

AD-A109 909

MITRE CORP MCLEAN VA METREK DIV

F/G 5/1

PRELIMINARY FUNCTIONAL DESCRIPTION OF INTEGRATED FLOW MANAGEMEN--ETC(U)

OCT 81 D L ADAMS, S M ALVANIA, R BRUBAKER

DTFA01-81-C-10001

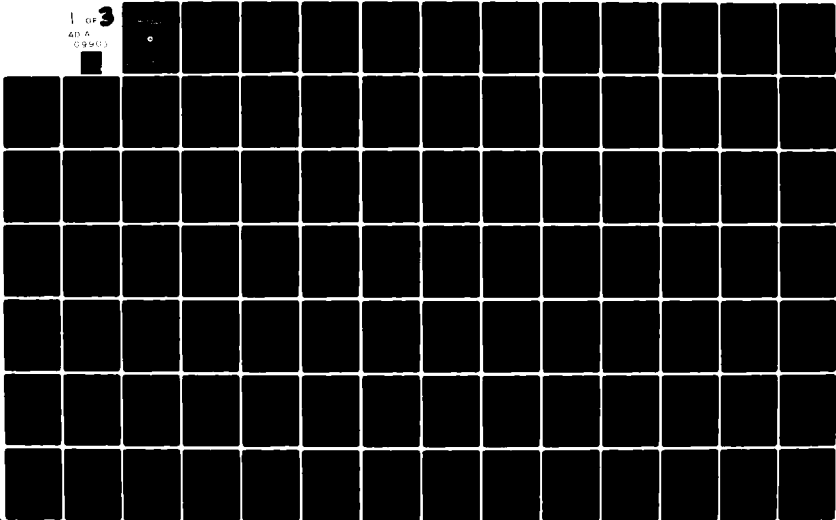
UNCLASSIFIED

MTR-81W252

FAA-EM-82-7

NL

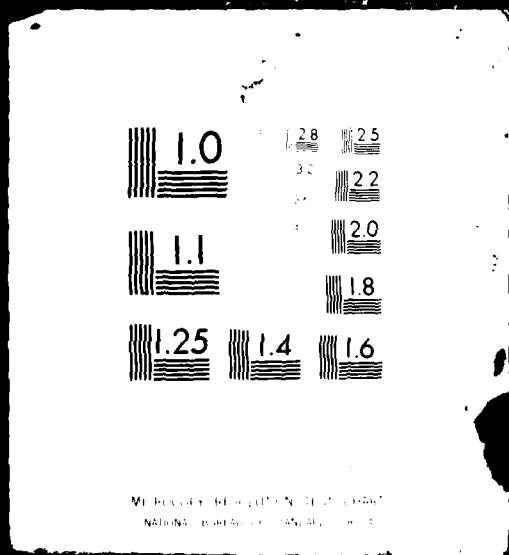
1 of 3
40 x
68903



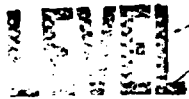
1 OF 3

AD A

109909



Report No. FAA-EM-82-7



12

40

AD A109909

PRELIMINARY FUNCTIONAL DESCRIPTION OF INTEGRATED FLOW MANAGEMENT



OCTOBER 1981

DTIC
SELECTE
JAN 21 1982
S A D

Document is available to the U.S. public through
the National Technical Information Service
Springfield, Virginia 22161

Prepared for

U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION
OFFICE OF SYSTEMS ENGINEERING MANAGEMENT

Washington, D.C. 20591

01 21 02 050

DTIC FILE COPY

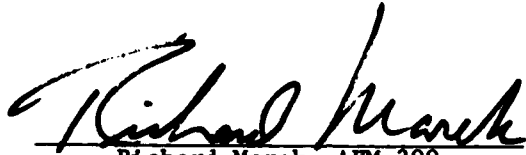
NOTICE

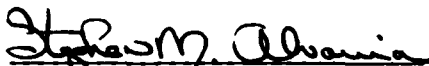
This document is disseminated under the sponsorship of the Department of Transportation in the interest of information exchange. The United States Government assumes no liability for its contents or use thereof.


Technical Report Documentation Page

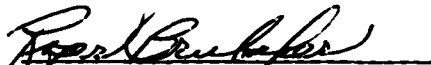
1. Report No. FAA-EM-82-7		2. Government Accession No. AD A109 909		3. Recipient's Catalog No.	
4. Title and Subtitle Preliminary Functional Description of Integrated Flow Management		5. Report Date October 1981		6. Performing Organization Code	
		8. Performing Organization Report No. MTR-81W252		10. Work Unit No. (TRAIS)	
7. Author(s) D. L. Adams*, S. M. Alvania**, R. Brubaker**, M. M. Levin*, W. J. Marek**, M. F. Medeiros***, G. R. Rowland**, A. N. Sinha*		9. Performing Organization Name and Address Department of Transportation Federal Aviation Administration & Metrek Division Washington, D. C. 20591 The MITRE Corporation 1820 Dolly Madison Bvd McLean, Va 22102		11. Contract or Grant No. DTFA01-81-C-10001	
12. Sponsoring Agency Name and Address Department of Transportation Federal Aviation Administration Office of Systems Engineering Management Washington, D. C. 20591		13. Type of Report and Period Covered		14. Sponsoring Agency Code AEM-300	
		15. Supplementary Notes * The MITRE Corporation ** Federal Aviation Administration *** Transportation Systems Center			
16. Abstract A preliminary functional description of Integrated Flow Management (IFM) is documented in this report. The objective is to provide a strawman concept so that further IFM development activities will proceed from a common reference point based upon agreement among all related program organizations. The distribution of flow management functions among the various ATC facilities and the related interfacility communications requirements are central issues addressed in this report. A road map projection of the IFM near term evolution through the late 1980s and remaining open issues related to the IFM development are also presented.					
17. Key Words Integrated Flow Management, Central Flow Control, En Route Metering, Terminal Configuration Management Systems, National Flow, Coordination, Communications			18. Distribution Statement Document is available to the public through the National Technical Information Service, Springfield, VA 22161		
19. Security Classif. (of this report) Unclassified		20. Security Classif. (of this page) Unclassified		21. No. of Pages	22. Price

This interim report is prepared for internal FAA coordination by the Integrated Flow Management Committee.


Richard Marek, AEM-300
Chairman

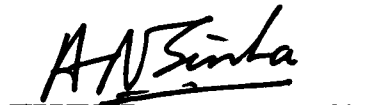

Stephen Alvania, AAT-320


Manuel F. Medeiros, TSC


Roger Brubaker, AAT-440


Gary Rowland, ARD-123


Kerry M. Levin
The MITRE Corp.


Agam N. Sinha
The MITRE Corp.

A



ACKNOWLEDGEMENT

The Integrated Flow Management Committee acknowledges the extensive support provided by Ms. D. L. Adams of The MITRE Corporation. Ms. Adams has supported all the technical phases of this activity by providing initial descriptions of the topics for the Committee's deliberations. The Committee members would also like to thank her for consolidating the results of hours of discussions into this report.

TABLE OF CONTENTS

	<u>Page</u>
1. INTRODUCTION	1-1
1.1 Background	1-1
1.2 Purpose and Scope	1-2
1.3 Assumptions	1-3
2. OVERVIEW OF INTEGRATED FLOW MANAGEMENT	2-1
2.1 Role of Flow Management	2-3
2.2 Goal of Integrated Flow Management	2-4
2.3 Implementation of the Flow Management Processes	2-5
3. CURRENT FLOW PLANNING AND SYSTEM NEEDS	3-1
3.1 Overview of Current Flow Management Processes	3-1
3.2 System Needs	3-4
4. INTEGRATED FLOW MANAGEMENT CONCEPT DEFINITION	4-1
4.1 Allocation of Flow Management Responsibilities	4-1
4.1.1 Alternative Flow Management Configurations	4-1
4.1.2 Concept for Delegation of IFM Responsibilities	4-3
4.2 Identification of IFM Functions by Facility	4-6
4.2.1 National Flow Management Functions	4-7
4.2.2 En Route Flow Management Functions	4-10
4.2.3 Terminal Flow Management Functions	4-15
4.3 Interfacility Communications	4-19
5. RELATIONSHIP OF FLOW MANAGEMENT TO TIME AND DEMAND LEVELS	5-1
5.1 Time Dimensional Overview of Flow Management Planning	5-1
5.1.1 Long Term Strategic Planning	5-2
5.1.2 Intermediate Long Term Planning	5-4
5.1.3 Near Term Strategic Planning	5-5
5.1.4 Tactical Planning	5-7

TABLE OF CONTENTS
(CONCLUDED)

	<u>Page</u>
5.2 Relationship of Flow Management to Demand Levels	5-8
6. ROADMAP OF NEAR TERM FLOW MANAGEMENT EVOLUTION	6-1
6.1 National Flow Management Near Term Developments	6-1
6.2 En Route Flow Management Near Term Developments	6-3
6.3 Terminal Flow Management Near Term Developments	6-5
7. REMAINING ISSUES	7-1
APPENDIX A: LIST OF FLOW MANAGEMENT FUNCTIONS BY FACILITY	A-1
APPENDIX B: IDENTIFICATION OF INPUTS AND OUTPUTS FOR THE INTEGRATED FLOW MANAGEMENT FUNCTIONS	B-1
APPENDIX C: FLOW MANAGEMENT INPUTS AND OUTPUTS LISTED BY FACILITY	C-1
APPENDIX D: INTEGRATED FLOW MANAGEMENT INTERFACILITY COMMUNICATIONS	D-1
APPENDIX E: ROADMAP OF NEAR TERM NATIONAL/EN ROUTE/TERMINAL FLOW MANAGEMENT FUNCTIONAL CAPABILITIES AND INTERFACES	E-1
APPENDIX F: REFERENCES	F-1

LIST OF ILLUSTRATIONS

TABLES

	<u>Page</u>
TABLE 4-1: NATIONAL FLOW MANAGEMENT FUNCTIONS	4-8
TABLE 4-2: EN ROUTE FLOW MANAGEMENT FUNCTIONS	4-12
TABLE 4-3: TERMINAL FLOW MANAGEMENT FUNCTIONS	4-16
TABLE 6-1: NEAR TERM IFM EVOLUTION	6-2

FIGURES

FIGURE 2-1: TYPICAL ATC FACILITY	2-2
FIGURE 2-2: FUNCTIONAL STRUCTURE OF THE ATC SYSTEM	2-6
FIGURE 4-1: IFM INTERFACILITY COMMUNICATIONS	4-21
FIGURE 5-1: CATEGORIES OF DEMAND PROFILES	5-9

1. INTRODUCTION

The establishment of a viable Integrated Flow Management (IFM) concept has been recognized as a necessary step in the course of planning for future improvements and automation enhancements to the current Air Traffic Control (ATC) system. This need encompasses all levels of ATC operations including local and interfacility procedures; further, IFM must address the problems of managing traffic flow in the current as well as the future ATC system framework. In fact, it is projected that further growth of aviation activity and skyrocketing fuel costs will impose an increased burden on the limited resources available within the existing air transportation system.

In response to these increasing needs, the Federal Aviation Administration (FAA) has initiated a program to establish a flow management concept that would assist in providing an efficient and coordinated flow of aircraft through the ATC system while minimizing the ATC delay cost impact on a system-wide basis. A further program objective would be the orderly and systematic integration of other developmental programs which will enhance ATC system operations. The formulation of the functional concepts for Integrated Flow Management is addressed in this report.

1.1 Background

A working committee comprised of FAA, Transportation Systems Center (TSC) and MITRE representatives was recently organized to develop a preliminary functional description of the Integrated Flow Management role for the 1995 - 2000 year ATC system. The general concepts concerning the flow management goals, relevant issues and the functional system structure were established initially as a preliminary step for subsequent IFM program development.

Further efforts of the study group have been directed toward expanding the conceptual framework into a mapping of the significant IFM functions that are envisioned for future development and preparation of a near term "roadmap" which outlines the expected steps of Integrated Flow Management evolution through the late 1980s. A central issue addressed is the distribution of flow management responsibilities among the various ATC facilities. In addition, the analysis includes a preliminary assessment of the interfacility communications flow requirements to support the IFM functions. This activity was conducted to provide the appropriate IFM inputs for the ATC Computer Replacement Specification (Reference 1).

1.2 Purpose and Scope

This report presents the interim results of the IFM working group activities to date. This material is documented for coordination purposes so that further development activities will proceed from an acceptable frame of reference based on agreement among all related program organizations.

The functional concepts developed in this document provide a general perspective of the role and objectives of Integrated Flow Management. The IFM concept description also delineates a possible configuration for delegating the major functions among the various levels of ATC facilities responsible for air traffic flow planning. The IFM functions are identified as basic processes which are considered necessary for achieving the flow management goal, but do not represent a detailed design specification. Similarly, the interfacility communications for each level of flow management are addressed in broad terms to establish the general types and frequency of information exchange that would support the identified functions. In addition, the flow management processes conducted within the national, en route and terminal ATC facilities over varying time intervals and changing demand characteristics are described to illustrate these relationships.

The roadmap of near term flow management evolution represents the expected operational steps of implementation and the projected time schedules for national, en route and terminal system improvements through the late 1980's. The emphasis of the roadmap outline is focused on the establishment of interfaces between the system components during the transition from the current capabilities to the projected flow management enhancements in the near term planning horizon. This roadmap provides an initial framework for planning the integration and systematic transition during the future development and implementation of the major FAA automation programs that support the flow management objectives.

Supplementary details related to the IFM functional concepts described herein are provided as appendices to this report. These additions represent an initial attempt to define the appropriate interfaces and to establish a time oriented sequence of planning operations in the future IFM system. The time dimension has been incorporated by projecting a gross estimate of "look-ahead" time for each of the generic types of flow management data exchanged between the respective facilities.

1.3 Assumptions

A set of assumptions established during the formulation of the IFM functional concepts are listed below:

1. Aircraft demand generation is entirely external to the IFM process.
2. The IFM processes will accommodate the evolution of the ATC system improvements, including advanced avionics.
3. Fuel will continue to be a dominant operating cost for all ATC system users; hence fuel conservation will continue to be a major concern to the ATC community beyond the year 2000.
4. Aviation activity will continue to generate peak demand which exceeds the capacity of the ATC system.
5. Long range IFM concepts assume that required future ATC systems will be available.
6. A level of intrafacility autonomy will exist in the future ATC system provided that it is consistent with all interfacility agreements.
7. Each facility will accept the principles of Integrated Flow Management and will cooperate as needed to meet flow management objectives.
8. IFM will include all aircraft that will interact with the ATC system and will provide a high degree of flexibility to system users.
9. Operators will perceive enough benefits to be willing to equip their aircraft to take full advantage of IFM capabilities.

In addition, several preliminary conditions established as guidelines for IFM development are identified below.

Integrated Flow Management must:

- Deal with predicted and unpredicted system delay and congestion

- Be compatible with the capabilities of the present and evolving ATC systems (e.g., advanced avionics, Automated En Route ATC (AERA), data link)
- Be able to accommodate minimally equipped aircraft
- Provide equitable delay distribution to the extent possible
- Improve the operational efficiency of the ATC system without degrading the system's capability to safely separate aircraft.

2. OVERVIEW OF INTEGRATED FLOW MANAGEMENT

Integrated Flow Management is a process that provides for planning, communications and coordination among various ATC facilities and users to assure efficient utilization of existing resources to meet the demand imposed on the ATC system. Significant elements of the flow management* process include flow planning related to the volume of traffic, expected and unexpected constraints, contingency plans, system efficiency and stability under current and predicted operating conditions. Flow management functions are performed at all levels of ATC system operation, and are conducted in a planning and coordination mode which assumes a broad view of air traffic and problems that affect traffic flow. Flow management concepts are not related to a new and separate facility (separate from central flow, en route centers and terminals) or a new hardware/software system that provides umbrella control of all aircraft. Although no direct control of aircraft is executed by the flow management process, appropriate interaction with the real-time control functions is necessary to achieve a coordinated system-wide pattern of efficient operations.

Figure 2-1 illustrates a simplified flow chart of a typical ATC facility. It has two major functions, namely planning and real-time control. The real-time control refers to interactions with the aircraft (e.g., issue of clearances, vectoring directions, and holding commands). As an aircraft navigates through the system, contact is maintained through the real-time control function using surveillance and communications. Transfer of aircraft control between ATC facilities is also a part of the real-time control function. The planning functions utilize flight data to plan the flow of traffic and provide inputs to the real-time control functions so as to execute the "current plan." A feedback on the progress of the plan is provided to the planning function. The planning process requires interactions with both upstream and downstream facilities for the flow of flight data and tentative agreements between facilities that are consistent with the overall plan. A flow management coordination function is responsible for ensuring that the pairwise tentative agreements between facilities are within the constraints and the parameter settings of the individual facilities and are consistent with the current plan for all the facilities impacted. The flow management coordination function

* The term "flow management" is used in a generic sense to identify the general characteristics of the IFM functional concepts developed in this report.

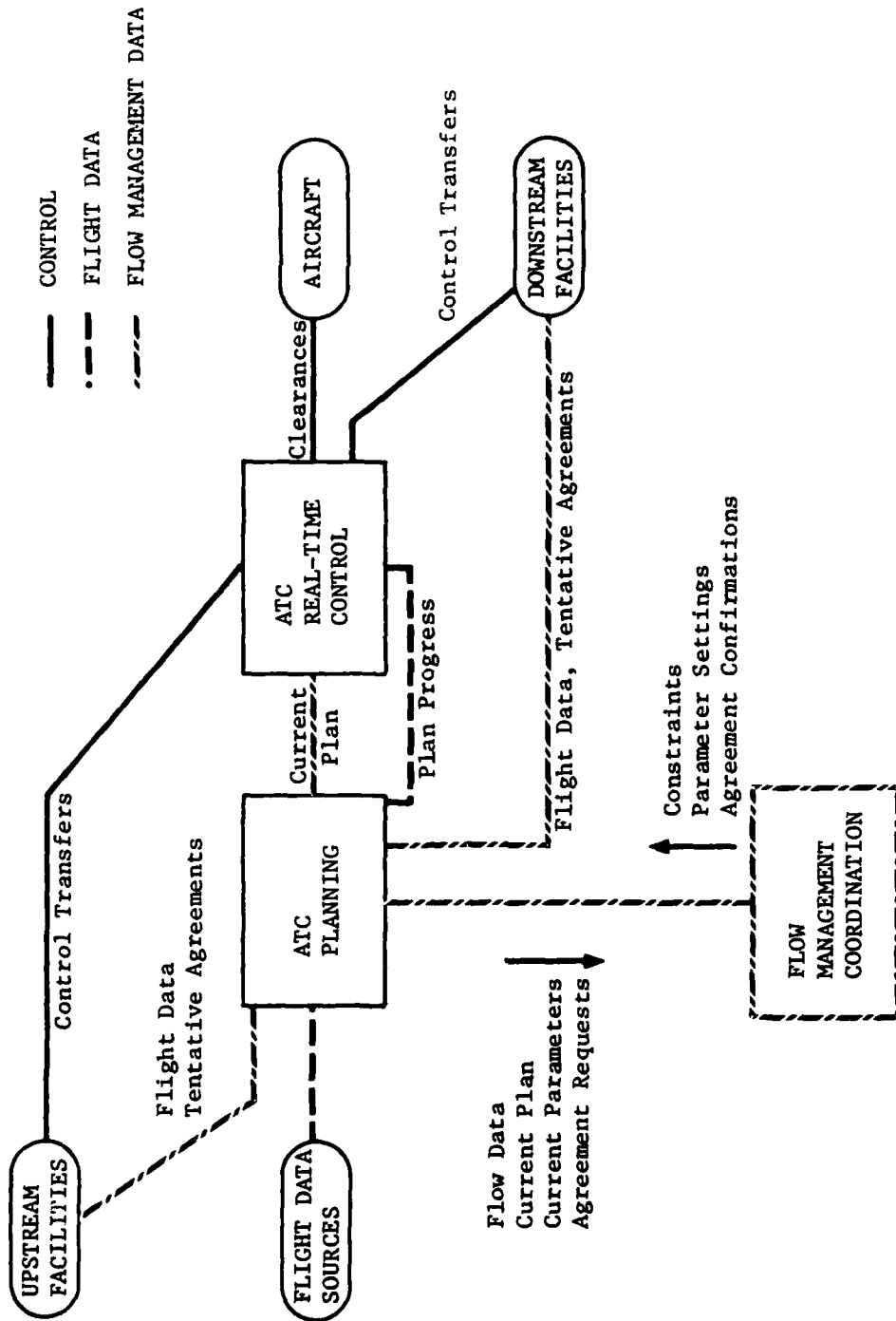


FIGURE 2-1
TYPICAL ATC FACILITY

is also responsible for providing agreement confirmations especially when multiple facilities are involved. The interfacility links shown here represent a conceptual form only. Most (but not necessarily all) of these links are two-way conduits. There are, however, significant differences in the content and frequency of the information flow into and out of a given facility.

Additional perspective on the nature of flow management and the goals identified in the preliminary development of the IFM concept are presented below.

2.1 Role of Flow Management

The general role of flow management can be illustrated by certain flow planning procedures that are operational within the current ATC system. Present Central Flow delay management programs are representative examples of interfacility traffic flow planning. These Central Flow programs include traffic rerouting for severe thunderstorms and ground holding, imposed when significant airborne delays are predicted. En Route Metering and runway configuration selection represent additional flow management operations conducted on a localized basis. The existing forms of flow management have demonstrated a substantial benefit in terms of minimizing the impact of many traffic flow problems. However, significant congestion and bottlenecks are also present in the current ATC system due to certain existing limitations in the traffic flow planning that must be factored in the evolution and development of an effective Integrated Flow Management function. An expanded description of the current flow management planning processes and the inherent system deficiencies is presented in Section 3.

The role of Integrated Flow Management will be different among the various ATC facilities, and will change with the varying time horizons and demand profiles. Generally the level of involvement by a particular facility will depend on the circumstances that trigger the specific flow management functions. For example, closure of a major airport or shutdown of runways at a high-density airport would require "central flow" types of ripples in the system affecting many facilities. On a smaller scale, a redistribution of traffic flow to balance runway utilization may only require coordination between a terminal and host center. The planning horizon for these examples could vary from a long (e.g., 24 hour) interval for the first case to a short term duration (e.g., less than one hour) for the second example. A functional delineation of flow

management responsibilities among the various ATC facilities and the related issues of communications, demand levels and planning horizons are addressed in further detail in Sections 4 and 5.

Another area of concern is related to the phased implementation of several current development efforts to provide automation aids and enhancements to the existing ATC system. The formulation of an Integrated Flow Management function should accommodate these planned elements, support the establishment of appropriate interfaces and provide for a smooth and orderly transition during the implementation of these automated system enhancements.

2.2 Goal of Integrated Flow Management

The goal of flow management can be stated as follows:

Anticipate and meet the traffic demand as efficiently as possible while maintaining the safety of the system and minimizing total system cost through an equitable and efficient utilization of all elements (e.g., airport, airspace, fuel) of any given set of ATC resources.

Significant components of the flow management process include:

- Terminal Delay Management
- En Route Congestion Management
- Accommodation of Fuel Efficient Profiles
- Weather Avoidance.

This statement of the flow management goal has many implicit objectives related to specific elements of the ATC system. "Anticipate and meet the traffic demand as efficiently as possible" implies the need for providing a planning function that can assess the impact of the traffic demand imposed on the ATC system. "Maintaining the safety" is, of course, a necessary requirement. The high safety level of the existing ATC system is not to be compromised in any flow management concept development. "Minimizing total system cost" for the users of the system means minimizing the direct operating costs currently dominated by fuel. "Equitable" utilization implies the need to be aware of not selectively and uniformly penalizing a particular sector of the users (e.g., a specific airline, a specific class of user community). While localized instances of inequities may remain, such inequities should be shared by all users in an economically efficient and operationally acceptable

manner. "Any given set of ATC resources" implies that flow management has a role in the existing ATC system as well as in a future highly automated system.

2.3 Implementation of the Flow Management Processes

Specific activities which comprise the Integrated Flow Management function will be performed throughout the ATC system structure including terminal and en route facilities and at a central level referred to herein as National Flow Management. Generally, the responsibilities should be delegated based on the ability of each designated facility to contribute effectively to the total flow management process. The purpose, frequency and types of functions at each facility will be different, except that the common goal of flow management will be applied at all levels.

Typically, each facility is primarily concerned with the traffic flow and related problems that occur within the local or in close proximity of the local environment (e.g., within adjacent facilities), resulting in some impact on local operations. Figure 2-2 provides a simplified view of the ATC structure and the interfacility relationships. As illustrated, all local planning functions are coordinated with the real-time control elements of the system, and each facility interacts with adjacent "upstream" and "downstream" facilities for the exchange of flight data and for the establishment of tentative agreements. Within this ATC structure, a centralized level of National Flow Management would be generally responsible for monitoring all unilateral or pairwise coordinated planning actions to assure that no contradictions disrupt the system-wide flow plan in effect. The primary purpose of flow management is to ensure feasible, efficient and robust plans that can account for perturbations without any significant degradation in achieving the flow management objective.

If the total system is operating efficiently, there is no need for any changes. However, when any resource is predicted to be saturated or approaching saturation, the flow management process shifts from a relatively passive monitoring function to an active, problem-solving function. If only a portion of the ATC system is affected by a problem, then flow management will operate on a localized basis. If a major problem develops impacting many facilities, then many levels of flow management may be operational at one time. It is very rare that the total ATC system would be devoid of any problems or congestion issues in the current or future system framework. Hence, some elements

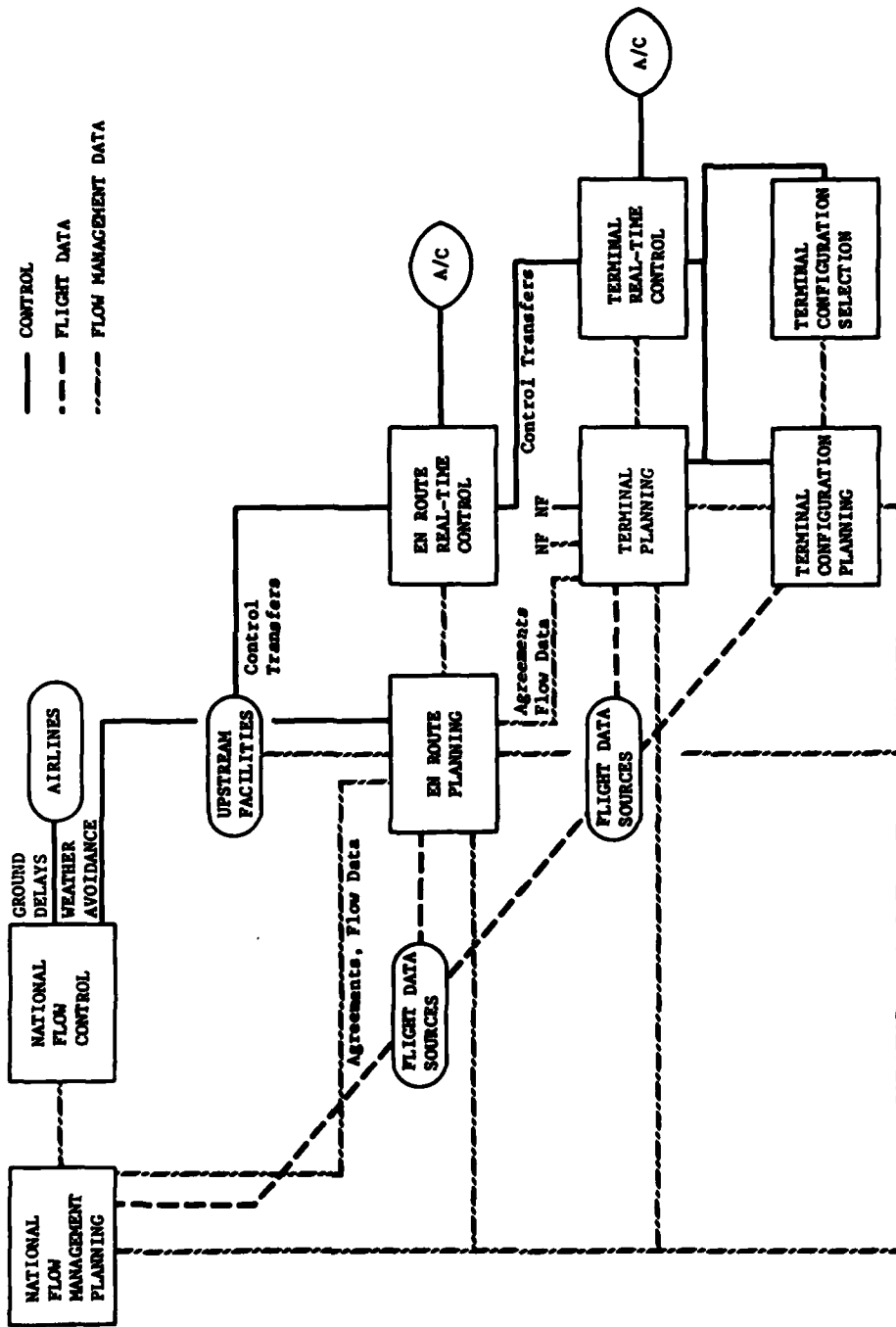


FIGURE 2-2
FUNCTIONAL STRUCTURE OF THE ATC SYSTEM

of the flow management process will probably be operational in some part of the ATC system at all times, but no single function is expected to be active at all times or at all facilities.

At this point of the Integrated Flow Management program, the specific design of the actual procedures or algorithms for conducting the flow management processes has not been developed. However, as a preliminary step, a general functional concept description has been formulated to address the central issues of Integrated Flow Management. The major issues analysed in the current study include the distribution of flow management responsibilities among the various facilities and the corresponding requirements for interfacility communications to support the delegated functions. The current flow management planning processes and limitations are discussed in the following section. This overview is provided to identify the system needs that are addressed in the functional IFM concepts documented in subsequent sections.

3. CURRENT FLOW PLANNING AND SYSTEM NEEDS

The present ATC system provides a basis for defining the role of flow management and for determining the inherent limitations in the ATC planning process. An initial step in the development of an IFM functional concept involves the identification of specific areas where substantial benefits can be derived through the establishment of additional capabilities or enhancements to the current system.

For background purposes, a general overview of the basic planning activities in the current ATC system is presented in this section. The emphasis of this summary is focused on the recognized deficiencies and areas where improvements are needed to enhance the effectiveness of the overall system planning process. The identified system needs are enumerated at the end of this section.

3.1 Overview of Current Flow Management Processes

The current ATC system has a form of flow management to address existing problems which affect the efficient and expeditious movement of air traffic. The Central Flow Control (CFC) facility, operated within a centralized command post at the FAA headquarters, is the focal point for the management of nationwide air traffic flow. Delay management procedures, such as ground holding or rerouting for severe weather avoidance, are directed by CFC to alleviate major traffic flow problems that have been detected by the Central Flow specialists or reported by delay impacted ATC facilities. Additional elements of flow management are present in local planning conducted in the en route and terminal facilities, including en route metering of arrival traffic and runway configuration selection.

The present Central Flow activities are primarily based on manual operations, supplemented with a limited automation capability to provide traffic summary information for several high-density or "pacing" airports maintained in the CFC data base. Central Flow specialists forecast air traffic activity and project problems through analysis of information received from various sources (primarily via telephone conferencing), including en route centers, high-activity terminal control towers, airline dispatch offices and weather specialists. Frequently, the CFC specialists can predict traffic flow problems, and preventive actions can be taken before the problems are fully developed. The ability of the Central Flow

Control facility to respond to severe weather problems is generally determined by the accuracy and timeliness of national weather forecasting.

Early problem prediction and long range planning are major goals of the Central Flow Control process. However, in current practice, many flow management activities are initiated on a reactionary basis in response to problems which have begun to develop. This limited planning horizon reflects the need for improved predictive capabilities for detecting potential air traffic congestion and severe weather conditions in the existing system. The CFC data base is comprised of extensive raw data related to scheduled operations and demand at several high activity airports. The major deficiencies of the CFC data base include: insufficient storage capacity, extremely gross capacity estimates, incomplete information of current demand, and limited automation to support analysis and demand prediction.

Delay management procedures are prescribed and issued through advisories by Central Flow specialists when significant delays are expected to continue over an extended time interval. CFC direction is generally not provided for problems of smaller scope, since unnecessary flow adjustments or false alarm conditions could result from decisions based on incomplete or inaccurate information. A major improvement needed in the current flow management process is an improved interactive capability to communicate and coordinate with the affected facilities and users involved in the execution of flow procedures developed by the Central Flow facility. Through improved communications, many unpredicted problems that impact multiple segments of the current ATC system could be more effectively managed by the Central Flow Control facility. Early coordination would reduce the lead time needed to execute the flow management plans while the problem effects are most severe. Further, the availability of current information and reduction in communications delays would result in the improved responsiveness by Central Flow in removing traffic restrictions immediately upon restoration of system capacity.

Similar characteristics are inherent in the local flow management process. Typically, each center has little knowledge of future traffic demand outside the center airspace boundaries beyond a short (e.g., 1/2 hour) planning range. Occasionally, verbal contact is established between adjacent en route facilities as significant problems related to weather or surges in traffic demand are developing. "Letters of Agreement" are sometimes established to formalize routine procedures for

improved traffic flow between facilities (e.g., handoff altitudes). Within the en route boundaries, the intra-center traffic flow management is predominantly focused on achieving the appropriate spacing of arrival traffic to individual terminals, based upon a rough estimate of the average hourly airport acceptance rate. The acceptance rate provided by the terminal is a relatively gross projection of capacity; this estimate must account for many variables in addition to the center arrival traffic (e.g., runway configurations and changes, weather conditions, operational status, departure traffic, and local VFR popups, satellite and tower en route operations). Often the interface between the terminal and en route facilities is managed by flow control specialists whose effectiveness is determined by the individual's experience, proficiency and familiarity with local operations and procedures.

Generally, the terminal traffic flow is adjusted and fine-tuned based upon manual operations to provide the necessary separation and delay absorption in conjunction with the real-time control process. The ability to resolve unanticipated problems on an ad hoc basis is a critical factor of terminal flow management, due to an extremely limited planning horizon (e.g., five minute lead time for center arrival traffic data). In the current system, during high demand periods the terminal must perform frequent adjustments to the arrival traffic sequence to account for variations in demand levels and capacity that are not reflected in the average acceptance rate provided to the host center.

