

MITRE PRODUCT

Summary of Second Half FY03 CAASD Technology Transfer Contributions

September 2003

Dr. Kenneth S. Lindsay

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Dr. Kenneth S. Lindsay

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Abstract

For Fiscal Year (FY) 2003, the Federal Aviation Administration requested that The MITRE Corporation’s Center for Advanced Aviation System Development (CAASD) continue to further Free Flight Phase 2 (FFP2) objectives by facilitating the incorporation of operationally mature functions from the baseline Collaborative Routing Coordination Tools (CRCT) into the Traffic Flow Management Infrastructure (TFM-I). This technology transfer task entails assisting the John A. Volpe National Transportation Systems Center (VNTSC) with the integration of these CRCT functions into the Enhanced Traffic Management System (ETMS), an existing operational system within the TFM-I.

A previously published document (MP 03W0000070, April 2003) summarizes accomplishments from the first half of FY 2003 (FY03). This document summarizes contributions from the second half of FY03. Technology transfer activities are divided into five types as defined in Table 1.

Table 1. FY03 Technology Transfer Activities

Activity Types	Activity Definitions
Procedure Development and Testing	CAASD supported development of procedures for using Flow Constrained Area (FCA) functions in ETMS, as documented in FAA General Notice (GENOT) N7210.542.
ETMS HCI Re-engineering	CAASD supported the re-engineering of the ETMS Human-Computer Interface (HCI) for CRCT functions that have been implemented in ETMS.
ETMS Requirements Reviews	CAASD reviewed requirements for implementing CRCT capabilities in ETMS and documented comments arising from the reviews.
Meetings	CAASD participated in ETMS Technical Interchange Meetings (TIMs) and Program Management Reviews (PMRs) and in ETMS Design and Requirements Meetings, hosted CAASD TFM PMRs, attended Collaborative Decision Making (CDM) meetings, and provided CRCT capability demonstrations.

Table 1. FY03 Technology Transfer Activities (Concluded)

Activity Types	Activity Definitions
Infrastructure Support	CAASD maintains an advanced Air Traffic Management (ATM) laboratory for conducting Traffic Flow Management (TFM) research. CAASD completed required coordination activities in order to have access to CDM data and to the Common Constraint Situation Display (CCSD), as well as to ETMS applications being evaluated in preparation for field deployment.

KEYWORDS: Technology Transfer, CRCT, ETMS, FFP2, TFM, TFM-I, VNTSC, Volpe

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Section 1

Introduction

1.1 Background

In Fiscal Year 2001 (FY01), the Federal Aviation Administration (FAA) requested that The MITRE Corporation's Center for Advanced Aviation System Development (CAASD) further FFP2 objectives by facilitating the incorporation of baseline Collaborative Routing Coordination Tools (CRCT) functions into the Traffic Flow Management (TFM) Infrastructure (TFM-I). As CRCT consists of various TFM tools at different stages in research and development (R&D), CRCT capabilities were considered individually for incorporation into TFM-I. Specifically, the technology transfer task entailed transfer of CRCT functions deemed operationally mature by the FAA to the TFM-I contractor, the John A. Volpe National Transportation Systems Center (VNTSC), for incorporation into the existing Enhanced Traffic Management System (ETMS).

The first step in this technology transfer process, identifying the operationally mature CRCT functions, was completed during FY01^[1]. In Fiscal Year 2002 (FY02), the focus shifted to documenting those functions, reviewing the requirements for implementing them in ETMS, evaluating proposed enhancements and refinements to the CRCT functions, and helping develop and validate TFM concepts and procedures for using the functions in an operational environment^[2]. These activities continued in Fiscal Year 2003 (FY03) with particular emphasis on the collective integration into ETMS of Flow Evaluation Areas (FEAs), Flow Constrained Areas (FCAs), rerouting, and automated generation of advisories with associated flight lists.

1.2 Scope

An earlier document summarizes CAASD's technology transfer accomplishments completed during the first half of FY03^[3]. This document summarizes technology transfer activities during the second half of FY03. Activities are divided into five groupings as follows.

