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MITRE TECHNICAL REPORT

# CRCT Capabilities Detailed Functional Description

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**Center for Advanced Aviation System Development**
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# Abstract

This report provides an initial baseline of new traffic flow management operational capabilities resident in the Collaborative Routing Coordination Tools (CRCT) Concept Demonstration Platform (CDP). Developed by the Center for Advanced Aviation System Development (CAASD), the CRCT CDP has been a key aspect of the conceptualization and development of CRCT capabilities by serving as a demonstration and evaluation platform. The CRCT functional capabilities implemented in the CRCT CDP consist of the Traffic Display Function, the Flow Constrained Area Function, the Rerouting Function and the Data Sharing Function.

The information in this report is intended to provide design and engineering guidance to those involved in the technology transfer and implementation of CRCT capabilities in the Enhanced Traffic Management System (ETMS). It will also be a useful reference for operational subject matter experts engaged in CRCT operational evaluation activities.

KEYWORDS: CRCT, air traffic control, decision support, platform, prototype, traffic flow management, rerouting, demand, traffic manager, capabilities, severe weather

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**Section 1**

# Introduction

## 1.1 Document Purpose

Traffic flow management (TFM) decision support functions known as Collaborative Routing Coordination Tools (CRCT) are under research and development (R&D) by the MITRE Corporation's Center for Advanced Aviation System Development (CAASD) in support of the Federal Aviation Administration (FAA). CRCT capabilities are being developed to help traffic managers improve the management of sector congestion, the effects of severe convective weather, and other operational conditions requiring traffic flow management actions.

This report provides an initial baseline of CRCT functional capabilities implemented in the CRCT Concept Development Platform (CDP) as of March 2001. Developed by CAASD, under contract with the FAA, the CDP has been a key aspect of the conceptualization and operational evaluation of CRCT capabilities. Consisting of hardware and software, the CDP is a demonstration and evaluation platform developed to define and evolve CRCT capabilities. The CDP serves as a vehicle for collecting input from flow management operational subject matter experts on the proposed capabilities. The feedback, in turn, has helped to refine operational concepts and define CRCT's requirements for technology transfer to the Traffic Flow Management Infrastructure (TFM-I).

The CDP in its offline form has also been utilized as a demonstration and evaluation tool for groups involved in airspace redesign and procedural and operational analysis. However, requirements for the offline capability are not addressed in this document.

## 1.2 Audience

This report will serve as a useful reference for several audiences, including the developers and implementers of CRCT capabilities, FAA management and operational personnel, and system engineering personnel. In particular, it will be a reference for the Volpe National Transportation Systems Center (VNTSC) software developers as they implement CRCT functionality in the TFM-I. It will also be of value to the CRCT Core Team as it works to define TFM operational requirements and evaluate evolving TFM-I technology. In particular, this report will help team members assimilate and understand the baseline set of CRCT capabilities that have evolved to date through the R&D process.

## 1.3 Background

### 1.3.1 Operational Need for CRCT Capabilities

Today, traffic managers are expected to manage traffic flow problems (e.g., traffic congestion, sector loading due to weather-related aircraft deviations) with somewhat limited information about expected future traffic demand. Few decision support aids are available to help ensure that their decisions are effective, including tools to assess the potential effects of traffic management actions before they are implemented. As a result of these information limitations, traffic management decisions may not have the desired effect of balancing traffic demand and available airspace capacity. Instead, flow problems may be alleviated in one area while negatively impacting traffic flow in other areas, or an action may be taken unnecessarily, unwittingly penalizing users as a byproduct.

In the current environment the sharing of traffic management data among FAA facilities, as well as between the FAA and airspace users, is sometimes inefficient and untimely. As a result, parties that need to be aware of potential problems and constraints in the National Airspace System (NAS) may not receive the needed information in time to plan and respond effectively and efficiently.

In summary, traffic managers need better information about future traffic developments and information characterizing to the potential impacts of proposed traffic flow management strategies before they are implemented. In addition, mechanisms for sharing traffic management data and plans within the FAA, as well as between the FAA and airspace users, are required to facilitate collaborative decision making and efficient coordination of planning and decision data.

### 1.3.2 Applicable Operational Environments for CRCT Capabilities

When deployed, the CRCT capabilities reflected in the CDP are intended for direct use in Traffic Management Units (TMUs) located in en route Air Route Traffic Control Centers (ARTCCs), and at the Air Traffic Control System Command Center (ATCSCC). Traffic management positions that could benefit from CRCT capabilities and data include the positions dedicated to severe weather planning, sector alert analysis and planning, and en route spacing of departures. The potential utility of the capabilities by Terminal Radar Approach Control Facilities (TRACONs) and airline operational control centers has not yet been evaluated.

### 1.3.3 Role of the CDP in the Evolution of CRCT Capabilities

The FAA's R&D process establishes a path for taking new capabilities through R&D and the transitions necessary to attain the goal of operational use. The process is structured into multiple phases, consisting of Concept Exploration (CE), Concept Development (CD), Prototype Development (PD), and Full Scale Development (FSD). During the CE Phase, an

initial operational concept is defined and technical feasibility is explored and established. During the CD phase, the concept defined during CE is expanded in detail and activities are conducted to define potential benefits and to verify that the concept satisfies the needs of the operational community. Users' functional and information needs are also delineated through the CD process. During PD, an operational prototype, based on the intended operational platform, is developed and implemented to further confirm the requirements. Finally, the functions are implemented at an operational level during FSD.

The CRCT CDP was developed and enhanced during the CE and CD phases of the R&D activity based on operational input from TFM field personnel. An initial version was implemented during CE, serving as a laboratory-based concept exploration platform. The CDP was used to facilitate visualization of initial CRCT functions and to define a preliminary operational concept for the functions when applied in the en route traffic management unit environment. During laboratory evaluations, traffic flow management field personnel provided input that led to the refinement and expansion of initial CRCT functions. These changes were necessary to shape the functionality to satisfy recognized traffic management operational needs.

During the CD phase, laboratory and field evaluations of CRCT functionality were conducted using the CDP. The system was initially installed in a laboratory at Kansas City ARTCC, and later in the facility's TMU. In the laboratory, evaluations were conducted in which field operational personnel (primarily en route TMU staff) participated in demonstrations of CRCT functions that depicted how they could potentially be applied to typical TMU events (e.g., predicted sector overloads and severe convective weather). After observing the demonstrations, verbal feedback was solicited from the participants. The feedback helped identify key operational information needs and verified that the information provided by the capabilities satisfied the field's operational requirements. The CDP Human Computer Interface (HCI) usability was also addressed during the evaluations with the goal of establishing adequate usability for the conduct of hands-on evaluations using the CDP. These laboratory activities led to the definition of an expanded CRCT operational concept and changes and enhancements to the CDP.

Besides laboratory exercises, the CDP has been used to support real-time field operational evaluations of CRCT functionality in the TMU. For these evaluations, a CDP configuration was installed in the operational control room and made available to field operational personnel. Based on their experience with CRCT functions provided by the CDP, the field participants provided feedback on whether CRCT functions and information satisfy their real-time operational needs. Areas were noted where more or different information is needed. In addition, the evaluations facilitated greater understanding of the potential operational uses of CRCT [1].

The first operational evaluation of CRCT functions implemented in the CDP was performed at Kansas City ARTCC's TMU from April through September 2000 and is

expected to resume in FY2001 [2]. Evaluations at the Indianapolis ARTCC TMU and the ATCSCC are also planned for 2001. The CDP will be modified, as necessary, in response to the field's input during these evaluations. After the completion of the evaluations, functions deemed mature will be documented and the technology transferred to VNTSC for implementation in the TFM-I.

### 1.3.4 Maturity of CRCT Functions

As part of the Fiscal Year (FY) 2000 CRCT evaluation at Kansas City ARTCC's TMU, the *maturity* of CRCT capabilities–their readiness for fielding in the TMU–was assessed by the facility's primary CRCT evaluator, who rated each set of functions. The results indicate the Flow Constrained Area and Rerouting functions are sufficiently mature for fielding in the TMU. To validate this preliminary result, additional operational input by a broader set of evaluators will be obtained during FY2001 evaluations at Kansas City ARTCC, Indianapolis ARTCC, and the Air Traffic Control System Command Center.

## 1.4 Document Organization

Following this Introduction are two sections describing the CDP's Decision Support Subsystem (DSS) in terms of its software structure (Section 2) and user capabilities (Section 3). Section 2 decomposes the CDP DSS functionality at a high level, explaining how the DSS uses its data inputs to provide the information needed by traffic managers. Three services are described (Flight Prediction Service, Flow Analysis Service, and the Human Computer Interface), as well as the relationships among those services, the system's data inputs, and user functionality.

Section 3 provides a detailed description of the user capabilities within the functional areas closely corresponding to VNTSC's plans for implementation of CRCT functions in the TFM-I. The Traffic Display functions (Section 3.1) correspond to VNTSC's current Traffic Situation Display, the Flow Constrained Area functions (Section 3.2) correspond to VNTSC's CRCT implementation Phase 1 plans, and the Rerouting functions (Section 3.3) correspond to Phase 2 of VNTSC's CRCT implementation plans. Section 3.4 contains a description of the CDP Data Sharing functional capabilities.

Finally, the Appendix lists capabilities that have been proposed by TFM field personnel who have participated in laboratory and field evaluations of CRCT functions. These proposed capabilities have not yet been implemented in the fielded version of the CDP. In some cases, a particular capability may need no evaluation, for example, because the operational concept is already well understood or the need for the enhancement in the field is self-evident. In other cases, the proposed capabilities are being developed for a future release of the CDP, or they are being implemented by CAASD in a concept exploration research platform separate from the CDP for evaluation in the laboratory setting. Further study of these capabilities by CAASD and the FAA is planned.

**Section 2**

# CDP Decision Support Subsystem Software Functions and Data Inputs

## 2.1 CDP Overview

The CDP has two subsystems: (1) Decision Support and (2) Data Collection. The Decision Support Subsystem (DSS) contains the Human Computer Interface (HCI) and two service functions that manage information for the user. The Data Collection Subsystem (DCS) continuously receives external data used by the DSS and archives it. Three different data sets are received: (1) live Host data (if CRCT is in a TMU), (2) Enhanced Traffic Management System (ETMS) data (which includes two sets of data: flight plan and other related Air Traffic Control [ATC] data, and NOWRAD [a national weather mosaic of NEXRAD reflectivity data] weather data), and (3) meteorological (wind, temperature and pressure) prediction data. Both subsystems have a status monitor process.

The CDP hardware supporting the user interface usually consists of a single SUN workstation with two 19-inch monitors and a color printer, as illustrated in Figure 2-1. This year the ATCSCC will be evaluating CRCT using a single-monitor configuration. The CDP HCI is presented on high-resolution color graphics monitors capable of providing information through various display windows. All display windows have standard display manipulation features such as scrolling, sizing, iconifying, and restoring. Descriptions and illustrations of the specific display designs associated with each DSS function will be available in April 2001 in *The CRCT User's Guide* [3].

The CDP's message entry is primarily menu based utilizing a single mouse operated with the two monitors for point and click actions. An alphanumeric keyboard is also provided, permitting text and numeric data entry.

## 2.2 Functional Design of the CDP DSS

The CDP DSS has three major functions, with the functional design shown in Figure 2-2. These consist of the HCI and two service functions that communicate with the HCI for user input and display, (1) the Flight Prediction Service (FPS) and (2) the Flow Analysis Service (FAS). The HCI is responsible for user input and output. The FPS concentrates on individual flights, maintaining a detailed, predicted trajectory for every active flight and for all flights expected to take off within the next six hours. This ensures the DSS is always cognizant of where a flight will be and when it will arrive there. The FAS concentrates on deriving aggregates of flights. It identifies individual flights involved in user-defined flows using the information provided by the FPS so that the DSS always maintains awareness of which flights will be in specific airspaces during specific time periods. The three DSS

functions share the dynamic aircraft data. The CRCT CDP software architectural design does not exactly correspond with the functional architecture, and will not be included in this description.

**Figure 2-1. CRCT Two-Monitor Configuration**

The three functions make use of dynamic and static data sources, as shown in Figure 2-2, each of which is updated according to different schedules, depending on when new information is available. Table 2-1 lists the update rates for each data source.