Loss of runway throughput or excessive terminal congestion are obvious consequences of inadequate coordination between the en route and terminal planning functions (e.g., errors in estimated airport acceptance rates). Further, inefficient procedures, such as low altitude holding due to large terminal delays, can eliminate most or all of the fuel conservation benefits derived from en route metering. These potential problems reflect the need for enhanced planning capabilities, possibly based on automation aids, and improved coordination between the en route and terminal facilities.

Except when major problems become apparent, local flow planning is primarily conducted by the individual ATC facilities with emphasis on achieving operational efficiency within the local jurisdiction. Most of the local planning activities do not account for the possible system-wide impact of the internal flow procedures. With limited knowledge of impending restrictions or problems developing beyond the immediate environment, the traffic flow plans formulated to achieve efficient operations

within an individual facility may inadvertently intensify or contribute to the severity of problems that occur in other parts of the system. Hence, there is a need to implement a process that provides for improved communications and coordination and better utilization of all existing resources.

3.2 System Needs

Specific limitations associated with the current flow management process provide a useful basis for establishing the general system needs to achieve an effective system-wide planning capability. The areas identified below do not represent an exhaustive set of all improvements required to meet the long term goals of Integrated Flow Management. However, during the initial phases of evolutionary development, the Integrated Flow Management process must be responsive to the present system needs. Successful resolution of the current system deficiencies is considered to be essential for the future IFM accommodation and utilization of ATC system enhancements and advanced automation technology.

The significant capabilities needed to eliminate the major limitations inherent in the present ATC flow management process include the following:

- Enhanced data collection, storage, processing, and distribution capabilities (traffic/weather/winds/operational status)
- Enhanced weather forecasting and delay prediction capabilities
- Automated assistance in selecting fuel efficient strategies based on optimal tradeoffs between throughput and delay/fuel penalties consistent with the airborne capabilities
- Improved coordination capabilities between National, En Route, and Terminal Flow functions
- Improved communication capabilities with system users (e.g., airline dispatch offices, general aviation)
- Expanded automation interface with system users and between flow management functions (e.g., Terminal Flow interface with En Route Metering)

- Expanded ability to add new functions to ATC automation systems (i.e., NAS, Automated Radar Terminal System (ARTS), CFC)
- Automation aids to provide the capability for the system to respond effectively to unexpected perturbations.

4. INTEGRATED FLOW MANAGEMENT CONCEPT DEFINITION

This section contains a functional description of the IFM capabilities and the allocation of the flow management functions within the ATC system hierarchy of national, en route and terminal facilities. In addition, the interfacility communications to support the identified functions are addressed.

4.1 Allocation of Flow Management Responsibilities

A major objective of the current study was to formulate a general framework for the development of IFM concepts. This framework delineates the level of planning and coordination and the other specific responsibilities delegated among the facilities involved in air traffic flow management. As previously emphasized, flow management would not entail a new or separate facility, but would be performed at all levels within the existing and planned ATC system structure. The ATC facilities that represent the basic levels of flow planning addressed herein are generically referenced as National, En Route and Terminal Flow. The functional representation of the IFM capabilities is intended to reflect the established objectives and goals of the Integrated Flow Management program. An additional concern is the need to maintain an acceptable balance of responsibility and planning authority within the existing and planned ATC system. Several alternative configurations and the selected approach for delegating the responsibilities among the appropriate facilities are discussed in this section.

4.1.1 Alternative Flow Management Configurations

The current ATC system has a basic form of flow management which is primarily "reactive" to most problem situations. Based on the limitations inherent in the existing system, the need for improved predictive capabilities, long term planning and system-wide integration and coordination of all traffic flow management processes is emphasized in the current formulation of functional concepts for Integrated Flow Management. At this point, there are several directions in which further development efforts can proceed. Three basic approaches which were considered in establishing the IFM functional configuration are addressed below.

a. Centralized Flow Management: A centralized approach would delegate most of the flow management tasks to a centralized National Flow authority, minimizing the number

of functions allocated to the en route and terminal facilities. The centralized flow management responsibilities would encompass all levels of ATC performance, including operations specific to individual centers and terminals as well as those involving multiple facilities. The local flow management would conduct the necessary on-site coordination and would provide the appropriate interface with the local real-time control processes.

b. Decentralized Flow Management This approach emphasizes the autonomy of the individual en route centers and terminals in traffic flow planning. Coordination needed to resolve problems affecting multiple facilities would be achieved by communications among the appropriate local flow management personnel. This coordination process would be conducted without a central point of authority for approval of local decisions and system-wide planning. The role of National Flow would be limited to provide basic advisory services (e.g., distribution of weather information) among the en route and terminal facilities.

c. Combined Approach (Delegated Responsibilities) The third alternative is a combined approach in which the flow management responsibilities are shared efficiently among all appropriate facilities at the national, en route and terminal levels of operation. The general philosophy of this approach is based on the establishment of a centralized National Flow Management authority. The central authority would be primarily responsible for handling problems of significant magnitude and scope (e.g., multi-facility and national problems) and for directing the necessary coordination among all affected facilities. In addition, a distributed network of independent facilities which would handle local problem situations of shorter duration where interfacility coordination is restricted to adjacent facilities. Appropriate information related to local operations would be provided to National Flow Management by the individual en route and terminal facilities as needed to achieve the most effective system-wide planning and problem resolution.

Several disadvantages related to the first two alternatives have been recognized. The first approach would require a large volume of data to be available at the National Flow facility. The level of detail needed to support a centralized capability for flow management of national and local traffic problems would

require extensive communications, storage capacity and processing (hence, duplicating large portions of the data base functions performed in the en route and terminal facilities), with a correspondingly large cost imposed throughout the system. Alternatively, the decentralized approach would probably incur some cost impact due to the additional storage and processing to support an increased lead time for flight information needed for long term planning. Under this approach, most traffic flow planning would emphasize the efficiency of local operations without concern for the effects of local procedures on the total system. Thus, pervasive system level problems may not receive adequate consideration without a central facility responsible for national traffic flow planning.

Based on the observed disadvantages of the sole applications of or centralized and decentralized flow management configurations, the last "combined" approach draws together the unique advantages of both previous alternatives. This approach is also considered to be the most feasible of the alternatives identified in terms of probable cost impact and efficient resource utilization. Further, the distributed approach of delegating the flow management functions among the national, en route and terminal facilities is generally consistent with the existing responsibilities within the ATC system framework. A related issue, addressed in the following section, is the development of specific criteria for allocating the flow management tasks among the designated facilities to provide the best configuration for accomplishing the goals of Integrated Flow Management.

4.1.2 Concept for Delegation of IFM Responsibilities

The principal objective in the allocation of flow management functions is to achieve the most efficient utilization of available ATC resources for performing each task of the Integrated Flow Management process. Specifically, the delegation of functions among the national, en route and terminal facilities is based on matching the abilities of each level of system operation with the expected capabilities required for conducting each identified function. The functional mapping of flow management tasks among the various facilities reflects a comparative assessment of the relative contributions of each alternative assignment. The general criteria used in the delegation of responsibilities developed in this report are summarized below.

The close proximity and familiarity with the local traffic demand patterns, control procedures and related problems enables the ATC personnel within the individual en route and terminal facilities to make the best judgements required for certain types of flow management operations. Specific examples include near term traffic flow planning, internal coordination and localized intrafacility problem resolution. It is unlikely that a central facility could achieve a comparable ability to perform the local traffic flow management activities that are generally based on real-time knowledge of a large number of factors specifically associated with the particular ATC environment. This observation supports the concept of delegating to the local en route and terminal facilities all flow management tasks that require extensive first-hand knowledge of the current operations and conditions within a single terminal or center.

The local flow management would also be responsible for providing the necessary support to National Flow for handling problems that are not confined to a single facility or where local procedures may impact other components of the total ATC system. In particular, certain high-density terminals would require close coordination and extensive interactions with the National Flow Management authority, since almost any operational procedure effected at these facilities would have some impact on other elements of the ATC system. For other facilities characterized by consistently low demand and few problems related to congestion, most of the traffic flow would be managed almost entirely at the local level, except when unusual circumstances occur requiring some assistance or direction from National Flow.

Similarly, flow management of en route traffic would be based on the assignment of most tasks to the en route level of planning that would interact routinely with its constituent terminal facilities to monitor the system performance within the en route center. En Route Flow Management would be responsible for handling short term localized problems and frequent interactions with National Flow. Additionally, some standard interfacility planning and coordination could be established between adjacent en route facilities for routine operations without obtaining recurring directives from National Flow, unless severe problems develop which could potentially impact other system components.

A centralized, National Flow Management facility would take a much broader view of the problems that impact air traffic flow than is provided at the local level. Within each en route and

terminal area, the major concern is with the flow of traffic in the immediate environment. Each local facility has a limited knowledge or interest in problems that occur outside the specific area of jurisdiction, unless the solution to such problems has a direct impact on the regional system operations. Being entirely removed from the details of the local control functions, the National Flow Management organization can maintain a general perspective of the overall system performance; this broad view transcends the particular focus of the en route and terminal facilities.

As a central point of access to information, National Flow would be best equipped to monitor and analyze the entire ATC system over a long planning horizon and to predict and resolve significant problems before they occur, rather than in a reactive mode. In general, the National Flow Management responsibilities would be primarily concerned with problems that could potentially affect more than a single facility. In this role, National Flow would continually monitor the overall status and performance of the system in order to detect existing problems, formulate and analyze alternative relief strategies, and predict potential delay and congestion which may be avoided or minimized through appropriate planning. For major interfacility bottlenecks characterized by recurrent delay and congestion, National Flow would establish "Letters of Agreement" to resolve the problems. Additional coordination of flow management procedures would be conducted by issuing advisories or directives to all impacted facilities. The level of involvement by the central authority in the flow management process will generally depend on the magnitude and duration of the specific problems and the ability of local facilities to resolve minor near term problems independently, without incurring penalties on other components of the ATC system.

The principal requirement for providing effective flow management on a system-wide basis is the availability of timely and accurate information at the National Flow facility and between the adjacent en route and terminal ATC facilities that are responsible for achieving coordinated and efficient local flow planning. Hence a major emphasis of the IFM functional concepts documented in this report is placed on the identification of the interfacility communications and the general types of information needed to support the defined flow management tasks.

4.2 Identification of IFM Functions by Facility

The major guidelines for delegating responsibilities among the various facilities which participate in the flow management process were addressed in the preceding discussion. A more specific breakdown of the functional capabilities assigned to each facility is presented below. This overview represents a preliminary step in the establishment of a functional framework for the IFM concept definition. The "strawman" concepts presented herein may undergo further modification or enhancement during subsequent reviews. Hence, the detailed requirements related to specific algorithms or software capabilities associated with the flow management process remain areas for future development. As previously noted, the purpose, frequency and types of functions will be different for the various facilities which conduct the flow management processes. However, for each type of facility the corresponding flow management functions can be classified into four general categories:

- Data Base Management: These functions include the collection of appropriate information to support the delegated flow management tasks.
- System Performance Analysis: Each facility will monitor system operations to predict problems, develop strategies for eliminating delays and congestion, and perform post analysis of all flow procedures implemented.
- Traffic Flow Management: These functions encompass the specific tasks for resolving problems after appropriate analysis has been conducted.
- Communications and Coordination: The exchange of information among all ATC facilities responsible for flow management is a major component of the Integrated Flow Management process.

A functional description of the flow management responsibilities delegated to the national, en route and terminal facilities is presented in the following subsections. For clarity, the functional concepts are organized according to the four general categories defined above and are summarized in a table form. A consolidated list of the IFM functions by facility is provided in Appendix A.

4.2.1 National Flow Management Functions

The major tasks delegated to National Flow Management are addressed in this section. Specifically the role of National Flow encompasses the long term planning and coordination between multiple facilities, prediction of significant delays and resolution of predicted or unanticipated problems which transcend the boundaries of any single facility. A summary of the National Flow functions discussed below is provided in Table 4-1.

a. National Flow Data Base Management

No actual control functions would be conducted within the National Flow facility. This characteristic reflects the primary role of National Flow as a centralized point for planning, coordination and monitoring to assure the efficient operation of all system components in accordance with the system-wide flow plan in effect. The National Flow Management functions are concerned with a broad view of traffic flow. Hence, detailed flight intent data, used in the real-time control functions performed at the en route and terminal facilities, would not be required at the centralized level of flow management operations. However, a sufficiently large volume of data must be available to provide a representative picture of the total ATC system for National Flow planning, problem identification and other functions. Additionally, a long term planning horizon is implicit in the National Flow Management processes. Hence, the information maintained in the National Flow data base should reflect a 16 to 24 hour future time interval whenever possible.

To maintain accurate and timely information vital to the National Flow Management process, a daily "roundup" of current domestic and international operations would be conducted. The sources of information provided in the survey would include all centers, high-density terminals, Official Airline Guide (OAG) published schedules and other appropriate user organizations. The specific types and frequency of data transmitted to National Flow would be determined by prior agreement and would be updated as needed on a routine basis.

TABLE 4-1
NATIONAL FLOW MANAGEMENT FUNCTIONS

- Maintain National Flow Data Base
 - Domestic and International Operations
 - Capacity and Demand Estimates
 - Weather Information
- System Performance Monitoring and Analysis
 - Identify Delays and Other Abnormal Conditions
 - Predict Problems and Develop Relief Strategies
 - Conduct Post Analysis of Problems
- Regulate Traffic Flow to Achieve Flow Management Objectives
 - Coordinate and Approve Interfacility Letters of Agreement
 - Coordinate Flow Procedures for Facilities and Users
- Distribute Flow Management Data to Appropriate Facilities
 - Issue Flow Advisories and Directives to Relieve Congestion
 - Coordinate and Distribute Analysis of Weather Data
- Provide System Performance Data to Appropriate Organizations

b. National Flow System Performance Analysis

The National Flow Management responsibilities would include the analysis of system-wide performance on a continual basis. The primary emphasis would be focused on the early prediction of impending or potential problems to facilitate adequate planning and coordination among the affected facilities, hence minimizing the expected impact on the total system traffic flow. The recognized benefits of advanced planning include the following:

- 1) All appropriate factors can be identified through careful analysis of available information and observed effects of flow management procedures.
- 2) Alternative relief strategies can be analysed extensively through system simulation in order to assess the probable results for each alternative and to select the "best" procedure and contingency plan for resolution of the identified problem.
- 3) Adequate coordination among all affected facilities can be achieved to allow an appropriate transition period for effective implementation of the necessary procedures.

A representative simulation model of the National Airspace System would provide an essential tool to support the capabilities for long term planning, problem prediction and assessment of alternative strategies for resolving anticipated problems related to system delays and congestion. An additional responsibility of National Flow would be the post analysis of system performance based upon local reports of actual delays and other relevant information obtained from analysis conducted at the national facility. The post analysis of problem situations would facilitate the evaluation of flow procedures implemented and would enhance the effectiveness of National Flow Directives.

c. National Traffic Flow Management

Generally, the National Flow Management functions would not be concerned with a specific aircraft that experiences delays in the ATC system. Direction from National Flow would be provided only for traffic flow problems of significant magnitude and duration, since only gross levels

of delay and congestion would be identifiable at the central facility. Hence, the operations performed in the national flow process would entail broad procedural changes which would be issued on an interfacility basis (rather than specific advisories to individual aircraft), either by Letter of Agreement or National Flow Directives. In addition, National Flow would serve as a central authority for decision making, coordination and approval of all proposed plans for resolving flow problems that impact more than a single ATC facility.

d. National Flow Communications and Coordination

The establishment of efficient communications with all individual facilities involved in ATC operations is an essential prerequisite for conducting the National Flow Management process. Each of the functions previously described can be performed only if the appropriate information is provided to National Flow on a timely basis. The results of the system level planning and analysis would be distributed to all impacted facilities to implement the directives or advisories issued by National Flow for problem resolution. Additionally, interfacility flow procedures would be submitted by local facilities for approval by National Flow to assure compliance with the system level plans in effect.

Additional National Flow responsibilities would include the distribution of weather information and related analyses among all appropriate ATC facilities and other user groups. System performance data and summary reports of current and predicted traffic demand and delays maintained by National Flow would also be available to requesting facilities and other ATC organizations. System-wide access to traffic demand distributions and national weather forecasts would provide enhanced look-ahead and planning capabilities to facilitate effective decision making at the local level of flow management operations.

4.2.2 En Route Flow Management Functions

Flow management functions delegated to the en route facilities are predominantly related to local traffic flow planning and coordination with adjacent en route and terminal facilities. These functions include capabilities for the en route prediction and resolution of intrafacility problems associated with congestion and delays. Additional responsibilities for

communications and coordination are established to support National Flow processes that affect the system-wide traffic flow and interfacility problem resolution. A general breakdown of the significant En Route Flow Management functions is presented below and summarized in Table 4-2.

a. En Route Data Base Management

Each center currently maintains a sizable data base containing flight intent data represented as a sequence of geographic points on the filed route of flight, calculated times of arrival at designated fixes within the center and other traffic demand information used in the control process. The automated Flight Data Processing (FDP) functions supported by the National Airspace System (NAS) provide a significant source of planning information needed to identify delay and congestion which affect the ability to control en route traffic. However, additional capabilities would be needed for the en route facilities to provide a comprehensive view of all center operations for effective traffic flow management. In order to predict near term problems and to determine appropriate relief strategies, each en route facility would maintain current and predicted estimates of capacity, demand and facility status for the en route airspace and all major terminals within the center boundaries. Additional types of information needed to conduct intrafacility planning include the current and expected changes in configurations for terminal runways and airspace; local, satellite, VFR and tower en route traffic not known to the center; capacity restrictions; regional weather data; forecasts of severe weather conditions; and estimates of en route demand, delays and capacities exchanged between adjacent centers. Other traffic statistics such as actual delays experienced within the en route facility prior to and following implementation of flow procedures would be required to support the post analysis of problem situations.

The predictive capabilities for En Route Flow Management would be functionally based on a near term planning horizon (e.g., up to 3 hours). The prediction of traffic demand over an extended look-ahead time interval could be enhanced by modification of the system parameters related to the lead times for automatic transmittal of information between adjacent facilities (e.g., from terminals within or adjacent to the en route facility boundaries and adjacent en route facilities).

TABLE 4-2
EN ROUTE FLOW MANAGEMENT FUNCTIONS

- Maintain En Route Flow Data Base
- Terminal Capacities, Configurations and Facility Status
- En Route Capacities, Demand, Delays, and Facility Status
- Weather Information
- System Performance Monitoring and Analysis
- Identify Delays, Congestion and Causal Factors
- Develop Relief Strategies for Local Problems
- Conduct Post Analysis of Problems and Procedures
- Conduct Flow Management of En Route Traffic
- Manage En Route Metering
- Initiate Local Flow Management Procedures for Traffic Flow Problems
- Implement Flow Directives Issued by National Flow
- Distribute Flow Management Data to Appropriate Facilities
- Participate in National Flow Survey of Domestic Operations
- Provide Post Analysis and System Performance Data to National Flow
- Advise Appropriate Facilities of Local Flow Strategies

b. En Route System Performance Analysis

En Route Flow Management is a local planning process which requires detailed knowledge of the nominal center operations and traffic demand characteristics. The functional capabilities to support this planning process would include: 1) prediction of near term traffic flow problems and development of appropriate relief strategies, 2) close monitoring of system performance to identify unanticipated problems or causal factors for excess delay and 3) post analysis of all problem situations to assess the resolution procedures applied.

Implicitly, the En Route Flow Management and control procedures must adhere to all applicable directives which have been issued by National Flow. System performance monitoring and analysis would assure that compliance with the flow procedures directed by National Flow is maintained. Additional responsibilities would include evaluating the effects on local traffic flow and actual delays incurred when flow procedures are implemented, and providing local assessments of flow operations to National Flow Management.

c. En Route Traffic Flow Management

The planning functions of flow management would be performed in conjunction with the real-time control of aircraft conducted by each center. In the current system, real-time control is based on interactions with specific aircraft (e.g., clearances issued and commands to direct aircraft position or to absorb delay). Control is maintained by use of surveillance and communications to establish the jurisdiction of control as a flight progresses through the ATC system. The close proximity with the control function provides a continual feedback of flight progress information to the planning process. Further, the planning role includes the appropriate input of traffic flow information to the control element to implement the identified procedures for preventing potential delays or reducing the impact of impending problems resulting from excess demand or capacity restrictions. A shared function between the control and planning processes is the interaction and coordination with "upstream" and "downstream" ATC facilities (e.g., adjacent centers or terminals). The control mode of interaction is primarily concerned with transfer of aircraft control. The

interfacility planning mode is responsible for achieving a balance between the traffic demand and available capacity and for establishing agreement with all impacted facilities on procedures which affect the flow of traffic on a multi-facility basis.

En Route Metering, a recent NAS enhancement, exemplifies the integration of the planning and real-time control modes of a typical en route facility. Elements of flow management are involved in the scheduling, delay estimation and identification of fuel-conservative delay absorption procedures. Execution of the delay absorption procedures is a control function, based on the automatic generation of advisory information to the position responsible for real-time control of the metered aircraft. Interfacility coordination is achieved through interactions with metered airports to determine appropriate schedules at the designated meter fixes, and coordination with adjacent centers for delay crediting or adjusting traffic flow rates between centers.

In the IFM system framework, the primary emphasis of the en route flow planning function would be to determine the magnitude of delays and to develop a plan for allocating the delays in an equitable and fuel-conservative manner consistent with the flow management goals. Delay allocation procedures would reflect the most efficient trade-off of penalties and benefits associated with capacity, fuel and delay. In addition, the procedures would account for interactions between individual flights in terms of fuel consumption, time and other relevant operating cost factors.

Interaction with National Flow would be an essential requirement for en route flow planning to assess the long term effects of delay reduction strategies within the en route facility boundaries and on other parts of the ATC system. Additionally, the longer planning horizon available through interactions with National Flow would enhance the development of robust plans and contingency procedures for possible changes in operating conditions. This coordination process would minimize the need to implement ad hoc solutions (e.g., last minute procedural changes) to unexpected traffic problems that result from inadequate planning.

Additional En Route Flow Management tasks would include the initiation of local procedures developed from careful analysis of alternative strategies for a specific problem. Appropriate ad hoc procedures would be developed for unanticipated problems, if necessary. Implementation and adherence to directives or Letters of Agreement issued by the National Flow authority would be conducted routinely by the appropriate en route planning and control processes.

d. En Route Communications and Coordination

As previously emphasized, interfacility communications and coordination would be two major components of the en route control and traffic flow planning processes. Further, En Route Flow Management would support the National Flow functions by forwarding selected flight data, current and predicted capacities, facility status, and other appropriate information designated as inputs for the National Flow roundup of domestic operations. As the central authority for planning interfacility flow management, National Flow would be contacted for approval or assistance in planning relief strategies for local or multi-facility traffic flow problem resolution. Additional feedback would be provided to National Flow and other appropriate organizations that conduct post analysis of significant problems and the effectiveness of procedures implemented.

4.2.3 Terminal Flow Management Functions

The Terminal Flow Management functions, which are summarized in Table 4-3, are generally focused on short term planning of local traffic flow and efficient utilization of the limited terminal resources. Interactions with the En Route Flow Management within the host center and National Flow are also identified as major Terminal Flow responsibilities. These activities are essential for supporting long range problem prediction, planning and interfacility coordination conducted on a system-wide basis encompassing all levels of ATC operations. The following subsections identify the general types of Terminal Flow Management functions represented in the IFM concept framework.

a. Terminal Flow Data Base Management

Most of the information applicable to the Terminal Flow Management functions would consist of terminal traffic demand data, facility status, configurations, local

TABLE 4-3
 TERMINAL FLOW MANAGEMENT FUNCTIONS

- Maintain Terminal Flow Data Base
- Terminal Capacities, Demand, Configuration and Facility Status
- Actual Terminal Delay Statistics and Terminal Operations
- Weather Information
- System Performance Monitoring and Analysis
- Identify Terminal Delays, Congestion and Causal Factors
- Develop Relief Strategies for Terminal Problems
- Conduct Post Analysis of Terminal Problems and Flow Procedures
- Conduct Flow Management of Terminal Traffic
- Conduct Configuration Planning for Airport and Terminal Airspace
- Manage Surface Traffic, Departure Flow, Terminal Sequencing and Spacing, and Satellite Traffic Flow
- Distribute Flow Management Data to Appropriate Facilities
- Participate in National Flow Survey of Domestic Operations
- Provide Post Analysis of Problems to Appropriate Facilities
- Advise Appropriate Facilities of Local Flow Procedures

weather, and flight intent data and updates currently used in the real-time control of aircraft. In addition to the frequent collection of planning information and associated processing, the Terminal Flow Management responsibilities would include the estimation of current and predicted capacities for runways, airport surface and terminal airspace elements. As in the current system, accurate capacity estimates would be essential for local traffic planning, effective en route metering of arrival traffic by the host center and National Flow adjustment of traffic flow when demand exceeds the expected terminal capacity. Terminal estimates of local VFR, tower en route and satellite operations would represent vital inputs to local planning and decision making functions at both the terminal and en route levels of flow management.

b. Terminal System Performance Analysis

Terminal Flow Management would closely monitor the local operations to predict near term problems associated with terminal delays and congestion. Close proximity to the situation would provide a more detailed view of the immediate operating conditions impacting the terminal traffic flow than would be provided at the en route facility. Relief strategies would be developed and executed internally for minor problems which do not affect other en route operations. Otherwise, if problems develop on a larger scale, causing rippling effects beyond the terminal airspace, extensive coordination with the En Route Flow and, if appropriate, National Flow would be established. In general, however, the problems of large magnitude would be initially detected through system monitoring conducted by the host En Route Flow Management facility or National Flow Management, since the terminal predictive capability would be based on a relatively short term planning interval (e.g., 1 1/2 hours).

Upon resolution of local problem situations or upon implementation of relief strategies or directives issued by National Flow, the terminal facility would perform post analysis and assessment of the flow procedures used and results. Traffic statistics and summary reports of actual delays and other relevant flow information would be assembled for local analysis. This data would be provided as input for En Route and National Flow system performance analysis and monitoring.

c. Terminal Traffic Flow Management

Analogous to the En Route Flow operations, the Terminal Flow planning functions would be conducted simultaneously with the local real-time control processes. Many of the Terminal Flow Management tasks would enhance the efficient use of limited terminal resources to meet the demand imposed by the ATC system. One example where significant capacity benefits may be derived is the planning and selection for airport and/or terminal airspace configurations. Configurations determined for a given set of existing and predicted operating conditions would be provided to the host center for en route traffic demand balancing.

Terminal sequencing and spacing is another flow management function that would be conducted (possibly with an automation aid) at most high-density terminals. This function would provide schedules to ensure that appropriate separation is maintained at the runways without significant loss of capacity. Implementation of the plans for aircraft sequencing and schedules would be delegated to the real-time control function. The interaction between the flow planning and control processes would be effected manually or possibly through the automatic display of advisories to the control position.

Other responsibilities of Terminal Flow would include the management of departure traffic flow, satellite airport operations, and terminal surface flow (e.g., taxiways, gates, and runways). The capabilities for performing these local flow management functions would be determined by the specific operating characteristics and traffic demand loads associated with a given terminal facility.

For congestion problems confined to the terminal facility, some site-specific strategies may be developed for local implementation. However, when traffic flow problems occur that extend beyond the terminal airspace (e.g., en route delays incurred upon runway closure), local plans would be coordinated with all affected, or potentially impacted facilities, including the host center, for joint resolution. Further, to provide a current system-level view of traffic flow for problem prediction, each major high density terminal facility would be responsible for the routine coordination of major local flow strategies and procedures with En Route Flow Management and with National

Flow. In all cases Terminal Flow functions would be conducted in accordance with any directives or orders issued by National Flow Management.

d. Terminal Flow Management Communications and Coordination

Each terminal facility would be responsible for the transmittal of appropriate planning information to the En Route Flow Management facility. General types of input would include selected flight data, facility status, capacities, terminal restrictions, local traffic demand and other relevant information required in the En Route Flow planning process. In addition to routine exchange of data and coordination of local flow procedures, certain terminals would participate in additional interfacility operations conducted within the host center (e.g., En Route Metering of arrival traffic and related scheduling conducted by the terminal).

Selected high-density terminals that experience frequent delay and congestion would interact directly with National Flow on a regular basis. These facilities would participate in the national "roundup" of domestic operations, coordinate all flow strategies and provide post analysis of local problems. Extensive interactions with National Flow would be required, since most local procedures or disturbances at these facilities would generally impact other major components of the total system. Other terminal facilities characterized by consistently low demand would interact primarily with En Route Flow Management without direct contact with National Flow, except when unusual and severe problems arise.

4.3 Interfacility Communications

Routine communications and coordination between all facilities and appropriate organizations involved in planning within the current and future ATC systems are essential to achieving the goals of Integrated Flow Management. In order to ascertain the characteristics and magnitude of information exchange needed to support the IFM capabilities envisioned, a set of inputs and outputs have been assembled for each of the identified functions described in the preceding section. The listed inputs and outputs for the flow management functions are summarized in Appendix B for the three levels of flow management responsibility. The I/O data is identified as general types or categories of information that are implicitly represented in the

IFM functional concept description. However, further expansion and refinement of the communications requirements remain future areas for development with the concurrent requirements analysis and specification of the flow management functions.

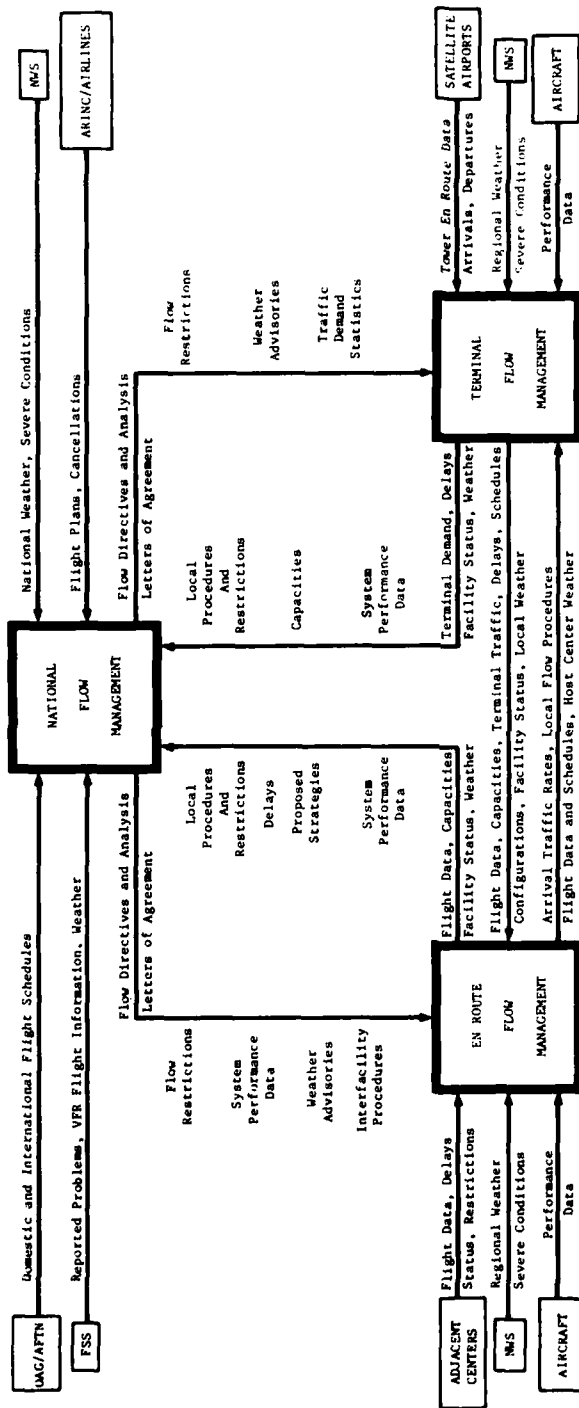
Figure 4-1 represents a system level block diagram of the major communications interfaces to illustrate the fundamental types and sources of information identified for the Integrated Flow Management function. The diagram depicts the significant communications links for the preliminary IFM functional concept addressed in this report; this illustration does not necessarily include all interactions between facilities or organizations which will be implemented in the future IFM communications network.

The content, volume and frequency of information flow in each direction between facilities will vary significantly depending on the types of functions and the time horizon of the planning process. To assess the relative impact of the IFM communications flow on the future ATC system computer interfaces, a preliminary investigation of the I/O processes for each level of flow management facility was conducted. The basic objective of this effort was to incorporate a broad time dimension in the functional framework of the IFM concept. Since a detailed specification of the IFM function has not been formulated, a quantitative estimate of the volume of information flow could not be determined in the current process of preliminary flow management concept definition.

The added time element is reflected in a breakdown of the inputs and outputs grouped by facility in Appendix C. The lists are organized into three groups consisting of: 1) inputs; 2) external outputs; and 3) local outputs generated internally within the referenced facility. In addition, for each type of input or output, the following details are provided:

1. Source or recipient of input/output data,
2. Estimated frequency of data transmitted between facilities,
3. Maximum look-ahead time approximated for the type of data transmitted.

The estimated frequencies and look-ahead time approximations presented in these tables represent a best-guess projection based on the conceptual time frame implicit in the functional



**FIGURE 4-1
IFM INTERFACILITY COMMUNICATIONS**

capabilities prescribed for flow management planning and prediction at each level of operation. Appendix D provides a summary of the IFM interfacility communications requirements that may represent a significant load factor in the future ATC communications system.

The detailed specification of message types, content, frequency and volume of information related to the flow management functions remains as an open issue. The flow management inputs and outputs and the corresponding temporal components identified for the IFM functions are provided to serve as an initial basis for further coordination and future requirements analysis.

5. RELATIONSHIP OF FLOW MANAGEMENT TO TIME AND DEMAND LEVELS

This section addresses the relationship of the IFM process to changes in the planning horizon and demand levels. The relational perspective is presented in two separate subsections which correspond to the time dimension and demand characteristics respectively. This distinction is made for ease of discussion; however in practical application, the IFM process would account for the time and demand factors simultaneously.

5.1 Time Dimensional Overview of Flow Management Planning

This subsection presents a time sequence perspective of the flow management processes, conducted on a parallel basis within the national, en route and terminal ATC facilities. This description is intended to represent an initial starting point for the development of an operational scenario concept that would illustrate the specific activities and all of the IFM elements and interrelationships in the future (e.g., late 1990's) ATC system.

The specific operational details related to the mechanics and algorithms of the flow management activities are not delineated in this overview. Further, while examples are provided where possible, this discussion is not oriented to a particular scenario, nor does it attempt to demonstrate the potential application of future automation capabilities and enhancements. The approach represented in this overview is to address the flow management functional process in terms of the planning horizon, based on four distinct intervals of look-ahead time identified below

- Long term strategic planning (8 or more hours in advance)
- Intermediate term strategic planning (3 to 6 hour projection interval)
- Near term strategic planning (1 1/2 to 3 hour projection interval)
- Near term tactical planning (0 to 1 1/2 hour projection interval).