- *Procedure Development and Testing:* CAASD supported development of procedures for using Flow Constrained Area (FCA) functions in ETMS, as documented in FAA General Notice (GENOT) N7210.542. As part of this activity, CAASD participated in various tests to define and better understand the multiple uses of FCAs.
- *ETMS HCI Re-engineering:* CAASD supported the re-engineering of the ETMS Human-Computer Interface (HCI) for CRCT functions that have been implemented in ETMS. This activity helped to ensure that lessons learned and insight gained by

CAASD participation in operational evaluations were reflected in the re-engineered ETMS HCI.

- *ETMS Requirements Reviews:* CAASD reviewed requirements for implementing baseline CRCT capabilities in ETMS and documented comments arising from the reviews. To share experience in TFM-related topics, CAASD also reviewed and commented on requirements not directly related to transfer of baseline CRCT technology to ETMS.
- *Meetings:* CAASD participated in VNTSC ETMS Technical Interchange Meetings (TIMs) and Program Management Reviews (PMRs) and in ETMS Design and Requirements Meetings, hosted CAASD TFM PMRs, attended Collaborative Decision Making (CDM) meetings, and provided several CRCT capability demonstrations.
- *Infrastructure Support:* CAASD maintains an advanced Air Traffic Management (ATM) laboratory for conducting TFM research. CAASD completed required coordination activities in order to have access to CDM data and to the Common Constraint Situation Display (CCSD), as well as to ETMS applications being evaluated in preparation for field deployment. Access to these systems helps CAASD to determine how best to integrate CRCT functions into TFM-I.

1.3 Organization

Section 2 describes the technology transfer activities completed by CAASD in the second half of FY03. Each activity is grouped by activity type and includes the following information:

- Name and date of the activity
- Description of what it was or what was done
- Description of why it was done and the value of this particular activity or product

Section 2

Summary of Technology Transfer Activities for the Second Half of FY03

The following subsections provide descriptions of technology transfer activities within the five activity types, namely procedure development and testing, ETMS HCI re-engineering, ETMS requirements reviews, meetings, and infrastructure support.

2.1 Procedure Development and Testing

During the second half of FY03, CAASD continued to develop procedures for using FCA functions in ETMS, as documented in FAA General Notice (GENOT) N7210.542, which became effective 12 May 2003. As part of this activity, CAASD participated in various FCA tests to define how FCAs will be used in ETMS and to assess the implications of their use. GENOT N7210.542 details the procedures and format for FCA-based Air Traffic Control System Command Center (ATCSCC) advisories and was largely drafted in the first half of FY03. However, testing sessions in the second half of FY03 helped to refine understanding, in both the FAA TFM service provider and airspace user communities, of the multiple applications of the FCA technology. CAASD continued to facilitate test planning and preparation, to track issues, and to document results^[4]. Table 2-1 presents a summary list of the FCA/Reroute Workgroup tests in which CAASD participated. Test numbers are a continuation of those reported for the first half of FY03. In addition to CAASD, ATCSCC and Kansas City (ZKC) Air Route Traffic Control Center (ARTCC) traffic managers, FAA support contractors, VNTSC, and air carrier representatives participated in the tests. The air carriers included American Airlines (AAL), Continental Airlines (COA), Delta Airlines (DAL), Federal Express (FDX), Northwest Airlines (NWA), United Airlines (UAL), and U.S. Airways (USA).

Table 2-1. FCA/Reroute Workgroup Tests

No.	Dates	Operational Participants
10	1-3 April 2003	ATCSCC, COA, NWA, UAL, USA, ZKC
11	7 May 2003	ATCSCC, AAL, COA, DAL, FDX, UAL, USA

CAASD also contributed analysis expertise to the FCA testing process and to understanding the operational use of FCA functions. For example, following the live tests, analyses using the CAASD Platform for En Route (CAPER) reroute modeling tools helped

to demonstrate what the impact would have been to the National Airspace System (NAS) and NAS users if the reroutes “filed” in the tests had been executed. CAASD also analyzed the FCA list data captured during the tests, examining issues such as how many of each user’s flights were captured in the FCA lists and how the number of flights filed through the FCA changes over the course of a constraint event. These and other analyses have led to enhancements to subsequent procedure development tests and to increased understanding of future automation needs to support the procedures that were tested.