**Table 2-1. CRCT Data Sources Update Rates**

| Data Source | Update Rate |
|---|---|
| Host track and sector with track control updates | Every 12 seconds |
| Host Sectorization | When changes occur |
| ETMS track updates | Every minute |
| ETMS other information (e.g., flight plan changes) | Immediately whenever Host passes the information to ETMS |
| NOWRAD weather radar data | Every five minutes |
| WARP meteorological data | Every three hours |
| Sector load thresholds | Weekly |
| ATC sector descriptions | Every 56 days |
| Navigational information | Every 56 days |
| ATC procedures information | Occasionally, when receive new data |
| Aircraft performance characteristics | Occasionally, when receive new data |
| SUA definitions | As needed |
| Geopolitical boundaries | As needed |

The next three subsections describe the responsibilities of each of the three DSS functions.

### 2.2.1 Flight Prediction Service

The FPS is responsible for tracking individual flights in the National Airspace System (NAS), whether proposed or active. When the FPS first receives proposed plan information for a flight through the Data Collection Subsystem's interface to ETMS, it creates an initial trajectory based on the planned departure time and route, the current wind forecasts, the departure airport delay statistics, the aircraft performance characteristics, navigational information, and any known Air Traffic Control (ATC) procedures or restrictions. (These last three sets of information are stored as static data sets, regularly updated offline.)

Subsequently, the composite flight data is stored in an internal aircraft-specific database and the other processes are informed.

The FPS continually generates new trajectories each time it gets information that affects its predictions. A new flight plan with a change in the altitude or route causes the FPS to generate a new trajectory, for example. If track messages indicate that a flight is off its planned route, a new trajectory is built to take this into account, assuming the flight intent is to rejoin the route downstream. Besides tracking active and proposed flights, the FPS tracks trial plans that CRCT users create when evaluating strategies for resolving problems. Trajectories are generated for these trial plans, then stored in the database, and the other services are informed about them.

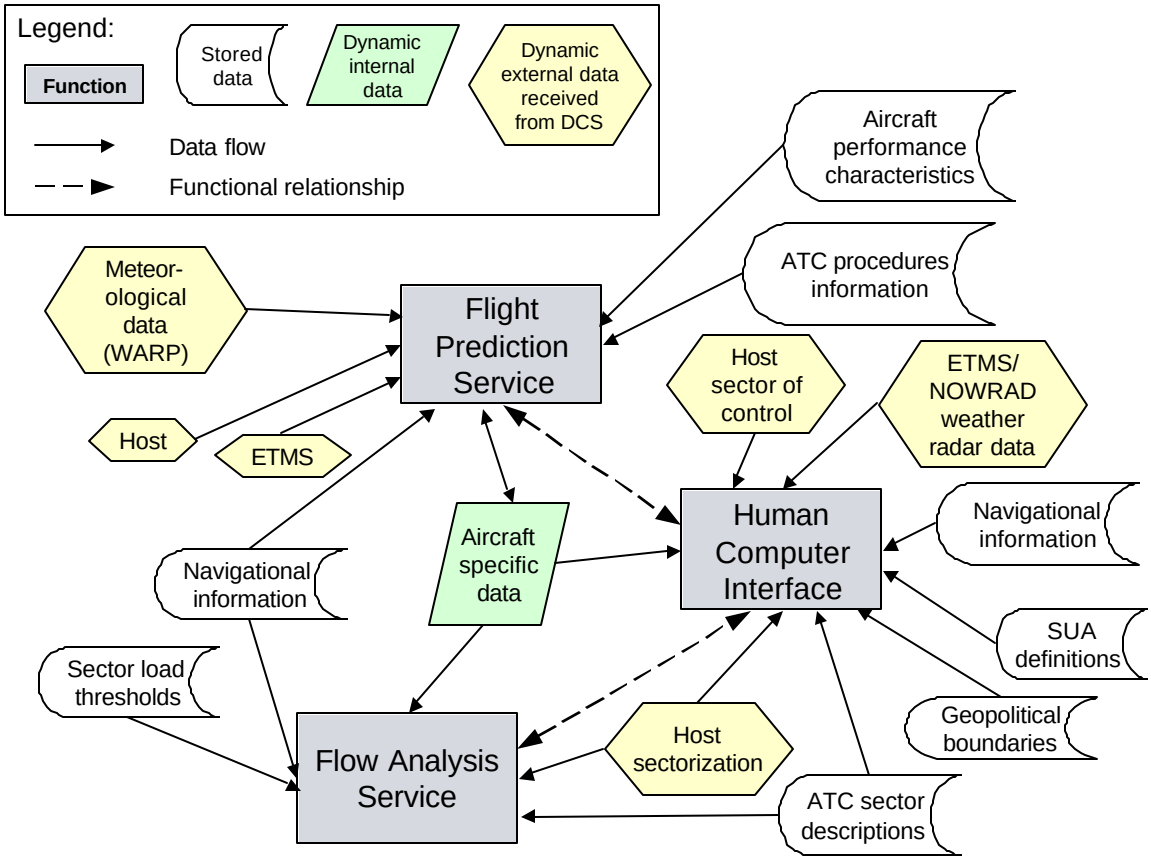


**Figure 2-2. CRCT CDP DSS Functional Design**

The FPS receives most of the external data used by CRCT. The three different external data sources with interfaces to the FPS via the Data Collection Subsystem are the Host, ETMS, and the Weather and Radar Processor (WARP).

If available, the FPS uses the local Host Computer System 12-second track updates to regenerate trajectory predictions as needed. This interface was implemented in order to be able to analyze whether these track updates would be useful for updating flight positions during times when aircraft are flying off their planned routes, e.g., during adverse weather conditions.

From ETMS, the FPS uses the flight plans, departure and arrival messages, track updates, and flight plan amendments to generate and update the aircraft information, including the trajectory prediction (along with the wind data received from the WARP interface). For those aircraft not receiving Host track updates, the FPS uses the ETMS track updates to follow the flight and update the trajectory predictions.

The FPS incorporates WARP's forecasts of wind, temperature, and pressure into an internal meteorological data grid, which is used by the trajectory prediction algorithm. The location of the Jet Stream, for example, affects the ground speed of those aircraft flying with or against it.

### 2.2.2 Flow Analysis Service

The FAS is responsible for generating and tracking aggregate information about traffic flows in the NAS. To do this, the FAS accesses the aircraft-specific flight data generated by the FPS. The FAS also accesses the same navigational information the FPS uses. In addition, the FAS makes use of sectorization messages received from the local Host and two other static data sets that are kept up to date offline: ATC sector descriptions and sector load thresholds.

The FAS predicts airspace loads in the NAS. It predicts sector loads using the latest trajectory predictions of active and proposed aircraft. These predictions are based on the air traffic control sector descriptions that assign airspace to sectors. For those CRCT CDP workstations with an interface to local HCS, HCS sectorization messages report any changes that the ARTCC makes in its assignment of airspace to sectors. When such revisions are received, the FAS updates the sector load predictions to reflect the new assignments and the HCI updates the displays.

The FAS is not limited to predicting sector loads. It also analyzes system flows to predict which aircraft will be in any defined airspace, or which aircraft make up specified flows (e.g., flows between certain city pairs). The most common such airspace is a Flow Constrained Area (FCA), airspace that is defined temporally, vertically, and laterally in the CRCT CDP using the FCA function (see Section 3.2).

In the CRCT CDP, FAS airspace load predictions are updated with every actual and proposed change in the system. They are dynamically accessed by the HCI, so as users create new trial plans, or change existing ones, the predictions are constantly updated.

### 2.2.3 Human Computer Interface

The HCI presents information to the user, and receives and passes on user requests to the FPS and the FAS. The HCI has numerous displays which allow the user to interact with the system. The Traffic Display toggles back and forth with the Future Traffic Display on a single monitor, and the other lists and displays (e.g., FCA List, Rerouting List, NAS Monitor and Sector Count Monitor, etc.) are presented on a second monitor (if available). The HCI receives current weather radar data enabling it to display reflectivity levels on the Traffic Display and Future Traffic Display. If available, it also receives the track updates, sectorization messages, and current sector of track control information from the local HCS, enabling it to display the aircraft positions, sector map, and aircraft lists correctly. In addition, the HCI has access to Special Use Airspace (SUA) definitions, ATC sector descriptions, navigational information, and geopolitical boundaries, all of which can be included or not included on the Traffic Display and Future Traffic Display at the request of the user.

Based on the information the FPS stores in the aircraft database, the HCI displays current position and route data on the Traffic Display and projected positions and route information on the Future Traffic Display. In addition to showing active aircraft, the HCI shows trial plan routes and positions on the Future Traffic Display. Using the information received from the FAS, the HCI depicts airspace expected aircraft demand on the various displays accessible from the NAS Monitor (e.g., the Sector Count Monitor and the Time in Sector displays, see Section 3.2). The HCI provides the user the capability to define airspace areas and flows of interest, as well as define reroutes for display and evaluation. It passes on to the FAS the airspace or flow definition so the FAS can provide a list of involved flights. The HCI passes on the traffic manager's proposed reroutes to the FPS, so that the FPS can create new trajectories based on the reroute data. The FAS uses the new trajectories to provide the before and after sector loading data for the HCI to display.

## 2.3 The Relationship Between CRCT CDP User Functionality and DSS Software

This section describes the relationship between the user functionality and the DSS software design in the CRCT CDP. For purposes of illustration, the steps of a typical flow management decision process is described through a scenario that calls for the use of aircraft rerouting around an area of severe convective weather. The scenario is structured in terms of three typical, high-level traffic management tasks: (1) identifying and analyzing TFM problems, (2) defining solutions and strategies to manage the problems, and (3) analyzing the impacts of those strategies.

CRCT's DSS first becomes aware of an individual flight when an ETMS flight schedule or flight plan message is received through the Data Collection Subsystem. The FPS creates a current prediction of the flight's expected trajectory. The trajectory takes into account winds predicted over the flight's projected path, as well as any known procedural restrictions. The FPS stores the flight information and notifies the FAS and the HCI. The HCI uses this flight information to update the Traffic Display and the Future Traffic Display. The Traffic Display shows the current positions of all active flights in the NAS, and the Future Traffic Display shows active flights and proposed flights as well, using the trajectory predictions to indicate expected future locations.

The FAS determines which sectors will be entered by the flight and the timing of the entries, and aggregates individual flights into totals. The HCI uses this information to update the NAS Monitor and Sector Count Monitor displays of projected sector counts. The Sector Count Monitor provides projections of the number of aircraft that are expected to populate each sector during each 15-minute time period. In addition, it provides data from the comparison of those totals with the sector thresholds, indicating whether sector totals over the threshold include proposed flights or only active flights.

The FPS continually updates trajectory predictions in the internal flight database as it receives new information about flights through the Data Collection Subsystem. Examples of flight events that trigger these updates are a planned departure time change, the departure message itself, a planned route change, a track message that the FPS recognizes is off the planned route, or an arrival message. Each time the flight database is updated, the FAS evaluates the impact on sectors and currently defined airspaces, so that the HCI always has access to the latest information available for display to the user.

When traffic managers at Air Route Traffic Control Center (ARTCC) TMUs or the ATCSCC are notified of an impending severe convective weather event, they can use CRCT data to identify and analyze the expected effects of the weather on traffic, to define aircraft reroutes, or to take other actions to manage the problem. In addition, they can use CRCT data to analyze the impacts of the proposed strategies before they are actually implemented. Sections 2.3.1 through 2.3.3 contain an example of the use of CRCT data to support each of these TFM analytical and problem solving activities.

### 2.3.1 Identifying and Analyzing a Flow Management Problem

When notified of a weather event such as a thunderstorm, the first thing the traffic manager does is to determine the extent of the problem. Specifically, they need to understand the aircraft demand expected in or near the convective activity.

First, the traffic manager creates FCAs. By creating an FCA around the weather area itself, the traffic manager can tell how many and which aircraft will be affected by the thunderstorm. By creating FCAs in the airspace north and south of the weather, the traffic

manager anticipates the likely demand on airspace where weather avoidance reroutes could potentially be added as additional traffic.