This breakdown is provided to illustrate the changing level of planning functions over the varying time horizons. The relative involvement of the various ATC facilities and the major types of

interactions associated with the planning time frames are highlighted to further differentiate between the functional roles of the national, en route and terminal facilities which participate in the IFM process.

The various flow management activities discussed in this section should be viewed as a continuous process rather than distinct events. Hence, the planning for each of the time intervals addressed would generally overlap and would possibly shift in accordance with the increased level of sophistication of the future ATC system and available technology. For convenience of discussion, the following overview of the flow management process identifies the different levels of functional planning for each time horizon.

5.1.1 Long Term Strategic Planning

The flow management activities associated with the long term strategic planning horizon generally represent the establishment of a basic reference plan for an entire day of operation. The emphasis is primarily on "network" flow planning to assemble a gross projection of the current system structure, facility status (e.g., operational availability), capacities and the expected traffic flow pattern projected over the day. The National Flow operation is the focal point of this planning activity, although individual ATC facilities must formulate inputs to be incorporated into the National Flow "reference plan" for the day.

Initially, prior to onset of the first traffic build-up, the National Flow demand data base would be loaded with traffic information from OAG schedules, bulk store, individual en route and terminal facilities and other sources. Automatic data reduction would be conducted to provide a summary of projected demand by time interval (e.g., number of operations by hour), and by type of operation (e.g., departure, arrival, or overflight) for major terminals and designated en route fixes or locations. Concurrently, based on the expected demand information, each en route and major terminal facility would provide National Flow with additional information related to current and predicated regional operating conditions, weather, facility status, configurations, local VFR operations and other relevant planning data. The processed demand data, when combined with the projected capacities, would provide a gross projection of potential delay and congestion for the day throughout the ATC system. Appropriate advisories of traffic information or alerts would be distributed to National Flow

specialists and, if appropriate, to individual ATC facilities to identify potential problems or bottlenecks based on gross demand projections.

Upon completion of the data base updating process, a NAS "Macro-Model" would be executed to simulate the current day's operations and to support prediction of potentially significant problems related to delays and congestion. The simulation results would be provided to National Flow specialists, with appropriate alerts of predicted problems and the specific problem characteristics (e.g., causal factors, expected duration and affected facilities). Further simulation analysis may be directed to formulate and assess the impact of alternate flow procedures for alleviating the problem effects.

On a local basis, some initial planning would be conducted by the en route and terminal facilities, especially when any deviations to the normal daily operations are anticipated. For example, if equipment outages, runway closures, or controller staffing shortages are scheduled, some planning would be necessary to determine the required adjustments to the normal procedures.

In general, most en route and terminal facilities would frequently adhere to an established routine plan for daily operations with few major variations. However, detailed strategic planning with feasible contingency procedures would be warranted on a daily basis at other ATC facilities characterized by a large number of planning variables and changes in operating conditions (e.g., Chicago O'Hare is particularly affected by frequent changes in weather and wind direction, requiring runway configuration changes). These facilities would require frequent analysis and extensive contingency planning, with possible support provided by automated aids specifically adapted for the critical problems typically associated with the operating environment (e.g., runway configuration management system at O'Hare). The expected benefit of providing automated planning capabilities would be primarily in achieving the consistent selection of the optimum strategy in terms of efficient resource utilization over a long planning horizon.

The local strategic planning function would involve early interactions between the terminal and en route facilities so that the en route flow management strategy for the day can account for the expected terminal operations and contingency procedures. Subsequently, individual en route and key terminal facilities would provide appropriate inputs to National Flow

Management so that the local strategies and contingency plans can be incorporated into the system-wide "reference" plan for the day. At this point, National Flow would analyze and evaluate the reference plan to determine if the coordinated strategic plans provided by the en route and terminal facilities effectively deal with the projected congestion. Appropriate adjustments to the local plans would be identified through simulation analysis to resolve conflicts or to improve the overall system performance. After final adjustments and coordination has been completed, the resulting agreed-upon strategy would represent the "reference" plan to which changes may be made throughout the day as increasing amounts and quality of operational data become available.

5.1.2 Intermediate Long Term Planning

The intermediate planning scope would encompass a 3 to 6 hour look-ahead time interval. The objective of this planning process is to determine the magnitude of expected problems, and to develop a detailed strategy for minimizing the congestion and for effectively allocating the unavoidable delays in a fuel efficient and equitable manner.

The National Flow activities related to this planning horizon would be focused on refining the details of the system-level "reference" plan to resolve large problems that have a high degree of certainty of occurring. This process would involve several iterations with affected facilities and users to achieve a coordinated and acceptable plan. Advance coordination of the flow management procedures would be critical, since extensive cooperation and assistance of many system users and facilities must be obtained. The plan must provide an action course that can be followed by all affected parties when the problem materializes. Additionally, the plan must include detailed contingency procedures to account for the range of capabilities of each facility and their sensitivities to changes in operating conditions, such as weather and unexpected system outages. Early coordination with system users would be initiated to facilitate smooth and orderly transition prior to implementation of the delay management program. For example, National Flow would notify the airline company dispatch offices when major traffic rerouting or ground delays are planned to be instituted over the intermediate planning range. In addition, projected congestion and recommended avoidance procedures would be provided to Flight Service Stations (FSS) to establish an early alert to general aviation pilots. An important key to achieving

an effective IFM program is the capability of National Flow Management to prepare for significant flow problems in advance, rather than reacting to congestion problems as they develop.

The intermediate range planning functions that would be conducted by En Route Flow Management include the interactions with National Flow to identify and resolve large scale problems associated with gross delay estimates. Local traffic information updates, selected real-time flight data, capacity estimates, weather and operational status would be provided to National Flow on a frequent basis, as detailed resolution strategies are being formulated for problems affecting the en route facility. Occasionally, adjustments to the current en route procedures would be implemented in response to advisories received from National Flow. Performance monitoring of local traffic conditions would be conducted to identify regional problems that are not within the scope of the gross delay prediction by National Flow Management. Local flow procedures would be developed through analysis and appropriate intrafacility coordination. Direction from National Flow Management would be obtained for resolving problems which impact other ATC facilities.

5.1.3 Near Term Strategic Planning

This planning horizon is approximately based on a 1 1/2 to 3 hour look-ahead time interval. The emphasis of this time frame would be directed to the local planning processes of the en route and terminal facilities. Since most flights in this time scenario are expected to be airborne or processed by the system, a finer level of planning detail would be available through better information and prediction capabilities.

In this time horizon, the National Flow strategies to resolve major system bottlenecks would be finalized and possibly in the early stages of implementation. The actual decision point for implementing the finalized strategy must be early enough to provide sufficient time and flexibility to prepare for and execute the plan; further the decision action must be late enough to be reasonably sure that the selected strategy will provide the best results. Hence, the National Flow activity would be oriented towards system performance monitoring to determine when to begin implementation or to assess the impact of the flow procedures in effect. Additionally, the National Flow facility would identify the need for instituting contingency plans when unanticipated changes occur.

The local ATC facilities would adhere to the general system-wide plan in effect, while invoking a more detailed level of planning. This process would include the development of delay absorption strategies and minor adjustments to the traffic flow distribution in the immediate environment. Feedback to National Flow would be established when the local flow strategies are expected to impact other facilities or when modifications to interfacility procedures are considered necessary. Advisories related to regional weather forecasts, gross projections of congestion and traffic delay statistics (e.g., en route fix loads) would be transmitted by National Flow to supplement the local planning information. However, the predominant planning coordination in the near term planning horizon would be conducted between adjacent en route facilities, and between the en route "host" centers and their key high density terminals, where traffic delays generally produce the greatest impact.

The result of this near term local planning process, after iterative coordination loops between facilities, would be a delay allocation strategy and a negotiated gross redistribution of traffic over key en route and terminal fixes. The major benefits of this process would include the reduction or avoidance of predicted problems, such as, sector overloading, excessive metering, and congestion in the terminal airspace. The en route planning process for developing the near term strategies would employ detailed analyses of trade-offs between capacity, delay and fuel for individual flights and the interactions of one flight on another with respect to fuel consumption and time. Hence the local decision making functions during this phase of planning would be primarily based upon information concerning the available control actions (e.g., speed control, vectoring, holding) and the magnitude of fuel penalties and delay controllability corresponding to each control action.

The principal near term planning activities conducted specifically within the terminal facilities would include the near term planning and selection of terminal configurations (e.g., runway and airspace configuration strategies) and the determination of current and predicted capacities for input to the host center and National Flow. The degree of accuracy in capacity estimation and prediction is a particularly critical factor, since the terminal airspace is characterized by extremely limited controllability.

5.1.4 Tactical Planning

As the planning horizon is reduced to a 1 1/2 hour time interval, the flow management planning process would begin to incorporate real-time data. This transition from planning based on extended flight data estimates and delay projections represents the principal difference between strategic and tactical flow planning.

In this time frame, most of the planning activity would be confined to individual facilities and coordination with adjacent facilities. The emphasis of the tactical flow management activities would be directed to the execution of the agreed-upon plan, with minor modifications to account for unanticipated changes or fine tuning based on available real-time flight data.

Various automation enhancements to the en route and terminal software (e.g., ERM and terminal planning aids) would facilitate the tactical adjustments by providing alerts of local traffic congestion and automatically generated advisories for allocating the delays in an equitable fuel efficient manner. Further tactical planning activities would include the transmission of delay advisories to adjacent facilities, with appropriate alerts provided to National Flow, when the delay build-up exceeds the controllability of the local en route flow management.

The primary tactical functions of En Route Flow Management would correspond to the sequencing and scheduling of the traffic flow between the en route host center and the major terminal facilities, while minimizing en route airspace congestion (e.g., sector overloads). Continuous negotiations between the en route and terminal flow specialists would be conducted to arrive at an agreed-upon plan. This plan would include precise schedules for departure and arrival traffic and would account for detailed delay allocations, preferences of individual flights (e.g., speed, descent profiles) and the fuel/time impact of the various ATC actions involved. The key to the tactical decision process is the optimal balancing of tradeoffs in terms of capacity, delay and fuel consumption.

The outputs of the tactical planning activity would include a negotiated sequence and schedule, runway and terminal fix assignments, and expected flight profiles which would account for VFR and tower en route traffic and weather conditions. The process would also generate feasible contingency plans acceptable to all affected facilities and users. These

contingency plans would be invoked only in the event of unexpected problems, such as abrupt weather changes (e.g., VFR to IFR conditions), thunderstorms, and equipment outages.

5.2 Relationship of Flow Management to Demand Levels

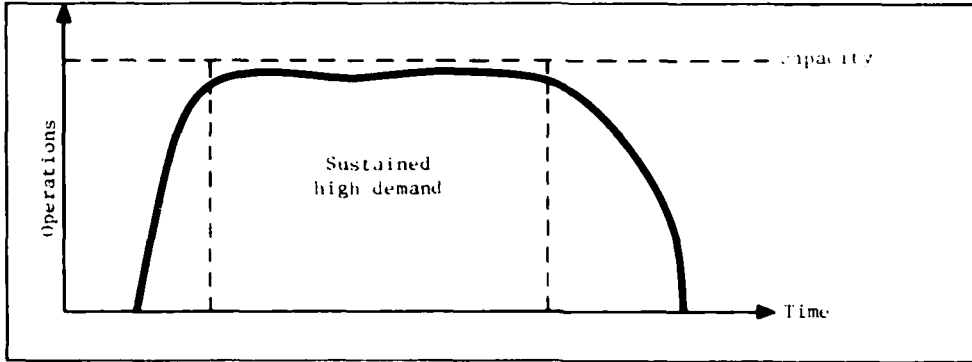
The flow management activities over the different look-ahead time intervals will also vary with the changes in demand characteristics throughout the planning horizon. If the system is projected to be operating efficiently throughout the planning time frame, the IFM process would not intervene to effect changes. Alternatively, when traffic demand is projected to approach or exceed the available capacity, some elements of the flow management process would be invoked. Selection of the appropriate flow management strategies would account for the specific characteristics of the traffic demand profile. For convenience of discussion, the types of ATC traffic demand can be classified into three broad categories, including

- high demand
- low demand
- intermittent high demand.

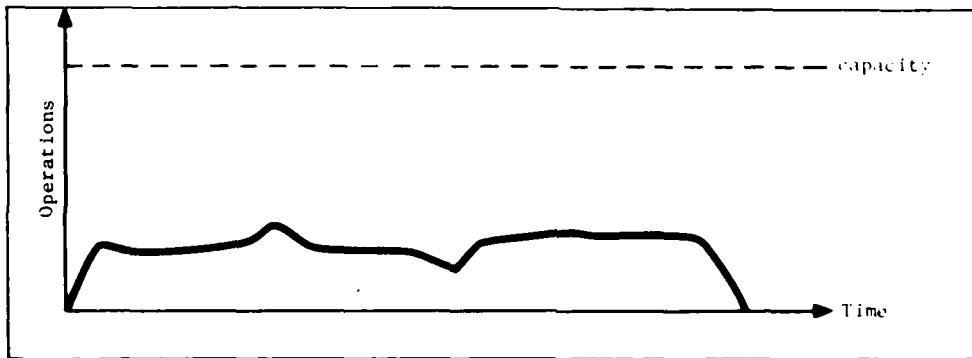
a. High Demand - In the case of high demand levels that approach or exceed the available system capacity, the flow management activities may be different for the three distinct phases illustrated in Figure 5-1(a). This demand profile is characterized by an initial phase of traffic demand buildup, a second phase of sustained traffic demand and, subsequently, a period of declining demand.

During the initial phase when traffic is building up to a high level, it may be advantageous to expedite traffic to reach the destination before the traffic demand peak. This approach may impose some individual inefficiencies for the global benefit. However if the buildup occurs as a sudden, abrupt perturbation to the normal system operation, the appropriate reaction may consist of ad hoc procedures for rerouting traffic to minimize the total delays and to reduce the peak level of demand.

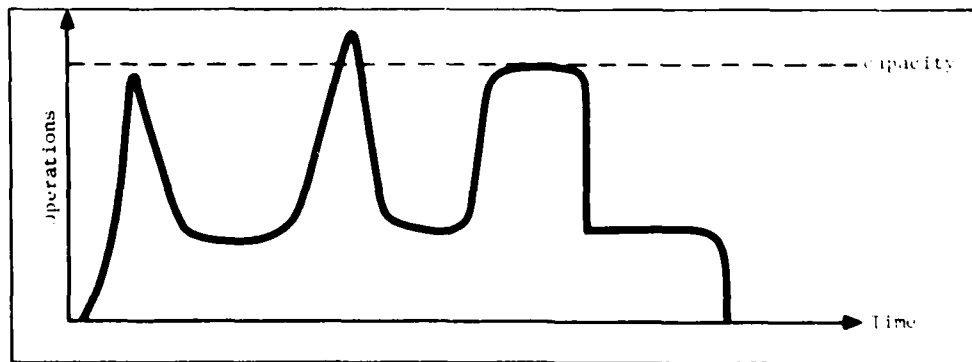
The second phase of sustained high demand represents the greatest pressure on the system. Efficient utilization of available resources (e.g., runway slots) is a major objective, since a lengthy traffic demand backlog can result in a large multiplicative factor on the penalties



a. High Demand



b. Low Demand



c. Intermittent High Demand

FIGURE 5-1
CATEGORIES OF DEMAND PROFILES

imposed on individual flights. Throughout the high demand intervals, the emphasis of the flow management process would be placed on the redistribution of traffic demand to match the available system capacity. In order to lower the total fuel consumption for all aircraft served, some, but not all opportunities for individual fuel efficiency may be sacrificed during the periods of sustained demand.

In the third phase when the traffic level is trailing down from the sustained high demand, the flow management process can relax the constraints imposed on the system. Hence, greater flexibility can be provided to individual aircraft to achieve the most fuel efficient flight profiles.

b. Low Demand - Under sustained low demand conditions, represented in Figure 5-1(b), the flow management process would assume a passive, monitoring role. When the system is devoid of problems and continued low demand is projected over a long planning horizon, there would be a high degree of latitude in accommodating the individual aircraft's preferred flight profiles (e.g., unrestricted descents).

c. Intermittent High Demand - The traffic flow management strategies for intermittent demand peaks would be strongly dependent on the level and the duration of the high demand periods. As illustrated in Figure 5-1(c), the intermittent peaks in demand may vary considerably in length of time and in magnitude over the planning horizon. Under these circumstances, the effectiveness of the IFM process would be primarily determined by the system capability to accurately predict demand fluctuations and to respond in a timely manner. The role of the IFM process may assume frequent shifts between an active function, to assure the efficient balance of resource utilization, and a relaxed mode, which provides a high level of user flexibility.

In summary, the flow management planning philosophy will vary with the traffic demand levels as well as the planning time horizon. Depending on the demand conditions, flow management can consider strategies that expedite traffic, delay traffic and impose varying degrees of flexibility to individual flights. A remaining issue for further study is the identification of specific procedures for given demand conditions and the strategies for managing the transitions. This will probably entail a set of operating guidelines, based on extensive analysis, that suggest to the flow management function which procedures have the greatest potential to achieve the best resource utilization with acceptable fuel usage.

6. ROADMAP OF NEAR TERM FLOW MANAGEMENT EVOLUTION

The evolution of the IFM process in the future ATC system is dependent upon the availability and the implementation sequence of automation enhancements and the related interfaces between the ATC facilities and their components. The extent that the far term advanced automation programs will impact or enhance the future IFM process is a major issue to be addressed in the formulation of the long range development plans. The near term IFM system evolution is expected to focus on the current system needs for providing a longer range planning capability through improved prediction and coordination at all levels of flow management.

This section presents a brief description of the expected steps of development in the near term (i.e., late 1980's) evolution of Integrated Flow Management. The emphasis of this "roadmap" is placed on the identification of specific elements corresponding to National, En Route and Terminal Flow Management, projected interactions between the various elements and their probable sequence of evolution. The major elements of the expected near term IFM evolution are indicated in Table 6-1. A further detailed breakdown of the identified IFM developments with a rough time-scale projection is provided in Appendix E.

6.1 National Flow Management Near Term Developments

The National Flow Management process will evolve from the current predominantly manual system supported by a limited data base to an expanded automation program. The most significant enhancements expected include the following:

- Expanded data base capacity to include traffic and other flow management planning information for all centers and major terminals
- Automated interfaces established with en route centers and major terminals for current status updates
- Automated delay recording and analysis capabilities
- Improved delay prediction capability based on enhanced weather forecasting and interfacility communications.

The initial step expected in the National Flow Management development is the expanded data base capability to include all centers and additional "pacing" (i.e., selected high-density)

TABLE 6-2
NEAR TERM IFM EVOLUTION

1980	1984	1988
<p>STEP 1</p> <ul style="list-style-type: none"> -Present System -Limited Data -Base Capacity -Predominantly Manual Interfaces -Limited Predictive Capability 	<p>STEP 2</p> <ul style="list-style-type: none"> -Expanded Data Base Capacity -Improved Manual/Automated Interfaces -Possible Automated Interface with ERM 	<p>STEP 3</p> <ul style="list-style-type: none"> -Expanded Automation for Interfacility Communications -Automated Interface with ERM -Added Predictive Capabilities
<p>STEP 1</p> <ul style="list-style-type: none"> -ERM 1 Present System -Computes First-Come-First-Served Schedules for Arrival Traffic to Meet Terminal Airport Acceptance Rate (AAR) -Computes Meter Fix Times (MFT) and Delays to Arrival Sector Controllers 	<p>STEP 2</p> <ul style="list-style-type: none"> -Delay Absorption Advisories Displayed to Sector Controllers -Possible Automated Interface with National Flow -Possible Transmission of ERM Schedules to Terminal -Outer Fix Delays Sent to Adjacent Centers 	<p>STEP 3</p> <ul style="list-style-type: none"> -ERM 2 Expanded Capabilities -Dynamic Rate Adjustment by ERM -Automatic Transmission of Outer Fix Times to Adjacent Centers <p>STEP 4</p> <ul style="list-style-type: none"> -Automated ERM/TPA Interface Established -Incorporates Terminal Feedback for Rate Adjustment -Automatic Transmission of Outer Fix Delays to National Flow <p>STEP 5</p> <ul style="list-style-type: none"> -Meter Fix Schedules Provided to ERM by Terminal Planning Aid -Possible ERM/TPA Interaction to Perform Departure Traffic Scheduling
<p>STEP 1</p> <ul style="list-style-type: none"> -Airport Acceptance Rate (AAR) and Runway Configuration Provided Manually to ERM 	<p>STEP 2</p> <ul style="list-style-type: none"> -Possible Early Interface to Provide ERM Schedules for Display to Terminal Controllers 	<p>STEP 1</p> <ul style="list-style-type: none"> -Possible Early Interface to Provide ERM Schedules for Display to Terminal Controllers <p>STEP 2</p> <ul style="list-style-type: none"> -Possible Early Interface to Provide ERM Schedules for Display to Terminal Controllers <p>STEP 3</p> <ul style="list-style-type: none"> -Possible Early Interface to Provide ERM Schedules for Display to Terminal Controllers <p>STEP 4</p> <ul style="list-style-type: none"> -Possible Early Interface to Provide ERM Schedules for Display to Terminal Controllers
<p>STEP 1</p> <ul style="list-style-type: none"> -Short Range One-Step Transition Runway Selection Capability for Chicago O'Hare (ORD) 	<p>STEP 2</p> <ul style="list-style-type: none"> -Possible Interface With ERM and Terminal Planning Aid (an Automated Enhancements are Implemented) 	<p>STEP 3</p> <ul style="list-style-type: none"> -Advanced Long Range Runway Selection Capability -For ORD and Possibly Other Sites <p>STEP 4</p> <ul style="list-style-type: none"> -Runway CMS Enhancements and Added Interfaces -Possible CMS Applications for Airspace and Ground Flow Problems
		<p>Terminal Planning Aid (TPA)</p> <p>Terminal Configuration Management System (CMS)</p> <p>Terminal Flow</p>

airports. In addition to increased data base capacity, software improvements are anticipated to provide increased input acceptance and processing of traffic information (e.g., an expanded set of NAS messages and bulk store flight plan data). These changes will result in a substantially improved prediction capability that will enable early recognition of traffic flow problems and timely flow adjustments with greater precision than is possible in the current system.

The next major level of near term improvements is directed towards improved communications, including automated interfaces with all centers, most key terminals, airlines and other users. This capability will further augment the National Flow ability to project potential problems with greater prediction accuracy than is currently achieved. The automatic transmission of outer fix delay advisory information from the En Route Metering (ERM) Function to National Flow is another capability to support early detection of delay buildup on a system-wide basis in the near term time frame.

An expanded data communication network is projected later in the near term, possibly with the integration of National Flow digital communications into the National Airspace Data Interchange Network (NADIN). This improvement will ensure that the National Flow data base information is current and reliable, and will provide for the rapid and broader dissemination of advisories and other information issued by National Flow Management. Through improved delay prediction (including en route fix loading), weather forecasting and expedient interfacility communications, National Flow will effectively minimize major disturbances through well-planned delay management programs, including assigned system-wide ground holding, for delay absorption, and traffic rerouting strategies. Further, performance monitoring and assessment of National Flow procedures will be enhanced by automated delay recording and analysis capabilities.

6.2 En Route Flow Management Near Term Developments

The near term evolution of En Route Flow Management corresponds primarily to the phased developments of En Route Metering (ERM) and the establishment of automated interfaces with other ATC elements.

The initial capability, designated ERM 1, is primarily achieved through manual coordination between the en route center and other ATC facilities. The major automated function of ERM 1 is

the generation of arrival traffic schedules based upon nominal flying time estimates and average airport acceptance rates provided by the terminal facility. The computed Meter Fix Times (MFT) and expected en route delays, based on first-come-first-serve (FCFS) arrival traffic schedules to meet the specified airport acceptance rate, are displayed automatically to the en route arrival sector controllers.

The second phase (ERM 2) will provide basic enhancements to transmit outer fix advisories to adjacent centers (and possibly to the National Flow facility) if delays are expected to exceed the nominal controllability of the host center. The interface with adjacent centers will also support the capability to provide delay crediting to account for previous ATC required delays imposed on specific flights (e.g., departure delays). Fuel efficient delay absorption advisories and applicable delay crediting information will be automatically generated for display to the en route sector controllers.

An intermediate step to establish an early interface with the terminal would be possibly available prior to the implementation of automated terminal planning capabilities. This enhancement would comprise a "passive" interface from the ERM function to provide the Meter Fix Time schedules generated by ERM 2 for display to the terminal controllers. Early notification of the arrival traffic schedules would expand the planning horizon and possibly augment the effectiveness of the manual terminal planning function. Further, dynamic rate adjustments may be performed by ERM 2 to account for the aircraft mix of arrival traffic and the runway configuration.

Later capabilities of ERM 2 over the near term will provide an expanded automation interface with the terminal sequencing and spacing function.* This interface will support dynamic terminal feedback to achieve fine tuned adjustments of ERM generated meter fix schedules, based on the available terminal controllability. Ultimately, the terminal sequencing and spacing function, supported by an automated planning aid, will generate the Meter Fix Times to reflect the computed landing schedule assignments. Further, the terminal will transmit the Meter Fix Time schedules to ERM for adjusting the arrival traffic demand.

* All references to the terminal sequencing and spacing function denote the generic capability, rather than a specific automation program.

6.3 Terminal Flow Management Near Term Developments

The near term development stages of the Terminal Flow Management process is expected to focus upon the Terminal Configuration Management Systems, expanded interaction with the En Route Metering function and improved terminal planning capabilities. The projected time frame for the various enhancements is dependent on the degree of automated planning aids available and the establishment of appropriate interfaces between the automation elements addressed.

The implementation of a Terminal Configuration Management System (CMS) is the first step identified in the evolution of Terminal Flow Management. The Terminal CMS is an automation aid to identify the best strategies for efficient utilization of available terminal area resources. The early phase is expected to provide optimal runway configuration strategies based on refined capacity estimates for the terminal operating environment.

These capacity estimates may be utilized to support the manual interface with ERM. An initial system developed for optimal runway configuration selection at Chicago O'Hare (ORD) is expected to provide longer range planning by extending the basic function to account for the effects of transitioning between alternative runway configurations imposed as changes in operating conditions occur. Further long range planning capabilities in the future CMS development stages will provide planning data through automated interfaces with the En Route Metering function and the automated terminal planning enhancements.

An automated Terminal Planning Aid (TPA) is a basic capability for improved traffic sequence planning projected for implementation in the initial stages of Terminal Flow development (e.g., 1985/86). The TPA would support the terminal control function by performing complex terminal traffic sequencing operations which would account for departures, VFR popups and local flights in the existing operational environment. The function would provide computed landing sequences and appropriate Meter Fix Time adjustments to enhance the effective utilization of terminal airspace and runway capacity. Through an automated interface with ERM the refined planning data would be applied to improve the match between the arrival traffic Meter Fix schedules and the variations in terminal capacity.

In the later operational stages of implementation (possibly in the late 1980's), the advanced terminal automation functions would include an expanded set of interfaces with ERM and the terminal planning process. The automated terminal/en route interface would be utilized to output directly to ERM the Meter Fix Times generated by the Terminal Planning Aid, based on the fine tuned sequencing and spacing computations performed by the terminal automation. This capability is expected to improve the efficiency of ERM by establishing an early "hand shake" with the terminal to achieve a precise metering strategy, based on actual runway assignments rather than an average airport acceptance rate. Further, the projected automated interfaces of the Terminal Planning Aid with ERM and CMS will support the use of fuel efficient descents and traffic readjustments for optimal fix load balancing.

7. REMAINING ISSUES

Several major issues that require further analysis have been identified during the preliminary stages of IFM functional concept development. Within the general framework documented in this report, many alternative options are available for subsequent formulation of a detailed IFM concept definition. The next level of this effort should be directed towards the evaluation of alternative system design approaches and expansion of the functional description to identify specific processes and algorithms for the general flow management functions. Concurrent activities would include a more detailed specification of the IFM interfacility communications requirements, identification all flow management message contents and the estimation of frequency and volume of information exchange between facilities and ATC system users.

Particular emphasis should be focused on the analysis of the far term evolution of IFM capabilities, specifically including identification of techniques for improved terminal traffic flow management. This area is a critical factor in the IFM process since historically most traffic flow problems are directly attributable to congestion in the terminal environment.

Some of the most significant issues which have surfaced during the formulation of the IFM functional description include the following:

- Improved weather forecasting is a major factor critical to achieving successful flow management planning. Better winds aloft information is a related area of concern for improved prediction accuracy and delay estimation which are basic requirements for the en route and terminal metering functions.
- The potential benefits which can be derived from information provided by advanced avionics (e.g., on-board flight management computers) and the ability of the IFM system to accommodate these capabilities have not been determined.
- The potential inconsistencies in meeting the goal for maintaining an equitable IFM system while providing maximum flexibility to aircraft equipped with flight management computers should be resolved.

- Flow management algorithms, remedial procedures and contingency plans to resolve specific types of flow problems should be identified in the next level of IFM concept development.
- The potential benefits of future automation enhancements (e.g., CDTI, DABS Data Link) and their role in the IFM process are open areas for future study.

Additional areas for further analysis related to National Flow Management are identified below.

- The level of detail represented in the NAS simulation model to support National Flow Management delay prediction and planning on a system-wide basis should be identified.
- The quantity of data and the degree of "centralized" processing needed to provide accurate and timely national traffic flow planning is an on-going area of study which must be resolved.
- An expanded lead time for problem prediction (e.g., weather disturbances, traffic congestion) is a vital factor needed for advance preparation and early coordination rather than reactive implementation of National Flow procedures.

Remaining issues related to local traffic flow management activities conducted within the en route and terminal facilities are summarized below.

- Analysis should be conducted to identify the quantifiable trade-offs between capacity, delay and fuel consumption, and the types of automation aids needed to select the best or "optimal" planning strategy.
- Determination of optimal flight profiles and delay discounting in terms of fuel and time penalties in a distributed ATC system needs further study.
- A quantitative assessment is needed to determine the potential benefits of advanced avionics equipment in terms of improved delivery precision and flight time estimation (including the applications for use of dynamic airspace and direct routes).

- Relaxation of current operating procedures of fix constraints and first-come-first serve priority can potentially provide greater planning flexibility and improvements in total system performance. This issue should be analyzed to determine the advantages and disadvantages of employing alternative schemes for "equitable delay distribution" in terms of fuel conservation, runway throughput, and utilization of other resources (e.g., priority determined by airline or class of aircraft rather than on an aircraft specific basis).
- The establishment of automated interfaces between the terminal and en route automation elements (e.g., ERM, Terminal CMS and planning aids for terminal traffic sequencing and spacing) should be addressed in conjunction with the development of the individual programs.
- A longer range terminal planning horizon (e.g., 2-3 hours lead time for flight information) could provide significant improvements in the terminal flow management operations. The IFM program should address this capability (possibly provided via a Terminal Information Display System, TIDS) and the associated cost-benefit tradeoffs.
- The transition impact and automated interfaces to support the IFM process during the phased implementation of the Automated En Route ATC (AERA) system should be examined.

APPENDIX A

LIST OF FLOW MANAGEMENT FUNCTIONS BY FACILITY

This appendix contains a list of the Integrated Flow Management functions by facility for National, En Route and Terminal Flow Management. The identified functions represent the general concepts, rather than a specific design for distribution of responsibilities among the various levels of ATC facilities. For each level of Flow Management operations, the functions are presented in four general categories or "processes" identified below.

1. Process P₁: Maintain Flow Management Data Base - Process P₁ encompasses the functions related to the maintenance of the flow management data base. The collection of accurate and timely data from all appropriate sources of traffic, weather and related information is a critical prerequisite for effective flow management planning, problem prediction and resolution.

2. Process P₂: Conduct System Performance Monitoring and Analysis - Process P₂ represents the general requirements for system performance monitoring and analysis of flow management operations. These functional capabilities include the prediction of traffic flow problems and development of appropriate relief strategies from available alternatives. Post analysis of problem situations is also prescribed to evaluate the procedures implemented and to assess the impact on local and interfacility traffic flow and delay.

3. Conduct Flow Management of Traffic - Process P₃ includes the flow management functions which interact with the real-time control functions to implement the procedures developed through planning and analysis. The close proximity with the control function provides a continual feed back of needed information between the planning and control elements to handle problems associated with delay and congestion.

4. Process P₄: Distribute Flow Management Data to Appropriate Facilities - Process P₄ represents the interfacility communications and coordination between facilities and users involved in the flow management of air traffic. These capabilities provide a communications network between the various ATC facilities and other users to assure system-wide coordination and efficient operations of all system components.

TABLE A-1
NATIONAL FLOW MANAGEMENT FUNCTIONS

1. Maintain National Flow Management Data Base
 - 1.1 Conduct Daily Survey of Domestic and International Operations
 - 1.2 Assemble and Maintain Current and Predicted Capacity Estimates for Centers and Key Terminals
 - 1.3 Assemble and Maintain Current and Predicted Demand Estimates for Centers and Key Terminals
 - 1.4 Assemble and Maintain National Weather Information
 - *1.5 Assemble and Maintain Stored Adaptation, Facility Demand Thresholds and System Monitoring Parameters
 - *1.6 Assemble and Maintain Actual Traffic Statistics (Delays, Congestion) Reported by Terminal and En Route Facilities
 - *1.7 Conduct Data Recording, Reduction and Analysis of Stored Information, including Historical Trends of Traffic Flow and Delays
2. Conduct National System Performance Monitoring and Analysis
 - 2.1 Monitor System Operation for Abnormal Conditions
 - 2.2 Collect, Analyze and Distribute System Performance Data
 - 2.3 Model and Simulate NAS System to Predict Gross Delays and Congestion
 - 2.3.1 Identify Situations and Causal Factors for Excess Delay

* Indicates Function Is Not Explicitly Included in Appendix B, Which Identifies Inputs and Output For the IFM Functions (i.e., Function is Implicitly Combined With Other Functions).