2.2 ETMS HCI Re-engineering

CAASD contributed to the re-engineering of the Human-Computer Interface (HCI) for CRCT functions as they have been designed and implemented in ETMS^[5]. In order to cross-check the FY02 operational evaluation findings regarding the perceived operational benefit of integrating FCA and reroute modeling functionality^[6], cognitive modeling analyses were employed using the Natural Language Goals, Operators, Methods, and Selection (NGOMSL) rules technique^[7]. This analysis demonstrated a physical and mental workload benefit from integrating the functionalities.

CAASD developed briefings that summarize operational evaluation and NGOMSL results and used mockups to illustrate the operational use of the integrated FCA and Reroute functions. These briefings were delivered to and discussed with the William J. Hughes Technical Center (WJHTC), VNTSC, and various FAA and airspace user stakeholders during the first half of FY03^[2]. In the second half of FY03, coordination activities continued. The briefings and mockups were modified based on ongoing feedback from the stakeholders. Most notable of the coordination activities were two meetings, one held at WJHTC on 1-2 July and the other a teleconference held on 14 July 2003. In addition to CAASD, meeting participants included human factors experts from WJHTC (ACB-220) and Ohio State University, and FAA operational personnel representing various CDM subgroups.

The VNTSC-developed user interface for multiple FCA filters in ETMS 7.7 is consistent with many of the functional enhancements recommended by the cognitive modeling analyses, as are user interface enhancements proposed by WJHTC for the Create Reroute function in ETMS 7.8. These enhancements all represent important steps toward the integrated FCA, Reroute Modeling, and Create Reroute functionality. The FY02 evaluations^[6] and anecdotal information from operational personnel have shown that the integration of these functions is deemed important by many FAA stakeholders.

2.3 ETMS Requirements Reviews

During the second half of FY03, CAASD continued to review ETMS requirements documents and to provide comments on those documents to VNTSC and to the FAA. The requirement reviews are used to ensure that the lessons learned and insight gained from the FY01 and FY02 CRCT operational evaluations are considered in defining requirements for

future ETMS releases. ETMS requirements for mature CRCT functionality^[8] are a subset of the requirements that were reviewed. Additional requirements that were reviewed are summarized herein. CAASD comments note relevant feedback received from operational personnel during the FY01^[9] and FY02^[6] FFP2 CRCT field evaluations. The reviews also request clarification of points that are not explicitly addressed in the requirements.

2.3.1 Dynamic Sectorization

CAASD reviewed ETMS requirements for dynamic sectorization. The requirements are for a capability to allow ETMS to dynamically update sector configuration and capacity. This is needed for accurate sector load monitoring and alerting. In June 2003, CAASD provided VNTSC with comments on the document: *ETMS System Requirements for Dynamic Airspace Configuration, Version 7.0*, dated 14 February 2003. On 28 March 2003, preliminary comments were sent directly to VNTSC and to the FAA via E-Mail and final comments were delivered to the FAA as a supplemental product as documented in letter F045-L03-023, dated 2 June 2003^[10], with a copy to VNTSC. In September 2003, CAASD provided VNTSC with preliminary comments on the most recent incarnation of the dynamic airspace configuration requirements: *Dynamic Sectorization ETMS System Requirements, Version 1.4*, dated 2 September 2003. Almost all CAASD comments made to the earlier versions of the requirements have been addressed in the latest version. CAASD's minor comments to the latest version were delivered via E-Mail to VNTSC and to the FAA.

2.3.2 FCA Flight Filtering

CAASD reviewed requirements for FCA flight filtering enhancements. The requirements specify ETMS enhancements to provide more flexibility in filtering FCA flights. In June 2003, CAASD provided VNTSC with comments on the document: *ETMS Memorandum on Proposed FEA/FCA Flight Filtering Enhancements (Revision #3)*, dated 6 March 2003. On 28 March 2003, preliminary comments were sent directly to VNTSC and to the FAA via E-Mail and final comments were delivered to the FAA as a supplemental product as documented in letter F045-L03-023, dated 2 June 2003^[10], with a copy to VNTSC. Most of the CAASD comments that arose from review of an earlier version of the flight filtering enhancements requirements are reflected in revision 3 of the requirements. Comments on the latter version focus on minor changes that would help to more clearly communicate the requirements.