The HCI collects the location and lateral and vertical boundaries of the airspace from the FCA definition provided by the traffic manager, as well as the duration of the FCA's active life span, and any direction and rate of movement data provided. The FAS uses this information, plus the aircraft-specific information stored in the internal flight database by the FPS, to predict which and how many aircraft are planned to operate through the FCAs. The HCI then displays the results of this analysis to the traffic manager. The HCI displays a list of all the aircraft projected to penetrate the FCA according to its parameters. It also displays these aircraft and their associated routes on the Traffic Display.

When Ground Delay or Ground Stop programs are implemented by the FAA, flight cancellations and flight plans with delayed departure times are received by the FPS, which updates the flight information database. The FAS responds to the new information by updating the FCA analysis and providing the analysis results to the HCI, which in turn reflects these changes in the FCA lists and displays.

In addition to the results of the FCA analyses, the FAS provides the HCI with sector loading information. The traffic manager can use the Sector Count Monitor to see whether the sectors near the weather area are close to their thresholds, and also whether all sectors are operating and staffed. Again, this information is useful when decisions regarding the use and location of reroutes are made.

### 2.3.2 Defining Strategies for Managing the Problem

Once the traffic manager understands the situation, a resolution may be formulated. One method of defining a solution to the weather problem and its effect on traffic is to filter the traffic through the FCA so that the traffic manager can focus on subsets of flows. Filters could be used to select only certain traffic through the city pairs, or only aircraft planned for a certain routing. When evaluating the problem initially, the traffic manager may realize that many aircraft planned to traverse the weather area are coming from or going to a specific airport. Other aircraft involved in the problem have not yet departed. The HCI provides a way to filter the traffic so that the FAS can list those aircraft to manage with one strategy (e.g., an aircraft reroute).

Another method for choosing a group of aircraft to manage is for the traffic manager to graphically define a crossing segment to the HCI on the Traffic Display. The HCI calculates which flows in the FCA List will cross that segment. The traffic manager then defines a reroute targeting only those identified aircraft. The traffic manager has the option of rerouting specific traffic flows in different ways in developing an overall strategy.

In each of these examples, the HCI accepts input from the traffic manager and passes that input on to the FAS. The FAS examines the internal flight database to find the flights that fit

the specified parameters, and sends those flights back to the HCI. The HCI assembles all the flight information to be displayed from the internal database, and presents the information for display.

When a traffic manager defines a reroute, all three processes are engaged. The HCI collects the definition of the reroute through any of the available message entry methods (graphical or text entry). Then the HCI passes the definition to the FPS. The FPS generates trial plans and stores the new trajectory predictions into the aircraft-specific database. The FAS uses those trial plans to compute the new sector and FCA loads if the plans were to be put into effect. The HCI then presents this new information to the traffic manager, who analyzes the impact of the reroutes on sector and FCA traffic volume.

### 2.3.3 Evaluating the Potential Effects of the Reroute Strategy

The traffic manager uses several HCI displays to evaluate the impact of proposed reroutes. The HCI is continuously updating the displays, reflecting any changes to flight plans received by the DSS and interpreted by the FPS and the FAS. These processes analyze all available data, enabling the HCI to display current flight plan data as well as data reflecting the proposed reroutes. By accessing the aircraft-specific database, route and position data reflecting the proposed reroutes are shown on the Traffic Display, the Future Traffic Display and the Sector Count Monitor. The FAS ensures that the HCI has the information needed to show the impact of the reroutes on sector loading and traffic density.

Each time the traffic manager interacts with the HCI to make a change, whether to add another FCA or to create an additional reroute, the FPS generates another predicted trajectory for each of the individual flights affected. The FAS evaluates the group impact on the system, analyzing individual sectors, the location of the reroutes, and how the reroutes interact with other traffic. Finally, this information is passed back to the HCI for display and additional inputs.

**Section 3**

# CRCT CDP DSS Functions and Capabilities

This section specifies the CRCT functions and their associated capabilities implemented in the CRCT CDP Decision Support component. At the top level, the functions consist of the following:

- Traffic Display Function
- Flow Constrained Area Function
- Rerouting Function
- Data Sharing Function

The Traffic Display Function provides capabilities depicting current and projected aircraft position data and an airspace plan view map representation and associated features (e.g., fixes, airways, sectors, facilities).

The Flow Constrained Area Function provides capabilities to enable the user to define any airspace resource as an area in which traffic management may be necessary, for example, an area where some or all flights may be rerouted to avoid the defined area. The FCA function may also be used to analyze traffic demand on any airspace resource in order to understand the volume and temporal characteristics of the demand. This information can assist the traffic manager in deciding if traffic management initiatives are needed. The FCA Function includes capabilities that automatically monitor the alert status and traffic demand for all ARTCC sectors.

The Rerouting Function has capabilities to allow the user to define, store and retrieve aircraft reroutes. The Rerouting Function also includes capabilities to assess the effects of reroutes on ARTCC sector volume and other traffic characteristics, before the reroutes are distributed to the operational positions for implementation.

The Data Sharing Function has capabilities to allow the user to save and update static screens of CRCT CDP data for the purpose of facilitating intra-facility and inter-facility coordination and planning. While the documented capabilities are currently resident in the CDP, the infrastructure needed to share the saved CRCT information across facilities is not yet fully implemented.

The capabilities and sub-capabilities listed under each CRCT CDP DSS function in the sections below have been evaluated in the laboratory and in the field with the exception of those capabilities marked with an asterisk (*). The latter consists of new capabilities available in the March 2001 CRCT CDP release. These capabilities are scheduled for laboratory and field assessment in FY2001.

## 3.1 Traffic Display Function

The CRCT CDP has two Traffic Display functional capabilities, the Traffic Display and the Future Traffic Display. These capabilities provide a graphical representation of aircraft positions on a plan view display map. The Traffic Display contains current aircraft positions and the Future Traffic Display contains current or projected future positions of active and inactive aircraft. The projected future positions are based on current flight plan data or flight plan data for reroutes. These functional capabilities are used to examine the nature and extent of traffic flows and to identify the current or future positions of flights.

FAA facility boundaries, sectorization by selected altitudes, Navigational Aids (NAVAIDs), airways, weather radar displays, and other map data are provided as a context for aircraft position data. The ETMS database is used to locate the current position of active flights. Where the CRCT CDP is interfaced with the local ARTCC Host Computer System, radar track positions may be used to display aircraft positions. An example of the information typically provided by the Future Traffic Display capability is provided in Figure 3-1.

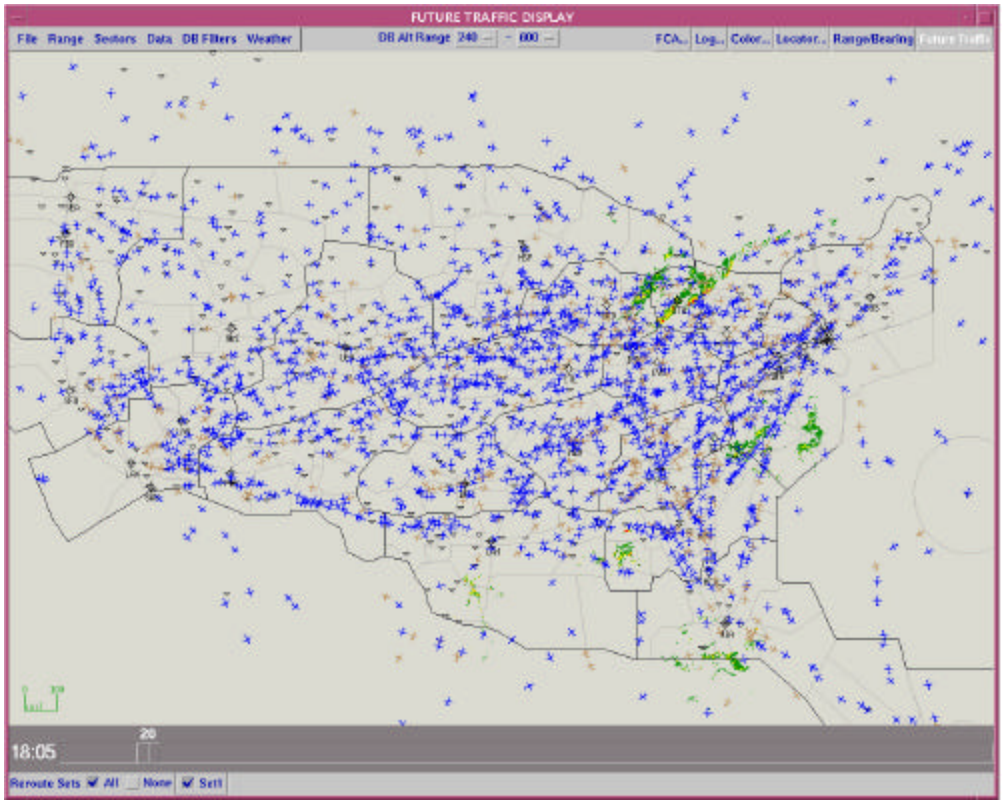


**Figure 3-1. Future Traffic Display Set 20 Minutes in the Future**

In this figure, the Future Traffic Display is set to twenty minutes in future time. Active flights are coded as blue icons, and inactive flights are represented by tan icons.

### 3.1.1 Traffic Display Capability

By default, the Traffic Display capability provides an automatic display of current aircraft position data on a single high-resolution monitor. The Traffic Display capability has many options for configuring the data presentation. Most options are selectable via pull down menus.

The Traffic Display capability has the following sub-capabilities:

1. Capability select/deselect the display of high, low or super high sectors
2. Capability to uniquely code National Route Program (NRP) flights
3. Capability to display airways
   - 3.1 Capability to display major high altitude airways
   - 3.2 Capability to display all high altitude airways
   - 3.3 Capability to display low altitude airways
   - 3.4 Capability to display airway identifications
4. Capability to display aircraft lateral and vertical positions within selected areas
5. Capability to select/deselect the display of weather radar returns
6. Capability to display selected weather radar intensities
7. Capability to modify color display settings
8. Capability to locate the position of any active aircraft
9. Capability to locate the departure airport of any inactive flight
10. Capability to display a message that a located aircraft has not departed
11. Capability to determine the distance and bearing between any two selected points on the map display
12. Capability to access the FCA capability
13. Capability to differentiate the display of radar track position from track positions obtained from the ETMS
14. Capability to differentiate the display of projected inactive flight positions from projected active flight positions

15. Capability to select/deselect the display of a graphical depiction of any aircraft's current flight plan route
16. Capability to display a graphical depiction of any aircraft's defined reroute
17. Capability to select/deselect the display of a full data block for any aircraft displayed
18. Capability to select any displayed aircraft for rerouting
19. Capability to select/deselect the display of flight data for any displayed aircraft
20. Capability to select/deselect the display of flight data for any inactive aircraft
21. Capability to select/deselect the display of high altitude NAVAIDs
22. Capability to select/deselect the display of all NAVAIDs and mapped fixes
23. Capability to select/deselect the display of all airports
24. Capability to select/deselect the display of ARTCC sector maps at selected altitudes
25. Capability to select/deselect the display of the boundaries of the states of the United States
26. Capability to select/deselect the display of all SUA
27. Capability to select/deselect the display of aircraft positions of aircraft not intersecting any FCA
28. Capability to automatically display a numeric indication of current map scale setting
29. Capability to display the map of facility boundaries according to selected altitude filter settings
30. Capability to store a map center as a home position
31. Capability to offset the map display from the stored home position
32. Capability to restore the displayed map to the stored home position
33. Capability to reposition any displayed aircraft data block
34. Capability to deselect any point selected by the cursor during the FCA definition process

35. Capability to deselect any point selected by the cursor during the reroute definition process
36. Capability to force any displayed window to the front
37. Capability to force any displayed window to the back
38. Capability to iconify any open window
39. Capability to restore the display of any iconified window
40. Capability to print the Traffic Display data presentation
41. Capability to display an adapted set of fixes
42. Capability to specify fixes for display *
43. Capability to display the list of specified fixes *
44. Capability to delete a fix from the list of specified fixes *
45. Capability to delete all fixes from the list of specified fixes *
46. Capability to select for display a fix from the list of specified fixes *
47. Capability to select for display all fixes in the list of specified fixes *
48. Capability to center the map display on a selected fix *

### 3.1.2 Future Traffic Display Capability

The Future Traffic Display of projected aircraft position data is displayed through user action on a single high-resolution physical display. When the Future Traffic Display is displayed, the Traffic Display is not visible. The CDP provides the same options for configuring the data presentation on the Future Traffic Display as those that are available on the Traffic Display. Most of the display options are selectable via pull down menus.