TABLE A-1
(CONCLUDED)

- 2.3.2 Develop "Best" Relief Strategy for Anticipated and Unanticipated Problems (Based on Assessment of Simulation Results for Alternative Procedures)
- 2.4 Conduct Post Analysis of System Performance to Evaluate Relief Strategies
- 3. Regulate National Traffic Flow to Achieve National Flow Management Objectives (Minimize Delays, Avoid Congestion, etc.)
 - 3.1 Coordinate and Approve Interfacility Flow Management Operations and Related Letters of Agreement
 - 3.2 Coordinate with Facilities and Users on Flow Procedures (e.g., Flight Priorities, Quota Restrictions, Rerouting, Weather Avoidance, etc.)
- 4. Distribute Flow Management Data to Appropriate Facilities/Users
 - *4.1 Issue Flow Advisories and Directives to Appropriate Facilities to Relieve Congestion and Enhance Orderly Flow of Traffic
 - *4.2 Coordinate and Provide Analysis of Weather Data to Appropriate Facilities
 - *4.3 Provide System Performance Data to Appropriate FAA & User Organizations (Including Normal Operations and Post Analysis of Relief Strategies)

* Indicates Function Is Not Explicitly Included in Appendix B, Which Identifies Inputs and Output For the IFM Functions (i.e., Function is Implicitly Combined With Other Functions).

TABLE A-2
EN ROUTE FLOW MANAGEMENT FUNCTIONS

1. **Maintain En Route Flow Management Data Base**
 - 1.1 **Obtain Current and Future Estimates of Flow Data from Terminal Facilities within Center**
 - 1.2 **Conduct Data Collection of Actual Traffic Delays Experienced in Center**
 - 1.3 **Maintain Current and Predicted Estimates of Nominal Demand of Adjacent Facility and Intrafacility Traffic**
 - 1.4 **Assemble and Maintain Current and Predicted Estimates of En Route Flow Data**
 - 1.5 **Assemble and Maintain Current and Predicted Weather Data**
2. **Conduct Analysis of En Route Flow Management Data**
 - 2.1 **From En Route Analysis, Identify Situations and Causal Factors for Excess Delay**
 - 2.2 **Develop Best Relief Strategies for Anticipated and Unanticipated Problems**
 - 2.3 **Monitor Local Traffic to Evaluate System Performance and Conformance to All Flow Management Strategies and Directives**
 - 2.4 **Conduct Post Analysis of All Local Problem Situations and Evaluate Relief Strategies**
 - 2.5 **Prepare Traffic Statistics and Summary Reports of En Route System Performance Data**

TABLE A-2
(CONCLUDED)

3. Conduct Flow Management of En Route Traffic
 - 3.1 Manage En Route Metering of Traffic
 - 3.2 Plan and Coordinate with National Flow and Appropriate Facilities En Route Flow Control Strategies Derived from Analysis
 - 3.3 Initiate Local Flow Management Measures to Relieve Congestion and Enhance the Orderly Flow of Traffic as Problems Occur
 - 3.4 Implement Flow Directives Issued by National Flow
4. Distribute Flow Management Data to Appropriate Facilities
 - 4.1 Participate in National Flow Daily Survey of Domestic and International Operations
 - 4.1.1 Provide En Route Capacities and System Status Data (Current and Predicted)
 - 4.1.2 Provide Statistical Data (Traffic Activity, Actual Delays, etc.)
 - 4.2 Provide Summary Data Related to Post Analysis of Problem Situations and System Performance to National Flow and Other Appropriate Facilities and Users
 - 4.3 Advise National Flow and Other Appropriate Facilities or Users of Planned Local Flow Management Strategies

TABLE A-3
TERMINAL FLOW MANAGEMENT FUNCTIONS

1. Maintain Terminal Flow Management Data Base
 - *1.1 Assemble and Maintain Current and Predicted Estimates of Terminal Operations (VFR, Tower, En Route, Satellite Operations)
 - *1.2 Assemble and Maintain Current and Predicted Estimates of Terminal Capacities, Demand and System Status
 - *1.3 Obtain Actual Delay Statistics
 - *1.4 Assemble and Maintain Current and Predicted Weather Data
2. Conduct System Performance Monitoring and Analysis of Terminal Flow Operations
 - 2.1 Identify Situations and Causal Factors Where Demand Exceeds Capacity
 - 2.2 Develop Best Relief Strategies for Anticipated and Unanticipated Problem Situations
 - 2.3 Conduct Post Analysis of Local Problem Situations and Evaluate Relief Strategies
 - *2.4 Prepare Traffic Statistics and Summary Reports of System Performance Data for Terminal Traffic Flow
3. Conduct Flow Management of Terminal Traffic
 - 3.1 Conduct Airport and Terminal Airspace Configuration Planning
 - 3.2 Manage Terminal Sequencing and Spacing of Arrival Traffic
 - 3.3 Plan and Coordinate with Host Center and Appropriate Facilities on Local Flow Management Strategies

* Indicates Function Is Not Explicitly Included in Appendix B, Which Identifies Inputs and Output For the IFM Functions (i.e., Function is Implicitly Combined With Other Functions).

TABLE A-3
(CONCLUDED)

- 3.4 Manage Departure Flow
- *3.5 Manage Traffic Flow at Satellite Airports
- 3.6 Manage Terminal Surface Traffic Flow
- *3.7 Implement Flow Directives Issued by Host Center and/or National Flow as Required
- 4. Distribute Flow Management Data to Appropriate Facilities
 - 4.1 Participate in National Flow Daily Survey of National and International Operations
 - *4.1.1 Provide Current and Future Airport Capacities and Facility Status to Host Center and National Flow
 - *4.1.2 Provide Flight Data and Traffic Estimates of Terminal Area Operations to Host Center and National Flow
 - *4.1.3 Provide Statistical Data (Traffic Activity, Actual Delays, etc.) to Host Center and National Flow
 - *4.2 Provide Summaries Concerning Post Analysis of Problems and System Performance Data to National Flow and Other Appropriate Facilities and Users
 - *4.3 Advise National Flow and Other Appropriate Facilities or Users of Planned Local Flow Procedures

* Indicates Function Is Not Explicitly Included in Appendix B, Which Identifies Inputs and Output For the IFM Functions (i.e., Function is Implicitly Combined With Other Functions).

APPENDIX B

IDENTIFICATION OF INPUTS AND OUTPUTS
FOR THE INTEGRATED FLOW MANAGEMENT FUNCTIONS

Significant types of information exchanged between facilities in conducting the IFM functions are identified herein. The information is presented as inputs and outputs listed for each function, and is organized in three tables which correspond to the National, En Route, and Terminal Flow Management facilities.

TABLE B-1
NATIONAL FLOW MANAGEMENT
INPUTS AND OUTPUTS BY FUNCTION

FUNCTION (1.1)*: CONDUCT DAILY SURVEY OF DOMESTIC AND INTERNATIONAL OPERATIONS

INPUTS:

FROM EN ROUTE FLOW MANAGEMENT

- o DAILY STATUS REPORTS (EQUIPMENT AVAILABILITY, STAFFING, AIRSPACE RESTRICTIONS)
- o SPECIAL ROUTINGS PLANNED OR IN EFFECT
- o CURRENT AND PREDICTED ESTIMATES OF NON-AIR CARRIER TRAFFIC IN CENTER (VFR, TOWER EN ROUTE, ETC.)
- o LOCAL WEATHER
- o SELECTED FLIGHT INFORMATION (NAS FLIGHT PLANS, PROGRESS REPORTS, DIVERSION, DEPARTURE, FLIGHT PLAN AMENDMENTS, REMOVE STRIP MESSAGES)
- o CENTER CAPACITY RESTRICTIONS
- o BULK STORED FLIGHT PLAN DATA

*NUMBER REPRESENTS A CROSS-REFERENCE TO THE CORRESPONDING FUNCTION LISTED IN TABLE A-1 OF APPENDIX A.

TABLE B-1
(CONTINUED)

FUNCTION (1.1): CONDUCT DAILY SURVEY OF DOMESTIC AND INTERNATIONAL
OPERATIONS (CONTINUED)

INPUTS:

FROM KEY TERMINALS

- o DAILY STATUS REPORTS AND UPDATES AS NEEDED (EQUIPMENT AVAILABILITY, STAFFING, CAPACITIES)
- o LOCAL WEATHER
- o TRAFFIC ESTIMATES OF TERMINAL AREA OPERATIONS (VFR, TOWER EN ROUTE, OTHER GA TRAFFIC, SATELLITE OPERATIONS)
- o SELECTED FLIGHT INFORMATION (E.G., ARRIVAL, DIVERSION, DEPARTURE MESSAGES)

FROM OAG

- o DOMESTIC AND INTERNATIONAL AIR CARRIER FLIGHT SCHEDULES AND UPDATES

FROM NWS

- o NATIONAL WEATHER CONDITIONS (CURRENT AND PREDICTED)
- o WEATHER FORECASTS
- o SEVERE WEATHER CONDITION REPORTS

TABLE B-1
(CONTINUED)

FUNCTION (1.1): CONDUCT DAILY SURVEY OF DOMESTIC AND INTERNATIONAL OPERATIONS
(CONTINUED)

INPUTS:

FROM AFTN

- o INTERNATIONAL FLIGHT PLANS
- o FLIGHT PLAN CANCELLATIONS
- o AFTN UPDATE MESSAGES (E.G., MODIFICATIONS, BOUNDARY ESTIMATES, DELAY, ETC.)

FROM ARINC/AIRLINES

- o UPDATES TO OAG SCHEDULES
- o FLIGHT PLAN CANCELLATIONS

FROM FSS

- o WEATHER REPORTS
- o REPORTED PROBLEMS
- o VFR FLIGHT DATA

TABLE B-1
(CONTINUED)

FUNCTION (1.1): CONDUCT DAILY SURVEY OF DOMESTIC AND INTERNATIONAL OPERATIONS (CONCLUDED)

OUTPUTS:

TO ENROUTE AND TERMINAL FLOW MANAGEMENT

- o ADVISORIES TO AFFECTED FACILITIES/USERS AS REQUIRED
- o UPDATED ESTIMATES OF CURRENT AND PREDICTED DEMAND AT KEY TERMINALS AND DESIGNATED EN ROUTE CONTROL POINTS
- o FLIGHT INFORMATION AND CANCELLATIONS FROM ARINC/AIRLINES FORWARDED TO APPROPRIATE CENTERS

TABLE B-1
(CONTINUED)

FUNCTION (1.2): ASSEMBLE AND MAINTAIN CAPACITY ESTIMATES

INPUTS:

FROM NATIONAL FLOW DATA BASE

- o STORED RANGES FOR DETECTING ABNORMALLY HIGH OR LOW CAPACITY ESTIMATES FOR EN ROUTE OR TERMINAL AIRSPACE (MAINTAINED IN NF DATA BASE)
- o CAPACITY ESTIMATES (CURRENT AND PREDICTED) FOR CENTERS OR TERMINALS
- o CAPACITY RESTRICTIONS (CURRENT OR PLANNED) IMPOSED BY CENTERS OR KEY TERMINALS

OUTPUTS:

TO EN ROUTE AND TERMINAL FLOW MANAGEMENT

- o VERIFICATION OF CAPACITY DATA WITH ORIGINATOR (TERMINAL OR CENTER) OF CAPACITY DATA IF ESTIMATES ARE ABNORMALLY HIGH OR LOW (BASED ON NOMINAL RANGE VALUES)
- o UPDATED SUMMARY REPORTS OF CAPACITY ESTIMATES
- o ADVISORIES OF CAPACITY RESTRICTIONS GENERATED TO AFFECTED FACILITIES/USERS

TABLE B-1
(CONTINUED)

FUNCTION (1.2): ASSEMBLE AND MAINTAIN CAPACITY ESTIMATES (CONCLUDED)

OUTPUTS:

TO ARINC/AIRLINES AND OTHER APPROPRIATE USERS

- o FLOW MANAGEMENT DATA (E.G., WEATHER, PROCEDURES IN EFFECT)
- o DELAY INFORMATION

TABLE B-1
(CONTINUED)

FUNCTION (1.3): ASSEMBLE AND MAINTAIN TRAFFIC DEMAND ESTIMATES

INPUTS:

FROM NATIONAL FLOW DATA BASE

- o BULK STORED AIR CARRIER FLIGHT PLANS AND NAS FLIGHT INFORMATION (FROM CENTERS)
- o OAG SCHEDULES AND UPDATES
- o ESTIMATED NUMBER OF NON-AIR CARRIER FLIGHTS FOR KEY TERMINALS (PROVIDED DAILY BY TERMINALS)
 - REVISIONS OR UPDATES REPORTED BY CENTERS AND KEY TERMINALS AS NEEDED
 - ESTIMATES INCLUDE VFR, TOWER EN ROUTE, OTHER GA TRAFFIC, AND SATELLITE OPERATIONS
- o INTERNATIONAL OPERATIONS
- o PRESTORED THRESHOLDS FOR DETECTING ABNORMALLY HIGH DEMAND LEVELS FOR DESIGNATED FACILITIES
- o FLIGHT DATA FROM ARINC/AIRLINES

TABLE B-1
(CONTINUED)

FUNCTION (1.3): ASSEMBLE AND MAINTAIN TRAFFIC DEMAND ESTIMATES
(CONCLUDED)

OUTPUTS:

TO EN ROUTE AND TERMINAL FLOW MANAGEMENT

- o UPDATED ESTIMATES OF CURRENT AND PREDICTED DEMAND AT KEY TERMINALS AND FOR EACH CENTER (AVAILABLE UPON REQUEST)
- o FLIGHT INFORMATION AND CANCELLATIONS FROM ARINC/AIRLINES FORWARDED TO APPROPRIATE CENTERS

TABLE B-1
(CONTINUED)

FUNCTION (1.4): ASSEMBLE AND MAINTAIN NATIONAL WEATHER INFORMATION

INPUTS:

FROM NWS

- o SEVERE WEATHER REPORTS
- o CURRENT CONDITIONS
- o PREDICTED CONDITIONS

FROM EN ROUTE AND TERMINAL FLOW MANAGEMENT

- o IMMEDIATE REPORTS OF SEVERE WEATHER CONDITIONS
- o PIREPS

FROM FSS

- o PILOT REPORTS OF SEVERE WEATHER
- o LOCAL WEATHER CONDITIONS

OUTPUTS:

TO EN ROUTE AND TERMINAL FLOW MANAGEMENT

- o ADVISORIES TO AFFECTED FACILITIES WHERE CURRENT OR PREDICTED SEVERE WEATHER CONDITIONS REQUIRE SPECIAL AVOIDANCE PROCEDURES
- o PERIODIC WEATHER SUMMARIES FOR SPECIFIED AIRSPACE AVAILABLE UPON REQUEST

TABLE B-1
(CONTINUED)

FUNCTION (2.1): MONITOR SYSTEM OPERATIONS

INPUTS:

FROM NATIONAL FLOW DATA BASE

- o SYSTEM PERFORMANCE DATA (NORMAL TRAFFIC ACTIVITY AND DEMAND LOADS) BASED ON HISTORICAL DATA RECORDING
- o CURRENT AND PREDICTED DEMAND AND CAPACITY ESTIMATES
- o STORED THRESHOLD INDICATORS FOR DETECTING DELAY BUILDUP
- o FACILITY STATUS REPORTS

FROM APPROPRIATE TERMINAL OR EN ROUTE FACILITIES

- o ALERTS OF SIGNIFICANT DEVIATIONS FROM FLOW DIRECTIVES
- o ADVISORIES OF CURRENT OR PLANNED RESTRICTIONS IN EN ROUTE AND TERMINAL AIRSPACE OR SURFACE TRAFFIC FLOW

OUTPUTS:

TO NATIONAL FLOW MANAGEMENT

- o NOTIFICATION OF POTENTIAL PROBLEM, AFFECTED FACILITIES AND USERS, EXPECTED TIME OF PROBLEM ONSET AND PREDICTED DURATION

TABLE B-1
(CONTINUED)

FUNCTION (2.1): MONITOR SYSTEM OPERATIONS (CONCLUDED)

OUTPUTS:

TO NATIONAL FLOW MANAGEMENT (CONCLUDED)

- o IDENTIFICATION OF FACILITIES OR AIRSPACE CHARACTERIZED BY LOW UTILIZATION (TO DEVELOP STRATEGIES FOR REDISTRIBUTION OF HIGH DENSITY TRAFFIC)
- o UPDATED RECORDED STATISTICS OF HISTORICAL TRAFFIC PATTERNS, PEAK DEMAND PERIODS, ETC.

TABLE B-1
(CONTINUED)

FUNCTION (2.2): COLLECT, ANALYZE AND DISTRIBUTE SYSTEM PERFORMANCE DATA
(NOTE: POST ANALYSIS OF SYSTEM IS ADDRESSED AS A
SEPARATE FUNCTION)

INPUTS:

FROM NATIONAL FLOW DATA BASE

- o CURRENT AND PREDICTED CAPACITIES THAT WERE PROVIDED BY EN
ROUTE AND TERMINAL FACILITIES
- o TRAFFIC DEMAND DATA MAINTAINED IN NATIONAL FLOW DATA BASE
- o COMPUTED DELAY AND CONGESTION GENERATED FROM NAS SIMULATION

FROM EN ROUTE AND TERMINAL FLOW MANAGEMENT

- o ACTUAL DELAYS AND OTHER SYSTEM PERFORMANCE DATA REPORTED BY
LOCAL FLOW MANAGEMENT
- o ASSESSED IMPACT OF NATIONALLY ISSUED FLOW DIRECTIVES REPORTED
BY LOCAL FLOW MANAGEMENT

TABLE B-1
(CONTINUED)

FUNCTION (2.2): COLLECT, ANALYZE AND DISTRIBUTE SYSTEM PERFORMANCE DATA
(CONCLUDED)

OUTPUTS:

TO NATIONAL FLOW AND OTHER APPROPRIATE ORGANIZATIONS

- o ESTIMATED ACCURACY OF PREVIOUS DELAY PREDICTIONS (BASED ON REPORTED DELAY STATISTICS)
- o TRAFFIC SUMMARY REPORTS AVAILABLE UPON REQUEST TO APPROPRIATE ORGANIZATIONS, INCLUDING THE FOLLOWING DATA:
 - TRAFFIC COUNTS
 - DELAY DISTRIBUTION
 - PEAK DEMAND LEVELS
- o CURRENT SYSTEM PERFORMANCE DATA PROVIDED TO APPROPRIATE ORGANIZATIONS UPON REQUEST

TABLE B-1
(CONTINUED)

FUNCTION (2.3): MODEL AND SIMULATE NAS SYSTEM

INPUTS:

FROM NATIONAL FLOW (NF) DATA BASE

- o NAS FLIGHT PLANS AND UPDATES
- o INTERNATIONAL FLIGHT PLANS
- o CURRENT AND PREDICTED CAPACITIES
- o CURRENT AND PREDICTED DEMANDS
- o CURRENT AND PREDICTED SYSTEMS STATUS
- o ALTERNATIVE "RELIEF" STRATEGIES FOR ALLEVIATING DELAY AND CONGESTION (INPUT BY NATIONAL FLOW MANAGEMENT TO ASSESS IMPACT OF FLOW MANAGEMENT PLANS)

OUTPUTS:

TO NATIONAL FLOW MANAGEMENT

- o TRAFFIC COUNTS
- SUMMARIES FOR DESIGNATED POINTS
- FOR KEY TERMINALS (E.G., DEPARTURES, ARRIVALS, OVERFLIGHTS)

TABLE B-1
(CONTINUED)

FUNCTION (2.3): MODEL AND SIMULATE NAS SYSTEM (CONCLUDED)

OUTPUTS:

TO NATIONAL FLOW MANAGEMENT (CONCLUDED)

- o PREDICTED GROSS DELAYS AT KEY TERMINALS AND EN ROUTE AIRSPACE (SECTORS/ROUTES/CONTROL POINTS)
- o SIMULATED RESULTS (TRAFFIC COUNTS AND DELAY DISTRIBUTION) CORRESPONDING TO EACH ALTERNATIVE FLOW MANAGEMENT STRATEGY

TABLE B-1
(CONTINUED)

FUNCTION (2.3.1): IDENTIFICATION OF CAUSAL FACTORS FOR EXCESS DELAY

INPUTS:

FROM CENTERS AND KEY TERMINALS

- o ACTUAL TRAFFIC DELAY STATISTICS
- o LOCAL INFORMATION CONCERNING CAUSAL FACTORS FOR EXCESS DELAY

FROM NATIONAL FLOW DATA BASE

- o FACILITY DEMAND DISTRIBUTION BY TIME AND GEOGRAPHY
- o FACILITY CAPACITIES

TABLE B-1
(CONTINUED)

FUNCTION (2.3.1): IDENTIFICATION OF CAUSAL FACTORS FOR EXCESS DELAY
(CONCLUDED)

OUTPUTS:

TO NATIONAL FLOW MANAGEMENT

o IDENTIFICATION OF ALL PRIMARY FACILITIES AFFECTED AND
SECONDARY EFFECTS

- MAGNITUDE OF PROBLEM

- EXPECTED DURATION

o LEVEL OF RESPONSIBILITY REQUIRED FOR PROBLEM RESOLUTION

- TERMINAL AIRSPACE FLOW MANAGEMENT

- INTRACENTER FLOW MANAGEMENT

- NATIONAL FLOW MANAGEMENT (E.G., COORDINATION BETWEEN
MULTIPLE FACILITIES NEEDED)

TABLE B-1
(CONTINUED)

FUNCTION (2.3.2): DEVELOP "BEST" RELIEF STRATEGY

INPUTS:

FROM NATIONAL FLOW MANAGEMENT

- o PROBLEM CHARACTERISTICS
- o ALTERNATIVE RELIEF STRATEGIES FOR RECURRENT TYPES OF PROBLEMS
- o STATUS REPORTS
- o REVISED CAPACITIES
- o CURRENT AND PREDICTED DELAYS

OUTPUTS:

TO NATIONAL FLOW MANAGEMENT

- o ASSESSED IMPACT OF ALTERNATIVE STRATEGIES (VIA SIMULATION REPORTS)
 - INTERCENTER FLOW QUOTAS
 - GROUND DELAYS
 - WEATHER AVOIDANCE REROUTING PROCEDURES
- o SELECTION OF "BEST" RELIEF STRATEGY AND CONTINGENT PLAN TO ACHIEVE EQUITABLE DELAY DISTRIBUTION AND MINIMUM LONG TERM IMPACT ON NORMAL OPERATIONS FOR THE SPECIFIC IDENTIFIED PROBLEM

TABLE B-1
(CONTINUED)

FUNCTION (2.4): CONDUCT POST ANALYSIS OF SYSTEM PERFORMANCE

INPUTS:

FROM NATIONAL FLOW DATA BASE

- o TRAFFIC STATISTICS IN NF DATA BASE REQUIRED TO COMPARE ANTICIPATED RESULTS WITH OUTCOME OF THE SELECTED RELIEF STRATEGY
- o HISTORICAL TRAFFIC PATTERNS AND PEAK DEMAND/CONGESTION PERIODS (DATA RECORDING MAINTAINED IN NF DATA BASE)

FROM EN ROUTE AND TERMINAL FLOW MANAGEMENT

- o DELAYS EXPERIENCED PRIOR TO AND FOLLOWING IMPLEMENTATION OF FLOW MANAGEMENT PROCEDURES
- o ASSESSED IMPACT OF NATIONAL FLOW DIRECTIVES ON LOCAL CONGESTION PROBLEMS

OUTPUTS:

TO NATIONAL FLOW MANAGEMENT

- o EVALUATION OF RELIEF STRATEGY SELECTED
 - ACTUAL VS. PREDICTED SYSTEM PERFORMANCE
- o DETECTION OF RECURENT PROBLEMS
- o UPDATED SUMMARIES OF NOMINAL TRAFFIC PATTERNS, DELAY PEAKS AND INTERVALS OF HIGH DEMAND ON A NATIONAL SCALE

TABLE B-1
(CONTINUED)

FUNCTION (2.4): CONDUCT POST ANALYSIS OF SYSTEM PERFORMANCE (CONCLUDED)

OUTPUTS:

TO NATIONAL FLOW (CONCLUDED)

- o ASSESSMENT OF FLOW DIRECTIVES ISSUED BY NATIONAL FLOW MANAGEMENT
- o ESTIMATED ACCURACY OF PREVIOUS DELAY PREDICTIONS (BASED ON REPORTED DELAY STATISTICS)

TO OTHER AFFECTED FACILITIES AND USERS

- o PERIODIC ANALYSIS OF PROBLEMS, RELIEF STRATEGIES AND SYSTEM PERFORMANCE
- o IDENTIFICATION OF NATIONAL AND INTERFACILITY ATC PROCEDURAL CHANGES TO ELIMINATE OR REDUCE THE IMPACT OF RECURRENT PROBLEMS

TABLE B-1
(CONTINUED)

FUNCTION (3.1): COORDINATE AND APPROVE INTERFACILITY FLOW MANAGEMENT PLANS

INPUTS:

FROM EN ROUTE AND TERMINAL FLOW MANAGEMENT

- o PROPOSED INTERFACILITY FLOW MANAGEMENT PLANS/PROCEDURES SUBMITTED BY CENTERS OR TERMINALS (INDEPENDENTLY OR JOINTLY)
- o RECURRENT PROBLEMS AND ALTERNATIVE SOLUTION PROCEDURES
- o STANDARD FLOW MANAGEMENT PROCEDURES IMPLEMENTED BY LOCAL FLOW AUTHORITIES (REPORTED TO NATIONAL FLOW AS PROBLEMS OCCUR)
- o LOCAL FLOW PROCEDURES EFFECTED ON AN AD HOC BASIS FOR UNANTICIPATED INTRAFACILITY PROBLEMS (SUBMITTED VIA ADVISORIES FROM LOCAL TERMINAL OR EN ROUTE FLOW MANAGEMENT)

TABLE B-1
(CONTINUED)

FUNCTION (3.1): COORDINATE AND APPROVE INTERFACILITY FLOW MANAGEMENT PLANS (CONCLUDED)

OUTPUTS:

TO AFFECTED EN ROUTE AND TERMINAL FLOW MANAGEMENT AND USERS

- o COORDINATED LETTERS OF AGREEMENT BETWEEN CENTERS UNDER AUSPICES OF NATIONAL FLOW MANAGEMENT
- o NATIONAL FLOW DIRECTIVES CONCERNING FLOW PROCEDURES APPLICABLE AT DESIGNATED KEY TERMINALS OR CENTERS
- o ADVISORIES ISSUED TO REQUESTING FACILITIES INDICATING APPROVAL OR DISAPPROVAL BY NATIONAL FLOW OF PROPOSED INTERFACILITY PROCEDURAL AGREEMENTS
- o ALTERNATIVE PROCEDURES FOR INTERFACILITY FLOW MANAGEMENT (MAY BE PROVIDED WHEN PROPOSED PLANS ARE NOT ACCEPTABLE)

TABLE B-1
(CONTINUED)

FUNCTION (3.2): PERFORM COORDINATION WITH FACILITIES AND USERS TO
IMPLEMENT FLOW PROCEDURES

INPUTS:

FROM NATIONAL FLOW MANAGEMENT

- o SELECTED RELIEF STRATEGY AND CONTINGENCY PLAN
- o DETAILED INSTRUCTIONS AND ASSESSED IMPACT FOR EACH FACILITY OR USER INVOLVED IN THE FLOW MANAGEMENT PLAN

FROM AFFECTED FACILITIES AND USERS

- o INTERFACILITY FLOW PROCEDURES

OUTPUTS:

TO EN ROUTE FLOW, APPROPRIATE KEY TERMINALS AND USERS

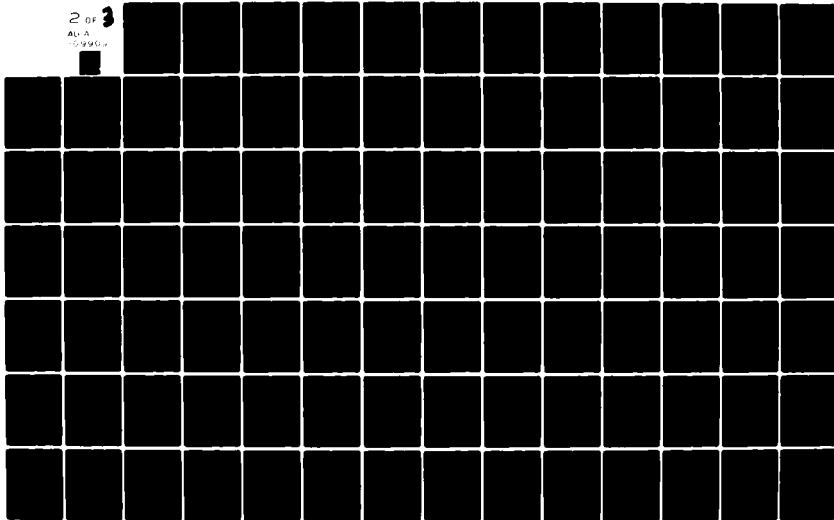
- o COORDINATION BETWEEN IMPACTED FACILITIES AND USERS TO IMPLEMENT NATIONAL FLOW PROCEDURES (E.G., WEATHER AVOIDANCE, REROUTING)
- COORDINATED LETTERS OF AGREEMENT BETWEEN AFFECTED EN ROUTE FACILITIES
- NATIONAL FLOW ORDERS CONCERNING LOCAL FLOW PROCEDURES
- ALTERNATIVE PROCEDURES FOR LOCAL FLOW PROBLEMS

AD-A109 909

MITRE CORP MCLEAN VA METREX DIV F/G 5/1
PRELIMINARY FUNCTIONAL DESCRIPTION OF INTEGRATED FLOW MANAGEMEN--ETC(U)
OCT 81 D L ADAMS, S M ALVANIA, R BRUBAKER DTFA01-81-C-10001
MTR-81W252 FAA-EM-82-7 NL

UNCLASSIFIED

2 of 3
AL-A
-09/80



2

OF

3

AD A

109909

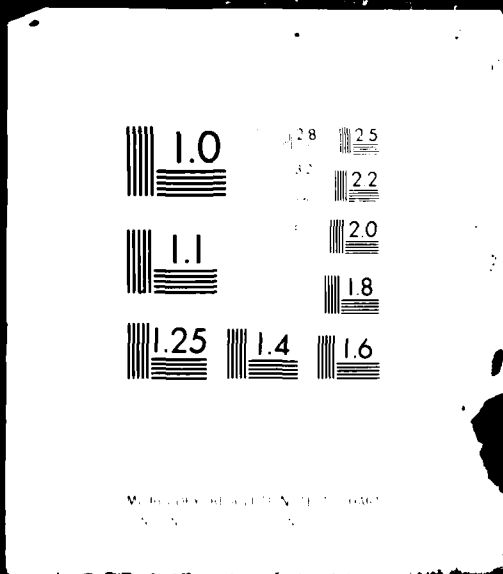


TABLE B-1
(CONTINUED)

FUNCTION (3.2): PERFORM COORDINATION WITH FACILITIES AND USERS TO
IMPLEMENT FLOW PROCEDURES (CONCLUDED)

OUTPUTS:

TO EN ROUTE FLOW, APPROPRIATE KEY TERMINALS AND USERS (CONCLUDED)

o NATIONAL FLOW MANAGEMENT ADVISORIES

- NATIONAL FLOW DIRECTIVES

- NOTIFICATION OF FLOW RESTRICTIONS AND TIME OF
IMPLEMENTATION

TABLE B-1
(CONTINUED)

FUNCTION (4.0): DISTRIBUTE FLOW MANAGEMENT DATA TO APPROPRIATE FACILITIES

INPUTS:

FROM NATIONAL DATA BASE

- o CURRENT AND PREDICTED DELAYS
- o CURRENT AND PREDICTED CAPACITIES
- o COMPUTED DELAYS, CONGESTION AND FLOW MANAGEMENT DATA FOR ALTERNATIVE STRATEGIES
- o WEATHER INFORMATION AND ANALYSIS RESULTS
- o SYSTEM PERFORMANCE DATA

OUTPUTS:

TO NATIONAL FLOW

- o PERIODIC THRESHOLD MONITORING REPORTS
- TO ALL AFFECTED TERMINAL AND EN ROUTE FACILITIES AND USERS

- o ADVANCE NOTIFICATION OF PLANNED FLOW CONTROL PROCEDURES/RESTRICTIONS AND TIME OF IMPLEMENTATION
- o NATIONAL FLOW DIRECTIVES/PLANS TO ACHIEVE EQUITABLE ALLOCATION OF DELAY AMONG ALL DELAY IMPACTED FACILITIES AND USERS
- o IMMEDIATE REMOVAL OF FLOW RESTRICTIONS UPON PROBLEM RESOLUTION

**TABLE B-1
(CONCLUDED)**

**FUNCTION (4.0): DISTRIBUTE FLOW MANAGEMENT DATA TO APPROPRIATE FACILITIES
(CONCLUDED)**

OUTPUT:

TO EN ROUTE AND TERMINAL FLOW MANAGEMENT

- o SYSTEM PERFORMANCE DATA
- o WEATHER INFORMATION AND ANALYSIS RESULTS

TABLE B-2

EN ROUTE FLOW MANAGEMENT
INPUTS AND OUTPUTS BY FUNCTION

FUNCTION (1.1)*: ASSEMBLE AND MAINTAIN FLOW DATA FROM TERMINALS

INPUTS:

FROM TERMINALS (WITHIN OR ADJACENT TO CENTER)

- o CURRENT AND PREDICTED FACILITY STATUS
- o CURRENT AND PREDICTED CAPACITIES
- o CURRENT AND PREDICTED DEMAND
- o CURRENT AND PREDICTED CAPACITY RESTRICTIONS
- o CURRENT AND PREDICTED AIRPORT ACCEPTANCE RATES (AAR) - FOR METERED AIRPORTS ONLY
- o SELECTED FLIGHT DATA (E.G., PROPOSED AND ACTUAL DEPARTURE TIMES)
- o ESTIMATES OF LOCAL VFR, TOWER EN ROUTE AND SATELLITE OPERATIONS
- o NOTIFICATION AND PREDICTION OF SIGNIFICANT DELAYS
- o ACTUAL TRAFFIC AND DEMAND DISTRIBUTION BY TIME AND GEOGRAPHY

*NUMBER REPRESENTS A CROSS-REFERENCE TO THE CORRESPONDING FUNCTION LISTED IN TABLE A-2 of APPENDIX A.

TABLE B-2
(CONTINUED)

FUNCTION (1.1): ASSEMBLE AND MAINTAIN FLOW DATA FROM TERMINALS (CONCLUDED)

LOCAL OUTPUTS:

TO FLOW CONTROLLER*

- o TERMINAL TRAFFIC SUMMARY DATA (E.G., CAPACITY, DEMAND, DEPARTURE COUNTS, ARRIVAL COUNTS)
- o TERMINAL FACILITY STATUS
- o TERMINAL CAPACITIES AND DEMAND ESTIMATES
- o REPORTED DELAYS EXPERIENCED BY TERMINALS

TO METER POSITION*

- o AIRPORT ACCEPTANCE RATES
- o TERMINAL TRAFFIC SUMMARY STATISTICS
- o SCHEDULING INFORMATION FOR METERED TRAFFIC
- o DISTRIBUTION OF ARRIVAL TRAFFIC TO METERED AIRPORTS

*OUTPUTS TO FLOW CONTROLLER AND METER POSITIONS REPRESENT THE OUTPUTS TO "TERMINAL FLOW MANAGEMENT."

