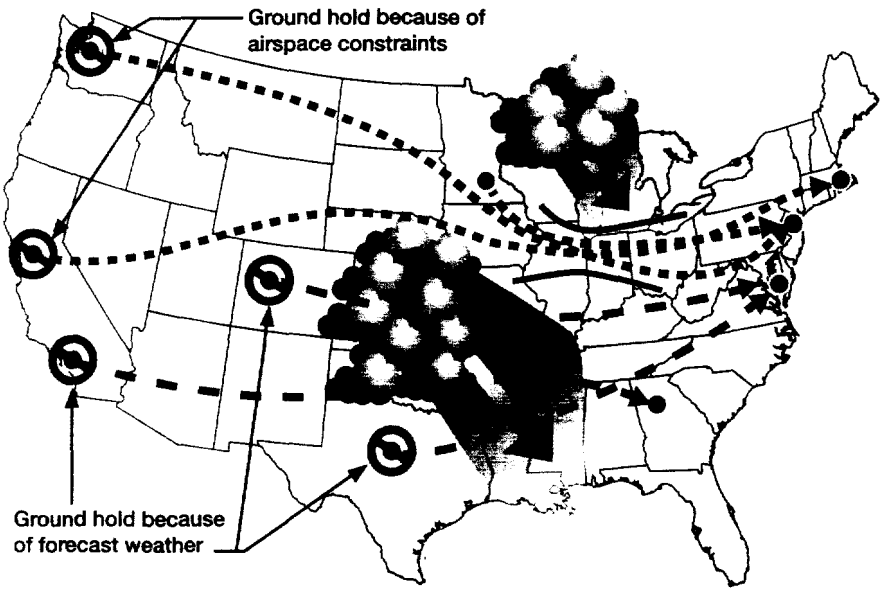
Dynamic Replanning.

Trajectory visualization will also help air traffic managers dynamically replan flights once aircraft are airborne. Today, air traffic controllers have little information on the intentions of flight crews. They can, therefore, predict the position of an aircraft only a few minutes into the future.

Aircraft trajectories will include information on flight crew intentions, thereby enabling the air traffic manager to anticipate the position of an airplane 40 minutes or more into the future. Using trajectories, the air traffic manager will be able to quickly visualize how a change in one flight plan will affect other flights in the region and will be able, therefore, to implement flight plan changes for airplanes in flight with a high degree of confidence that the changes will not produce disruptions elsewhere in the system.

3.2 The Common Information Network enables dynamic flight replanning. Flexible Flow Management.

Using aircraft trajectory visualization to adjust flight plans before airplane departure will help flight planners avoid air traffic system overloads. The Common Information Network will multiply the capacity benefits of trajectory-based planning by making real-time trajectory, weather, and other information available to air traffic service providers and air traffic system users throughout the NAS. This capacity will enable planners, services providers, and flight crews to adapt to adverse traffic conditions that arise while aircraft are en route. The ability to replan flightpaths of airborne aircraft will enable planners to sustain near-normal airspace capacity during disruptive events.



Inability to change flight plans after aircraft pushback from the gate leaves air traffic controllers no alternative to ground holds when weather is uncertain or congestion is probable.

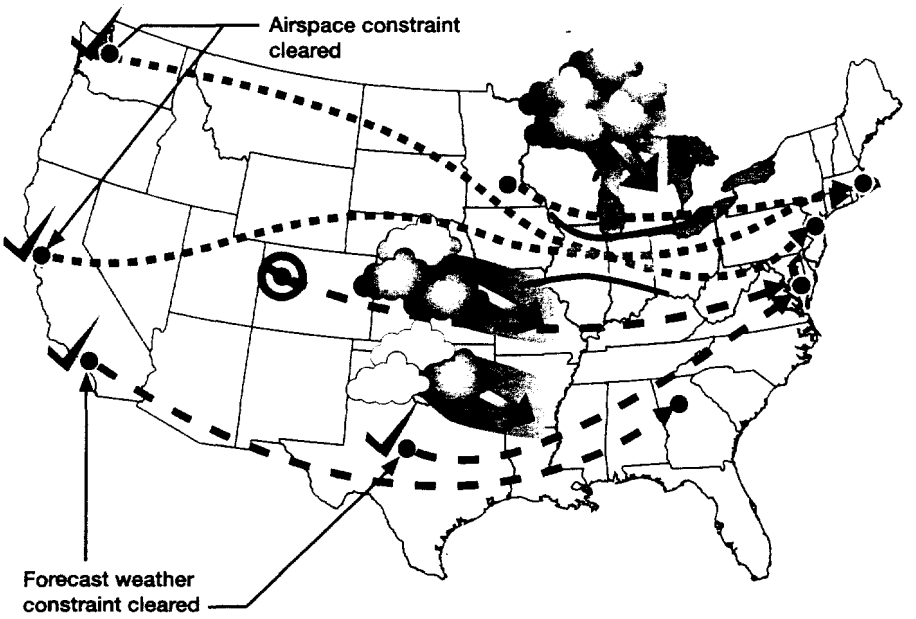
Data Link Communications.