The Future Traffic Display capability has the following additional sub-capabilities:

1. Capability to display projected positions of active and inactive flights along the current flight plan route at any selected future time within parameter time
2. Capability to display projected positions of active and inactive flights along any proposed reroute flight plan route at any selected future time within parameter time
3. Capability to display projected positions of active and inactive flights along the current flight plan route at 5-minute intervals within parameter time

4. Capability to display projected positions of active and inactive flights along any proposed reroute flight plan route at 5-minute intervals within parameter time
5. Capability to display projected positions of active and inactive flights along the current flight plan route by moving the cursor within parameter time
6. Capability to display projected positions of active and inactive flights along any proposed reroute flight plan route by moving the cursor within parameter time
7. Capability to print the Future Traffic Display data presentation

## 3.2 Flow Constrained Area Function

The FCA Function consists of five capabilities. These capabilities enable the user to identify and analyze the level of traffic demand on any airspace resource. The capabilities are:

- NAS Monitor
- Sector Count Monitor
- Flow Constrained Area
- FCA Demand Graph
- Time in Sector

### 3.2.1 NAS Monitor Capability

The NAS Monitor capability provides the sector alert status of the 20 contiguous ARTCCs for parameter hours. Figure 3-2 provides an illustration of this capability.

The left side of the window consists of current through future time segments divided into 15-minute periods. The row along the bottom contains the ARTCC identifiers. For each cell denoting a 15-minute time period, a red alert indicates the predicted peak instantaneous count of active flights for any sector(s) within the ARTCC may exceed the Monitor Alert Parameter (MAP) some time within the 15-minute period. A yellow alert indicates the predicted peak instantaneous count of active and inactive flights for any sector within the ARTCC will exceed the MAP; however, the MAP will not be exceeded by active flights alone. Fifteen-minute periods coded green are not in alert status. The number of sectors in alert status is indicated in each 15-minute cell that is alerted.

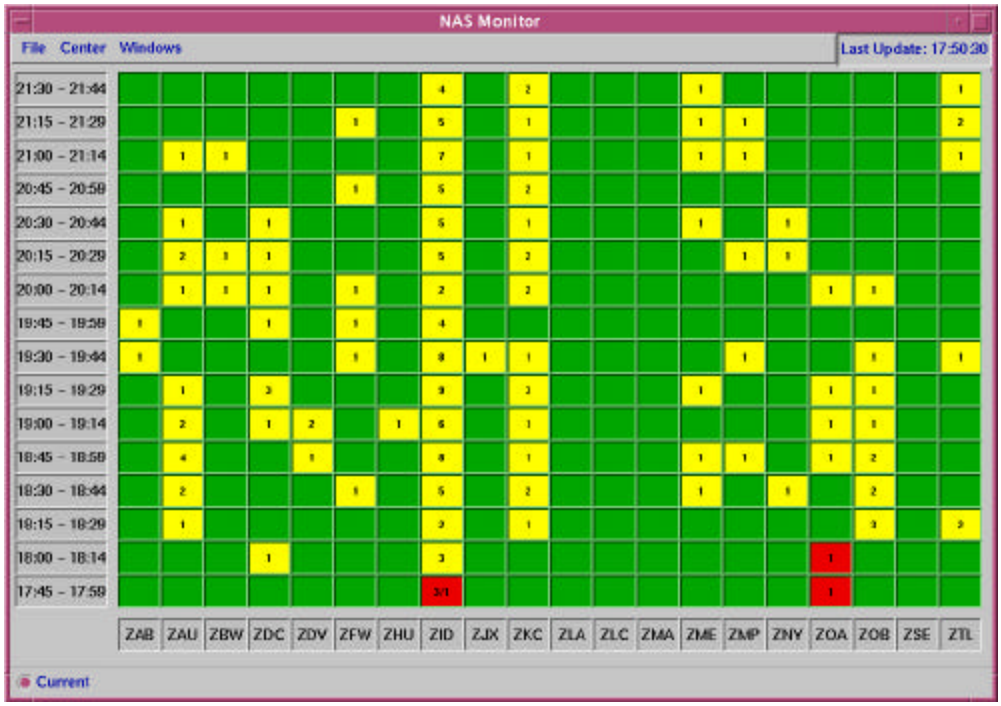


**Figure 3-2. NAS Monitor Capability**

The NAS Monitor capability includes the following sub-capabilities:

1. Capability to automatically display graphical red and yellow alerts for any ARTCC sector in the 20 contiguous ARTCCs for a parameter time automatically
2. Capability to display facility identifiers for the 20 contiguous ARTCCs (e.g., ZKC for Kansas City ARTCC)
3. Capability to indicate that displayed data is current data
4. Capability to display the identification of all existing reroute sets, (e.g., Set 1; ORD South)
5. Capability to select/deselect the graphical display of red or yellow sector alerts resulting from the evaluation of any existing reroute set for any ARTCC sector in the 20 contiguous ARTCCs
    - 5.1 Capability to indicate that displayed data is the result of the evaluation of a reroute set(s)
6. Capability to select for display for any alert:
    - 6.1 ARTCC and ARTCC sector identification

6.2 Type of alert (red or yellow)

6.3 ARTCC sector peak count

6.4 Monitor Alert parameter (MAP) for the selected sector

6.5 Number of active flights in the peak count exceeding MAP

6.6 Total flights (active and inactive) in the peak count exceeding MAP

6.7 Total number of active and inactive flights in the peak count

7. Capability to automatically display in graphical form the highest level of ARTCC sector alerts (red or yellow) existing in any 15-minute period for parameter hours for any ARTCC sector in the 20 contiguous ARTCCs

8. Capability to indicate the number of red and yellow ARTCC sector alerts in any 15-minute period in the 20 contiguous ARTCCs for parameter hours

9. Capability to display the last update time

10. Capability to print the displayed data

11. Capability to select the display of the Sector Count Monitor capability for any of the 20 contiguous ARTCCs

12. Capability to select the display of the Sector Count Monitor capability for all of the 20 contiguous ARTCCs

13. Capability to indicate that a Sector Count Monitor for a specific ARTCC is selected

14. Capability to access the FCA capability

15. Capability to select for display the FCA Demand graph capability

16. Capability to access the Rerouting capability

17. Capability to access the Reroute Set Management capability

18. Capability to access the Reroute Set Merge capability

19. Capability to print the NAS Monitor

20. Capability to close the NAS Monitor display

### 3.2.2 Sector Count Monitor Capability

The Sector Count Monitor is an automatic capability that provides ARTCC sector peak counts and alerts derived from current flight plans (active or proposed) and/or schedule and historical data. It is used to monitor and examine ARTCC sector count and alert data. It is also used to examine ARTCC sector peak counts and alerts resulting from the evaluation of

any existing reroute set for the selected ARTCC for parameter hours. The Sector Count Monitor capability for a specific ARTCC is displayed on a single monitor when that ARTCC identifier is selected on the NAS Monitor. When the CRCT CDP is installed at an ARTCC, the Sector Count Monitor for that ARTCC is displayed as the default.

The Sector Count Monitor capability has the following sub-capabilities:

1. Capability to automatically display ARTCC sector peak counts for the selected ARTCC for each 15-minute period for parameter hours
2. Capability to automatically graphically display red or yellow ARTCC sector alerts for the selected ARTCC for each 15-minute period for parameter hours automatically
3. Capability to automatically display the sector identification for all open sectors in the selected ARTCC when the CRCT CDP is receiving radar track data
4. Capability to display the sector identification for all sectors in the selected ARTCC when the CRCT CDP is not receiving radar track data
5. Capability to indicate that displayed data is current data
6. Capability to display the identification of all existing reroute sets
7. Capability to display red or yellow ARTCC sector alerts in the selected ARTCC resulting from the evaluation of any existing reroute set(s)
8. Capability to display ARTCC sector peak counts in the selected ARTCC resulting from the evaluation of any existing reroute set(s)

    8.1 Capability to indicate that displayed data is the result of the evaluation of a reroute set(s)

9. Capability to indicate changes in ARTCC sector peak counts in the selected ARTCC in any 15-minute period resulting from the evaluation of any existing reroute set(s) as a peak count increase or decrease compared to current flight plan data
10. Capability to indicate any change in ARTCC sector red or yellow alerts resulting from the evaluation of any existing reroute set
11. Capability to select the NAS Monitor for display
12. Capability to close the window in which the Sector Count Monitor is displayed
13. Capability to select/deselect for display ARTCC sector MAPs for the selected ARTCC
14. Capability (default) to display ARTCC sector identification in ascending order for

the selected ARTCC

15. Capability to select/deselect for display ARTCC sector identification grouped by ARTCC area of specialization for the selected ARTCC
16. Capability to select/deselect for display ARTCC sector identification grouped by ARTCC type of sector for the selected ARTCC
17. Capability to select for display the Time in Sector Display for the selected ARTCC for any 15-minute period displayed in the Sector Count Monitor
18. Capability to display the last update time
19. Capability to print the Sector Count Monitor
20. Capability to utilize radar track data when available when determining ARTCC peak count and alert data
21. Capability to select/deselect sectors for display in the Sector Count Monitor
22. Capability to modify the adapted ARTCC sector MAPs
23. Capability to access the FCA capability
24. Capability to select for display the FCA Demand graph capability
25. Capability to access the Rerouting capability
26. Capability to access the Reroute Set Management capability
27. Capability to access the Reroute Set Merge capability
28. Capability to select/deselect the display of MAPs for ARTCC sectors

### 3.2.3 Flow Constrained Area Capability

The FCA capability is used to analyze traffic demand on a volume of airspace in which traffic management action may be necessary. The capability generates the following data for a default or specified time interval:

- Aircraft demand on any airspace resource that has been defined as a FCA
- Aircraft predicted to enter a specific ARTCC sector(s) during a specified time period
- Aircraft predicted to enter a specific SUA during a specified time period
- Aircraft predicted to enter a volume of airspace that does not conform to any ARTCC sector or facility boundary
- Aircraft predicted to cross a specific fix and/or pass within a distance of that fix

- Aircraft predicted to fly along a specific airway or other route and/or within a distance of that airway or route
- Aircraft predicted to enter and/or exit another facility's airspace
- Aircraft predicted to arrive and/or depart an airport during a specified time period

Once a FCA is created, the FCA capability provides the following information for each aircraft projected to intersect the FCA:

- Aircraft identification
- Graphical display of each aircraft route
- Tailored flight data
- Identification of the ARTCC or ARTCC sector where the aircraft is currently located
- The projected altitude at which the aircraft will intersect the FCA
- Identification of the FCA being intersected, and the hours/minutes/seconds until the aircraft intersects the FCA
- Clock time at which the aircraft is projected to intersect the FCA

The FCA capability is accessed through the FCA Definition Window (refer to Figure 3-3). This window allows the user to define the parameters for the FCA that is being created. The window can be requested from multiple CRCT CDP displays, including the Traffic Display, the Future Traffic Display, or by selecting the FCA Definition menu option available on the FCA List window, NAS Monitor window, Sector Count Monitor window, and the FCA Demand Graph window.

The FCA capability has the following sub-capabilities.