TABLE B-2
(CONTINUED)

FUNCTION (1.2): CONDUCT DATA COLLECTION OF ACTUAL TRAFFIC DELAYS
EXPERIENCED IN CENTER

INPUTS:

FROM TERMINALS

- o NOTIFICATION AND PREDICTION OF SIGNIFICANT DELAYS

FROM NAS EN ROUTE COMPUTER

- o COMPUTED DELAYS

OUTPUTS:

TO NATIONAL FLOW

- o ADVISORIES OF ACTUAL TRAFFIC DELAYS EXPERIENCED

TO FLOW CONTROLLER

- o SUMMARY REPORTS OF ACTUAL TRAFFIC DELAYS EXPERIENCED IN CENTER

TABLE B-2
(CONTINUED)

FUNCTION (1.3): ASSEMBLE AND MAINTAIN CURRENT AND PREDICTED ESTIMATES OF
NOMINAL DEMAND OF ADJACENT FACILITIES AND INTRAFACILITY
TRAFFIC

INPUTS:

FROM ADJACENT CENTERS

- o FACILITY STATUS REPORTS (E.G., EQUIPMENT AVAILABILITY, STAFFING)
- o DEMAND LEVELS AND FLOW RATES
- o CURRENT OR PLANNED FLOW RESTRICTIONS
- o APPROPRIATE FLIGHT DATA (E.G., COORDINATION FIX TIME UPDATES)

FROM NATIONAL FLOW

- o CURRENT AND PREDICTED TRAFFIC COUNTS, DEMAND, DELAY AND CAPACITY ESTIMATES
- o FLIGHT DATA UPDATES AND CANCELLATIONS REPORTED BY ARINC/AIRLINES

LOCAL OUTPUTS:

TO FLOW CONTROLLER

- o TRAFFIC SUMMARY DATA (E.G., FIX LOADS, TERMINAL DEPARTURES AND ARRIVALS)
- o ADJACENT CENTER FLOW DATA (E.G., FACILITY STATUS, CAPACITY RESTRICTIONS)

TABLE B-2
(CONTINUED)

FUNCTION (1.3): ASSEMBLE AND MAINTAIN CURRENT AND PREDICTED ESTIMATES OF
NOMINAL DEMAND OF ADJACENT FACILITIES AND INTRAFACILITY
TRAFFIC (CONCLUDED)

LOCAL OUTPUTS

TO METER POSITIONS

- o ADJACENT CENTER FLOW DATA (E.G., FLOW RATES, GEOGRAPHIC
DISTRIBUTION AND AIRCRAFT MIX)
- o COORDINATION FIX TRAFFIC DATA (E.G., INTERCENTER DELAYS AND
COORDINATION FIX TIMES)

TABLE B-2
(CONTINUED)

FUNCTION (1.4): ASSEMBLE AND MAINTAIN CURRENT AND PREDICTED ESTIMATES OF EN ROUTE FLOW DATA

INPUTS:

FROM BULK STORE

o FILED FLIGHT PLANS

FROM NAS EN ROUTE COMPUTER

o NAS FLIGHT PLANS AND UPDATES (E.G., MODIFICATIONS, CANCELLATIONS)

o NAS FDP DATA (E.G., CTA'S AT DESIGNATED FIXES, ACTIVATION TIMES)

FROM NATIONAL FLOW

o ESTIMATES OF PREDICTED TRAFFIC COUNTS AT DESIGNATED FIXES OR ROUTES

FROM TERMINALS (WITHIN OR ADJACENT TO CENTER)

o CURRENT AND PREDICTED ESTIMATES OF VFR, TOWER EN ROUTE AND SATELLITE OPERATIONS

o SELECTED FLIGHT INFORMATION (E.G., PROPOSED AND ACTUAL DEPARTURE TIMES)

FROM AIRCRAFT

o AIRCRAFT PERFORMANCE DATA VIA PILOTS REPROTS OR DATA LINK (E.G., CURRENT AND PREDICTED DATA FOR AIRCRAFT EQUIPPED WITH FLIGHT MANAGEMENT COMPUTERS)

TABLE B-2
(CONTINUED)

FUNCTION (1.4): ASSEMBLE AND MAINTAIN CURRENT AND PREDICTED ESTIMATES OF EN
ROUTE FLOW DATA (CONTINUED)

INPUTS:

FROM FLIGHT SERVICE STATIONS (FSS)

- o VFR FLIGHT INFORMATION

OUTPUTS:

TO NATIONAL FLOW

- o SELECTED NAS FLIGHT INFORMATION (E.G., DELAYS, CANCELLATIONS)
- o BULK STORED AIR CARRIER FLIGHT PLANS
- o CURRENT AND PREDICTED FACILITY STATUS REPORTS
- o SPECIAL ROUTINGS PLANNED OR IN EFFECT
- o EN ROUTE CENTER CAPACITY ESTIMATES (CURRENT AND PREDICTED)
- o CURRENT AND PREDICTED CAPACITY RESTRICTIONS (E.G., AIRSPACE SATURATION)
- o TRAFFIC SUMMARY STATISTICS (E.G., SECTOR LOADS, ROUTE USAGE)
- o CURRENT AND PREDICTED ESTIMATES OF NON-AIR CARRIER TRAFFIC IN CENTER.

TABLE B-2
(CONTINUED)

FUNCTION (1.4): ASSEMBLE AND MAINTAIN CURRENT AND PREDICTED ESTIMATES OF EN
ROUTE FLOW DATA (CONCLUDED)

OUTPUTS:

TO TERMINALS (WITHIN OR ADJACENT TO CENTER)

- o APPROPRIATE FLIGHT INFORMATION (E.G., METER FIX TIME UPDATES)
- o CURRENT AND EXPECTED RATES, GEOGRAPHIC DISTRIBUTION AND AIRCRAFT MIX OF ARRIVAL TRAFFIC

TO ADJACENT CENTERS

- o SELECTED FLIGHT INFORMATION (E.G., BOUNDARY CROSSING TIMES)
- o CURRENT AND PREDICTED TRAFFIC DEMAND AFFECTING ADJACENT CENTER
- o CURRENT AND PREDICTED CAPACITY AND RESTRICTIONS OF ORIGINATING CENTER

LOCAL OUTPUTS:

TO FLOW CONTROLLER

- o PROCESSED INTRACENTER FLIGHT INFORMATION (E.G., TRAFFIC COUNTS FOR DESIGNATED FIXES OR SECTORS IN THE EN ROUTE AIRSPACE)

TO METER POSITION

- o SCHEDULING INFORMATION FOR METERED TRAFFIC

TABLE B-2
(CONTINUED)

FUNCTION (1.5): ASSEMBLE AND MAINTAIN CURRENT AND PREDICTED WEATHER DATA
BASE

INPUTS:

FROM NWS

- o CURRENT AND FORECAST REGIONAL WEATHER
- o REPORTS OF SEVERE WEATHER CONDITIONS

FROM FSS

- o LOCAL WEATHER REPORTS

FROM AIRCRAFT

- o WINDS ALOFT

FROM NATIONAL FLOW

- o ADVISORIES OF SEVERE WEATHER CONDITIONS AND (IF APPROPRIATE)
AVOIDANCE PROCEDURES
- o CURRENT AND FORECAST NATIONAL WEATHER INFORMATION

FROM TERMINALS

- o LOCAL WEATHER INFORMATION

TABLE B-2
(CONCLUDED)

FUNCTION (1.5): ASSEMBLE AND MAINTAIN CURRENT AND PREDICTED WEATHER DATA
BASE (CONCLUDED)

OUTPUTS:

TO NATIONAL FLOW

o LOCAL WEATHER REPORTS

TO TERMINALS (WITHIN OR ADJACENT TO CENTER)

o ADVISORIES OF WEATHER INFORMATION IMPACTING TERMINAL OPERATIONS

LOCAL OUTPUTS:

TO FLOW CONTROLLER

o REGIONAL WEATHER INFORMATION

o ADVISORIES OF SEVERE WEATHER CONDITIONS

o SEVERE WEATHER AVOIDANCE PROCEDURES ISSUED BY NATIONAL FLOW

TABLE B-2
(CONTINUED)

FUNCTION (2.1): IDENTIFY SITUATIONS AND CAUSAL FACTORS FOR PREDICTED
EXCESS DELAY AND FOR PREVIOUS DELAY PROBLEMS

INPUTS:

FROM EN ROUTE FLOW DATA BASE

o EN ROUTE FDP AND FLOW MANAGEMENT DATA INCLUDING

- FIX LOADS

- TERMINAL LOADS, CAPACITIES AND DEMAND

- SECTOR LOADS

- HOLDING LEVELS

o SPECIFIC POINTS/SECTORS/ROUTES WHERE PREDICTED VALUES EXCEED DELAY
THRESHOLD VALUES

o PREDICTED SEVERE WEATHER DISTURBANCES

FROM NATIONAL FLOW

o ADVISORIES OF PREDICTED PROBLEMS ASSOCIATED WITH GROSS DELAY AND
CONGESTION

o PERIODIC ANALYSIS OF PROBLEMS AND RELIEF STRATEGIES

TABLE B-2
(CONTINUED)

FUNCTION (2.1): IDENTIFY SITUATIONS AND CAUSAL FACTORS FOR PREDICTED EXCESS DELAY AND FOR PREVIOUS DELAY PROBLEMS (CONCLUDED)

OUTPUTS:

TO NATIONAL FLOW

- o IDENTIFICATION OF FACTORS ASSOCIATED WITH RECURRENT PROBLEMS (BASED ON INFORMATION RECORDED BY CENTERS) AND CAUSAL FACTORS FOR DELAY
- o ASSESSED IMPACT OF NATIONAL FLOW DIRECTIVES (E.G., ACTUAL DELAYS INCURRED PRIOR TO AND AFTER IMPLEMENTATION OF PROCEDURES)
- o TO TERMINALS (WITHIN OR ADJACENT TO CENTER)
- o IDENTIFICATION OF FACTORS ASSOCIATED WITH RECURRENT PROBLEMS AND CAUSAL FACTORS FOR DELAY

LOCAL OUTPUTS:

TO EN ROUTE FLOW CONTROLLER

- o PREDICTED PROBLEMS
- o IDENTIFICATION OF ALL FACILITIES AND USERS AFFECTED BY PREDICTED EXCESS DELAY
- MAGNITUDE OF PROBLEM
- EXPECTED DURATION OF PROBLEM

TABLE B-2
(CONTINUED)

FUNCTION (2.2): DEVELOP "BEST" LOCAL RELIEF STRATEGIES FOR ANTICIPATED AND UNANTICIPATED PROBLEMS

INPUTS:

FROM EN ROUTE ANALYSIS RESULTS

- o PROBLEM CHARACTERISTICS
- o ALTERNATIVE LOCAL RELIEF STRATEGIES

FROM NATIONAL FLOW

- o NATIONALLY ISSUED LOCAL FLOW DIRECTIVES

OUTPUTS:

TO NATIONAL FLOW

- o ADVISORY TO NATIONAL FLOW CONTROL IF LOCAL STRATEGIES WILL NOT SOLVE PROBLEM (I.E., INTERCENTER RESOLUTION REQUIRED BEYOND LETTERS OF AGREEMENT)

TABLE B-2
(CONTINUED)

FUNCTION (2.2): DEVELOP "BEST" LOCAL RELIEF STRATEGIES FOR ANTICIPATED AND UNANTICIPATED PROBLEMS (CONCLUDED)

LOCAL OUTPUTS:

TO EN ROUTE FLOW CONTROLLER

o ASSESSED IMPACT OF ALTERNATIVE STRATEGIES, INCLUDING

- RESECTORIZATION
- EN ROUTE HOLDING
- TRAFFIC REROUTING
- GROUND DELAYS

o SELECTED STRATEGY AND CONTINGENCY PLAN BASED ON EQUITABLE DELAY DISTRIBUTION (I.E., FUEL AND DELAY CONSIDERATIONS ON AN INDIVIDUAL FLIGHT BASIS)

TABLE B-2
(CONTINUED)

FUNCTION (2.3): MONITOR LOCAL TRAFFIC TO EVALUATE SYSTEM PERFORMANCE AND CONFORMANCE TO ALL FLOW MANAGEMENT STRATEGIES AND DIRECTIVES

INPUTS:

FROM EN ROUTE FLOW DATA BASE

- o TRAFFIC SUMMARY STATISTICS
- o CURRENT AND PREDICTED CAPACITIES, DEMAND AND DELAYS
- o DELAYS WHICH EXCEED PREDETERMINED THRESHOLD VALUES

FROM TERMINALS

- o ALERTS OF SIGNIFICANT DEVIATIONS FROM FLOW DIRECTIVES
- o NOTIFICATION AND PREDICTION OF SIGNIFICANT DELAYS
- o CURRENT AND PREDICTED DEMAND, CAPACITY AND FACILITY STATUS

FROM NATIONAL FLOW

- o SYSTEM PERFORMANCE DATA (E.G., GROSS DELAYS, CAPACITY UTILIZATION)
- o NATIONALLY ISSUED LOCAL FLOW DIRECTIVES

TABLE B-2
(CONTINUED)

FUNCTION (2.3): MONITOR LOCAL TRAFFIC TO EVALUATE SYSTEM PERFORMANCE AND CONFORMANCE TO ALL FLOW MANAGEMENT STRATEGIES AND DIRECTIVES (CONTINUED)

INPUTS:

FROM ADJACENT CENTERS

- o BOUNDARY TRAFFIC DEMAND, DELAY AND FLOW RATES
- o TRAFFIC FLOW RESTRICTIONS PLANNED OR IN EFFECT
- o FACILITY STATUS REPORTS

OUTPUTS:

TO NATIONAL FLOW

- o INFORMATION CONCERNING CAUSAL FACTORS FOR EXCESS DELAY
- o ACTUAL TRAFFIC DELAY, CONGESTION AND OTHER SYSTEM PERFORMANCE DATA
- o ALERTS OF SIGNIFICANT DEVIATIONS FROM FLOW DIRECTIVES

TO TERMINALS WITHIN OR ADJACENT TO CENTER

- o IDENTIFICATION OF FACTORS ASSOCIATED WITH RECURRENT PROBLEMS AND CAUSAL FACTORS FOR EXCESS DELAY
- o ALERTS OF SIGNIFICANT DEVIATIONS FOR FLOW DIRECTIVES

TABLE B-2
(CONTINUED)

FUNCTION (2.3): MONITOR LOCAL TRAFFIC TO EVALUATE SYSTEM PERFORMANCE AND CONFORMANCE TO ALL FLOW MANAGEMENT STRATEGIES AND DIRECTIVES (CONCLUDED)

LOCAL OUTPUTS:

TO EN ROUTE FLOW CONTROLLER

- o IDENTIFICATION OF FACTORS ASSOCIATED WITH RECURRENT PROBLEMS AND CAUSAL FACTORS FOR EXCESS DELAY
- o ALERTS OF SIGNIFICANT DEVIATIONS FROM FLOW DIRECTIVES

TABLE B-2
(CONTINUED)

FUNCTION (2.4): CONDUCT POST ANALYSIS OF PROBLEM SITUATIONS AND EVALUATE RELIEF STRATEGIES

INPUTS:

FROM EN ROUTE FLOW DATA BASE

- o TRAFFIC STATISTICS PRIOR TO AND AFTER IMPLEMENTATION OF LOCAL RELIEF STRATEGIES
- o TRAFFIC STATISTICS RELATED TO USE OF NATIONALLY ISSUED LOCAL FLOW DIRECTIVES
- o FREQUENT PROBLEMS AND RESOLUTION STRATEGIES
- o CAUSAL FACTORS FOR EXCESS DELAY IDENTIFIED BY LOCAL FLOW MANAGEMENT
- o ACTUAL DELAYS EXPERIENCED IN THE TERMINAL AND CENTER AIRSPACE

FROM NATIONAL FLOW

- o PERIODIC ANALYSIS OF PROBLEMS AND RELIEF STRATEGIES
- o SYSTEM PERFORMANCE DATA (E.G., GROSS DELAYS, CAPACITY UTILIZATION)
- o IDENTIFICATION OF NATIONAL AND INTERFACILITY CHANGES TO ELIMINATE OR REDUCE THE IMPACT OF RECURRENT PROBLEMS

TABLE B-2
(CONTINUED)

FUNCTION (2.4): CONDUCT POST ANALYSIS OF PROBLEM SITUATIONS AND EVALUATE
RELIEF STRATEGIES (CONTINUED)

INPUTS:

FROM TERMINALS WITHIN OR ADJACENT TO CENTER

- o INFORMATION CONCERNING CAUSAL FACTORS FOR EXCESS DELAY
- o ASSESSED IMPACT OF LOCAL RELIEF STRATEGIES AND FLOW DIRECTIVES

OUTPUTS:

TO NATIONAL FLOW

- o ASSESSED IMPACT OF NATIONAL FLOW DIRECTIVES
- o ACTUAL TRAFFIC DELAY AND CONGESTION EXPERIENCED IN CENTER
- o INFORMATION CONCERNING CAUSAL FACTORS FOR EXCESS DELAY
- o IDENTIFICATION OF LOCAL AND INTERFACILITY ATC PROCEDURAL CHANGES
TO ELIMINATE OR REDUCE THE IMPACT OF RECURRENT PROBLEMS

TABLE B-2
(CONTINUED)

FUNCTION (2.4): CONDUCT POST ANALYSIS OF PROBLEM SITUATIONS AND EVALUATE
RELIEF STRATEGIES (CONCLUDED)

OUTPUTS:

TO AFFECTED LOCAL EN ROUTE OR TERMINAL FACILITIES

- o ASSESSMENT OF LOCAL RELIEF STRATEGIES AND NATIONALLY ISSUED LOCAL
FLOW DIRECTIVES
- o IDENTIFICATION OF LOCAL OR INTERFACILITY ATC PROCEDURAL CHANGES
NEEDED TO PREVENT OR REDUCE THE IMPACT OF RECURRENT TYPES OF
PROBLEMS
- o APPROPRIATE ADVISORIES TO LOCAL FACILITIES AND USERS TO SPECIFY
PROCEDURAL REVISIONS OR CONTINGENCY PLAN IMPLEMENTATION
- o IDENTIFICATION OF FACTORS ASSOCIATED WITH RECURRENT PROBLEMS AND
CAUSAL FACTORS FOR EXCESS DELAY

TABLE B-2
(CONTINUED)

FUNCTION (2.5): PREPARE TRAFFIC STATISTICS AND SUMMARY REPORTS OF EN ROUTE SYSTEM PERFORMANCE

INPUTS:

FROM EN ROUTE FLOW DATA BASE

- o PROCESSED FLIGHT INFORMATION (E.G., CTA'S, DEPARTURE AND ARRIVAL TIME, ETC.)
- o ADJACENT CENTER TRAFFIC DATA
- o DEMAND AND CAPACITY INFORMATION REPORTED BY TERMINALS

OUTPUTS:

TO NATIONAL FLOW, TERMINALS AND USERS

- o SELECTED SUMMARY REPORTS OF EN ROUTE SYSTEM PERFORMANCE AVAILABLE BY PRIOR AGREEMENT OR BY REQUEST

TABLE B-2
(CONTINUED)

FUNCTION (2.5): PREPARE TRAFFIC STATISTICS AND SUMMARY REPORTS OF EN ROUTE
SYSTEM PERFORMANCE (CONCLUDED)

LOCAL OUTPUTS:

TO EN ROUTE FLOW CONTROLLER

- o TRAFFIC STATISTICS (CURRENT AND PREDICTED), INCLUDING
 - FIX LOADS
 - SECTOR LOADS
 - ARRIVAL COUNTS
 - DEPARTURE COUNTS
 - BOUNDARY CROSSING RATES
- o SYSTEM PERFORMANCE DATA (E.G., ACTUAL VS PREDICTED DELAYS,
AIRPORT CAPACITY UTILIZATION, ETC.)

TABLE B-2
(CONTINUED)

FUNCTION (3.1, 3.2): ANALYZE, PLAN, COORDINATE AND MANAGE EN ROUTE FLOW
CONTROL STRATEGIES AND METERING

INPUTS:

FROM EN ROUTE FLOW DATA BASE

- o TRAFFIC SUMMARY STATISTICS (DEMAND LOADS)
- o AIRCRAFT PERFORMANCE DATA (CHARACTERISTICS BY AIRCRAFT TYPE)
- o COMPUTED FLIGHT SCHEDULES FOR DESIGNATED CONTROL POINTS AND METER FIXES
- o ADJACENT CENTER FACILITY STATUS REPORTS, DEMAND LEVELS, RESTRICTIONS IMPOSED, DELAY CREDITING FOR DESIGNATED FLIGHTS

FROM TERMINALS

- o AIRPORT ACCEPTANCE RATES (E.G., BY RUNWAY AND TOTAL AIRPORT)
- o DESIRED RATE, MIX AND GEOGRAPHIC DISTRIBUTION OF ARRIVAL TRAFFIC
- o CAPACITY AND TRAFFIC RESTRICTIONS
- o DELAY CREDIT FOR GROUND DELAYS IMPOSED ON INDIVIDUAL FLIGHTS
- o DEMAND DATA FOR VFR, TOWER EN ROUTE AND SATELLITE AIRPORTS
- o SELECTED FLIGHT DATA

TABLE B-2
(CONTINUED)

FUNCTION (3.1, 3.2): ANALYZE, PLAN, COORDINATE AND MANAGE EN ROUTE FLOW CONTROL STRATEGIES AND METERING (CONTINUED)

FROM ADJACENT CENTERS

- o APPROPRIATE FLIGHT DATA
- o DELAY CREDITS FOR DESIGNATED FLIGHTS
- o DEMAND LEVELS AND FLOW RATES
- o RESTRICTIONS PLANNED ON IN EFFECT

FROM AIRCRAFT

- o AIRCRAFT PERFORMANCE DATA VIA PILOT REPORTS OR DATA LINK (E.G., CURRENT AND PREDICTED POSITION DATA FOR AIRCRAFT EQUIPPED WITH FLIGHT MANAGEMENT COMPUTERS)
- o WINDS ALOFT INFORMATION VIA PILOT REPORTS OR DATA LINK

OUTPUTS:

TO NATIONAL FLOW

- o IMPLEMENTATION OF APPROVED LOCAL FLOW PROCEDURES
- o ACTUAL TRAFFIC DELAY AND CONGESTION
- o SPECIAL ROUTINGS PLANNED OR IN EFFECT
- o SELECTED FLOW/METERING INFORMATION (E.G., OUTER FIX ADVISORY DATA)

TABLE B-2
(CONTINUED)

FUNCTION (3.1, 3.2): ANALYZE, PLAN, COORDINATE AND MANAGE EN ROUTE FLOW
CONTROL STRATEGIES AND METERING (CONTINUED)

TO KEY TERMINALS (WITHIN OR ADJACENT TO CENTER)

- o CURRENT AND EXPECTED RATES, GEOGRAPHIC DISTRIBUTION AND AIRCRAFT MIX OF ARRIVAL TRAFFIC
- o APPROPRIATE FLIGHT INFORMATION (E.G., METER FIX CTA UPDATES)
- o TENTATIVE SCHEDULES AND DELAY INFORMATION FOR ARRIVAL TRAFFIC

TO ADJACENT CENTERS

- o CURRENT AND PREDICTED TRAFFIC DEMAND AFFECTING ADJACENT CENTER
- o CURRENT AND PREDICTED CAPACITY AND RESTRICTIONS TO PROVIDE FLOW PLANNING FOR ADJACENT CENTER
- o NOTICE OF PLANNED IMPLEMENTATION OF EN ROUTE FLOW STRATEGIES (PLANNED OR AD HOC) WHICH AFFECT TRAFFIC FLOW AT CENTER BOUNDARIES
- o SELECTED FLIGHT INFORMATION (E.G., BOUNDARY CROSSING TIMES)
- o DELAY CREDITS FOR DESIGNATED FLIGHTS

TABLE B-2
(CONTINUED)

FUNCTION (3.1, 3.2): ANALYZE, PLAN, COORDINATE AND MANAGE EN ROUTE FLOW
CONTROL STRATEGIES AND METERING (CONTINUED)

LOCAL OUTPUTS:

TO METER POSITION

- o DELAY ALLOCATION STRATEGY TO EQUITABLY DISTRIBUTE DELAY AMONG ALL
FLIGHTS IN CENTER (WITH DELAY CREDITING, IF NEEDED)
- o INTRACENTER FLIGHT DATA (E.G., REVISED TIMES AND FLOW RATES AT
CONTROL POINTS)
- o COORDINATED PROCEDURES TO ACHIEVE METERING SCHEDULES; EXAMPLES
INCLUDE
 - EN ROUTE HOLDING
 - QUOTA AND FLOW RESTRICTIONS FROM ADJACENT CENTERS AND/OR
TERMINALS
 - TRAFFIC REROUTING
 - RESECTORIZATION
- o EN ROUTE METERING SCHEDULES
- o AIRPORT ACCEPTANCE RATES
- o DESIRED RATES, MIX AND GEOGRAPHIC DISTRIBUTION OF ARRIVAL TRAFFIC
REQUESTED BY TERMINALS

TABLE B-2
(CONTINUED)

FUNCTION (3.1, 3.2): ANALYZE, PLAN, COORDINATE AND MANAGE EN ROUTE FLOW
CONTROL STRATEGIES AND METERING (CONCLUDED)

LOCAL OUTPUTS:

TO EN ROUTE FLOW CONTROLLER

- o INTRACENTER FLIGHT DATA
- o TRAFFIC SUMMARY STATISTICS
- o COORDINATED PROCEDURES TO ACHIEVE METERING SCHEDULES

TABLE B-2
(CONTINUED)

FUNCTION (3.3, 3.4): IMPLEMENT COORDINATED LOCAL FLOW MANAGEMENT
PROCEDURES AND DIRECTIVES ISSUED BY NATIONAL FLOW

INPUTS:

FROM EN ROUTE FLOW MANAGEMENT

- o SELECTED RELIEF STRATEGY AND CONTINGENCY PLAN
- o DETAILED INSTRUCTIONS AND ASSESSED IMPACT FOR EACH FACILITY/USER INVOLVED IN THE FLOW MANAGEMENT PLAN
- o FREQUENT LOCAL UPDATE REPORTS (E.G., REVISED CAPACITIES AND EFFECTS OF RELIEF STRATEGY)

FROM NATIONAL FLOW

- o ADVISORIES AND DIRECTIVES FOR LOCAL AND INTERFACILITY TRAFFIC FLOW MANAGEMENT

FROM TERMINALS

- o ALERTS OF SIGNIFICANT DEVIATIONS FROM FLOW DIRECTIVES
- o PROPOSED INTERFACILITY FLOW MANAGEMENT STRATEGIES (FOR SEVERE PROBLEMS)
- o ADVISORIES OF CURRENT OR PLANNED LOCAL FLOW PROCEDURES AND RESTRICTIONS IN TERMINAL AIRSPACE OR SURFACE TRAFFIC FLOW PROCEDURES

TABLE B-2
(CONTINUED)

FUNCTION (3.3, 3.4): IMPLEMENT COORDINATED LOCAL FLOW MANAGEMENT PROCEDURES AND DIRECTIVES ISSUED BY NATIONAL FLOW (CONTINUED)

OUTPUTS:

TO NATIONAL FLOW

- o PROPOSED INTERFACILITY FLOW MANAGEMENT PLANS (LONG TERM OR IMMEDIATE)
- o IMPLEMENTATION OF APPROVED LOCAL FLOW MANAGEMENT PROCEDURES
- o COORDINATION OF AD HOC LOCAL FLOW MANAGEMENT PROCEDURES FOR UNANTICIPATED PROBLEMS
- o ALERTS OF SIGNIFICANT DEVIATIONS FROM FLOW DIRECTIVES

TO AFFECTED TERMINALS

- o ADVISORIES TO IMPLEMENT APPROVED (PLANNED OR AD HOC) RELIEF STRATEGY
 - DETAILED INSTRUCTIONS FOR RELIEF STRATEGY
 - CONTINGENCY PLAN
 - EXPECTED IMPACT AND DURATION
 - SPECIFY COMPLIANCE WITH DIRECTIVES ISSUED BY NATIONAL FLOW

TABLE B-2
(CONTINUED)

FUNCTION (3.3, 3.4): IMPLEMENT COORDINATED LOCAL FLOW MANAGEMENT
PROCEDURES AND DIRECTIVES ISSUED BY NATIONAL FLOW
(CONCLUDED)

OUTPUTS:

TO AFFECTED TERMINALS (CONCLUDED)

- o ADVISORIES TO MODIFY PROCEDURES IN EFFECT (OR TO IMPLEMENT
CONTINGENCY PLAN) IN RESPONSE TO REAL-TIME LOCAL INPUTS AND
SYSTEM PERFORMANCE MONITORING, IF NECESSARY
- o ALERTS OF SIGNIFICANT DEVIATIONS FROM FLOW DIRECTIVES

TABLE B-2
(CONTINUED)

FUNCTION (4.1): PARTICIPATE IN NATIONAL FLOW DAILY SURVEY OF DOMESTIC AND INTERNATIONAL OPERATIONS

INPUTS:

FROM EN ROUTE FLOW DATA BASE

- o SELECTED NAS INFORMATION
- o LOCAL FACILITY STATUS REPORTS (E.G., EQUIPMENT, STAFFING, ETC.)
- o BULK STORED FLIGHT PLAN DATA (MAINTAINED BY CENTERS)
- o FLIGHT DATA UPDATES AND CANCELLATIONS FROM ARINC/AIRLINES FORWARDED BY NATIONAL FLOW
- o LOCAL WEATHER
- o EN ROUTE AND TERMINAL CAPACITY, DEMAND AND DELAY DATA

TABLE B-2
(CONTINUED)

FUNCTION (4.1): PARTICIPATE IN NATIONAL FLOW DAILY SURVEY OF DOMESTIC AND
INTERNATIONAL OPERATIONS (CONCLUDED)

OUTPUTS:

TO NATIONAL FLOW

- o CURRENT AND FORECAST LOCAL WEATHER
- o SELECTED NAS INFORMATION (FOR FLIGHTS SCHEDULED TO ENTER KEY TERMINALS OR DESIGNATED EN ROUTE AIRSPACE), INCLUDING
 - CANCELLATIONS
 - FLIGHT PLAN AMENDMENTS
 - DEPARTURE MESSAGES
 - PROGRESS REPORTS
 - ARRIVAL MESSAGES
- o BULK STORED AIR CARRIER FLIGHT PLANS
- o SPECIAL ROUTINGS PLANNED OR IN EFFECT
- o PERIODIC STATUS REPORTS (AND UPDATES, AS NEEDED)
- o CURRENT AND PREDICTED ESTIMATES OF NON-AIR CARRIER TRAFFIC IN CENTER (VFR, TOWER EN ROUTE, ETC.)
- o CURRENT AND PREDICTED ESTIMATES OF CAPACITY, DEMAND, DELAY AND CAPACITY RESTRICTIONS

TABLE B-2
(CONTINUED)

FUNCTION (4.2): PROVIDE SUMMARY DATA RELATED TO POST ANALYSIS OF PROBLEM SITUATIONS AND SYSTEM PERFORMANCE TO APPROPRIATE FACILITIES

INPUTS:

FROM EN ROUTE FLOW ANALYSIS

- o ACTUAL AND DELAY AND CONGESTION INCURRED PRIOR TO AND AFTER IMPLEMENTATION OF FLOW PROCEDURES
- o PREDICTED DELAYS AND RELATED TRAFFIC FLOW PROBLEMS
- o SYSTEM PERFORMANCE DATA
- o INFORMATION CONCERNING CAUSAL FACTORS FOR EXCESS DELAY
- o IDENTIFICATION OF ALL FACILITIES/USERS AFFECTED BY EXCESS DELAY
- o IDENTIFICATION OF RECURRENT PROBLEMS
- o ASSESSMENT OF LOCAL RELIEF STRATEGIES AND NATIONALLY ISSUED LOCAL FLOW DIRECTIVES
- o TRAFFIC SUMMARY STATISTICS (E.G., SECTOR AND FIX LOADS, TERMINAL DEPARTURE AND ARRIVAL COUNTS, BOUNDARY CROSSING TRAFFIC LOADS)

TABLE B-2
(CONTINUED)

FUNCTION (4.2): PROVIDE SUMMARY DATA RELATED TO POST ANALYSIS OF PROBLEM SITUATIONS AND SYSTEM PERFORMANCE TO APPROPRIATE FACILITIES (CONCLUDED)

OUTPUTS:

TO NATIONAL FLOW (AND OTHER APPROPRIATE FACILITIES OR USERS)

- o INFORMATION CONCERNING CAUSAL FACTORS FOR EXCESS DELAY
- o ACTUAL TRAFFIC DELAY, CONGESTION, AND OTHER SYSTEM PERFORMANCE DATA
- o LOCAL POST ANALYSIS OF PROBLEMS AND ASSESSED IMPACT OF NATIONAL FLOW DIRECTIVES (E.G., ACTUAL DELAYS INCURRED PRIOR TO AND AFTER IMPLEMENTATION OF PROCEDURES)
- o IDENTIFICATION OF LOCAL AND INTERFACILITY PROCEDURAL CHANGES TO ELIMINATE OR REDUCE THE IMPACT OF RECURRENT PROBLEMS (E.G., MODIFICATIONS TO LETTERS OF AGREEMENT)
- o TRAFFIC SUMMARY STATISTICS (E.G., SECTOR AND FIX LOADS, TERMINAL DEPARTURE AND ARRIVAL COUNTS)

TO TERMINALS

- o IDENTIFICATION OF FACTORS ASSOCIATED WITH RECURRENT TYPES OF PROBLEMS AND CAUSAL FACTORS FOR EXCESS DELAY
- o IDENTIFICATION OF LOCAL AND INTERFACILITY ATC PROCEDURAL CHANGES TO ELIMINATE OR REDUCE THE IMPACT OF RECURRENT PROBLEMS

TABLE B-2
(CONTINUED)

FUNCTION (4.3): ADVISE NATIONAL FLOW AND OTHER APPROPRIATE FACILITIES OR
USERS OF PLANNED LOCAL FLOW MANAGEMENT STRATEGIES

INPUTS:

FROM EN ROUTE FLOW ANALYSIS

- o LOCAL RELIEF STRATEGIES AND ASSESSED IMPACT
- o INTERFACILITY PROCEDURES PLANNED OR IN EFFECT

OUTPUTS:

TO NATIONAL FLOW

- o PROPOSED INTERFACILITY FLOW MANAGEMENT PLANS (AD HOC OR LONG TERM)
- o IMPLEMENTATION OF APPROVED LOCAL FLOW MANAGEMENT PROCEDURES
- o COORDINATION OF AD HOC LOCAL FLOW MANAGEMENT PROCEDURES FOR UNANTICIPATED PROBLEMS

TABLE B-2
(CONCLUDED)

FUNCTION (4.3): ADVISE NATIONAL FLOW AND OTHER APPROPRIATE FACILITIES OR
USERS OF PLANNED LOCAL FLOW MANAGEMENT STRATEGIES
(CONCLUDED)

OUTPUTS:

TO TERMINALS (OR OTHER AFFECTED FACILITIES/USERS)

o ADVISORIES TO IMPLEMENT APPROVED (PLANNED OR AD HOC) RELIEF
STRATEGIES

o ADVISORIES TO MODIFY FLOW PROCEDURES IN EFFECT

TO ADJACENT CENTERS

o NOTICE OF PLANNED IMPLEMENTATION OF EN ROUTE FLOW STRATEGIES
WHICH AFFECT TRAFFIC FLOW AT CENTER BOUNDARIES

TABLE B-3
TERMINAL FLOW MANAGEMENT
INPUTS AND OUTPUTS BY FUNCTION

FUNCTION (1.0)*: ASSEMBLE AND MAINTAIN TERMINAL FLOW MANAGEMENT DATA BASE

INPUTS:

FROM TERMINAL AND SATELLITE AIRPORTS

- o CURRENT AND PREDICTED TRAFFIC DATA
 - VFR, TOWER EN ROUTE AND SATELLITE AIRPORT OPERATIONS
 - DEPARTURE COUNTS
 - ARRIVAL COUNTS
 - TRAFFIC COUNTS FOR DESIGNATED POINTS
- o CURRENT AND PREDICTED STATUS
 - EQUIPMENT
 - STAFFING

*NUMBER REPRESENTS A CROSS-REFERENCE TO THE CORRESPONDING FUNCTION LISTED IN
TABLE A-3 OF APPENDIX A.