2.3.3 Monitor/Alert Facelift

CAASD reviewed system and software requirements for an ETMS Monitor/Alert facelift. The requirements are for the implementation of three baseline CRCT capabilities: the NAS Monitor, the Center Monitor, and the Time in Sector display. In July 2003, CAASD provided VNTSC with comments on the two requirements documents: *ETMS 7.6 System Requirements for Monitor/Alert Facelift (Version 1.2)*, dated 22 May 2002 and *ETMS 7.6*

Software Requirements for Monitor/Alert Facelift (Version 1.4), dated 11 December 2002. Preliminary comments on these two sets of requirements were sent to VNTSC and to the FAA by E-Mail on 18 April 2003. Final comments were delivered to the FAA as a supplemental product as documented in letter F045-L03-032, dated 11 July 2003^[11], with a copy to VNTSC. In September 2003, CAASD provided VNTSC with preliminary comments on: *ETMS System Requirements for MonitorAlert Facelift/Monitor Alert Integration, Version 2.0*, dated 29 August 2003. Comments were delivered via E-Mail to VNTSC and to the FAA.

CAASD comments on version 1.2 of the system requirements include new comments on that version and address the disposition of CAASD comments on earlier versions (1.0 and 1.1) of the requirements. Some of the comments on the earlier versions were addressed while others are still pending. None of the comments on version 1.2 were addressed in version 2.0 of the system requirements. CAASD comments on version 1.4 of the software requirements include new comments on that version and address the disposition of CAASD comments on earlier versions (1.2 and 1.3) of the requirements. Almost all of the comments address presentation of information in the Time in Sector Chart.

Although the current versions of the Monitor/Alert Facelift system and software requirements do not address some of the CAASD comments to earlier versions, future versions may address the comments. CAASD comments to ETMS requirements are sometimes not addressed until several ETMS releases (and a year or more) in the future. Sometimes the requirements for an ETMS capability are never modified to address CAASD comments although the capability, as implemented, reflects the comments.

2.3.4 FCA Database and TSD FCA Functions

CAASD reviewed software requirements for FCA Database Functions and for TSD FCA Functions. FCA Database Functions allow TSD users to share FCA definitions with other TSD users at the same or at another facility. TSD FCA functions allow TSD users to define FCAs, manage the FCA definitions, display FCAs on the TSD, and obtain information about the flights predicted to penetrate the FCAs. In July 2003, CAASD provided VNTSC with comments on: *ETMS 7.7 Software Requirements for FCA Database Functions (Version 2.9)*, dated 4 April 2003 and on *ETMS 7.7 Software Requirements for TSD FCA Functions (Version 3.0)*, dated 4 April 2003. As no later versions of the two sets of software requirements have been reviewed, the impact of the CAASD comments is to be determined.

2.3.5 ETMS Use of RAT Reroutes

CAASD reviewed an Advanced Traffic Management System (ATMS) memorandum that proposes to use reroutes from the Reroute Advisory Tool (RAT) list to replace historical routes. RAT reroutes should be more accurate than historical routes and using them instead of the historical routes should improve the predictive accuracy of the ETMS Monitor/Alert

function. In August 2003, CAASD provided VNTSC with comments on the following ATMS Memorandum from Ken Howard and Rick Oiesen to the CDM Group: *Automatic Use by ETMS of Reroutes in a RAT List*, dated 21 July 2003. While it is too early to assess the impact of CAASD comments, it was pointed out that CRCT technology, such as reroute modeling, could be used to implement the proposal.