1. Capability to define a FCA with any lateral, vertical, and temporal limits
    - 1.1 Capability to graphically define the lateral outline of the FCA
    - 1.2 Capability to default the FCA name
    - 1.3 Capability to specify the FCA name
    - 1.4 Capability to default the FCA start time
    - 1.5 Capability to default the FCA end time
    - 1.6 Capability to specify the FCA start time
    - 1.7 Capability to specify the FCA end time

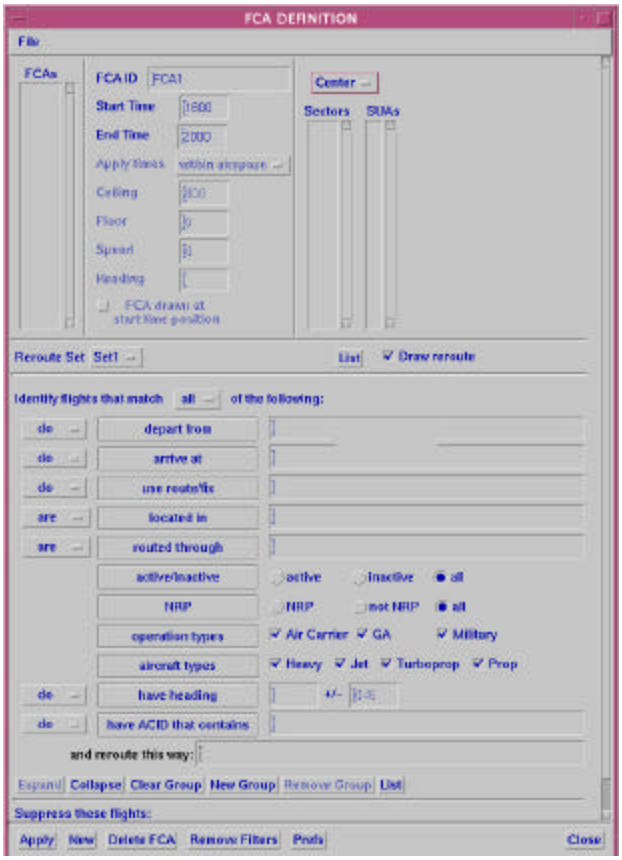


**Figure 3-3. FCA Definition Window**

1.8 Capability to default altitude limits

1.9 Capability to specify altitude limits

2. Capability to define any ARTCC sector as a FCA

2.1 Capability to display the identification of all sectors for any ARTCC

2.2 Capability to select any ARTCC sector identification to automatically apply the lateral boundaries of the selected sector as the lateral boundaries of the FCA

2.3 Capability to automatically apply the selected ARTCC sector identification as the default FCA name

2.4 Capability to specify the FCA name

2.5 Capability to specify the FCA start time

2.6 Capability to specify the FCA end time

2.7 Capability to automatically apply the adapted altitude limits of the selected ARTCC sector as the default altitude limits

2.8 Capability to specify altitude limits that are different from the adapted altitude limits of the selected ARTCC sector

3. Capability to define any SUA as a FCA

3.1 Capability to display the SUA identification for all SUAs in any ARTCC

3.2 Capability to select any SUA identification to automatically apply the lateral boundaries of the selected SUA as the lateral limits of the FCA

3.3 Capability to apply the selected SUA identification as the default FCA name

3.4 Capability to specify the FCA name

3.5 Capability to specify the FCA start time

3.6 Capability to specify the FCA end time

3.7 Capability to specify altitude limits that are different from the adapted altitude limits of the selected SUA

4. Capability to define any departure facility or airport as a FCA

4.1 Capability to specify the departure airport(s) and/or departure facility(s)

4.2 Capability to default the FCA name

4.3 Capability to specify the FCA name

4.4 Capability to default the FCA start time

4.5 Capability to default the FCA end time

4.6 Capability to specify the FCA start time

4.7 Capability to specify the FCA end time

4.8 Capability to display the aircraft identification and flight data of all aircraft that have aircraft trajectories with departure times within the range of the FCA start time and end time (default capability)

4.9 Capability to select the display of aircraft identification and flight data of all aircraft that have aircraft trajectories with arrival times within the range of the FCA start time and end time

5. Capability to define any arrival facility or airport as a FCA

    5.1 Capability to specify the arrival airport(s) and/or arrival facility(s)

    5.2 Capability to default the FCA name

    5.3 Capability to specify the FCA name

    5.4 Capability to default the FCA start time

    5.5 Capability to default the FCA end time

    5.6 Capability to specify the FCA start time

    5.7 Capability to specify the FCA end time

    5.8 Capability to display the aircraft identification and flight data of all aircraft that have aircraft trajectories with arrival times within the range of the FCA start time and end time (default capability)

    5.9 Capability to select the display of aircraft identification and flight data of all aircraft that have aircraft trajectories with departure times within range of the FCA start time and end time

6. Capability to select/deselect the display of aircraft routes for aircraft intersecting any FCA

7. Capability to display the aircraft identification and flight data of all aircraft that have aircraft trajectories that intersect any FCA with lateral and vertical limits within range of the FCA start and end times (default capability)

8. Capability to specify the display of the aircraft identification and flight data of all aircraft that have aircraft trajectories that result in the aircraft departing within the range of the FCA start and end times and intersect any FCA with lateral and vertical limits

9. Capability to display active flights for FCAs with "apply times at departure" *

10. Capability to select/deselect the display of rerouted aircraft entries in any FCA List

11. Capability to select/deselect an abbreviated entry format for aircraft in any FCA List

12. Capability to select the display of the hours/minutes/seconds until aircraft intersect the FCA

13. Capability to select the display of the clock time at which aircraft will intersect the FCA

14. Capability to select/deselect the FCA(s) for which the FCA list(s) information is displayed
15. Capability to specify the arrival airport(s) or facility(s)
16. Capability to specify user class as Commercial, General Aviation, Military, or any combination of these
17. Capability to specify active and/or inactive flight status
18. Capability to specify NRP flights, or flights other than NRPs
19. Capability to specify Filed True Airspeed as greater than or less than the specified value
20. Capability to specify an aircraft track and to specify a ± value
21. Capability to specify any route
22. Capability to specify any fix
23. Capability to specify facility where aircraft are currently located
24. Capability to specify aircraft identification
25. Capability to specify specific air carrier identification(s), e.g., AAL or AAL224; or general aviation identification, e.g., N or N123X; or specific military identification (e.g., BAMBI25)
26. Capability to identify aircraft rerouted through an ARTCC by specifying the ARTCC *
27. Capability to identify aircraft in performance classes by specifying the performance class *
28. Capability to select the application of the specified FCA filter criteria to any or all specified values
29. Capability to select the application of any specified FCA filter criteria that does or does not match the specified value
30. Capability to remove FCA filters
31. Capability to clear a group of FCA filters
32. Capability to create a new group of FCA filters
33. Capability to select and delete any FCA
34. Capability to apply the FCA

35. Capability to create a new FCA (This clears all values in the displayed FCA Definition Window and prepares the CRCT CDP for a new FCA.)

36. Capability to close the FCA Definition Window

37. Capability to display aircraft identification and flight data in list format for any aircraft intersecting any FCA

    37.1 Capability to display a separate list of aircraft identification and flight data for all aircraft intersecting each FCA

    37.2 Capability to display all FCA Lists

    37.3 Capability to select for display the list(s) associated with a specific FCA(s)

    37.4 Capability to sort the FCA List in time order that aircraft will intersect the FCA (default capability)

    37.5 Capability to display the trajectory altitude at the point where the aircraft intersects the FCA

    37.6 Capability to display the sector that has track control of the aircraft when the CRCT CDP is receiving radar track data for the aircraft

    37.7 Capability to display the ARTCC where the aircraft is located when the CRCT CDP is not receiving radar track data for the aircraft

    37.8 Capability to display the ARTCC identification where the departure airport is located (applies to inactive flights)

    37.9 Capability to display the FCA identification

    37.10 Capability to display the hours, minutes, and seconds until the aircraft intersects the FCA (default capability)

    37.11 Capability to select for display the clock time the aircraft will intersect the FCA

    37.12 Capability to display the total number of aircraft in the FCA List(s)

    37.13 Capability to display the total number of inactive aircraft in the FCA List(s)

    37.14 Capability to display the total number of active aircraft in the FCA List(s)

    37.15 Capability to differentiate the display of active and inactive flights in the FCA List

    37.16 Capability to scroll the FCA List

37.17 Capability to print the FCA List sorted by area of specialization where the aircraft are located when the CRCT CDP is receiving radar track data for the aircraft

37.18 Capability to print the FCA List sorted by the ARTCC where the aircraft are located and/or are departing when the CRCT CDP is not receiving radar track data for the aircraft

37.19 Capability to sort the FCA List in alphabetical order of aircraft identification

37.20 Capability to sort the FCA List in alphabetical order of by aircraft arrival airport

37.21 Capability to sort the FCA List in alphabetical order of aircraft departure airport

37.22 Capability to sort the FCA List in active and inactive flight order

37.23 Capability to sort the FCA List according to aircraft's facility/sector (where applicable) location

37.24 Capability to sort the FCA List in FCA identification order (default capability)

38. Capability indicating the CDP is operating in FCA Definition Mode

39. Capability to utilize radar track data, when available, to identify aircraft intersecting the FCA

40. Capability to utilize local adaptation data (Standard Operation Procedures [SOPs], Letter of Agreement [LOA]), Preferential Routes), when available, to identify aircraft intersecting the FCA

41. Capability to delete multiple FCAs concurrently with a single data entry *

### 3.2.4 FCA Demand Graph Capability

Once a FCA has been defined and applied, the FCA Demand Graph capability can be selected for display through user action. This capability is used to analyze the volume and temporal characteristics of the traffic intersecting the FCA over the remaining time until the FCA expires. Figure 3-4 contains an example of this capability. It depicts FCA entries, i.e., the number of aircraft entering the FCA plotted over five-minute intervals for the time span in which the FCA is in effect.

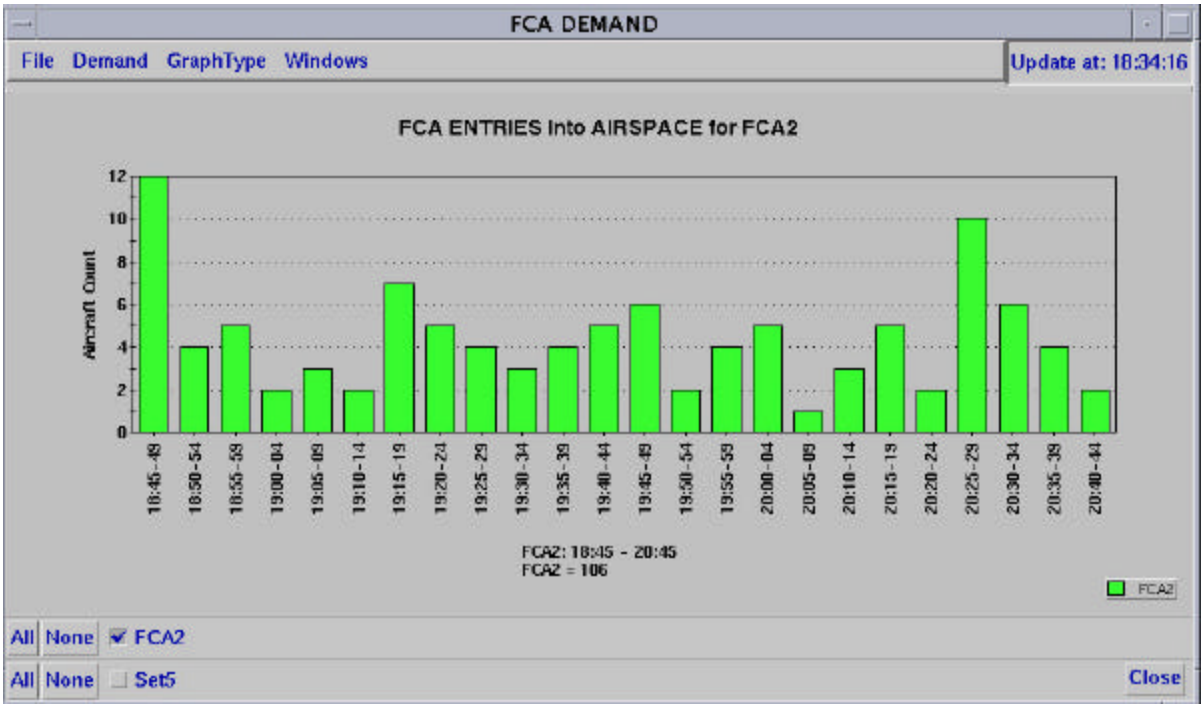


**Figure 3-4. FCA Demand Graph Depicting FCA Entries**

The FCA Demand Graph capability has the following sub-capabilities.