TABLE B-3
(CONTINUED)

FUNCTION (1.0): ASSEMBLE AND MAINTAIN TERMINAL FLOW MANAGEMENT DATA BASE
(CONTINUED)

INPUTS:

FROM TERMINAL AND SATELLITE AIRPORTS (CONCLUDED)

- o CURRENT AND PREDICTED CAPACITIES
 - TERMINAL AIRSPACE
 - HOLDING PATTERNS
 - AIRPORT SURFACE
 - RESTRICTIONS (TERMINAL AIRSPACE OR SURFACE TRAFFIC)
- o LOCAL WEATHER INFORMATION
- o CURRENT AND PREDICTED CONFIGURATIONS
 - TERMINAL AIRSPACE
 - AIRPORT RUNWAYS
- o FLIGHT PLAN DATA AND UPDATES

FROM HOST CENTER

- o CURRENT AND PREDICTED RATES, GEOGRAPHIC DISTRIBUTION AND AIRCRAFT MIX OF ARRIVAL TRAFFIC
- o SELECTED FLIGHT INFORMATION (VIA ARTS/NAS INTERFACE)

TABLE B-3
(CONTINUED)

FUNCTION (1.0): ASSEMBLE AND MAINTAIN TERMINAL FLOW MANAGEMENT DATA BASE
(CONTINUED)

INPUTS:

FROM AIRCRAFT

- o WINDS ALOFT
- o FLIGHT PLAN INFORMATION
- o AIRCRAFT PERFORMANCE DATA

FROM FSS

- o VFR FLIGHT DATA
- o LOCAL WEATHER

FROM NWS

- o CURRENT AND PREDICTED LOCAL WEATHER

TABLE B-3
(CONTINUED)

FUNCTION (1.0): ASSEMBLE AND MAINTAIN TERMINAL FLOW MANAGEMENT DATA BASE
(CONCLUDED)

OUTPUTS:

TO TERMINAL FLOW MANAGEMENT

- o TERMINAL TRAFFIC SUMMARY REPORTS
 - DEPARTURE AND ARRIVAL DEMANDS
 - TRAFFIC COUNTS FOR SELECTED POINTS
- o CURRENT AND PREDICTED TERMINAL CONFIGURATION AND CAPACITY SUMMARIES

TO EN ROUTE FLOW MANAGEMENT

- o SELECTED FLIGHT INFORMATION FORWARDED TO EN ROUTE FLOW (PARAMETER LEAD TIME)

TABLE B-3
(CONTINUED)

FUNCTION (2.1): IDENTIFY SITUATIONS AND CAUSAL FACTORS FOR PREDICTED
EXCESS DELAY

INPUTS:

FROM TERMINAL FLOW MANAGEMENT DATA BASE

- LANDING RATES
- DEPARTURE RATES
- HOLDING PATTERN CAPACITIES
- AIRSPACE SATURATION
- SURFACE LOADS
- AVAILABLE CAPACITIES (FOR PRIMARY AND SATELLITE AIRPORTS)
- WEATHER
- EQUIPMENT AVAILABILITY
- SURFACE CONDITIONS
- STAFFING

TABLE B-3
(CONTINUED)

FUNCTION (2.1): IDENTIFY SITUATIONS AND CAUSAL FACTORS FOR PREDICTED
EXCESS DELAY (CONCLUDED)

OUTPUTS:

TO TERMINAL FLOW MANAGEMENT

- o IDENTIFICATION OF ALL FACILITIES/USERS AFFECTED
 - MAGNITUDE OF PROBLEM
 - EXPECTED DURATION OF PROBLEM
- o ASSESSMENT OF NEED TO OBTAIN EN ROUTE AND/OR NATIONAL FLOW
MANAGEMENT ASSISTANCE

TO EN ROUTE AND (IF APPROPRIATE) TO NATIONAL FLOW MANAGEMENT

- o NOTIFICATION AND PREDICTION OF SIGNIFICANT DELAYS
- o ASSESSED IMPACT OF LOCAL RELIEF STRATEGIES AND FLOW DIRECTIVES
(E.G., DELAYS INCURRED PRIOR TO AND AFTER IMPLEMENTATION OF
PROCEDURES)
- o INFORMATION CONCERNING CAUSAL FACTORS FOR EXCESS DELAY

TABLE B-3
(CONTINUED)

FUNCTION (2.2): DEVELOP RELIEF STRATEGY FOR ANTICIPATED AND UNANTICIPATED
PROBLEM SITUATIONS

INPUTS:

FROM EN ROUTE AND NATIONAL FLOW MANAGEMENT

- o FLOW DIRECTIVES ISSUED BY HOST CENTER AND/OR NATIONAL FLOW

FROM TERMINAL FLOW MANAGEMENT

- o PROBLEM CHARACTERISTICS
- o ALTERNATIVE LOCAL RELIEF STRATEGIES COMPLIANT WITH FLOW DIRECTIVES

OUTPUTS:

TO TERMINAL FLOW MANAGEMENT

- o ASSESSMENT OF ALTERNATIVE STRATEGIES
- o SELECTION OF BEST RELIEF STRATEGY AND CONTINGENCY PLAN

TABLE B-3
(CONTINUED)

FUNCTION (2.2): DEVELOP RELIEF STRATEGY FOR ANTICIPATED AND UNANTICIPATED
PROBLEM SITUATIONS (CONCLUDED)

OUTPUTS:

TO EN ROUTE AND (IF APPROPRIATE) NATIONAL FLOW MANAGEMENT

- o ADVISORIES OF CURRENT OR PLANNED LOCAL FLOW PROCEDURES
- o PROPOSED FLOW STRATEGIES (TO OBTAIN APPROPRIATE APPROVAL OR COORDINATION)

TO AFFECTED USERS

- o ADVISORIES OF FLOW STRATEGIES TO BE IMPLEMENTED

TABLE B-3
(CONTINUED)

FUNCTION (2.3): CONDUCT POST ANALYSIS OF PROBLEM SITUATIONS

INPUTS:

FROM TERMINAL FLOW MANAGEMENT

- o TRAFFIC STATISTICS PRIOR TO AND FOLLOWING IMPLEMENTATION OF LOCAL RELIEF STRATEGIES
- o TRAFFIC STATISTICS RELATED TO USE OF NATIONALLY ISSUED FLOW DIRECTIVES

OUTPUTS:

TO EN ROUTE AND (IF APPROPRIATE) NATIONAL FLOW MANAGEMENT

- o ACTUAL DELAYS OBSERVED PRIOR TO AND AFTER IMPLEMENTATION OF FLOW MANAGEMENT PROCEDURES
- o IDENTIFICATION OF LOCAL AND INTERFACILITY ATC PROCEDURAL CHANGES TO ELIMINATE OR REDUCE THE IMPACT OF RECURRENT PROBLEMS
- o ASSESSED IMPACT OF PROBLEM RELIEF STRATEGIES

TABLE B-3
(CONTINUED)

FUNCTION (3.1): CONDUCT AIRPORT AND AIRSPACE CONFIGURATION PLANNING,
CAPACITY PREDICTIONS AND ANALYSIS OF TERMINAL OPERATIONS

INPUTS:

FROM TERMINAL FLOW DATA BASE

- o WIND, WEATHER, VISIBILITY
- o NOISE RESTRICTIONS
- o TERMINAL PLANNING INFORMATION (CURRENT AND PREDICTED), INCLUDING:
 - FACILITY STAFFING AND EQUIPMENT AVAILABILITY
 - AIRPORT RESTRICTIONS (RUNWAY CLOSURES, ETC.)
 - DEMAND DISTRIBUTION OVER FIXES
 - TRAFFIC AND CAPACITY DATA MAINTAINED BY TERMINAL FOR CURRENT AND FUTURE TERMINAL OPERATIONS

OUTPUTS:

TO TERMINAL FLOW MANAGEMENT

- o CURRENT AND PROJECTED CAPACITIES
- o CURRENT AND FUTURE CONFIGURATION FOR AIRSPACE, RUNWAYS, AND AIRPORT SURFACE

TABLE B-3
(CONTINUED)

FUNCTION (3.1): CONDUCT AIRPORT AND AIRSPACE CONFIGURATION PLANNING,
CAPACITY PREDICTIONS AND ANALYSIS OF TERMINAL OPERATIONS
(CONCLUDED)

OUTPUTS:

TO TERMINAL FLOW MANAGEMENT (CONCLUDED)

o TRAFFIC COUNTS OVER DESIGNATED FIXES, DEPARTURES AND ARRIVALS
OVER FIXED TIME INCREMENTS; DEMAND DISTRIBUTIONS, HOLDING
PATTERNS CAPACITIES

TO NATIONAL AND EN ROUTE FLOW MANAGEMENT

o TERMINAL FLOW PLANNING DATA (CURRENT AND PREDICTED), INCLUDING:
- CAPACITIES
- CONFIGURATIONS
- TRAFFIC COUNTS
- DEMAND DISTRIBUTION
- ESTIMATES OF OTHER TERMINAL AREA OPERATIONS (TOWER EN ROUTE,
VFR AND SATELLITE OPERATIONS)
- ACCEPTABLE FLOW RATES

TABLE B-3
(CONTINUED)

FUNCTION (3.2): MANAGE TERMINAL SEQUENCING, SCHEDULING AND SPACING OF
ARRIVAL TRAFFIC

INPUTS:

FROM HOST CENTER

- CURRENT AND EXPECTED RATES, GEOGRAPHIC DISTRIBUTION AND AIRCRAFT MIX OF ARRIVAL TRAFFIC
- FLOW PROCEDURES PLANNED OR IN EFFECT
- APPROPRIATE FLIGHT DATA PROVIDED AT PARAMETER LEAD TIMES

FROM SATELLITE AIRPORTS

- TOWER EN ROUTE TRAFFIC ESTIMATES
- CURRENT AND PREDICTED DEPARTURES
- CURRENT AND PREDICTED ARRIVALS

FROM TERMINAL FLOW DATA BASE

- FLIGHT PLANS AND UPDATES
- TRACKING DATA
- FACILITY STATUS
- WINDS ALOFT AND SURFACE WEATHER
- ARRIVAL FLOW CONFIGURATION

TABLE B-3
(CONTINUED)

FUNCTION (3.2): MANAGE TERMINAL SEQUENCING, SCHEDULING AND SPACING OF
ARRIVAL TRAFFIC (CONTINUED)

INPUTS:

FROM AIRCRAFT

- o WINDS ALOFT
- o PERFORMANCE DATA

OUTPUTS:

TO TERMINAL FLOW MANAGEMENT AND CONTROL FUNCTIONS

- o FLIGHT SEQUENCES, FIX TIMES, EXPECTED LANDING TIMES
- o COMPUTED METERING AND SPACING SCHEDULES
- o REQUIRED DELAYS OR SCHEDULE MODIFICATIONS (ON AN INDIVIDUAL FLIGHT BASIS)
- o CURRENT TERMINAL AIRSPACE AND RUNWAY CAPACITY (HOLDING LEVELS, VECTORING SPACE, ETC.)
- o AIRPORT ACCEPTANCE RATE ADJUSTMENTS NEEDED

TABLE B-3
(CONTINUED)

FUNCTION (3.2): MANAGE TERMINAL SEQUENCING, SCHEDULING AND SPACING OF
ARRIVAL TRAFFIC (CONCLUDED)

OUTPUTS:

TO HOST CENTER (EN ROUTE FLOW MANAGEMENT)

- o REVISED AIRPORT ACCEPTANCE RATES, AS NEEDED
- o REQUESTS FOR GEOGRAPHIC, TIME AND MIX REDISTRIBUTION OF ARRIVAL TRAFFIC (BASED ON RUNWAY CAPACITY AND CONFIGURATION)
- o ADVISORIES OF LOCAL PROCEDURES AND RESTRICTIONS (CURRENT AND PLANNED)
- o AIRSPACE AND RUNWAY CONFIGURATIONS (IN USE AND PLANNED)

TABLE B-3
(CONTINUED)

FUNCTION (3.3): PLAN AND COORDINATE WITH HOST CENTER AND APPROPRIATE FACILITIES ON LOCAL FLOW MANAGEMENT STRATEGIES

INPUTS:

FROM TERMINAL FLOW DATA BASE

- o TERMINAL AIRSPACE, AIRPORT SURFACE AND SATELLITE AIRPORT TRAFFIC ACTIVITY AND CAPACITIES (CURRENT AND PREDICTED)
- o TERMINAL FACILITY STATUS (EQUIPMENT AVAILABILITY, STAFFING, ETC.)
- o CURRENT AND PLANNED LOCAL FLOW PROCEDURES

FROM EN ROUTE FLOW MANAGEMENT

- o HOST CENTER FLOW RATES AND ARRIVAL TRAFFIC DISTRIBUTION BY TIME AND AIRCRAFT TYPE INTO TERMINAL AIRSPACE
- o EN ROUTE FLOW PROCEDURES AND RESTRICTIONS

OUTPUTS:

TO TERMINAL FLOW MANAGEMENT

- o ASSESSED IMPACT OF CURRENT FLOW PROCEDURES
- o IDENTIFICATION OF POTENTIAL OR EXISTING DELAY AND CONGESTION
- o NOTIFICATION OF NEED TO MODIFY AIRPORT ACCEPTANCE RATE

TABLE B-3
(CONTINUED)

FUNCTION (3.3): PLAN AND COORDINATE WITH HOST CENTER AND APPROPRIATE FACILITIES ON LOCAL FLOW MANAGEMENT STRATEGIES (CONCLUDED)

OUTPUTS:

TO HOST CENTER (EN ROUTE FLOW MANAGEMENT)

- o ADVISORIES OF CURRENT OR PLANNED LOCAL FLOW PROCEDURES OR RESTRICTIONS
- o REVISED AIRPORT ACCEPTANCE RATES
- o REQUEST FOR RATE, GEOGRAPHY OR MIX REDISTRIBUTION OF ARRIVAL TRAFFIC
- o RECOMMENDED CHANGES IN ATC PROCEDURES TO REDUCE CONGESTION, DELAY AND RECURRENT PROBLEMS
- o RUNWAY AND AIRSPACE CONFIGURATIONS
- o ALERTS OF SIGNIFICANT DEVIATIONS FROM FLOW PROCEDURES
- o PROPOSED INTRAFACILITY FLOW MANAGEMENT STRATEGIES (FOR SEVERE PROBLEMS)

TO NATIONAL FLOW MANAGEMENT

- o ADVISORIES OF CURRENT OR PLANNED LOCAL FLOW PROCEDURES OR RESTRICTIONS
- o PROPOSED INTERFACILITY PROCEDURES FOR SEVERE PROBLEMS AFFECTING MULTIPLE FACILITIES

TABLE B-3
(CONTINUED)

FUNCTION (3.4): MANAGE DEPARTURE TRAFFIC FLOW

INPUTS:

FROM TERMINAL FLOW DATA BASE

- o CURRENT AND PREDICTED RUNWAY AND SURFACE CONFIGURATIONS AND CAPACITIES
- o CURRENT AND PREDICTED TRAFFIC DATA
 - DEMAND
 - DELAYS
 - AIRLINE RESERVATIONS (IF APPLICABLE)
 - AIRSPACE CAPACITY

FROM EN ROUTE AND NATIONAL FLOW MANAGEMENT

- o CENTER AND NATIONAL FLOW DIRECTIVES (IF APPLICABLE)
 - GROUND DELAYS
 - NOISE ABATEMENT PROCEDURES

TABLE B-3
(CONTINUED)

FUNCTION (3.4): MANAGE DEPARTURE TRAFFIC FLOW (CONCLUDED)

OUTPUTS:

TO TERMINAL FLOW MANAGEMENT

- o DEPARTURE SCHEDULES TO PRESERVE EQUITABLE DELAY DISTRIBUTION
- o IDENTIFICATION OF POTENTIAL DEPARTURE DELAYS
- o ALERTS TO IDENTIFY VIOLATIONS OF FLOW DIRECTIVES

TO TERMINAL CONTROL FUNCTION (INCLUDING SATELLITE AIRPORT OPERATIONS)

- o ADVISORIES OF RECOMMENDED ATC PROCEDURES TO FACILITATE LOCAL DEPARTURE TRAFFIC FLOW

TO HOST CENTER AND (IF APPROPRIATE) NATIONAL FLOW MANAGEMENT

- o NOTIFICATION OF LARGE DEPARTURE DELAYS
- o ADVISORIES INDICATING EFFECTS OF FLOW DIRECTIVES ON DEPARTURE FLOW
- o DEPARTURE TRAFFIC SCHEDULING INFORMATION

TABLE B-3
(CONTINUED)

FUNCTION (3.5): MANAGE TERMINAL SURFACE TRAFFIC FLOW

INPUTS:

FROM TERMINAL FLOW DATA BASE

- o CURRENT AND PREDICTED AIRPORT TRAFFIC ACTIVITY
 - GATE SCHEDULES/AVAILABLE CAPACITY
 - RESTRICTIONS (E.G., TAXIWAY OR RUNWAY CLOSURES)
 - DEPARTURE AND ARRIVAL OPERATIONS
 - RUNWAY CONFIGURATIONS
- o WEATHER CONDITIONS/RESTRICTIONS
 - VISIBILITY
 - WIND
 - SURFACE ICE, SNOW, ETC.

TABLE B-3
(CONTINUED)

FUNCTION (3.5): MANAGE TERMINAL SURFACE TRAFFIC FLOW (CONCLUDED)

OUTPUTS:

TO TERMINAL FLOW MANAGEMENT

- o IDENTIFICATION OF IMMINENT OR POTENTIAL PROBLEMS (CAPACITY LEVELS EXCEEDED, NEED TO CHANGE RUNWAY CONFIGURATION, ETC.)
- o PREDICTED MOVEMENT OF SURFACE TRAFFIC
- o RESOLUTION OF CONFLICTS DUE TO SCHEDULING

TO EN ROUTE AND NATIONAL FLOW (IF APPROPRIATE)

- o NOTIFICATION OF EXCESS DEMAND
- o ADVISORIES OF CURRENT OR PLANNED RESTRICTIONS

TABLE B-3
(CONTINUED)

FUNCTION (4.1): PARTICIPATE IN NATIONAL FLOW DAILY SURVEY OF DOMESTIC AND INTERNATIONAL OPERATIONS

INPUTS:

FROM TERMINAL FLOW DATA BASE

- o TERMINAL TRAFFIC INFORMATION AND UPDATES
- INCLUDING TRAFFIC DEMAND FOR VFR, TOWER EN ROUTE AND SATELLITE AIRPORTS
- o FACILITY STATUS REPORTS
- o LOCAL WEATHER (PIREPS)

OUTPUTS:

TO EN ROUTE AND NATIONAL FLOW MANAGEMENT

- o TRAFFIC INFORMATION AND UPDATES
- o CURRENT AND PREDICTED FACILITY STATUS
- EQUIPMENT AVAILABILITY
- STAFFING
- RUNWAYS IN USE

TABLE B-3
(CONCLUDED)

FUNCTION (4.1): PARTICIPATE IN NATIONAL FLOW DAILY SURVEY OF DOMESTIC AND
INTERNATIONAL OPERATIONS (CONCLUDED)

OUTPUTS:

TO EN ROUTE AND NATIONAL FLOW MANAGEMENT

- o CURRENT AND PREDICTED LOCAL WEATHER CONDITIONS
 - WIND
 - VISIBILITY
 - SURFACE CONDITIONS
- o CURRENT AND PREDICTED CAPACITIES

APPENDIX C

FLOW MANAGEMENT INPUTS AND OUTPUTS LISTED BY FACILITY

This appendix is divided into three sections which represent inputs, external outputs and local (i.e., internal to the referenced facility) outputs. Within each section, the input or output data, estimated frequency and look-ahead times are listed by facility for National, En Route and Terminal Flow Management.

INTEGRATED FLOW MANAGEMENT

INPUTS

NATIONAL FLOW MANAGEMENT

INPUTS

1. From Centers and Key Terminals

1.1 INPUT: Facility Status Reports (Current and Predicted)
(Equipment Availability, Staffing, etc.)

FREQUENCY: Daily, and Updated As Needed

LOOK AHEAD TIME:* 24 Hours

1.2 INPUT: Special Routings Planned or in Effect (From
Centers)

FREQUENCY: Daily, and Updated As Needed

LOOK AHEAD TIME: 24 Hours

1.3 INPUT: Local Current and Forecast Weather Reports

FREQUENCY: Daily, and Updated As Needed

LOOK AHEAD TIME: 24 Hours

1.4 INPUT: Center and Key Terminal Capacity Estimates
(Current and Predicted)

FREQUENCY: Daily, and Updated As Needed

LOOK AHEAD TIME: 24 Hours

1.5 INPUT: Center and Key Terminal Capacity Restrictions
(Current and Predicted)

FREQUENCY: Daily, and Updated As Needed

LOOK AHEAD TIME: 24 Hours

* Look Ahead Time represents a maximum time unless indicated
otherwise.

NATIONAL FLOW MANAGEMENT

INPUTS

From Centers and Key Terminals (Continued)

- 1.6 INPUT: Bulk Stored Air Carrier Flight Plans (From Centers Only)
- FREQUENCY: Daily, and Updated As Needed
- LOOK AHEAD TIME: 24 Hours
- 1.7 INPUT: Selected NAS Flight Information
- FREQUENCY: Daily and Updated as Needed
- LOOK AHEAD TIME: 24 Hours (Current and Parameter Lead Times)
- 1.8 INPUT: Current and Predicted Estimates of Non-Air Carrier Traffic in Center and Key Terminals (e.g., VFR, Tower En Route and Satellite Operations)
- FREQUENCY: Daily, and Updated As Needed
- LOOK AHEAD TIME: 24 Hours
- 1.9 INPUT: Information Concerning Causal Factors for Excess Delay
- FREQUENCY: Upon Problem Resolution
- LOOK AHEAD TIME: After the Fact
- 1.10 INPUT: Actual Traffic Delay, Congestion, and Other System Performance Data
- FREQUENCY: As Delays Occur and Upon Problem Resolution
- LOOK AHEAD TIME: As Needed; After the Fact

NATIONAL FLOW MANAGEMENT

INPUTS

From Centers and Key Terminals (Continued)

- 1.11 INPUT: Proposed Interfacility Flow Management Plans
(Submitted Jointly or by Independent Facilities)

FREQUENCY: As Problems Are Detected/Predicted

LOOK AHEAD TIME: Long Term or Immediate (24 Hours)

- 1.12 INPUT: Implementation by Local Authorities of Approved
Local Flow Management Procedures

FREQUENCY: As Needed

LOOK AHEAD TIME: 24 Hours

- 1.13 INPUT: Coordination of Ad Hoc Local Flow Management
Procedures for Unanticipated Problems

FREQUENCY: As Problems Arise

LOOK AHEAD TIME: 24 Hours

- 1.14 INPUT: Local Post Analysis of Problems and Assessed
Impact of National Flow Directives (e.g., Actual
Delays Incurred Prior to and After Implementation
of Procedures)

FREQUENCY: Upon Implementation of Flow Procedures

LOOK AHEAD TIME: After the Fact

NATIONAL FLOW MANAGEMENT

INPUTS

From Centers and Key Terminals (Concluded)

1.15 INPUT: Identification of Local and Interfacility ATC Procedural Changes to Eliminate or Reduce the Impact of Recurrent Problems (e.g., Modifications to Letters of Agreement)

FREQUENCY: As Needed

LOOK AHEAD TIME: Long Term

1.16 INPUT: Alerts of Significant Deviations from Flow Directives

FREQUENCY: As Needed

LOOK AHEAD TIME: Current

1.17 INPUT: Notification of Significant Departure Delays (Current and Predicted) for Key Terminals

FREQUENCY: As Problems Are Detected/Predicted

LOOK AHEAD TIME: 2 Hours

NATIONAL FLOW MANAGEMENT

INPUTS

2. From OAG

2.1 INPUT: Domestic and International Air Carrier Schedules

FREQUENCY: Daily

LOOK AHEAD TIME: 24 Hours

2.2 INPUT: Updates and Revisions to OAG Schedules

FREQUENCY: As Available*

LOOK AHEAD TIME: Hours

3. From NWS

3.1 INPUT: Current and Predicted National Weather Conditions

FREQUENCY: Daily and as Updates Are Received

LOOK AHEAD TIME: 24 Hours

3.2. INPUT: Reports of Severe Weather Conditions

FREQUENCY: Immediate Transmittal of Severe Weather
Conditions As Reported

LOOK AHEAD TIME: 24 Hours

4. From ARINC/Airlines

4.1 INPUT: Flight Plan Data (Updates to OAG Schedules and
Bulk Stored Flight Plans)

FREQUENCY: As Received

LOOK AHEAD TIME: 24 Hours

* As Available implies immediate transmittal of information

NATIONAL FLOW MANAGEMENT

INPUTS

4. From ARINC/Airlines (Concluded)

4.2 INPUT: Flight Plan Cancellations

FREQUENCY: As Received

LOOK AHEAD TIME: 24 Hours

5. From AFTN

5.1 INPUT: Flight Plan Messages for International Flights

FREQUENCY: Upon Receipt of Data

LOOK AHEAD TIME: Filed Lead Time

5.2 INPUT: Flight Plan Modifications or Cancellations

FREQUENCY: Upon Receipt of Data

LOOK AHEAD TIME: Filed Lead Time

6. From FSS

6.1 INPUT: Weather Reports

FREQUENCY: As Updates Are Received

LOOK AHEAD TIME: 24 Hours

6.2 INPUT: Reported Problems

FREQUENCY: As Updates Are Received

LOOK AHEAD TIME: 24 Hours

6.3 INPUT: VFR Flight Data

FREQUENCY: As Requested

LOOK AHEAD TIME: As Available

EN ROUTE FLOW MANAGEMENT

INPUTS

1. From National Flow

1.1. INPUT: Current and Predicted Traffic Counts, Demand,
Delay and Capacity Estimates (and Other Traffic
Summary Reports)

FREQUENCY: Upon Request

LOOK AHEAD TIME: 24 Hours

1.2 INPUT: Flight Data Updates and Cancellations Reported by
ARINC/Airlines

FREQUENCY: As Available

LOOK AHEAD TIME: 24 Hours

1.3 INPUT: Advisories of Severe Weather Conditions and (If
Appropriate) Avoidance Procedures

FREQUENCY: As Needed

LOOK AHEAD TIME: 24 Hours

1.4 INPUT: National Weather Information (Current and
Forecast)

FREQUENCY: Upon Request, Updated Daily

LOOK AHEAD TIME: 24 Hours

EN ROUTE FLOW MANAGEMENT

INPUTS

From National Flow (Continued)

1.5 INPUT: Flow Management Procedures

- Coordinated Letters of Agreement
Between Affected En Route Facilities
- National Flow Orders Concerning Local
Flow Procedures
- Alternative Procedures for Local Flow
Problems

FREQUENCY: As Needed

LOOK AHEAD TIME: Long Term

1.6 INPUT: National Flow Management Advisories

- National Flow Directives
- Notification of Flow Restrictions/
Procedures and Time of Implementation

FREQUENCY: As Needed

LOOK AHEAD TIME: 24 Hours

1.7 INPUT: Approval or Disapproval of Proposed Interfacility
Flow Procedures

FREQUENCY: Upon Receipt of Proposed Plans

LOOK AHEAD TIME: Long Term (e.g., Modifications to Letters
of Agreement) or 3 Hours (e.g., Ad Hoc
Agreements)

EN ROUTE FLOW MANAGEMENT

INPUTS

From National Flow (Concluded)

- 1.8 INPUT: Removal of Flow Restrictions Imposed by National Flow
- FREQUENCY: Upon Problem Resolution
- LOOK AHEAD TIME: As Determined (e.g., Function of Problem)
- 1.9 INPUT: Periodic Analysis of Problems, Relief Strategies and System Performance
- FREQUENCY: As Needed
- LOOK AHEAD TIME: After the Fact
- 1.10 INPUT: System Performance Data
- FREQUENCY: Available Upon Request
- LOOK AHEAD TIME: Current
- 1.11 INPUT: Identification of National and Interfacility Changes to Eliminate or Reduce the Impact of Recurrent Problems
- FREQUENCY: As Needed
- LOOK AHEAD TIME: Long Term
- 1.12 INPUT: Alternative Procedures for Interfacility Flow Management in Response to Requests by Local Flow for National Approval of Proposed Plans
- FREQUENCY: As Needed
- LOOK AHEAD TIME: Long Term

EN ROUTE FLOW MANAGEMENT

INPUTS

2. From Terminals Within or Adjacent to Center

2.1 INPUT: Current and Predicted Capacities

FREQUENCY: Daily and Updated as Needed

LOOK AHEAD TIME: 8 Hours

2.2 INPUT: Current and Predicted Demands (e.g., VFR and Tower
En Route Demand not Known by Center)

FREQUENCY: Daily and Updated as Needed

LOOK AHEAD TIME: 8 Hours

2.3 INPUT: Current and Predicted Facility Status

- Equipment Availability
- Staffing
- Configurations (Runway and Airspace)
- Runways in Use
- Facility Restrictions (e.g., Taxiway Repairs)

FREQUENCY: Daily and Updated As Needed

LOOK AHEAD TIME: 24 Hours

2.4 INPUT: Local Weather

FREQUENCY: Daily and Updated as Needed

LOOK AHEAD TIME: 8 Hours

EN ROUTE FLOW MANAGEMENT

INPUTS

From Terminals Within Center (Continued)

- 2.5 INPUT: Actual Traffic Distribution and Demand
Distribution by Time and Geography
- FREQUENCY: Daily and Updated as Needed
- LOOK AHEAD TIME: 8 Hours
- 2.6 INPUT: Airport Acceptance Rates (by Runway and Total
Airport)
- FREQUENCY: As Needed
- LOOK AHEAD TIME: 3 Hours
- 2.7 INPUT: Desired Rates, Mix and Geographic Distribution of
Arrival Traffic
- FREQUENCY: As Needed
- LOOK AHEAD TIME: 3 Hours
- 2.9. INPUT: Information Concerning Causal Factors for Excess
Delay
- FREQUENCY: Upon Problem Resolution
- LOOK AHEAD TIME: After the Fact
- 2.9 INPUT: Delay Credits for Ground Delays
- FREQUENCY: As Delays Occur
- LOOK AHEAD TIME: Current

EN ROUTE FLOW MANAGEMENT

INPUTS

From Terminals Within Center (Continued)

2.10 INPUT: Advisories of Current or Planned Local Flow Procedures and Restrictions in Terminal Airspace or Surface Traffic Flow Procedures

FREQUENCY: As Needed

LOOK AHEAD TIME: 3 Hours

2.11 INPUT: Notification and Prediction of Significant Delays

FREQUENCY: As Delays Are Detected/Predicted

LOOK AHEAD TIME: 3 Hours

2.12 INPUT: Proposed Interfacility Flow Management Strategies (for Severe Problems)

FREQUENCY: As Problems Are Detected/Predicted

LOOK AHEAD TIME: 3 Hours

2.13 INPUT: Assessed Impact of Local Relief Strategies and Flow Directives (e.g., Delays Incurred Prior to and After Implementation of Procedures)

FREQUENCY: Upon Problem Resolution

LOOK AHEAD TIME: After the Fact

2.14 INPUT: Identification of Local and Interfacility ATC Procedural Changes to Prevent or Reduce the Impact of Recurrent Problems

FREQUENCY: As Needed

LOOK AHEAD TIME: Long Term

EN ROUTE FLOW MANAGEMENT

INPUTS

From Terminals Within Center (Concluded)