Boeing envisions a system in which real-time, digital data-link communications make flight planning, replanning, and coordination a continuous process. Data from aircraft flight decks, weather satellites and weather services forecasts, ground- and satellite-based aircraft tracking stations, airport runway monitoring stations, and airspace system loading and status monitoring centers will be sent by data link to be combined in a National System Flow Model.

The National System Flow Model will synthesize a picture of the entire

airspace system with unprecedented accuracy and completeness. Flight planners and traffic managers will be able to zoom in on a portion of the model to view a common picture of the air traffic situation when changes are being considered.

Analysis tools will allow traffic managers to simulate the system flow in fast-forward mode so that they can evaluate the consequences of particular flight plan or traffic flow changes. All participants will be able to view the same what-if scenario to reach a mutually acceptable plan of action. An agreed-upon set of metrics will ensure that the consequences of changes are distributed fairly among all participants.



Improved forecasting and dynamic flight replanning allow traffic managers to adjust routes and sector timings while airplanes are in flight.

Changes will be communicated directly to the flight management systems (FMS) on aircraft flight decks. Flight crews will acknowledge receipt of new instructions and verify by data link that the changes have been implemented.

Though air traffic managers will retain radio voice communication capability as an emergency backup and to enable tactical interventions, routine communications with aircraft and communication of flight plan changes will be by system-to-system data links.

The enhanced dynamic planning capability, trajectory-based flow visualization and analysis tools, and direct system-to-system data links will free air traffic managers from the overwhelming burden of routine voice interaction with aircraft flight crews. As a result, they will be able to handle more aircraft and larger expanses of airspace. They will make the highest and fullest use of their skills, experience, and judgment to prevent or minimize the effects of traffic disruptions, rather than devising remedial strategies and performing repetitive tasks.

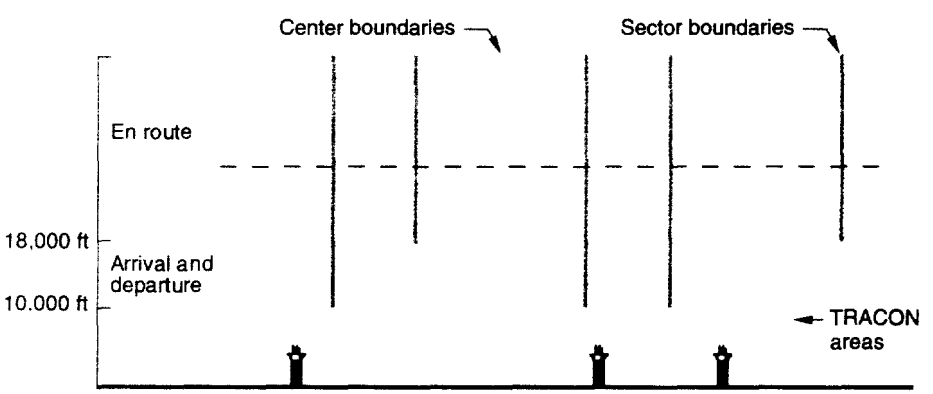
The Common Information Network will provide alternatives to holding aircraft on the ground when disruptions occur. Airline flight planners will be

better able to ensure that equipment is available where needed and that flight connections will be made. Passengers will be subjected to significantly fewer takeoff delays and flight cancellations. When delays are unavoidable, airlines will be able to give passengers—and the people who are meeting them—more accurate estimates of the duration of the delay and of arrival times.

While we recognize that aircraft will have different levels of equipage, the system will provide benefits to all classes of operators at each phase of implementation. For example, general aviation and small commercial operators will enjoy the advantages of a system optimized to handle the prevailing volume of traffic. Fully equipped participants, however, will gain the most flexibility to avoid ground holds and delays related to air traffic .

3.3 Restructured airspace reflects new operational capabilities. Simplified Airspace.

Our concept takes advantage of the enhanced visualization, planning, and communication capabilities provided by the National System Flow Model and the Common Information Network to simplify air traffic procedures and the structure of the airspace.



Under the current airspace structure, air traffic control is composed of towers, TRACONs, and air route traffic control centers that maintain authority over controlled airspace.