1. Capability to select for display in 5-minute increments a graphical representation of the total aircraft projected to enter any FCA over the FCA's defined temporal limits
2. Capability to select for display in 5-minute increments a graphical representation of the total aircraft projected to occupy any FCA over the FCA's defined temporal limits, except for an airport defined as a FCA
3. Capability to select any existing FCA for display on a single graph
4. Capability to select all existing FCAs for display on a single graph
5. Capability to select for display the list of aircraft and the associated flight data for each aircraft projected to enter the FCA in any 5-minute period
6. Capability to select for display the list of aircraft and the associated flight data for each aircraft projected to occupy the FCA in any 5-minute period
7. Capability to automatically display the last update time

8. Capability to select for display in 5-minute increments a bar graph of the total aircraft projected to occupy any FCA over the FCA's defined temporal limits, except for an airport defined as a FCA
9. Capability to select for display in 5-minute increments a 3D-bar graph of the total aircraft projected to occupy any FCA over the FCA's defined temporal limits, except for an airport defined as a FCA
10. Capability to select for display in 5-minute increments a bar graph of the total aircraft projected to enter any FCA over the FCA's defined temporal limits
11. Capability to select for display in 5-minute increments a 3D bar graph of the total aircraft projected to enter any FCA over the FCA's defined temporal limits
12. Capability to select for display in 5-minute increments a stacked bar graph of the total aircraft projected to occupy selected FCAs
13. Capability to select for display in 5-minute increments side by side bar graphs of the total aircraft projected to enter selected FCAs
14. Capability to select for display in 5-minute increments a stacked 3D bar graph of the total aircraft projected to occupy selected FCAs
15. Capability to select for display in 5-minute increments side by side 3D bar graphs of the total aircraft projected to enter selected FCAs
16. Capability to select any existing reroute set for display in the FCA Demand Graph
17. Capability to display in 5-minute intervals the projected change in the total aircraft projected to enter any selected FCA over the FCA's defined temporal limits as a result of the selected reroute set
18. Capability to display in 5-minute intervals the projected change in the total aircraft projected to occupy any selected FCA over the FCA's defined temporal limits as a result of the selected reroute set, except for an airport defined as a FCA

### 3.2.5 Time in Sector Capability

The Time in Sector capability is used to analyze the detailed demand on any ARTCC sector. It is particularly useful for investigating the characteristics of a sector alert. Selecting any cell in the Sector Count Monitor results in the display of the Time in Sector display. The display depicts alert and other data for the 15-minute period that was selected.

The Time in Sector capability has the following sub-capabilities.

1. Capability to display the ARTCC identification, sector identification and selected time period
2. Capability to display the Monitor Alert Threshold for the selected sector
3. Capability to display the peak count for each minute of the selected 15-minute period
4. Capability to label each minute of the selected 15-minute period
5. Capability to display the sector entry and exit time for each aircraft predicted to occupy the sector during the selected 15-minute period
6. Capability to display the total number of aircraft predicted to occupy the sector during the selected 15-minute period
7. Capability to code each minute of the selected 15-minute period with the appropriate alert coding
8. Capability to indicate the duration of each alert period
9. Capability to display the aircraft identification of each aircraft predicted to occupy the sector at any time during the selected 15-minute period
10. Capability to indicate each aircraft involved in any alert for the selected 15-minute period
11. Capability to identify aircraft predicted to occupy the sector during the selected 15-minute period as active or inactive flights
12. Capability to display the ARTCC sector that has track control of the aircraft when the CRCT CDP is receiving radar track data for the aircraft
13. Capability to display the ARTCC where the aircraft is located when the CRCT CDP is not receiving radar track data for the aircraft
14. Capability to display the departure airport for each inactive flight predicted to occupy the sector during the selected 15-minute period
15. Capability to select the display of full route information for each aircraft predicted to occupy the sector during the selected 15-minute period
16. Capability to select the display of abbreviated route information for each aircraft predicted to occupy the sector during the selected 15-minute period without losing the display of predicted sector entry and exit times and appropriate alert coding

17. Capability to sort the list of aircraft predicted to occupy the sector during the selected 15-minute period in ascending time order of sector entry (default capability)

18. Capability to sort the list of aircraft predicted to occupy the sector during the selected 15-minute period as active or inactive flights with time order of sector entry as a default sub sort

19. Capability to sort the list of aircraft predicted to occupy the sector during the selected 15-minute period in alphabetical order of the aircraft identification with time order of sector entry as a default sub sort

20. Capability to sort the list of aircraft predicted to occupy the sector during the selected 15-minute period in alphabetical order of the aircraft departure airport with time order of sector entry as a default sub sort

21. Capability to sort the list of aircraft predicted to occupy the sector during the selected 15-minute period in alphabetical order of the aircraft destination airport with time order of sector entry as a default sub sort

22. Capability to sort the list of aircraft predicted to occupy the sector during the selected 15-minute period in ARTCC facility alphabetical order of the aircraft location for active flights and departure airports for inactive flights with time order of sector entry as a default sub sort

23. Capability when the CRCT CDP is receiving radar track data to sort the list of aircraft predicted to occupy the sector during the selected 15-minute period in numerical order of the ARTCC sector with track control of the aircraft and alphabetical order of the ARTCC facility of the aircraft location for active flights or departure airports for inactive flights with time order of sector entry as a default sub sort

24. Capability to graphically display the route of flight and a limited data block on the Traffic Display for each aircraft occupying the sector for any minute by selecting that minute of the selected 15-minute period

25. Capability to graphically display on the Traffic Display the route of flight and a limited data block for any aircraft included in the peak count for any minute by selecting the peak count for that minute of the selected 15-minute period

26. Capability to select aircraft for rerouting by selecting the aircraft identification

27. Capability to select aircraft for rerouting by selecting the aircraft time bar

28. Capability to print the Time in Sector display

29. Capability to close the Time in Sector display window
30. Capability to utilize radar track data when available when determining aircraft sector and entry times
31. Capability to utilize local adaptation data (SOPs, LOAs, Preferential Routes) when available when determining aircraft sector entry and exit times

## 3.3 Rerouting Function

The Rerouting Function is comprised of five capabilities:

- Reroute Definition, Storage and Retrieval
- Reroute Display
- Reroute Set Management
- Reroute FCA
- Reroute Evaluation

The Reroute Definition, Storage and Retrieval capability enables the user to select single or multiple aircraft for rerouting, define aircraft reroutes for the selected aircraft, store the reroutes if desired, and retrieve them for use with other aircraft selected for reroute. The reroutes may be defined on an ad hoc basis graphically or through text entry, or they may be retrieved from stored, pre-defined reroutes. Reroutes can be defined for groups of aircraft, if the problem is extensive from the standpoint of the number of aircraft involved, the geographic area, or the time span of the problem. Reroutes for individual aircraft can also be defined when rerouting only a few aircraft will resolve the problem. Reroutes representing changes to the aircraft route of flight and/or altitude are definable in the CRCT CDP.

The Reroute Display capability allows the user to graphically display aircraft reroutes for individual aircraft or groups of aircraft in a variety of combinations. The CRCT CDP stores each aircraft reroute in a reroute set. The Reroute Set Management capability allows the user to organize, manage, display, and manipulate multiple reroute sets.

The Reroute FCA capability allows the traffic manager to associate a reroute(s) with a FCA. The associated reroute(s) can be dynamically defined using any of the CRCT CDP's reroute definition methods, or the FCA and associated reroute(s) can be retrieved from files of predefined FCAs (i.e., standard ) and reroutes, for example, a play from the ATCSCC's National Playbook. A reroute FCA can be defined in much the same manner as a non-reroute FCA, except a reroute is applied to at least one filter group of the reroute FCA. At the time a reroute FCA is applied, aircraft matching the FCA filters will automatically be assigned the specified reroute(s). This automatic rerouting process will continue with each additional aircraft predicted to enter the reroute FCA prior to the FCA's expiration.

The Reroute Evaluation capability enables the user to evaluate the predicted effects of reroute sets on sector volume, traffic density levels and other traffic characteristics before the reroutes are issued for implementation. If necessary, the reroute set can be modified to achieve the desired predicted effects on traffic volume.

Figure 3-5 contains an illustration of one data presentation associated with this capability. It shows a Sector Count Monitor containing the projected effects of the proposed reroutes on sector counts. The cells with light blue coding show sector peak count decreases. Darker blue coding indicates the sector peak counts are expected to increase as a result of the reroutes.

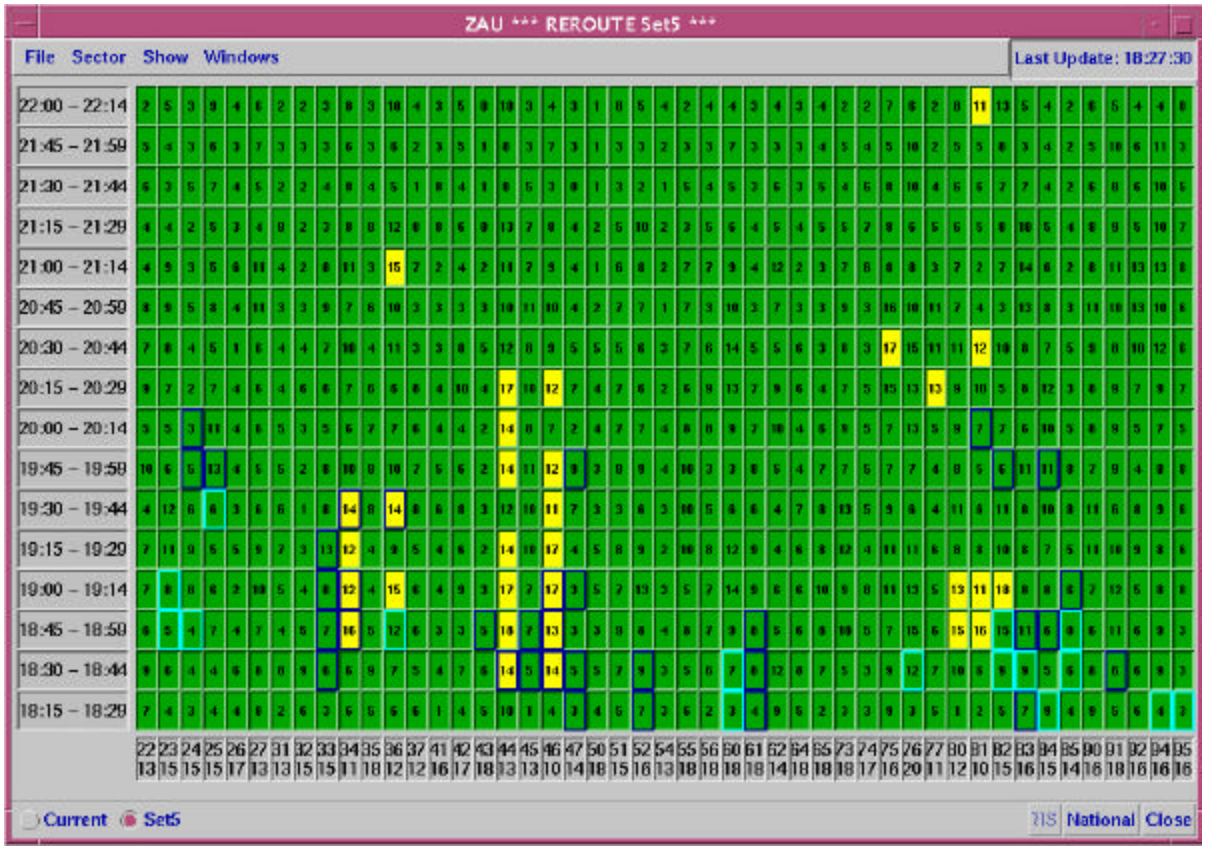


**Figure 3-5. Reroute Evaluation Capability Depicting Sector Count Impacts**

### 3.3.1 The Reroute Definition, Storage and Retrieval Capability

The Reroute Definition, Storage and Retrieval capability has the following sub-capabilities:

1. Capability to access the Rerouting capability
2. Capability to indicate the CRCT CDP is operating in the Reroute Mode (i.e., the next user action will result in the definition aircraft reroutes)
3. Capability to select a single aircraft for rerouting by selecting the reroute option in the popup menu accessed by selecting any aircraft icon on the Traffic Display
4. Capability to select a single aircraft for rerouting by selecting the reroute option in the popup menu accessed by selecting any aircraft icon on the Future Traffic Display
5. Capability to select a single aircraft for rerouting by selecting the reroute option in the popup menu accessed by selecting the aircraft entry in the FCA list
6. Capability to select a single aircraft for rerouting by selecting the reroute option in the popup menu accessed by selecting the aircraft entry in the Flight Information Window
7. Capability to select single or multiple aircraft for rerouting that have routes of flight that pass between two points (i.e., Crossing Segment) selected on the Traffic Display
    - 7.1 Capability to delete any points selected on the Traffic Display for the purpose of selecting any aircraft for rerouting
    - 7.2 Capability to select a direction of flight for selecting aircraft for rerouting that have routes of flight that pass between two points selected on the Traffic Display
    - 7.3 Capability to indicate the CRCT CDP is operating in Crossing Segment mode
8. Capability to select single or multiple aircraft for rerouting that have routes of flight that pass between two points selected on the Future Traffic Display
    - 8.1 Capability to delete any points selected on the Future Traffic Display that were selected for the purpose of rerouting
    - 8.2 Capability to indicate a direction of flight for selected aircraft undergoing rerouting that have routes of flight that pass between two points selected on the Future Traffic Display
    - 8.3 Capability to indicate the CRCT CDP is operating in Crossing Segment Mode
9. Capability to simultaneously select for rerouting all aircraft in any FCA List

10. Capability to select for rerouting only active flight plans
11. Capability to select for rerouting only inactive flight plans
12. Capability to select for rerouting only reroute flight plans
13. Capability to select for rerouting any combination of inactive, active, and reroute flight plans
14. Capability to define a reroute by editing the route of flight displayed in the rerouting window when a single aircraft is selected for rerouting
15. Capability to define a reroute by simultaneously editing the routes of flight displayed in the rerouting window when multiple aircraft are selected for rerouting
16. Capability to define a reroute for a single aircraft by selecting points on the Traffic Display
17. Capability to define a reroute for a single aircraft by selecting points on the Future Traffic Display
18. Capability to define a reroute for multiple aircraft by selecting points on the Traffic Display
19. Capability to define a reroute for multiple aircraft by selecting points on the Future Traffic Display
20. Capability to define a reroute(s) as a series of fixes, fix/radial/distance points, latitude/longitude coordinates, NAVAIDs, airways, airway segments, Standard Instrument Departures (SIDs), Standard Terminal Arrival Routes (STARs), or any other way routes are normally described
21. Capability to define a reroute for a single or multiple aircraft as a single altitude
22. Capability to define a reroute for a single or multiple aircraft as a single altitude and any reroute definition method provided by the CRCT CDP
23. Capability to automatically create a route segment from the last defined fix in a reroute to the next fix that is on the aircraft's current route of flight that is a parameter distance in front of the last defined fix in the reroute
24. Capability to save any reroute *
25. Capability to retrieve any saved reroute *
26. Capability to modify any saved reroute *
27. Capability to indicate that a saved reroute has been modified *
28. Capability to save and retrieve a modified standard reroute *

29. Capability to save and retrieve standard reroutes *
30. Capability to modify a standard reroute *
31. Capability to store reroutes in a file *
32. Capability to name the file in which reroutes are stored *
33. Capability to retrieve reroutes from a file *
34. Capability to specify preferential routes to be used in conjunction with the reroutes in a reroute FCA *
35. Capability to specify a specific preferential route to be used for a specific destination *
36. Capability to save/retrieve preferential routes *
37. Capability to modify preferential routes *
38. Capability to save modified preferential routes *

### 3.3.2 Reroute Display Capability

The Reroute Display capability has the following sub-capabilities:

1. Capability to graphically display the current route of flight and the aircraft limited data block on the Traffic Display when any aircraft is selected for rerouting by any selection method provided by the CRCT CDP
2. Capability to graphically display the current route of flight and the aircraft limited data block on the Future Traffic Display when any aircraft is selected for rerouting by any selection method provided by the CRCT CDP
3. Capability to automatically display the rerouting window when any aircraft is selected for rerouting
4. Capability to automatically display the current flight plan data of aircraft in the rerouting window when any aircraft is selected for rerouting by any selection method provided by the CRCT CDP
5. Capability to automatically display in graphical form on the Traffic Display any reroute defined by any reroute definition method provided by the CRCT CDP
6. Capability to automatically display in graphical form on the Future Traffic Display any reroute defined by any reroute definition method provided by the CRCT CDP

7. Capability to display a reroute(s) as a series of fixes, fix/radial/distance points, latitude/longitude coordinates, NAVAIDs, airways, airway segments, SIDs, STARs, or any other way routes are normally described

8. Capability when processing defined reroutes to bypass unrecognized fixes, fix/radial/distance points, latitude/longitude coordinates, NAVAIDs, airways, airway segments, SIDs, and STARs and continue route processing at the next recognized fix, fix/radial/distance point, latitude/longitude coordinate, NAVAID, airway, airway segment, SID, or STAR

9. Capability to print any reroute(s) defined by any reroute definition method provided by the CRCT CDP

    9.1 Capability to print any reroute(s) defined by any reroute definition method provided by the CRCT CDP sorted by ARTCC area of specialization when the CRCT CDP is receiving radar track data on the rerouted aircraft

    9.2 Capability to print any reroute(s) defined by any reroute definition method provided by the CRCT CDP sorted by ARTCC where the aircraft is located when the CRCT CDP is not receiving radar track data on the rerouted aircraft

10. Capability to display the aggregate number of aircraft selected for rerouting

11. Capability to display any change to the flight distance for any aircraft for which a reroute has been evaluated

12. Capability to display any change to the flight time for any aircraft for which a reroute has been evaluated

13. Capability to display the aggregate change to the flight distance for all aircraft for which a reroute has been evaluated

14. Capability to display the aggregate change to the flight time for all aircraft for which a reroute has been evaluated

15. Capability to display the average change to the flight distance for all aircraft for which a reroute has been evaluated

16. Capability to display the average change to the flight time for all aircraft for which a reroute has been evaluated

17. Capability to automatically display the reroute flight plan in the Rerouting Window for any aircraft selected for rerouting

18. Capability to clear the display of current aircraft flight plans selected for rerouting

19. Capability to clear the display of reroute flight plans
20. Capability to display alphanumerically any reroute(s) defined by any reroute definition method provided by the CRCT CDP
21. Capability to automatically display on the Traffic Display any reroute(s) created when any reroute FCA is applied (default capability) *
22. Capability to suppress/restore the display of any reroute(s) displayed on the Traffic Display *
23. Capability to label fixes describing any displayed reroute(s) created by any reroute FCA (default capability) *
24. Capability to code any displayed reroute in a manner to clearly distinguish the displayed reroute from any other display *
25. Capability to automatically display any reroute(s) created by a specific reroute FCA when the reroute FCA is loaded from a file *
26. Capability to automatically update the display of any reroute as the reroute is modified *
27. Capability to automatically display preferential routes when a reroute FCA with preferential routes is loaded from a file or from the list of FCAs *
28. Capability to select preferential routes for display *

### 3.3.3 Reroute Set Management

1. Capability to default a unique name for each reroute set created
2. Capability to name a reroute set(s)
3. Capability to combine any existing reroute sets into a single merged reroute set
4. Capability to de-combine any existing merged reroute set into single existing reroute sets
5. Capability to access the Reroute Set Management capability
6. Capability to access the Reroute Set Merge capability
7. Capability to delete any aircraft from any reroute set
8. Capability to delete a selected reroute set
9. Capability to delete all existing reroute sets

10. Capability to automatically associate a reroute set with a reroute FCA definition *
11. Capability to automatically place any reroutes created when the reroute FCA is applied into the reroute set associated with the reroute FCA *
12. Capability to select and modify reroutes in the active reroute set *
13. Capability to display the identification of all existing reroute sets *
14. Capability to select a reroute set to be the active reroute set *
15. Capability to select a different reroute set to be associated with a reroute FCA *
16. Capability to create a new reroute set *
17. Capability to automatically move any reroutes in the active reroute set to the new active reroute set when the active reroute set associated with a reroute FCA is changed *
18. Capability to select/deselect for display one or more reroute sets *
19. Capability to select/deselect for display all reroute sets *
20. Capability to automatically display the new active reroute set when the active reroute set is changed *
21. Capability to code the display of the active reroute set to differentiate it from the display of non-active reroute sets

### 3.3.4 Reroute FCA Capability

The Reroute FCA capability has the following sub-capabilities:

1. Capability to assign one or more reroutes to a specific FCA *
2. Capability to automatically create a trial plan(s) that matches a predefined reroute(s) for each flight identified by the FCA *
3. Capability to automatically delete the trial plan(s) that matches the pre-defined reroute(s) when an aircraft's current flight plan matches the trial plan *
4. Capability to define and apply a reroute FCA *
5. Capability to apply one or more groups of FCA filters to a reroute FCA *
6. Capability to describe a reroute to apply to each filter group *
7. Capability to save a reroute FCA *

8. Capability to retrieve and apply a saved reroute FCA *
9. Capability to modify a saved reroute FCA *
10. Capability to create a standard reroute FCA *
11. Capability to save a standard reroute FCA *
12. Capability to retrieve and apply a saved standard reroute FCA *
13. Capability to modify a standard reroute FCA *
14. Capability to save and retrieve a modified standard reroute FCA *
15. Capability to assign a name to a modified standard FCA *
16. Capability to indicate that a standard reroute FCA has been modified *
17. Capability to specify standard FCA filter groups(s) to apply to each standard reroute(s) *
18. Capability to cancel a standard FCA filter group *
19. Capability to restore a cancelled standard filter group *
20. Capability to indicate that a standard filter group is cancelled *
21. Capability to select a standard reroute to apply to each standard filter group of a standard FCA *
22. Capability to automatically create a trial plan(s) that matches the standard reroute(s) for each flight identified by a standard reroute FCA *
23. Capability to automatically delete the trial plan(s) that matches the standard reroute(s) when the aircraft's current flight plan matches the trial plan *
24. Capability to list the aircraft identified by any reroute FCA *
25. Capability to print the list of aircraft identified by any reroute FCA *
26. Capability to list the aircraft identified by any filter group of any reroute FCA *
27. Capability to print the list of aircraft identified by any filter group of any reroute FCA *
28. Capability to automatically apply the specified preferential route to aircraft identified by one of the reroute FCA filter groups *
29. Capability to create a non-reroute FCA by deleting the reroute(s) specified for a reroute FCA *

30. Capability to create a reroute FCA by specifying and applying reroutes to a non-reroute FCA *

### 3.3.5 Reroute Evaluation Capability

The Reroute Function's Reroute Evaluation capability enables the user to evaluate the projected effects of a reroute before it is implemented. The effects are expressed as ARTCC sector peak count data, demand graph information, and graphical display data representing traffic density and spacing.