2.15 INPUT: Selected Flight Information (e.g., Proposed and Actual Departure Times)

FREQUENCY: Daily and Updated As Needed

LOOK AHEAD TIME: 24 Hours; ARTS/NAS Parameters

2.16 INPUT: Alerts of Significant Deviations from Flow Directives

FREQUENCY: As Needed

LOOK AHEAD TIME: Current

EN ROUTE FLOW MANAGEMENT

INPUTS

3. From Adjacent Centers

3.1 INPUT: Facility Status Reports

FREQUENCY: Daily and Updated as Needed

LOOK AHEAD TIME: 8 Hours

3.2 INPUT: Demand Levels and Flow Rates

FREQUENCY: Daily and Updated as Needed

LOOK AHEAD TIME: 8 Hours

3.3 INPUT: Restrictions Imposed or Planned

FREQUENCY: As Needed

LOOK AHEAD TIME: 1 1/2 Hours

3.4 INPUT: Delay Credits for Designated Flights

FREQUENCY: As Needed

LOOK AHEAD TIME: 1 1/2 Hours

3.5 INPUT: Appropriate Flight Data (e.g., Coordination Fix
Time Updates)

FREQUENCY: As Available

LOOK AHEAD TIME: Current and Parameter Lead Time

EN ROUTE FLOW MANAGEMENT

INPUTS

4. FROM NWS

4.1 INPUT: Current and Predicted Regional Weather Conditions

FREQUENCY: Daily and as Updates are Received

LOOK AHEAD TIME: 24 Hours

4.2 INPUT: Reports of Severe Weather Conditions

FREQUENCY: Immediate Transmittal of Severe Weather
Conditions as Reported

LOOK AHEAD TIME: 8 Hours

5. FROM AIRCRAFT

5.1 INPUT: Aircraft Performance Data via Pilot Reports or
Data Link (e.g., Current and Predicted Position
Data for Aircraft Equipped with Flight Management
Computers)

FREQUENCY: Upon Request

LOOK AHEAD TIME: Current

5.2 INPUT: Wind Information via Pilot Reports or Data Link

FREQUENCY: Upon Request

LOOK AHEAD TIME: Current

TERMINAL FLOW MANAGEMENT

INPUTS

1. From National Flow:

1.1 INPUT: Current Predicted Traffic Counts, Demand, Delay and Capacity Estimates (and Other Traffic Summary Reports)

FREQUENCY: Upon Request

LOOK AHEAD TIME: 24 Hours

1.2 INPUT: Advisories of Severe Weather Conditions and (If Appropriate) Avoidance Procedures

FREQUENCY: As Needed

LOOK AHEAD TIME: 24 Hours

1.3 INPUT: National Weather Information (Current and Forecast)

FREQUENCY: Upon Request, Updated Daily

LOOK AHEAD TIME: 24 Hours

1.4 INPUT: Flow Management Procedures

- Coordinated Letters of Agreement Between Affected Facilities
- National Flow Orders Concerning Local Traffic Flow
- Alternative Procedures for Local Flow Problems

FREQUENCY: As Needed

LOOK AHEAD TIME: Long Term

TERMINAL FLOW MANAGEMENT

INPUTS

From National Flow (Continued)

1.5 INPUT: National Flow Management Advisories

- National Flow Directives
- Notification of Flow Restrictions/
Procedures and Time of Implementation

FREQUENCY: As Needed

LOOK AHEAD TIME: 24 Hours

1.6 INPUT: Approval or Disapproval of Proposed Interfacility
Flow Procedures (If Applicable)

FREQUENCY: Upon Receipt of Proposed Plan

LOOK AHEAD TIME: Long Term (e.g., Modifications to
Letters of Agreement) or 3 Hours (e.g.,
Ad Hoc Agreements)

1.7 INPUT: Removal of Flow Restrictions Imposed by National
Flow

FREQUENCY: Upon Problem Resolution

LOOK AHEAD TIME: As Determined (e.g., Function of
Problem)

1.8 INPUT: Periodic Analysis of Problems, Relief Strategies
and System Performance

FREQUENCY: As Needed

LOOK AHEAD TIME: After the Fact

TERMINAL FLOW MANAGEMENT

INPUTS

From National Flow (Concluded)

1.9 INPUT: System Performance Data

FREQUENCY: Available Upon Request

LOOK AHEAD TIME: Current

1.10 INPUT: Alternative Procedures for Interfacility Flow
Management in Response to Requests by Local Flow
for National Approval of Proposed Plans

FREQUENCY: As Needed

LOOK AHEAD TIME: Long Term

TERMINAL FLOW MANAGEMENT

INPUTS

2. From Host Center

2.1 INPUT: Current and Expected Rates, Geographic
Distribution and Aircraft Mix of Arrival Traffic

FREQUENCY: Upon Request or When Changes Are Expected

LOOK AHEAD TIME: 3 Hours (Planning); 1 1/2 Hours
(Control)

2.2 INPUT: Identification of Factors Associated with
Recurrent Problems and Causal Factors for Excess
Delay

FREQUENCY: Upon Problem Resolution

LOOK AHEAD TIME: After the Fact

2.3 INPUT: Appropriate Flight Information (e.g., Meter Fix
CTA Updates)

FREQUENCY: As Available

LOOK AHEAD TIME: Current and Parameter Lead Times

2.4 INPUT: Weather Information Impacting the Terminal
Operations

FREQUENCY: Periodic and As Needed

LOOK AHEAD TIME: 8 Hours

2.5 INPUT: Identification of Factors Associated with
Recurrent Problems and Causal Factors for Excess
Delay

FREQUENCY: Upon Problem Resolution

LOOK AHEAD TIME: After the Fact

TERMINAL FLOW MANAGEMENT

INPUTS

2. From Host Center (Concluded)

2.6 INPUT: Advisories to Implement Approved (Planned or Ad Hoc) Strategy

FREQUENCY: As Problems Are Detected

LOOK AHEAD TIME: 8 Hours

2.7 INPUT: Advisories to Modify Flow Procedures in Effect (In Response to Local Inputs and System Performance Monitoring)

FREQUENCY: During Problem Resolution

LOOK AHEAD TIME: 8 Hours

2.8 INPUT Alerts of Significant Deviations from Flow Directives

FREQUENCY: As Needed

LOOK AHEAD TIME: Current

TERMINAL FLOW MANAGEMENT

INPUTS

3. From Satellite Airports

3.1 INPUT: Tower En Route Traffic Estimates

FREQUENCY: Upon Request

LOOK AHEAD TIME: 1 1/2 Hours

3.2 INPUT: Current and Predicted Departure Counts

FREQUENCY: Upon Request

LOOK AHEAD TIME: 1 1/2 Hours

3.3 INPUT: Current and Predicted Arrival Counts

FREQUENCY: Upon Request

LOOK AHEAD TIME: 1 1/2 Hours

4. From NWS

4.1 INPUT: Current and Forecasted Weather Information

FREQUENCY: Periodic and Upon Request

LOOK AHEAD TIME: 24 Hours

5. FROM AIRCRAFT

5.1 INPUT: Aircraft Performance Data via Pilot Reports or Data Link (e.g., Current and Predicted Position Data for Aircraft Equipped with Flight Management Computers)

FREQUENCY: Upon Request

LOOK AHEAD TIME: Current

TERMINAL FLOW MANAGEMENT

INPUTS

5. FROM AIRCRAFT (Concluded)

5.2 INPUT: Wind Information via Pilot Reports or Data Link

FREQUENCY: Upon Request

LOOK AHEAD TIME: Current

INTEGRATED FLOW MANAGEMENT

OUTPUTS

NATIONAL FLOW MANAGEMENT

OUTPUTS

1. To En Route Flow, Appropriate Key Terminals and Users

1.1 OUTPUT: National Flow Management Advisories to Affected En Route and Terminal Facilities

- National Flow Directives
- Notification of Flow Restrictions and Time of Implementation

FREQUENCY: As Needed

LOOK AHEAD TIME: 24 Hours

1.2 OUTPUT: Flow Management Procedures

- Coordinated Letters of Agreement Between Affected En Route Facilities
- National Flow Orders Concerning Local Flow Procedures
- Alternative Procedures for Local Flow Problems

FREQUENCY: As Needed

LOOK AHEAD TIME: Long Term

1.3 OUTPUT: Flight Data Updates and Cancellations from ARINC/Airlines Forwarded to Appropriate Centers

FREQUENCY: As Available

LOOK AHEAD TIME: 24 Hours

NATIONAL FLOW MANAGEMENT

OUTPUTS

1. To En Route Flow, Appropriate Key Terminals and Users (Continued)

1.4 OUTPUT: Updated Summary Reports of Current and Predicted Demand and Capacity Estimates for Designated Centers and Key Terminals

FREQUENCY: Output Upon Request, Updated Daily

LOOK AHEAD TIME: 24 Hours

1.5 OUTPUT: Advisories of Severe Weather Conditions and (if Appropriate) Avoidance Procedures

FREQUENCY: As Needed

LOOK AHEAD TIME: 24 Hours

1.6 OUTPUT: Periodic National Weather Information (Current and Forecast)

FREQUENCY: Output Upon Request, Updated Daily

LOOK AHEAD TIME: 24 Hours

1.7 OUTPUT: Traffic Summary Reports

- Traffic Counts
- Delay Distributions
- Peak Demand Levels

FREQUENCY: Output Upon Request, Updated Daily

LOOK AHEAD TIME: 24 Hours

NATIONAL FLOW MANAGEMENT

OUTPUTS

1. To En Route Flow, Appropriate Key Terminals and Users (Continued)

1.8 OUTPUT: Approval or Disapproval by National Flow of Proposed Interfacility Flow Procedures to Requesting Facility

FREQUENCY: Upon Receipt of Request

LOOK AHEAD TIME: Long Term (e.g., Modifications to Letters of Agreement) or 3 Hours (e.g., Ad Hoc Agreements)

1.9 OUTPUT: Alternative Procedures for Interfacility Flow Management in Response to Requests by Local Flow for National Approval of Proposed Plans

FREQUENCY: As Needed

LOOK AHEAD TIME: Long Term

1.10 OUTPUT: Removal of Flow Restrictions Imposed by National Flow

FREQUENCY: Upon Problem Resolution

LOOK AHEAD TIME: As Determined (e.g., Function of Problem)

1.11 OUTPUT: Periodic Analysis of Problems, Relief Strategies and System Performance

FREQUENCY: As Needed

LOOK AHEAD TIME: After the Fact

NATIONAL FLOW MANAGEMENT

OUTPUTS

1. To En Route Flow, Appropriate Key Terminals and Users (Concluded)

1.12 OUTPUT: Identification of National and Interfacility ATC
Procedural Changes to Eliminate or Reduce the
Impact of Recurrent Problems

FREQUENCY: As Needed

LOOK AHEAD TIME: Long Term

1.13 OUTPUT: System Performance Data

FREQUENCY: Available Upon Request

LOOK AHEAD TIME: Current

NATIONAL FLOW MANAGEMENT

OUTPUTS

2. To Appropriate Organizations

2.1 OUTPUT: System Performance Data

FREQUENCY: Available Upon Request

LOOK AHEAD TIME: Current

3. To OAG or ARINC/Airlines

3.1 OUTPUT: Notification of Errors in Reported Scheduling Data

FREQUENCY: As Schedule Updates Are Received

LOOK AHEAD TIME: Based on Schedule Times

EN ROUTE FLOW MANAGEMENT

OUTPUTS

1. To National Flow Management

1.1 OUTPUT: Selected NAS Flight Information

FREQUENCY: Daily and Updated as Needed

LOOK AHEAD TIME: 24 Hours (Current and Parameter Lead Times)

1.2 OUTPUT: Bulk Stored Air Carrier Flight Plans

FREQUENCY: Daily and Updated as Needed

LOOK AHEAD TIME: 24 Hours

1.3 OUTPUT: Facility Status Reports (Current and Predicted)

FREQUENCY: Daily and Updated as Needed

LOOK AHEAD TIME: 24 Hours

1.4 OUTPUT: Local Current and Forecast Weather Reports

FREQUENCY: Daily and Updated as Needed

LOOK AHEAD TIME: 24 Hours

1.5 OUTPUT: Center Capacity Estimates (Current and Predicted)

FREQUENCY: Daily and Updated as Needed

LOOK AHEAD TIME: 24 Hours

EN ROUTE FLOW MANAGEMENT

OUTPUTS

1. To National Flow Management (Continued)

1.6 OUTPUT: Center Capacity Restrictions (Current and Predicted)

FREQUENCY: Daily and Updated as Needed

LOOK AHEAD TIME: 24 Hours

1.7 OUTPUT: Current and Predicted Estimates of Non-Air Carrier Traffic In Center (VFR, Tower En Route, etc.)

FREQUENCY: Daily and Updated as Needed

LOOK AHEAD TIME: 24 Hours

1.8 OUTPUT: Proposed Interfacility Flow Management Plans

FREQUENCY: As Problems are Detected/Predicted

LOOK AHEAD TIME: 24 Hours

1.9 OUTPUT: Proposed Long Term Interfacility Flow Management Plans

FREQUENCY: Upon Resolution of Expected Problems

LOOK AHEAD TIME: Long Term

EN ROUTE FLOW MANAGEMENT

OUTPUTS

1. To National Flow Management (Continued)

1.10 OUTPUT: Implementation of Approved Local Flow Management Procedures

- Recurrent Problems and Alternative Solutions
- Standard Flow Management Procedures for Local Traffic Problems

FREQUENCY: As Needed

LOOK AHEAD TIME: 24 Hours

1.11 OUTPUT: Coordination of Ad Hoc Local Flow Management Procedures for Unanticipated Problems

FREQUENCY: As Needed

LOOK AHEAD TIME: 24 Hours

1.12 OUTPUT: Actual Traffic Delay, Congestion, and Other System Performance Data

FREQUENCY: As Delays Occur; Upon Problem Resolution

LOOK AHEAD TIME: As Needed; After the Fact

1.13 OUTPUT: Assessed Impact of National Flow Directives (e.g., Actual Delays Incurred Prior to and After Implementation of Procedures)

FREQUENCY: Upon Implementation of Flow Procedures

LOOK AHEAD TIME: After the Fact

EN ROUTE FLOW MANAGEMENT

OUTPUTS

1. To National Flow Management (Concluded)

1.14 OUTPUT: Alerts of Significant Deviations from Flow Directives

FREQUENCY: As Needed

LOOK AHEAD TIME: Current

1.15 OUTPUT: Information Concerning Causal Factors for Excess Delay

FREQUENCY: Upon Problem Resolution

LOOK AHEAD TIME: After the Fact

1.16 OUTPUT: Special Routings Planned or in Effect (From Centers)

FREQUENCY: Daily and Updated as Needed

LOOK AHEAD TIME: 24 Hours

1.17 OUTPUT: Identification of Local and Interfacility ATC Procedural Changes to Eliminate or Reduce the Impact of Recurrent Problems

FREQUENCY: As Needed

LOOK AHEAD TIME: Long Term

EN ROUTE FLOW MANAGEMENT

OUTPUTS

2. Outputs to Terminal Flow Management

2.1 OUTPUT: Identification of Factors Associated with
Recurrent Types of Problems and Causal Factors
for Excess Delay

FREQUENCY: Upon Problem Resolution

LOOK AHEAD TIME: After the Fact

2.2 OUTPUT: Advisories to Implement Approved (Planned or Ad
Hoc) Relief Strategy

- Detailed Instructions
- Contingency Plan
- Expected Impact and Duration of Problem
- Specify Compliance with Directives
Issued by National Flow Management

FREQUENCY: As Problems Are Detected

LOOK AHEAD TIME: 8 Hours

2.3 OUTPUT: Advisories to Modify Flow Procedures in Effect
(In Response to Local Inputs and System
Performance Monitoring)

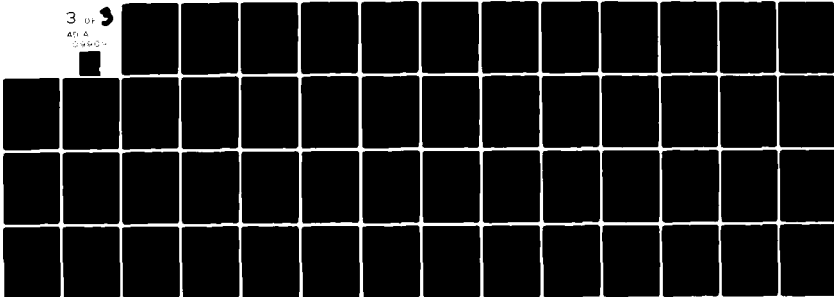
FREQUENCY: During Problem Resolution

LOOK AHEAD TIME: 8 Hours

AD-A109 909

MITRE CORP MCLEAN VA METREK DIV F/6 5/1
PRELIMINARY FUNCTIONAL DESCRIPTION OF INTEGRATED FLOW MANAGEMEN--ETC(U)
OCT 81 D L ADAMS, S M ALVANIA, R BRUBAKER DTFA01-81-C-10001
UNCLASSIFIED MTR-81W252 FAA-EM-82-7 NL

3 of 3
AD 4
04600

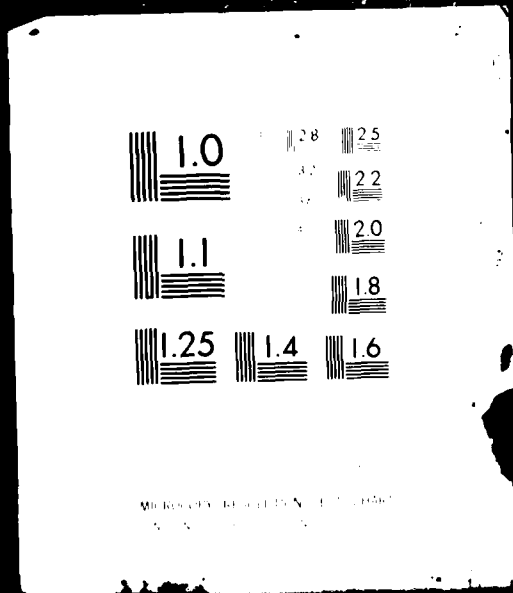


END
DATE
FILMED
02-82
DTIC

3 OF 3

AD A

109909



EN ROUTE FLOW MANAGEMENT

OUTPUTS

2. Outputs to Terminal Flow Management (Concluded)

2.4 OUTPUT: Identification of Local and Interfacility ATC
Procedural Changes to Eliminate or Reduce
Recurrent Problems

FREQUENCY: As Needed

LOOK AHEAD TIME: Long Term

2.5 OUTPUT: Current and Expected Rates, Geographic
Distribution and Aircraft Mix of Arrival Traffic

FREQUENCY: Upon Request or When Changes are Expected

LOOK AHEAD TIME: 3 Hours (Planning); 1 1/2 Hours (Control)

2.6 OUTPUT: Appropriate Flight Information (e.g., Meter Fix
CTA Updates)

FREQUENCY: As Available

LOOK AHEAD TIME: Current and Parameter Lead Times

2.7 OUTPUT: Weather Information Impacting Terminal Operations

FREQUENCY: Periodic or As Needed

LOOK AHEAD TIME: 8 Hours

2.8 OUTPUT: Alerts of Significant Deviations from Flow
Directives

FREQUENCY: As Needed

LOOK AHEAD TIME: Current

EN ROUTE FLOW MANAGEMENT

OUTPUTS

3. To Adjacent Centers

3.1 OUTPUT: Current and Predicted Traffic Demand Affecting
Adjacent Center

FREQUENCY: During Peak Demand Periods

LOOK AHEAD TIME: 3 Hours

3.2 OUTPUT: Current and Predicted Capacity (of Originating
Center) to Provide Flow Planning Information for
Adjacent Centers

FREQUENCY: Daily and Updated as Needed

LOOK AHEAD TIME: 24 Hours

3.3 OUTPUT: Selected Flight Information

FREQUENCY: As Available

LOOK AHEAD TIME: Appropriate NAS Interfacility Flight Data
Parameter

3.4 OUTPUT: Notice of Planned Implementation of En Route Flow
Strategies Which Affect Traffic Flow at Center
Boundaries

FREQUENCY: As Needed

LOOK AHEAD TIME: 8 Hours

3.5 OUTPUT: Notice of Implementation of Ad Hoc Flow Strategies

FREQUENCY: As Needed

LOOK AHEAD TIME: 3 Hours

EN ROUTE FLOW MANAGEMENT

OUTPUTS

3. To Adjacent Centers (Concluded)

3.6 OUTPUT: Delay Credit for Designated Flights

FREQUENCY: As Needed

LOOK AHEAD TIME: 1 1/2 Hours

TERMINAL FLOW MANAGEMENT

OUTPUTS

1. To National Flow (From Key Terminals Only)

1.1 OUTPUT: Selected Flight Information (e.g., Departure and Arrival Messages)

FREQUENCY: Daily and Updated As Needed

LOOK AHEAD TIME: 24 Hours; ARTS/NAS Parameters

1.2 OUTPUT: Facility Status (Current and Predicted)

- Equipment Availability
- Staffing
- Configuration (Runway and Airspace)
- Runway Surface Conditions
- Facility Restrictions (e.g., Taxiway Repairs)

FREQUENCY: Daily and Updated as Needed

LOOK AHEAD TIME: 24 Hours

1.3 OUTPUT: Local Weather

FREQUENCY: Daily and Updated as Needed

LOOK AHEAD TIME: 24 Hours

TERMINAL FLOW MANAGEMENT

OUTPUTS

1. To National Flow (From Key Terminals Only) (Continued)

1.4 OUTPUT: Periodic Terminal Traffic Information

- Current and Predicted Capacities
- Actual Traffic Distribution
- Demand Distribution by Time and Geography
- Estimates of Other Terminal Area Operations (e.g., VFR, Tower En Route)

FREQUENCY: Daily and Updated As Needed

LOOK AHEAD TIME: 24 Hours

1.5 OUTPUT: Notification of Significant Departure Delays (Current and Predicted)

FREQUENCY: As Problems Are Detected/Predicted

LOOK AHEAD TIME: 2 Hours

1.6 OUTPUT: Assessed Impact of Nationally Issued Flow Directives (e.g., Actual Delays Incurred Prior To and After Implementation of Procedures)

FREQUENCY: Upon Implementation of Flow Procedures

LOOK AHEAD TIME: After the Fact

1.7 OUTPUT: Advisories of Current or Planned Restrictions in Terminal Airspace or Surface Traffic Flow

FREQUENCY: As Problems Are Detected/Predicted

LOOK AHEAD TIME: Problem Duration

TERMINAL FLOW MANAGEMENT

OUTPUTS

1. To National Flow (From Key Terminals Only) (Concluded)

1.8 OUTPUT: Information Concerning Causal Factors for Excess Delay

FREQUENCY: Upon Problem Resolution

LOOK AHEAD TIME: After the Fact

1.9 OUTPUT: Proposed Flow Management Strategies (When Severe Problems Occur)

FREQUENCY: As Problems Are Detected/Predicted

LOOK AHEAD TIME: Problem Duration

1.10 OUTPUT: Coordination of Ad Hoc Flow Management Procedures for Unanticipated Problems

FREQUENCY: As Needed

LOOK AHEAD TIME: 24 Hours

1.11 OUTPUT: Identification of Local and Interfacility ATC Procedural Changes to Eliminate or Reduce the Impact of Recurrent Problems

FREQUENCY: Upon Problem Resolution

LOOK AHEAD TIME: After the Fact

1.12 OUTPUT: Alerts of Significant Deviations from Flow Directives

FREQUENCY: As Needed

LOOK AHEAD TIME: Current

TERMINAL FLOW MANAGEMENT

OUTPUTS

2. To En Route Flow Control (Host Center)

2.1 OUTPUT: Selected Flight Information (via ARTS/NAS Interface)

FREQUENCY: Daily and Updated as Needed

LOOK AHEAD TIME: 24 Hours; ARTS/NAS Parameters

2.2 OUTPUT: Facility Status Reports (Current and Predicted)

- Equipment Availability
- Staffing
- Configurations (Runway and Airspace)
- Runways in Use
- Facility Restrictions (e.g., Taxiway Repairs)

FREQUENCY: Daily and Updated as Needed

LOOK AHEAD TIME: 24 Hours

2.3 OUTPUT: Local Weather

FREQUENCY: Daily and Updated as Needed

LOOK AHEAD TIME: 8 Hours

TERMINAL FLOW MANAGEMENT

OUTPUTS

2. To En Route Flow Control (Host Center) (Continued)

2.4 OUTPUT: Periodic Terminal Traffic Information

- Current and Predicted Capacities
- Actual Traffic Distribution
- Demand Distribution By Time and Geography
- Estimates of Other Terminal Area Operations (e.g., VFR, Tower En Route)

FREQUENCY: Daily and Updated as Needed

LOOK AHEAD TIME: 8 Hours

2.5. OUTPUT: Airport Acceptance Rate (By Runway and Total Airport)

FREQUENCY: As Needed

LOOK AHEAD TIME: 3 Hours

2.6 OUTPUT: Requests for Geographic, Time and Mix Redistribution of Arrival Traffic

FREQUENCY: As Needed

LOOK AHEAD TIME: 3 Hours

2.7 OUTPUT: Advisories of Current or Planned Local Flow Procedures and Restrictions in Terminal Airspace or Surface Traffic Flow

FREQUENCY: As Needed

LOOK AHEAD TIME: 3 Hours

TERMINAL FLOW MANAGEMENT

OUTPUTS

2. To En Route Flow Control (Host Center) (Continued)

2.8. OUTPUT: Notification and Prediction of Significant Delays

FREQUENCY: As Delays are Detected/Predicted

LOOK AHEAD TIME: 3 Hours

2.9 OUTPUT: Assessed Impact of Local Relief Strategies and Flow Directives (e.g., Delays Incurred Prior to and After Implementation of Procedures)

FREQUENCY: Upon Problem Resolution

LOOK AHEAD TIME: After the Fact

2.10 OUTPUT: Delay Credits for Ground Delays

FREQUENCY: As Delays Occur

LOOK AHEAD TIME: Current

2.11 OUTPUT: Information Concerning Causal Factors for Excess Delay

FREQUENCY: Upon Problem Resolution

LOOK AHEAD TIME: After the Fact

2.12 OUTPUT: Proposed Intrafacility Flow Management Strategies (For Severe Problems)

FREQUENCY: As Problems Are Detected/Predicted

LOOK AHEAD TIME: 3 Hours

TERMINAL FLOW MANAGEMENT

OUTPUTS

2. To En Route Flow Control (Host Center) (Concluded)

2.13 OUTPUT: Identification of Local and Interfacility ATC
Procedural Changes to Eliminate or Reduce the
Impact of Recurrent Problems

FREQUENCY: As Needed

LOOK AHEAD TIME: Long Term

2.14 OUTPUT: Alerts of Significant Deviations From Flow
Directives

FREQUENCY: As Needed

LOOK AHEAD TIME: Current

TERMINAL FLOW MANAGEMENT

OUTPUTS

3. To Satellite Airports

3.1 OUTPUT: Identification of Terminal Flow Procedures in Effect or Planned

FREQUENCY: As Problems are Detected/Predicted

LOOK AHEAD TIME: 3 Hours

3.2 OUTPUT: ATC Procedural Guidelines to Minimize Terminal Airspace Congestion

FREQUENCY: As Problems are Detected

LOOK AHEAD TIME: Long Term

3.3 OUTPUT: Recommended ATC Procedures to Facilitate Local Traffic Flow

FREQUENCY: As Problems are Detected

LOOK AHEAD TIME: Long Term

INTEGRATED FLOW MANAGEMENT

LOCAL OUTPUTS

NATIONAL FLOW MANAGEMENT

LOCAL OUTPUTS

1. OUTPUTS: Updated Estimates of Current and Predicted Demand at Key Terminals and Designated En Route Control Points

FREQUENCY: Upon Request

LOOK AHEAD TIME: 24 Hours

2. OUTPUTS: Weather Summaries

FREQUENCY: Upon Request

LOOK AHEAD TIME: 24 Hours

3. OUTPUTS: Traffic Counts for Designated Flow Management Control Points and Key Terminals

FREQUENCY: Upon Request

LOOK AHEAD TIME: 24 Hours

4. OUTPUTS: Predicted Gross Delays at Key Terminals and En Route Airspace

FREQUENCY: Upon Request

LOOK AHEAD TIME: 24 Hours

5. OUTPUTS: Simulated Results (Traffic Counts and Delay Distribution) Corresponding to Each Alternative Flow Management Strategy

FREQUENCY: Upon Request

LOOK AHEAD TIME: 24 Hours or Problem Duration

NATIONAL FLOW MANAGEMENT

LOCAL OUTPUTS

6. OUTPUTS: Notification of Potential Problem, Affected Facilities and Users, Time of Problem Onset and Expected Duration
FREQUENCY: As Problems Are Detected/Predicted
LOOK AHEAD TIME: 24 Hours

7. OUTPUTS: Updated Recorded Statistics (DR & A) of Historical Traffic Patterns, Peak Demand Periods, etc.
FREQUENCY: Updated As Data Is Reported; Available Upon Request
LOOK AHEAD TIME: Current and After the Fact

8. OUTPUTS: Estimated Accuracy of Previous Delay Predictions
FREQUENCY: Updated As Data Is Reported; Available Upon Request
LOOK AHEAD TIME: After the Fact

9. OUTPUTS: System Performance Data
FREQUENCY: Updated As Data Is Reported; Available Upon Request
LOOK AHEAD TIME: Current and After the Fact

10. OUTPUTS: Threshold Monitoring Reports for Detecting Excess Delay
FREQUENCY: As Problems Are Detected/Predicted
LOOK AHEAD TIME: Duration of Problem

NATIONAL FLOW MANAGEMENT

LOCAL OUTPUTS

11. OUTPUTS: National Flow Directives/Plans
FREQUENCY: As Problems Are Detected/Predicted
LOOK AHEAD TIME: Long Term

12. OUTPUTS: Causal Factors for Excess Delay
 - Facilities Affected
 - Magnitude of Problem
 - Expected Duration of ProblemFREQUENCY: Upon Problem Resolution
LOOK AHEAD TIME: After the Fact

13. OUTPUTS: Identification of All Facilities/Users Affected by Excess Delay
FREQUENCY: Upon Problem Detection/Prediction
LOOK AHEAD TIME: Problem Duration

14. OUTPUTS: Assessed Impact of Alternative Relief Strategies
FREQUENCY: As Problems Are Detected/Predicted
LOOK AHEAD TIME: Problem Duration

15. OUTPUTS: Selection of Best "Relief" Strategy and Contingency Plan for the Specified Problems
FREQUENCY: As Problems Are Detected/Predicted
LOOK AHEAD TIME: Problem Duration

NATIONAL FLOW MANAGEMENT

LOCAL OUTPUTS

16. OUTPUTS: Post Analysis Evaluation of Relief Strategy Implemented (Actual vs. Predicted System Performance)
- FREQUENCY: Upon Problem Resolution
- LOOK AHEAD TIME: After the Fact
17. OUTPUTS: Identification of Recurrent Types of Problems
- FREQUENCY: Upon Problem Resolution
- LOOK AHEAD TIME: After the Fact
18. OUTPUTS: Updated Summaries of Nominal (Actual) Traffic Patterns, Delay Peaks, Intervals of High Demand on a National Scale
- FREQUENCY: Upon Request
- LOOK AHEAD TIME: Current and After the Fact
19. OUTPUTS: Assessment of Flow Directives Issued by National Flow Management
- FREQUENCY: Upon Problem Resolution
- LOOK AHEAD TIME: After the Fact

EN ROUTE FLOW MANAGEMENT

LOCAL OUTPUTS

1. OUTPUT: Intracenter Flight Data
- Fix Times
 - Traffic Counts (Current and Predicted) for Selected Sector or Point
 - Delay Needed to Meet Airport Acceptance Rates (for Metered Airports)
 - Distribution of Demand in Center by Time and Geography
 - Boundary Crossing Times

FREQUENCY: NAS Update Times; Available Upon Request

LOOK AHEAD TIME: 3 Hours, or as Restricted by NAS Data Availability

2. OUTPUT: Traffic Summary Statistics
- Center Boundary Traffic Loads
 - Sector Loads
 - Holding Pattern Load Capacities
 - Route Usage
 - Remaining Airspace Load Capacities

FREQUENCY: NAS Update Times; Available Upon Request

LOOK AHEAD TIME: 3 Hours, or as Restricted by NAS Data Availability

EN ROUTE FLOW MANAGEMENT

LOCAL OUTPUTS

3. OUTPUT: Delay Allocation Strategy
FREQUENCY: As Intracenter Flow Problems are Detected/
Predicted
LOOK AHEAD TIME: 8 Hours
4. OUTPUT: System Performance Data
FREQUENCY: Updated as Data Is Reported; Available Upon
Request
LOOK AHEAD TIME: Current and After the Fact
5. OUTPUT: En Route Metering Schedules
FREQUENCY: En Route Metering Function Update Times
LOOK AHEAD TIME: 3 Hours
6. OUTPUT: Advisories of Procedures to Meet Metering
Schedules
FREQUENCY: As Needed
LOOK AHEAD TIME: 3 Hours
7. OUTPUT: Identification of Potential Delay and Congestion
(Based on En Route Simulation Capabilities)
FREQUENCY: As Problems Are Detected/Predicted
LOOK AHEAD TIME: 8 Hours

EN ROUTE FLOW MANAGEMENT

LOCAL OUTPUTS

8. OUTPUT: Identification of All Facilities/Users Affected by Excess Delay (Current and Predicted)

- Magnitude of Problem
- Expected Duration of Problem

FREQUENCY: As Problems Are Detected/Predicted

LOOK AHEAD TIME: 8 Hours

9. OUTPUT: Identification of Recurrent Problems

FREQUENCY: Upon Problem Resolution

LOOK AHEAD TIME: After the Fact

10. OUTPUT: Assessed Impact of Alternative Strategies

FREQUENCY: As Problems Are Detected/Predicted

LOOK AHEAD TIME: 8 Hours

11. OUTPUT: Information Concerning Causal Factors for Excess Delay

FREQUENCY: Upon Problem Resolution

LOOK AHEAD TIME: After the Fact

12. OUTPUT: Revised Flow Management Strategy or Contingency Plan in Response to Real-Time Inputs or System Performance Monitoring

FREQUENCY: During Problem Resolution

LOOK AHEAD TIME: Current

EN ROUTE FLOW MANAGEMENT

LOCAL OUTPUTS

13. OUTPUT: Assessment of Local Relief Strategies and
Nationally Issued Local Flow Directives
- FREQUENCY: Upon Problem Resolution
- LOOK AHEAD TIME: After the Fact
14. OUTPUT: Identification of Local ATC Procedural Changes to
Eliminate or Reduce the Impact of Recurrent Types
of Problems
- FREQUENCY: As Needed
- LOOK AHEAD TIME: After the Fact
15. OUTPUT: Aircraft Performance Data
- FREQUENCY: Available Upon Request
- LOOK AHEAD TIME: Current

TERMINAL FLOW MANAGEMENT

LOCAL OUTPUTS

1. OUTPUTS: Current and Predicted Capacities
FREQUENCY: Upon Request
LOOK AHEAD TIME: 3 Hours

2. OUTPUTS: Current and Future Configuration for Terminal Airspace, Runways, and Airport Surface
FREQUENCY: Upon Request
LOOK AHEAD TIME: 3 Hours

3. OUTPUTS: Current and Predicted Traffic Counts Over Designated Fixes, Departure and Arrival Demand Distributions, Holding Pattern Loads
FREQUENCY: Upon Request
LOOK AHEAD TIME: 1 1/2 Hours

4. OUTPUTS: Estimated Flight Sequences, Computed Fix Times, Expected Landing Times (To Terminal Control Function)
FREQUENCY: As Needed
LOOK AHEAD TIME: 1 1/2 Hours

5. OUTPUTS: Computed Arrival and Departure Schedule to Achieve Maximum Throughput (To Terminal Control Function)
FREQUENCY: As Needed
LOOK AHEAD TIME: 1 1/2 Hours

TERMINAL FLOW MANAGEMENT

LOCAL OUTPUTS

6. OUTPUTS: Required Schedule Delays or Sequencing Modifications on an Individual Flight Basis (To Local Control Function)

FREQUENCY: As Needed

LOOK AHEAD TIME: 1 1/2 Hours

7. OUTPUTS: Terminal Airspace and Runway Capacities (Holding Levels, Vectoring Space)

FREQUENCY: Upon Request

LOOK AHEAD TIME: Current

8. OUTPUTS: Airport Acceptance Rate (AAR) Adjustments Needed

FREQUENCY: As Problems Are Detected/Predicted

LOOK AHEAD TIME: 3 Hours

9. OUTPUTS: Assessed Impact of Local Flow Procedures

FREQUENCY: Upon Problem Resolution

LOOK AHEAD TIME: After the Fact

10. OUTPUTS: Identification of Potential Delay and Congestion

FREQUENCY: As Problems Are Detected/Predicted

LOOK AHEAD TIME: 3 Hours

TERMINAL FLOW MANAGEMENT

LOCAL OUTPUTS

11. OUTPUTS: Departure Schedules to Preserve Equitable Delay Distribution
FREQUENCY: As Needed
LOOK AHEAD TIME: 1 1/2 Hours

12. OUTPUTS: Identification of Potential Unscheduled Departure Delays
FREQUENCY: As Needed
LOOK AHEAD TIME: 1 1/2 Hours

13. OUTPUTS: Implementation of Flow Management Scheduled Departure Delays (e.g., FAD)
FREQUENCY: As Needed
LOOK AHEAD TIME: 16 Hours

14. OUTPUTS: Traffic Activity Summaries for Each Satellite Airport
FREQUENCY: Upon Request
LOOK AHEAD TIME: 1 1/2 Hours

15. OUTPUTS: Schedule of Surface Traffic Flow
FREQUENCY: Upon Request
LOOK AHEAD TIME: 1 1/2 Hours

TERMINAL FLOW MANAGEMENT

LOCAL OUTPUTS

16. OUTPUTS: Surface Traffic Scheduling Conflicts
FREQUENCY: As Problems Are Detected/Predicted
LOOK AHEAD TIME: 1 1/2 Hours
17. OUTPUTS: Identification of All Facilities/Users Affected
by Excess Delay
- Magnitude of Problem
 - Expected Duration of Problem
- FREQUENCY: As Problems Are Detected/Predicted
LOOK AHEAD TIME: 1 1/2 Hours
18. OUTPUTS: Assessment of Alternative Relief Strategies
FREQUENCY: As Problems Are Detected/Predicted
LOOK AHEAD TIME: 3 Hours

APPENDIX D

INTEGRATED FLOW MANAGEMENT
INTERFACILITY COMMUNICATIONS

The general types of data which represent a significant communications load between the IFM facilities are identified below for each level (National, En Route, and Terminal) of Flow Management.