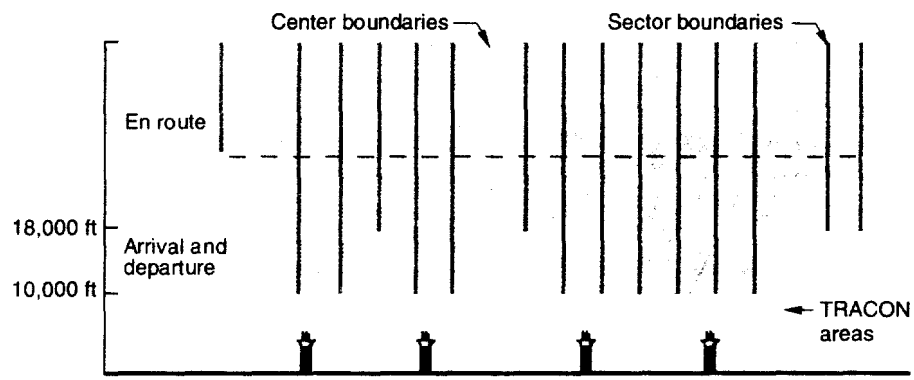
The NAS is currently organized into a complex puzzle of positive-controlled and other airspace, tower, and arrival/departure control regions; en route flow spaces; and air traffic control sectors. This structure was the most effective one possible, given the capabilities of World War II–era technology, such as radar tracking, radio voice communications, and ground-based radio beacon navigational aids. The current structuring of the airspace into air traffic control sectors complicates planning and coordination of control across boundaries.

Though airspace system technology has evolved incrementally, the airspace structure and air traffic procedures remain largely the same. For example, flight-management equipment currently installed on most transport category

aircraft would support simpler and much more effective trajectory-based procedures. The airspace is not, however, structured to support those capabilities, and the air traffic controller's tools are often not as capable as those onboard the aircraft.

Existing plans to update air traffic equipage to accommodate higher traffic volumes, in many cases, address air traffic controller workload by further subdividing the airspace into smaller control sectors. Construction of new runways could require expansion of controlled terminal area airspace, under current airspace design and procedures. New airspace design and procedures will ensure that general aviation continues to enjoy access to large volumes of airspace.

The proposed concept envisions a redesign of the airspace. En route airspace will not be divided and subdivided into sectors in response to air traffic volume fluctuations. Individual air traffic managers will be able to handle more aircraft and larger volumes of airspace, reducing at once the proliferation of sectors, control sector radio frequencies, and the repetitive routine of handoffs as airplanes cross from one sector to another. At and around airports, the need for expansive controlled airspace will be minimized, and fly-through routes will be reserved for general aviation.



Projected traffic growth will continue the proliferation of control sectors. More and smaller sectors mean more routine, repetitive tasks, such as control hand-offs, for service providers and flight crews.

Decreased Congestion.

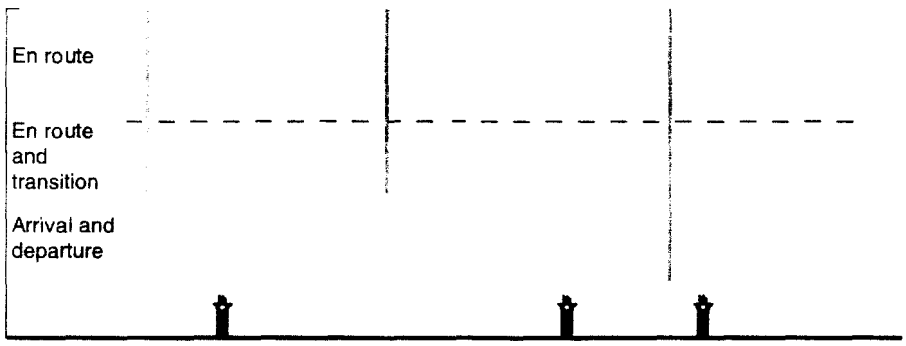
In the transition airspace between en route and final approach, trajectory-based flow management tools will help air traffic managers alleviate congestion around busy airports during peak hours. Air traffic controllers must currently reserve large blocks of airspace to ensure safe separations for approaching and departing aircraft because they lack detailed and dependable information about the performance characteristics of individual airplanes and the intentions of individual flight crews. During peak hours the volume of reserved airspace can grow until it restricts flow to nearby airports. Trajectory-based flow management tools will give air traffic managers a dependable vertical flight profile for individual

airplanes, greatly reducing the amount of airspace that must be reserved to compensate for flight path uncertainties.

Flight trajectories will enable conformance monitoring. In conjunction with high-integrity, mutually agreed-upon, trajectory-based flight plans, conformance monitoring will support new separation-assurance standards, enhancing safety while permitting closer minimum spacing than is possible using current radar-based monitoring and controller-intensive vectoring procedures. Aircraft that are not equipped to participate in trajectory-based flight planning will continue to use voice clearances during approach.

3.4 Innovative satellite-based CNS services support advanced air traffic applications.

A unique satellite architecture (app. A) is being developed to support safety-of-flight applications, with appropriate levels of accuracy, availability, integrity, and continuity of function. This real-time extension of the Boeing Common Information Network will provide CNS services to support air traffic management functions for the next 25 years and beyond. The satellite constellation's integrated design allows synergy among CNS services. The system will complement the existing GPS constellation and support global CNS operations with accuracies down to meter levels. This system will support the trajectory-based air traffic management applications envisioned in the fully operational system, as described in section 4.3.



The proposed Boeing concept takes advantage of improved planning and satellite CNS capabilities to simplify air traffic procedures and the design of the airspace.