The Reroute Evaluation capability has the following sub-capabilities:

1. Capability to display a graphical representation of projected future positions of aircraft in any reroute set concurrent with each aircraft's current flight plan projected future position
2. Capability to display any projected change to ARTCC sector peak counts in any 15-minute period resulting from any reroute(s) defined by any reroute definition method provided by the CRCT CDP
3. Capability to display any projected change to ARTCC sector alerts in any 15-minute period resulting from any reroute(s) defined by any reroute definition method provided by the CRCT CDP
4. Capability to differentiate with coding any increase in projected ARTCC sector peak counts in any 15-minute period resulting from any reroute(s) defined by any reroute definition method provided by the CRCT CDP
5. Capability to differentiate with coding any decrease in projected ARTCC sector peak counts in any 15-minute period resulting from any reroute(s) defined by any reroute definition method provided by the CRCT CDP
6. Capability to differentiate with coding any changes in projected ARTCC sector alerts in any 15-minute period resulting from any reroute(s) defined by any reroute definition method provided by the CRCT CDP
7. Capability to display the projected change to ARTCC sector alerts for any merged reroute set
8. Capability to display the projected change to ARTCC sector peak counts for any merged reroute set
9. Capability to utilize radar track data when available when evaluating any reroute set(s)

10. Capability to utilize local adaptation data (SOPs, LOAs, Preferential Routes) when available when evaluating any reroute set(s)
11. Capability to evaluate and display the change to ARTCC sector alerts for any merged reroute set
12. Capability to evaluate and display the change to ARTCC sector peak counts for any merged reroute set
13. Capability to evaluate and display the change to ARTCC sector peak counts resulting from reroute(s) defined by any reroute definition method provided by the CRCT CDP
14. Capability to evaluate and display the change to ARTCC sector alerts resulting from reroute(s) defined by any reroute definition method provided by the CRCT CDP
15. Capability to select/deselect the graphical display of red or yellow sector alerts resulting from the evaluation of any existing reroute set for any ARTCC sector in the 20 contiguous ARTCCs

## 3.4 Data Sharing Function

The Data Sharing Function enables the user to label and save static screens of CRCT data and post them to a web site. This function is expected to enhance inter and intra-facility coordination and collaboration during the planning and execution of flow management problem resolution strategies. Data Sharing consists of the following capabilities:

1. Capability to name an event by using text entry *
2. Capability to select/deselect the Traffic Display *
3. Capability to select/deselect the FCA List *
4. Capability to select/deselect the Rerouting Window *
5. Capability to select/deselect the Future Traffic Display *
6. Capability to select/deselect the Sector Count Monitor for any ARTCC *
7. Capability to select/deselect the FCA Demand Graph *
8. Capability to select/deselect the NAS Monitor *
9. Capability to select/deselect the FCA parameters *
10. Capability to send any selected named event and the associated selected display(s) to the ATCSCC web site *

11. Capability to display a list of named events *
12. Capability to select/deselect any named event *
13. Capability to update any selected named event *
14. Capability to send any updated named event and the associated selected display(s) to the ATCSCC web site *
15. Capability to send any updated named event and the associated selected display(s) to the ATCSCC web site *
16. Capability to delete a selected named event and the associated selected display(s) *
17. Capability to delete a selected named event and the associated selected display(s) *
18. Capability to delete all named events and deselect the associated selected display(s) *
19. Capability to reset the Capture Event window to default settings *
20. Capability to delete all named events and deselect the associated selected display(s) *

# List of References


1. Rhodes, L. R, and L. S. Carlson, *Updated Operational Concept for Traffic Management Collaborative Routing Coordination Tools (CRCT)*, MP 00W0000228, October 2000, The MITRE Corporation, McLean, VA.
2. Barlow, Warren E., L. S. Carlson, J. A. Houde, and R. C. Watkins, *Results of FY00 Evaluation of CRCT Functions at Kansas City ARTCC (Coordination Draft*), MP 00W0000223, September 2000, The MITRE Corporation, McLean, VA.
3. Rhodes, L.S. and P. Kapoor, *Collaborative Routing Coordination Tools (CRCT) User's Guide*, MP01W0000066, April 2001, The MITRE Corporation, McLean, VA.

**Appendix A**

# Enhancement Requests

This Appendix lists enhancements and capabilities requested by the field facilities but not implemented in the CRCT CDP, often because of insufficient time and resources to build and evaluate the requested enhancement. In some cases, a particular request did not need evaluation, for example, because the operational concept was already well understood, the need for that enhancement was self-evident, or the feature was already part of ETMS. In other cases, if the enhancements were not ready for Concept Development, but needed further Concept Exploration and evaluation, the enhancements were built into CRCT for Concept Exploration use only. In these cases, the new functionality is available in a laboratory version, but not in the fielded CRCT CDP.

The enhancement requests have been organized as follows:

- Traffic Display and Future Traffic Display capabilities
- FCA-related Capabilities
- Rerouting and Reroute Set Management capabilities
- Miscellaneous other capabilities
- Capabilities in development for a future release of the CRCT CDP
- Capabilities for Concept Exploration work in the laboratory

## A.1 Traffic Display and Future Traffic Display Capabilities

1. Provide a default capability to display FCA aircraft with the route display suppressed when applying a FCA.
2. Provide a capability for the user to define a range ring display on the Traffic Display specifying single or multiple airport(s) and the ring range.
3. Provide a capability to display inactive flights when they are coded on the Traffic Display by clicking in the airport circle. Display content for the inactive flights is the same content as the FCA List.
4. Provide a capability to display tops and strike data to the CRCT CDP weather display.
5. Enhance the display of sector numbers on the Traffic Display to make them more legible.

6. Use ATCSCC Traffic Situation Display (TSD) coding for actives and inactives in all lists (red and green).
7. Provide a capability to toggle the display of airways from a list. Also, provide a capability to insert, store, and delete any route in the list of airways as needed.
8. Enhance the coding of the Future Traffic Display to avoid confusion with the Traffic Display.
9. Provide a capability to display full rather than partial data blocks for aircraft selected for rerouting.
10. Provide a capability to color code displayed routes with sector alert status.
11. Provide a capability for the user to specify individual airways to display via text entry of airway name.
12. Provide a capability to display the lateral outline of the Collaborative Convective Forecast Product (CCFP) on the Traffic Display.

## A.2 FCA-related Capabilities

1. Provide a capability to display sectors on the Sector Count Monitor grouped by Area of Specialization.
2. Restore the capability to examine projected sector count data for a sector combination or de-combination before the change is implemented.
3. Provide a capability to select and designate multiple laterally and/or vertically adjacent ARTCC sectors or SUAs as a single FCA.
4. Provide a capability for the user to assign different colors to flows filtered with the FCA Definition function. Allow a unique color for each FCA outline correlated with the colored flow.
5. Provide a capability to filter regional jets.
6. Provide a capability to select any ARTCC as a FCA.
7. Provide a capability for the user to predefine a geographical area for the departure or arrival fields in the FCA Filters. For example, "LA Basin" would include a set of predefined Los Angeles area airports.
8. Provide a capability to specify "apply time at fix" as a FCA filter.
9. Provide a capability to have an FCA's start and end times continuously move forward in time maintaining constant offsets from the current time. For example, an

FCA created at 1000 with relative start time of 1 hour and relative end time of 2 hours would be active from 11-1200 at creation, and at 1200 would list flights matching the parameters from 1300-1400.

10. Provide a capability to create FCAs with shelving i.e., multiple floors and ceilings.
11. Provide a capability to select any TRACON as a FCA.
12. Provide a capability to copy and paste of CRCT list data into text files.
13. Provide a capability to select one line entries in the FCA List.
14. Provide a capability to select multiple FCA List entries for suppression with a single keystroke.
15. Provide a capability to divide the FCA List into 15, 30, or 60 minute intervals.
16. Provide a capability to display of entries for a selected FCA by selecting the FCA identification.
17. Provide a capability to display only one FCA List entry for each aircraft intersecting multiple FCAs, and indicate in the entry all FCAs penetrated by that aircraft. Retain the current FCA List display options. Display All would be the default.
18. Provide a default capability to display FCA Occupancy in the FCA Demand Graph window.
19. Provide a capability to select display times for the FCA Demand Graph.
20. Provide a capability to code the subject sector on the Traffic Display when the Time in Sector display is opened.
21. Provide a capability to code active and inactive flights in the Time in Sector display to be clearly distinguishable.
22. Provide a capability to print the Time in Sector display.

## A.3 Rerouting and Reroute Set Management Capabilities

1. Provide a capability to select multiple Rerouting Window entries for deletion with a single keystroke
2. Provide a capability to display the same content in the Rerouting Window entries as in the FCA List entries.
3. Restore the capability to Rename and Copy Reroute Sets.
4. Provide a capability to print entries selected for rerouting and displayed in Rerouting Window before they are evaluated.

5. Provide a capability to display merged reroute sets in the Rerouting Window.
6. Provide an option to color code reroute sets displayed on the Traffic Display.
7. Provide a capability for the user to color code and add labels to reroute sets on the Traffic Display.
8. Provide the user an option to display single line reroute entries in the Rerouting window.
9. Improve the capability to evaluate reroutes (both laterally and vertically) when using low altitude arrival and departure route procedures.
10. Provide a capability to graphically display the Reroute Set(s) that is selected in the Sector Count Monitor or NAS Monitor. When this option is selected, selecting a reroute set on the NAS Monitor or Sector Count Monitor would result in the graphic display of the reroute set on the Traffic Display. Selecting merged sets in the NAS Monitor or Sector Count Monitor would display the merged set on the Traffic Display.
11. Provide a toggle to disable the default to originally filed SIDs or STARs.
12. Provide a default capability to open the text entry window when the Rerouting Window is displayed.
13. Provide a capability to edit route strings of individual aircraft displayed in the Rerouting Window directly editing the route strings.
14. Provide a capability to specify the reason for a reroute in the Remarks field of reroute entry

## A.4 Miscellaneous Other Capabilities

1. Provide a capability to send CRCT information to ETMS email for field distribution.
2. Provide a capability to assign departure delay to individual inactive flights and to evaluate the impacts on the Evaluation displays (Sector Count Monitor, NAS Monitor, Time in Sector Display, FCA Demand, Future Traffic Display). A possible method the delay could be assigned is from the Time in Sector display by sliding the bars of selected inactive flights to denote the assigned delay times. Delay should also be assignable by text entry.
3. Provide a capability to assess the impact of ground delays/ground stops
4. Provide a capability to assess the impact of en route and arrival miles-in-trails

5. Provide a capability to dynamically enter and apply altitude/route restrictions, for example, create a temporary boundary crossing restriction with start/end time; altitude, location. Trajectory modeling would apply the temporary restriction data in all trajectory calculations affected by the temporary restriction.
6. Provide a capability for the user to dynamically turn on/off applicability of route/altitude restrictions with trajectory modeling taking the changes into account.
7. Provide a capability to display reroutes for active aircraft at the sectors with track control of the subject aircraft
8. Provide a capability to send reroute sets electronically to other facilities so that the receiving facilities do not have to reenter them into the Host Computer System (HCS)
9. Provide a capability for a TMU to electronically apply reroutes to flight plans of inactive aircraft resulting in amended flight plans in the HCS.

## A.5 Capabilities in Development for a Future Release of the CRCT CDP

1. Provide a capability to display a sector and the alert condition that is alerted (as depicted on the NAS Monitor) on the Traffic Display and Future Traffic Displays.
2. Provide a capability to operate several CRCT user interfaces simultaneously. Control over data sharing would have to be provided. It must be possible to create both private (seen only on creator's display) and public (seen on all displays) FCAs and reroutes.
3. Provide a capability to quickly and easily send CRCT displays electronically for field distribution.

## A.6 Capabilities for Concept Exploration

1. Provide a capability to assess impact of MIT on internal departures only
2. Provide a capability to assess the impact of a proposed MIT on delays, aircraft spacing, and sector volume.
3. Provide a capability to assess the impact of a combination of reroutes—ground delays, and MIT on sector volume, aircraft spacing and delay
4. Provide a capability to select and delay groups of inactive flights
5. Provide a capability to automatically generate reroute sets around weather cells

# Glossary

| | |
|---|---|
| **ARTCC** | Air Route Traffic Control Center |
| **ATC** | Air Traffic Control |
| **ATCSCC** | Air Traffic Control System Command Center |
| **CAASD** | Center for Advanced Aviation Development |
| **CCFP** | Collaborative Convective Forecast Product |
| **CD** | Concept Development |
| **CE** | Concept Exploration |
| **CDP** | Concept Development Platform |
| **CRCT** | Collaborative Routing Coordination Tools |
| **DCS** | Data Collection Subsystem |
| **DOT** | Department of Transportation |
| **DSS** | Decision Support Subsystem |
| **ETMS** | Enhanced Traffic Management System |
| **FAA** | Federal Aviation Administration |
| **FAS** | Flow Analysis Service |
| **FCA** | Flow Constrained Area |
| **FPS** | Flight Prediction Service |
| **FSD** | Full Scale Development |
| **FY** | Fiscal Year |
| **HCI** | Human Computer Interface |
| **HCS** | Host Computer System |
| **LOA** | Letter of Agreement |
| **MAP** | Monitor Alert Parameter |
| **NAS** | National Airspace System |
| **NAVAID** | Navigational Aid |
| **NOWRAD** | A national weather mosaic of NEXRAD refle |
| **NRP** | National Route Program |
| **PD** | Prototype Development |
| **R&D** | Research and Development |
| **SID** | Standard Instrument Departure |
| **SOP** | Standard Operating Procedure |
| **STAR** | Standard Terminal Arrival Route |
| **SUA** | Special Use Airspace |
| **TFM** | Traffic Flow Management |
| **TFM-I** | TFM Infrastructure |
| **TMU** | Traffic Management Unit |
| **TRACON** | Terminal Radar Approach Control Facility |
| **TSD** | Traffic Situation Display |
| **WARP** | Weather and Radar Processor |
| **VNTSC** | Volpe National Transportation Systems Cent |