D.1 National Flow Management Inputs

- a. Selected flight information from centers and major terminals are listed below.
 - Data may be filtered by aircraft identification (ACID) and/or geographic position (e.g., designated boundary points).
 - Typical flight information transmitted includes: ACID, accumulated delays, position data (e.g., fix or departure point), time information (CTA's, departure times, etc.) and flight schedule modifications.
 - Specific message types include
 - Flight Plans
 - Flight Plan Modifications
 - Departure and Arrival Messages
 - Progress Report
 - Cancellation
 - Diversion Messages.
 - Inputs received by National Flow may include multiple messages for a single ACID (e.g., up to 10 updates per center along the filed route)

NOTE: The volume of flight information transmitted to National Flow will be principally determined by the level of complexity associated with the National Airspace System (NAS) model simulation and the criteria for selecting information to be forwarded to National Flow.

- During the advanced stages of implementation, the En Route Metering (ERM) function may include a capability to transmit to National Flow the Outer Fix Advisory delays being sent to the adjacent centers.

- b. Weather information from the National Weather Service (NWS) may include

- Remote radar weather recordings (WBRR)
- Satellite weather information
- National weather reports and forecasts.

NOTE: The communications load impact will be based on the frequency and quantity of weather data reported. Another related factor is the extent of data reduction and filtering performed by NWS prior to transmittal of the information to National Flow.

- c. Flight Service Station (FSS) facility inputs may include

- VFR flight information (may represent a significant communications load under VFR conditions)
- Pilot Reports (PIREP's)
- Local Weather.

D.2 En Route Flow

- a. The intercenter exchange of selected flight information (via NAS Interface) is addressed below.

- Enhanced En Route Metering capabilities may include the transmittal of Outer Fix Times (for metered flights) and associated delays to adjacent centers
- Delay "crediting" information may be transmitted between adjacent centers for metered flights crossing the center boundaries.

NOTE: Current NAS parameter lead times may be increased to provide a longer planning horizon for improved flow management prediction and planning.

- b. Inputs from aircraft to the controlling center may include

- System performance data (possibly via data link)
- Flight schedule data (e.g., accurate fix crossing times augmented by on-board flight management systems).

c. Inputs from major terminals (for which En Route Metering is provided) within the center are addressed below.

- During initial implementation of an automated Terminal Planning Aid (TPA) to support arrival traffic sequencing and spacing, the terminal will transmit Proposed Times of Departure (PTD's) on an aircraft specific basis when ERM scheduled Meter Fix Times do not provide for sufficient delay absorption.
- In the final operational stages of the automated Terminal Planning Aid implementation, the terminal will provide a complete schedule of Meter Fix Times to ERM (with a subsequent reduction in scheduling information input from ERM to the TPA).
- Delay credits for scheduled departure delays (e.g., locally implemented fuel conservative ground delay programs) could be sent on an aircraft specific basis to the host center.

D.3 Terminal Flow Management Inputs

- a. ERM inputs to the Terminal include computed Meter Fix Times (MFT), and associated delays for all metered flights. MFT's would be provided automatically from at least 90 minutes (parameter lead time) prior to airport arrival (MFT's updated as appropriate). This interface would be established during or prior to the initial implementation of an automated TPA.
- b. Inputs from aircraft may include
 - System performance data
 - Flight schedule data (from on-board flight management systems).

APPENDIX E

ROADMAP OF NEAR TERM NATIONAL/EN ROUTE/TERMINAL FLOW
MANAGEMENT FUNCTIONAL CAPABILITIES AND INTERFACES

This appendix presents an outline summary of the expected sequence of phased implementation for the near term flow management capabilities and program interfaces. The roadmap of projected IFM developments addresses the following major system components:
1) National Flow Management; 2) En Route Metering; 3) Terminal Traffic Flow Planning Automation; and 4) Terminal Configuration Management Systems.

TABLE E-1
NATIONAL FLOW MANAGEMENT CAPABILITIES
ROADMAP

1. STEP 1: Present System (1981)

1.1 Demand (Flight) Data Base (Central Flow Computer)

1.1.1 Official Airline Guide (OAG) Schedules, Historical Estimates of Unknown Traffic in the National Airspace System (NAS) (e.g., VFR, Tower En Route, Pop-Ups, etc.)

1.1.2 Manual Updates and Interactions with Air Route Traffic Control Centers (ARTCC's) and Key Terminal Facilities

1.1.3 Verbal (Telephone) and Teletype Inputs from Airlines

1.1.4 Limited NAS Flight Data for Arrivals to Pacing Airports

1.2 Capacity Data Base (Central Flow Computer)

1.2.1 Verbal Transmission of Runway Configurations, Capacity Estimates and Conditions for Pacing Airports

1.2.2 Performance Measurement System (PMS) Capacity Data Maintained to Facilitate Airport Capacity Estimation

1.2.3 Airport Capacity Estimates Assembled for Periodic Time Intervals (Based on PMS Data and Reported Runway Configurations, Capacity Estimates and Conditions)

1.2.4 En Route Capacity Estimation Not Provided

1.3 Weather Data Base (Manual)

1.3.1 National Weather Service (NWS) Information (Forecasts, Weather Radar Reports, etc.)

1.3.2 Telephone Coordination of Weather Information with Center Weather Service Units (CWSU's)

TABLE E-1
(CONTINUED)

1. STEP 1: Present System (1981) (Continued)

1.4 User Interface

1.4.1 Delay Information Transmitted to Some Airlines via ARINC Teletype Network

1.4.2 Verbal Coordination (Telephone) of Delay Programs with All Users

1.5 National Flow Management - Airport

1.5.1 Selected Airports in Data Base and Software

*1.5.2 Assignment of Blanket (not Aircraft Specific) Ground Delays (Provided Directly to Air Carriers, Users) at Any Airport When 30 Minute Airborne Delays are Predicted to Occur for at Least 2 Hours at an Impacted Airport

*1.5.3 Manage Arrival Traffic Flow (Adjust Arrival Rate) to Selected Airports to Avoid Ground Traffic Saturation (By Assigning Blanket Ground Delays to Aircraft at Selected Airports Feeding the Impacted Airport)

1.6 National Flow Management - En Route

1.6.1 Reactive to Problem Situations (e.g., Weather, Restricted Airspace, Military Missions); Problem Description and Relief Strategy Coordinated by Telephone or Teletype Communications with Facilities and Users

1.6.2 Limited Predictive Capability for Meter Fix Loading at Pacing Airports

1.6.3 Fuel Economy Flow Management Considerations to Minimize Airborne Holding

* These activities are transparent to the impacted airport and the airports where ground delays have been imposed since all time adjustments will be performed by the individual users (as instructed by National Flow) rather than the terminal control function.

TABLE E-1
(CONTINUED)

1. STEP 1: Present System (1981) (Concluded)
 - 1.7 National Delay Analysis and Performance Reporting
 - 1.7.1 Manually Compiled Delay and Performance Reports
 - 1.7.2 Verbal Transmission from Pacing Airports of Actual Performance Data for High Demand Periods
 - 1.7.3 Hourly Review of Capacity Estimates for High Demand Periods Based on Comparison of Actual and Predicted Performance

TABLE E-1
(CONTINUED)

2. STEP 2: 1983 System

2.1 Demand (Flight) Data Base (Central Flow Computer)

2.1.1 OAG Schedules, Historical Estimates of Unknown NAS Traffic (e.g., VFR, Tower En Route, Pop-Ups, etc.)

2.1.2 Automated/Manual Updates and Interactions with* ARTCC's and Key Terminal Facilities

2.1.3 Automated/Manual Inputs from Airlines

2.1.4 Expanded NAS Flight Data for Arrivals to Pacing Airports

2.1.5 Automated Transmission of ERM 2 Outer Fix Advisory Data from Host Center to Central Flow Computer (If Possible)

2.2 Capacity Data Base (Central Flow Computer)

2.2.1 Verbal Transmission of Runway Configurations, Capacity Estimates and Conditions for Pacing Airports

2.2.2 Performance Measurement System Capacity Data Maintained to Facilitate Airport Capacity Estimation

2.2.3 Airport Capacity Estimates Assembled for Periodic Time Intervals (Based on PMS Data and Reported Runway Configurations, Capacity Estimates and Conditions)

2.2.4 Host Center Terminal Arrival Meter Fix Capacity Estimates Available

2.3 Weather Data Base (Manual)

2.3.1 National Weather Service Information (Forecasts, Weather Radar Reports, etc.)

2.3.2 Telephone Coordination of Weather Information with Center Weather Service Units

* Underlined text denotes added capabilities.

TABLE E-1
(CONTINUED)

2. STEP 2: 1983 System (Continued)

2.4 User Interface

2.4.1 Automated Communications Interface with Most Users
(for Advisories) via ARINC Teletype Network

2.4.2 Verbal Coordination of Delay Programs with Other Users

2.5 National Flow Management - Airport

2.5.1 All Pacing Airports in Data Base and Software

*2.5.2 Assignment of Blanket (not Aircraft Specific) Ground Delays (Provided Directly to Air Carriers, Users) at Any Airport When 15 Minute Airborne Delays are Predicted to Occur for at Least 2 Hours at an Impacted Airport

*2.5.3 Manage Arrival Traffic Flow (Adjust Arrival Rate) to Selected Airports to Avoid Ground Traffic Saturation (By Assigning Blanket Ground Delays to Aircraft at Selected Airports Feeding the Impacted Airport)

2.6 National Flow Management - En Route

2.6.1 Reactive to Problem Situations (e.g., Weather, Restricted Airspace, Military Missions); Problem Description and Relief Strategy Coordinated by Telephone or Teletype Communications with Facilities and Users

2.6.2 Predictive Capability for Meter Fix Loading at Pacing Airports

2.6.3 Fuel Economy Flow Management Considerations to Minimize Airborne Holding

* These activities are transparent to the impacted airport and the airports where ground delays have been imposed since all time adjustments will be performed by the individual users (as instructed by National Flow) rather than the terminal control function.

TABLE E-1
(CONTINUED)

2. STEP 2: 1983 System (Concluded)

2.7 National Delay Analysis and Performance Reporting

2.7.1 Manually Compiled Delay and Performance Reports

2.7.2 Automated Transmission from Pacing Airports of Actual
Performance Data for Their High Demand Periods

2.7.3 Hourly Review of Capacity Estimates for High Demand
Periods Based on Comparison of Actual and Predicted
Performance

TABLE E-1
(CONTINUED)

3. STEP 3: 1986 System

3.1 Demand (Flight) Data Base (National Flow Computer)

3.1.1 OAG Schedules, Historical Estimates of Unknown NAS Traffic (e.g., VFR, Tower En Route, Pop-Ups, etc.)

3.1.2 Automated Updates* from All Centers and All Major Terminals

3.1.3 Automated Inputs from Airlines

3.1.4 Expanded NAS Flight Data for Arrivals and Departures for Pacing Airports

3.1.5 Manual Oceanic and Automated Central Altitude Reservation Function (CARF) Data Interface

3.1.6 Automated Transmission of ERM 2 Outer Fix Advisory Data from Host Center to National Flow Computer

3.1.7 Bulk Stored Flight Data (Batch Transmission from Centers to National Flow)

3.2 Capacity Data Base (National Flow Computer)

3.2.1 Automated/Manual Transmission of Runway Configurations, Capacity Estimates and Conditions for Major Airports

3.2.2 Performance Measurement System Capacity Data Maintained to Facilitate Airport Capacity Estimation

3.2.3 Airport Capacity Estimates Assembled for Periodic Time Intervals (Based on PMS Data and Reported Runway Configurations, Capacity Estimates and Conditions); May be Determined by a Simplified Terminal Configuration Management Capability

* The Expanded Communications Requirements for the Future IFM System will Probably be Supported by the National Airspace Data Interchange Network (NADIN).

TABLE E-1
(CONTINUED)

3. STEP 3: 1986 System (Continued)

3.2.4 Capacity Estimates for Host Center Terminal Arrival
Meter Fixes and Other Selected En Route Fixes

3.3 Weather Data Base (Automated/Manual)

3.3.1 National Weather Service Information (Forecasts,
Weather Radar Reports, etc.)

3.3.2 Telephone Coordination of Weather Information with
Center Weather Service Units

3.4 User Interface

3.4.1 Automated Communications Interface with Most Users
(for Advisories) via ARINC Teletype Network

3.4.2 Verbal Coordination of Delay Programs with Other
Users

3.5 National Flow Management - Airport

3.5.1 Data Base and Software Expanded to Include All Major
Terminals

3.5.2 Automated Accounting for Multi-Airport Interactions
During Flow Management of Simultaneous Congestion
Problems

*3.5.3 Assignment of Ground Delays on an Individual Aircraft
Basis (Provided Directly to Air Carriers, Users) at
Any Airport When 15 Minute Airborne Delays are
Predicted to Occur for at Least 2 Hours at an
Impacted Airport

* These activities are transparent to the impacted airport and the airports where ground delays have been imposed since all time adjustments will be performed by the individual users (as instructed by National Flow) rather than the terminal control function.

TABLE E-1
(CONCLUDED)

3. STEP 3: 1986 System (Concluded)

*3.5.4 Manage Arrival/Departure Traffic Flow (Adjust Arrival/Departure Rate) to Selected Airports to Avoid Ground Traffic Saturation (By Assigning Ground Delays to Individual Aircraft at Selected Airports Feeding the Impacted Airport)

3.6 National Flow Management - En Route

3.6.1 Reactive to Problem Situations (e.g., Weather, Restricted Airspace, Military Missions); Problem Description and Relief Strategy Coordinated by Telephone or Teletype Communications with Facilities and Users

3.6.2 Predictive Capability for Selected En Route Fix Loading (Including Meter Fixes)

3.6.3 Fuel Economy Flow Management Considerations to Minimize Airborne Holding

3.6.4 Implementation of Manual Flow Management Procedures Based on Limited Automated Prediction Capability

3.6.5 Limited Direct Routing Accommodated in En Route Capacity Predictive Model

3.7 National Delay Analysis and Performance Reporting

3.7.1 Automated Compilation by National Flow of Actual Delay and Performance Data for High Demand Periods Transmitted from Pacing Airports

3.7.2 Hourly Review of Capacity Estimates for High Demand Periods Based on Comparison of Actual and Predicted Performance

3.7.3 Limited Capability to Recreate (Simulation) and Analyze Terminal Delay Situations

* These activities are transparent to affected airports, since adjustments will be performed by individual users.

TABLE E-2
AUTOMATED EN ROUTE ARRIVAL METERING
ROADMAP

1. (1981/82) STEP 1: ERM 1* Basic Capabilities

1.1 En Route Metering 1 (ERM 1) Outputs

a. To Terminal

- None (Except for Delivery of Aircraft to Match Terminal's Desired Rate)

b. To Adjacent Centers and/or National Flow Management

- None (Manual Coordination Only)

1.2 Inputs to ERM 1 from Major Terminals (for which Arrival Traffic Metering is Provided)

- Airport Acceptance Rate** (AAR)
 - Current and One Planned Future AAR Change
- Runway Configuration**
 - Current and One Planned Future Configuration Change

1.3 ERM 1 Functions

- First Come, First Served (FCFS) Schedules Based on Nominal Flying Time Estimates and Terminal Acceptance Rate
- Meter Fix Time (MFT) and Delay at Adapted Meter Fixes for Center Only to Arrival Sector Controllers

* ERM 1 Denotes the Automated En Route Metering Capability Developed by the Air Traffic Service (AAT) of the Federal Aviation Administration. This Automated National Airspace System Enhancement Corresponds to the NAS Change Proposal (NCP) 4319.

** The Determination of These Inputs Could be Enhanced by use of an Automated Selection Capability Provided by a Terminal Configuration Management System.

TABLE E-2
(CONTINUED)

ASSUMPTIONS

- Terminal Sequencing and Spacing Functions Performed Manually
- The Determination of Terminal Inputs to ERM Could be Enhanced by use of an Automated Resource Planning and Selection Capability Provided by a Terminal Configuration Management System.

TABLE E-2
(CONTINUED)

2. (1983/84) STEP 2: ERM 2* Basic Capabilities

2.1 ERM 2 Outputs

- a. To Terminal
 - None (Except for Delivery of Aircraft to Match Terminal's Desired AAR)
- b. To Adjacent Centers
 - Transmission of Outer Fix Advisories (Outer Fix Times and Associated Delay) for Delays which Exceed the Nominal Controllability Available to the Host Center
- c. To Host Center (Local Outputs)
 - FCFS Schedules Based on Aircraft Specific Flying Time Estimates and Terminal AAR
 - MFT and Delay to Arrival Sector Controllers
 - Delay Absorption Advisories (Speed, Descent, Outer Fix and Hold) to Sector Controllers (Arrival and Upstream Sectors)
 - Delay Crediting (to Accommodate Departure Delays Scheduled Locally or by National Flow)
- d. To National Flow (If Possible)
 - Automatic Transmission of Outer Fix Advisory Delays that are Also Being Sent to Adjacent Centers

* ERM 2 Denotes the Enhanced En Route Metering Capabilities Developed by the Systems Research and Development Service (ARD) of the Federal Aviation Administration.

TABLE E-2
(CONTINUED)

2. (1983/84) STEP 2: ERM 2 Basic Capabilities (Concluded)

2.2 Inputs to ERM 2 from Major Terminals (for which Arrival Traffic Metering Is Provided)

- Airport Acceptance Rate (Manually Provided)
 - Current and One Planned Future AAR Change
- Airport Configuration (Manually Provided)
 - Current and One Planned Future Configuration Change

ASSUMPTION

- Terminal Sequencing and Spacing Functions Performed Manually
- Determination of Terminal Inputs to ERM Could be Enhanced by Use of an Automated Resource Planning and Selection Capability Provided by a Terminal Configuration Management System (CMS).
- A Possible Early One-Way Interface Could be Implemented to Provide ERM Scheduling Information (e.g., Meter Fix Times, Aircraft Identification and Type) for Display to the Terminal Controllers. The Arrival Traffic Scheduling Data Would Facilitate Terminal Planning by Providing Early Notification of Future Traffic Demand.

TABLE E-2
(CONTINUED)

3. (1984/85) STEP 3: Expanded En Route Metering Capabilities (ERM 2)

3.1 ERM 2 Expanded Functions

- ERM 2 Provides Dynamic Rate Adjustment Based on Given Mix of Arrival Traffic (e.g., High Performance, Heavy and Low Performance Classes) and Runway Configuration. (NOTE: This capability may be available for designated terminals where a large percentage of traffic is known; Could be Time of Arrival (TOA) Calculations or Table Driven).
- ERM 2 Automatically Transmits Scheduled Outer Fix Times (OFT) to Adjacent Centers; Possibly, Delay Absorption Advisories Could Be Generated to Controllers in the Adjacent Center to Meet the OFT.

3.2 Inputs to ERM 2 from Major Terminals (for which Arrival Traffic Metering Is Provided)

- Manual Feedback: Adjustment of the Computed Times to Fly to Runway as Conditions Change (e.g., Winds Change, or Aircraft Taking Short Finals)

ASSUMPTIONS

- Terminal Sequencing and Spacing Functions Performed Manually
- FCFS Order Maintained in Schedules Generated by ERM
- Initial Feed-back From the Terminal for AAR Adjustment may be Performed Manually; the Fine-tuned Adjustments Could be Facilitated by a Terminal CMS.
- ERM Arrival Traffic Schedules may be Provided Via an Automated Interface for Display to the Terminal Controllers.

TABLE E-2
(CONTINUED)

4. (1985/86) STEP 4: ERM 2 Capabilities During Step 1 of Terminal Planning Aid Automation

4.1 ERM 2 Outputs to Terminal Planning Aid (TPA)

- ERM Automatically Provides (to Terminal Planning Aid) Current Scheduled Meter Fix Times (MFT) and the Unrestricted Time of Arrival at the Meter Fix (CTA) for All Metered Flights, from at Least 90 Minutes Prior to Estimated Time of Arrival at the Runway (CTAs & MFTs Updated as Appropriate; i.e., Radar Track and Progress Report Updates).
- ERM Provides Terminal (for Coordination Purposes) the Current Runway/Meter Fix Sequence and Schedule to Meet the Terminal Specified AAR -- When Requested by Terminal.

4.2 ERM 2 Outputs to National Flow

- Automatic Transmission of Outer Fix Advisory Delays that Are Also Being Sent to Adjacent Centers.

4.3 Terminal Outputs to ERM (from Terminal Planning Aid)

- Two Methods for Adjusting the ERM Schedules When There is a Possible Mismatch Between the Acceptance Rate Provided by the Terminal and the Fine-tuned Capacity Estimated Derived by the TPA.
 - a. Aircraft Specific Adjustments
 - Proposed Times of Departure (PTDs)* from the Meter Fix (and Possibly Altitude at Meter Fix) for Aircraft when ERM Meter Fix Time Does Not Provide for Sufficient Delay Absorption (Automatically Sent to ERM for ERM Adjustment of

* PTD is the Earliest Time an Aircraft Can Cross the Meter Fix Without Having to Absorb Delay Beyond that Which Would be Nominally Available (Without Holding) in the Terminal Area.

TABLE E-2
(CONTINUED)

MFT to PTD When Additional Delay is Needed) --
the PTD Must Be Available to ERM at Least a
Specific Parameter Lead Time Prior to the Meter
Fix CTA.

- b. Airport Acceptance Rate Adjustment (Impacts all
Arrival Traffic)

ASSUMPTIONS

- Initial Operational Capabilities of Terminal Planning Aid
and Automated ERM/TPA Interfaces Implemented.
- Possible Application of Terminal Configuration Management
System to Facilitate Fine-tuned Schedule Adjustments (Via
Interface with TPA and Possibly ERM).

TABLE E-2
(CONCLUDED)

5. (1986/87) STEP 5: ERM 2 Capabilities During Step 2 of Terminal Automation Enhancements

- 5.1 ERM Will Output to the TPA the Unrestricted Calculated Time of Arrival (CTA) at the Meter Fix for Each Metered Flight (Adjusted for Expected Nominal Aircraft Performance)
- 5.2 ERM Will Not Perform Scheduling to Runway Based on AAR Specified by Terminal (Scheduling Function (i.e., MFTs) Will Be Provided by TPA)
- 5.3 Terminal Sequencing and Spacing Calculations Will be Performed by the TPA to Provide MFT Schedules and Possibly Altitude Over Meter Fix to ERM at a Specific Parameter Lead Time Prior to the Flights Meter Fix CTA

ASSUMPTIONS

- Advanced Terminal Planning Automation May Not Be Implemented at Some Airports for Which Arrival Traffic Metering Is Provided. For Those Cases, the ERM Function Would Perform All Scheduling Computations as Defined in STEP 3.
- Additional Information Exchange Between ERM and the TPA May Be Required if an Automatic Departure Traffic Scheduling Capability is Incorporated in the TPA.

TABLE E-3
TERMINAL TRAFFIC FLOW PLANNING AUTOMATION ROADMAP

1. (1985/86) OPERATIONAL STEP 1: Basic Terminal Planning Aid (TPA)* Capabilities

NOTE: The First Two Items Below Correspond to STEP 4 of ERM Capabilities

1.1 Minimum Level of ERM Support for the TPA Would Include the Following Inputs

- Meter Fix Times (Scheduled by ERM) for Each Metered Flight (at Least 90 Minutes Prior to ETA at Airport Runway and Updated as Appropriate)
- Computed Estimates of the Unrestricted Times of Arrival (CTA) at the Meter Fix

1.2 Terminal Outputs to ERM (From Terminal Planning Aid) Proposed Times of Departure (PTD's) from Meter Fix and Possibly Altitude at the Meter Fix (or AAR Adjustment) when ERM Rate (MFTs) Does Not Match Terminal Capabilities as Estimated by the TPA (PTD Provided Automatically to ERM at Least a Specific Parameter Lead Time Prior to the Aircraft's CTA)

1.3 Basic TPA Function

- Automatically Computed Landing Sequence Provided to Terminal Controllers (e.g., Displayed in Full Data Blocks)

* The Current Implementation Status of Terminal Automation Programs has not been Resolved. Hence the Implementation Schedules for the Terminal Automation Capabilities Identified Herein are Speculative Approximations.

TABLE E-3
(CONTINUED)

1. (1985/86) OPERATIONAL STEP 1: Basic Terminal Planning Aid (TPA) Capabilities (Concluded)

ASSUMPTIONS

- FCFS Ordering Reflected in Schedules with Possible Adjustments Based on Fuel and Operational Considerations
- A Possible Early Interface may be Established Prior to TPA Implementation to Provide ERM Arrival Traffic Scheduling Information for Display to the Terminal Controllers.
- Possible Application of Terminal Configuration Management System to Facilitate Fine-tuned Sequencing and Spacing Computations.

TABLE E-3
(CONCLUDED)

2. (1986/87) OPERATIONAL STEP 2: Enhanced Terminal Planning Aid Capabilities

2.1 ERM Will Provide to the TPA Calculated Time of Arrival and Possibly Altitude at Meter Fix for Each Metered Flight (Adjusted for Expected Nominal Aircraft Performance)

2.2 A Terminal Configuration Management System (TCMS) May Provide Basic Information to the TPA on Configuration, Capacity and Constraints

2.3 TPA Will Compute

- Landing Sequence and Schedule
- Scheduled Times at Meter Fixes Based on Fine Tuned Sequence and Schedule

2.4 TPA Will Output to ERM

- MFT and Possibly Altitude at the Meter Fix (at least a Specific Parameter Lead Time Prior to the Aircraft's CTA at the Meter Fix)

ASSUMPTIONS

- Automatic Departure Flow Management May be Possibly Incorporated in the TPA to Perform Terminal Departure Traffic Scheduling. This Capability Would Require Additional Information From ERM to Account for Interactions Between Arrival and Departure Traffic Flow.
- A Possible Interface with an Automated Terminal Configuration Management System may be Provided to Support Terminal Capacity Estimation and Optimal Fix Load Balancing in the TPA Scheduling Process.

TABLE E-4
TERMINAL CONFIGURATION MANAGEMENT SYSTEMS
ROADMAP

1. (1981/82) STEP 1: Runway Configuration Management System (CMS): Short Range Dynamic Capability Developed for Chicago (ORD)
 - a. INPUTS: Set of Current and Forecast Operating Conditions
 - Geographic Distribution of Arrival Traffic
 - Wind and Weather (e.g., Visibility, Ceilings)
 - Arrival/Departure Traffic Mix
 - Aircraft Traffic Mix by Performance Classes
 - Runway Availability (i.e., Closures for Maintenance and Snow Removal)
 - Current Equipment Status (Outages)
 - Impact on Runway Operations by Traffic at Nearby Airports (e.g., Midway Traffic Affects O'Hare Operations)
 - Runway Surface Conditions (e.g., Ice, Braking Conditions)

TABLE E-4
(CONTINUED)

1. (1981/82) STEP 1: Runway Configuration Management System:
Short Range Dynamic Capability Developed for Chicago (ORD)
(Concluded)

b. OUTPUTS: To Terminal Control (at ORD)

- Ordered List of Feasible Runway Configurations in Decreasing Order of Capacity (with Corresponding Estimates of Runway Capacity for Each Configuration) for a Single Set of Given Operating Conditions
- Ordered List of Feasible Configuration Pairs (from Current Configuration) Based on Total Capacity (Including Capacity Estimates for Each Runway Configuration and the Intermediate Transition)

c. APPLICATIONS

- Aid in Selection of Configurations which Would Minimize Delays Over a Longer Planning Period Where Some Operating Conditions Are Expected to Change
- Provides Demand Balancing Information (e.g., Geographic Distribution of Arrival Traffic) to Improve Capacity for a Given Runway Configuration
- Provides Terminal with Information Needed to Estimate Current Capacity and Acceptance Rates
- Accounts for Impact on Capacity During Transition from Current Runway Configuration to Another (as a Result of Changes in Operating Conditions)

TABLE E-4
(CONTINUED)

2. (1984/86) STEP 2: Projected Runway CMS Interface with ERM and Terminal Planning Aid (via Manual or Automatic Input)
 - a. Selected Runway Configuration Output to ERM and the Terminal Planning Aid (TPA), as These Automated Capabilities Become Available
 - b. Estimated Capacity for Runways and Total Airport (AAR Determined from Runway Capacity Provided to ERM during Initial Steps of Implementation)
 - c. Optimal Arrival Traffic Demand Balance (i.e., Geographic and Time Distribution) at Terminal Boundaries Provided to TPA by Runway CMS

TABLE E-4
(CONTINUED)

3. (1985/86) STEP 3: Advanced Long Range Dynamic Runway CMS Capability (ORD and Possibly Other Sites)
 - a. Addresses Extended Planning Horizon Over "N" Time Frames
 - b. Accounts for Transition Effects for Multiple Runway Configuration Changes Based on Expected Changes in Operating Conditions during Each Time Frame
 - c. Output of Model Includes an Ordered List of Feasible Runway Configuration Selection Strategies Based on Achieving High Capacity Over an Extended Planning Period
 - d. The Advanced Capability Requires a Significant Increase in the Availability and Quality of Forecasted Input Data Over the Extended Planned Horizon. An Integrated Flow Management System Will Provide an Improved Predictive Capability to Support the Longer Range Planning Function.

TABLE E-4
(CONCLUDED)

4. (1986/87) STEP 4: Other Possible Terminal Configuration Management System (TCMS) Enhancements

a. Runway Configuration Management Systems

- Runway Selection Could Explicitly Include Other Constraints Such as Noise and Staffing Levels
- Automated Interfaces with Runway Configuration Management Could Possibly Include
 - Vortex Advisory Systems
 - Equipment Monitoring Systems
 - Weather Information Systems
- Automated Sequence and Spacing Adjustment by an Automated Terminal Planning Aid could be Facilitated by the Availability of the Runway CMS Dynamic Outputs.

b. Other TCMS Site - Specific Applications

- Possible TCMS Application for Terminal Airspace Configuration Planning for Sites Characterized by Congested Airspace (e.g., New York)
- Possible TCMS Application to Manage Ground Flow Problems at Terminals Where Aircraft Must Taxi Across Active Runways.

APPENDIX F

REFERENCES

1. D. L. Adams, "Integrated Flow Management Inputs for the ATC Computer Replacement Specification," WP-81W381, The MITRE Corporation, McLean, Va., July 1981.
2. P. O. Dodge, et al., "Definition, Description, and Interfaces of the FAA's Developmental Programs," MTR-7904, The MITRE Corporation, McLean, Va., September 1978.
3. K. M. Levin and N. J. Zech, "En Route Metering Functional Specification," MTR-79W115, Revision 2, The MITRE Corporation, McLean, Va., September 1980.
4. A. N. Sinha, J. S. Matney, and K. M. Levin, "Preliminary Strawman Concept of Flow Management," WP-80W848, The MITRE Corporation, McLean, Va., October 1980.
5. A. N. Sinha and R. L. Fain, "Runway Configuration Management System Concepts," MP-79W18, The MITRE Corporation, McLean, Va., May 1979.
6. K. M. Levin, "Implementable Terminal Sequencing and Spacing Minimum Functional Requirements," WP-81W607, The MITRE Corporation, McLean, Va., October 1981.