2.3.6 Reroute Modeling

CAASD reviewed system and software requirements for a reroute modeling capability that enables ETMS to predict the change in sector traffic loads if a particular rerouting plan is implemented. In August 2003, CAASD provided VNTSC with comments on the system requirements: *ETMS System Requirements: Reroute Modeling Function, version 1.3*, dated 24 January 2003 and on the two companion software requirements: *ETMS Software Requirements: Reroute Modeling – TSD and ALMON Functions, version 1.1*, dated 13 December 2002 and *ATMS/ETMS Software Requirements: Rerouter Back End, version 1.2*, dated 4 February 2003. Preliminary comments were sent to VNTSC and to the FAA by E-Mail on 8 August 2003. Final comments were delivered to the FAA as a supplemental product as documented in letter F045-L03-043, dated 15 August 2003^[12], with a copy to VNTSC.

2.3.7 RNP Impact on TFM Operations

CAASD investigated changes in en route operation due to the Required Navigation Performance (RNP) program and identified their impact on TFM operations. Although the subject of RNP impact on TFM operations is not directly related to the transfer of CRCT technology to ETMS, it falls within the broader objective of sharing CAASD expertise on TFM-related topics. A draft description of the impact was sent via E-mail to VNTSC and to the FAA on 19 August 2003. The final description was delivered to the FAA as a supplemental product as documented in letter F045-L03-047, dated 25 August 2003^[13], with a copy to VNTSC.

2.4 Meetings

CAASD participated in and hosted various meetings and provided several demonstrations of CRCT capabilities. Table 2-2 presents a summary list of the meetings, which are described in more detail in Sections 2.4.1 through 2.4.3. Section 2.4.4 presents a summary list and descriptions of the CRCT demonstrations.

Table 2-2. Technology Transfer Meetings

Date	Title	Location
8-9 April 2003	ETMS 7.7 Design Review	VNTSC
30 April-1 May 2003	ETMS TIM and PMR	ATCSCC
13 May 2003	FCA Rerouting Workgroup	Detroit, MI
13-15 May 2003	Collaborative Routing (CR) Meeting	Detroit, MI
30 May 2003	NAS Configuration Control Board (CCB)	FAA Headquarters
11 June 2003	FCA Rerouting Workgroup	Teleconference
12 June 2003	CAASD PMR with AUA-700	CAASD
12, 23, 25 June and 28 July 2003	Role of Emerging Technologies in Integration of ATM Operations	CAASD
18 June 2003	FCA Rerouting Workgroup	Teleconference
18-19 June 2003	ETMS TIM and PMR	VNTSC
23 June 2003	Review of 18-19 June 2003 TIM and PMR	CAASD
15 July 2003	ETMS 7.8 Requirements Review	ATCSCC
16 July 2003	TFM Research Briefing	CAASD
9 September 2003	TFM Review Board Meeting	Northrop Grumman
9-11 September 2003	CR Workshop	Northrop Grumman
10 September 2003	TFM User Team (TUT) Meeting	CAASD

2.4.1 ETMS TIMs/PMRs

During the first half of FY03, CAASD participated in ETMS TIM/PMR meetings as part of the technology transfer process^[3]. CAASD continued this technology transfer activity during the second half of the fiscal year, participating in the TIMs/PMRs listed in Table 2-2.

Among other topics, TIM/PMR meetings addressed the allocation of CRCT capabilities to future ETMS releases and the implementation of the capabilities in the releases. During these meetings CAASD provided information about CRCT capabilities and shared insight gained from CRCT evaluations. These discussions helped to promote a better understanding among all participants of the issues involved in implementing CRCT capabilities in ETMS.

During the TIM/PMR meetings CAASD provided input on issues not directly related to the transfer of CRCT technology into ETMS. This included pointing out, clarifying, and resolving inconsistencies within ETMS requirements documents and between requirements documents and ETMS TIM/PMR briefings. CAASD also used the meetings to raise ETMS training issues and to confirm that significant ETMS requirements issues, previously raised by CAASD, have been adequately addressed.

2.4.2 Meetings with the FAA

During the second half of FY03, CAASD attended various meetings with the FAA. This included a 30 May 2003 NAS Configuration Control Board (CCB) meeting to support AUA in submitting two CRCT NAS Change Proposals (NCPs) for approval. On 16 July, CAASD presented a TFM research briefing to Patty Swenor (ARU/AUA-700), Kevin Debeneditis (National Air Traffic Controller's Association [NATCA] TUT co-lead), and Mark Marchese (AUA-700 TUT co-lead).

CAASD held several meetings with Tim Gilbert (AOZ-40). During a meeting on 23 June 2003, CAASD presented the highlights of the 18-19 June ETMS TIM/PMR. This meeting and the remaining ones (12, 25 June and 28 July 2003) were used to define a task to explore the role of emerging technologies in facilitating the integration of ATM operations and to outline a position paper on the topic. CAASD is currently working with Mr. Gilbert to draft the paper.

2.4.3 CDM Meetings

CAASD participated in several CR workshops and FCA Rerouting Workgroup meetings, as listed in Table 2-2. CR workshops address issues related to the execution of collaborative routing by TFM service providers and users. FCA Rerouting Workgroup meetings are used to develop procedures and tests for FCA capabilities that are to be implemented in ETMS.

2.4.4 CRCT Capability Demonstrations

During the second half of FY03, demonstrations of CRCT capabilities and functions were given to the FAA and to foreign research organizations and Communications, Navigation, and Surveillance/Air Traffic Management (CNS/ATM) service providers. Demonstrations were customized to each particular audience to focus on its specific needs. Table 2-3 lists the demonstrations that were given.

Demonstrations educated audiences about CRCT from an operational and engineering perspective. The demonstrations consisted of an overview of CRCT capabilities as currently implemented. CAASD used the demonstrations to answer questions regarding CRCT capabilities and to help promote collaboration on TFM activities for consideration as possible joint efforts.

Table 2-3. List of CRCT Demonstrations

Date	Organization/Attendees
22 April 2003	Japan's Mitsubishi Heavy Industry
25 April 2003	Korean delegation and FAA representative
26 April 2003	Director of Philippine CNS/ATM
18 June 2003	Shirley McGowan, FAA ASD-103; Jada Wells, FAA AOZ-500

2.5 Infrastructure Support

CAASD maintains an advanced ATM laboratory for conducting TFM research. To facilitate research on new concepts and automated capabilities for implementation in ETMS, the laboratory includes workstations that can access ETMS research, evaluation, and test strings. The ATM laboratory is used in part to evaluate ETMS requirements, including those for implementing CRCT capabilities in ETMS.

During the second half of FY03, CAASD maintained the hardware and software infrastructure that accesses ETMS and CCSD. CAASD worked with VNTSC to resolve ETMS workstation configuration problems related to the transition to ETMS v7.6. CAASD also supported VNTSC resolution of a router connection problem that prevented communication between the CAASD ETMS workstation and the ETMS Hub. In the first half of FY03, CAASD secured approval for access to CDM data, and in the second half of FY03, completed assisting VNTSC in setting up web connections for CCSD in the CAASD ATM laboratory.

CAASD also made changes to the CRCT infrastructure. As message contents and data format changed during the transition to ETMS v7.6, CAASD updated the ETMS message parser used by CRCT. To facilitate the transfer of CRCT capabilities to ETMS, CAASD has been modifying the CRCT HCI to make it more like the ETMS HCI. As part of this effort, echo tops and National Convective Weather Forecast (NCWF) polygons were added to the CRCT prototype.

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13. *Impact of Required Navigation Performance (RNP) on Traffic Flow Management (TFM) Capabilities*, 25 August 2003, F045-L03-047, The MITRE Corporation, McLean, VA.

Glossary

AAL	American Airlines
ACB-220	FAA WJHTC Office of Innovations and Solutions
ATCSCC	Air Traffic Control System Command Center
AOZ-40	Free Flight Performance Metrics Team
AOZ-500	Terminal/En Route Integrated Products Team
ARTCC	Air Route Traffic Control Center
ASD-103	FAA Office of System Architecture and Investment Analysis
ATM	Air Traffic Management
ATMS	Advanced Traffic Management System
AUA	FAA Office of Air Traffic Systems Development
CAASD	Center for Advanced Aviation System Development
CAPER	CAASD Analysis Platform for En Route
CCB	Configuration Control Board
CCSD	Common Constraint Situation Display
CDM	Collaborative Decision Making
CNS	Communications, Navigation, Surveillance
COA	Continental Airlines
CR	Collaborative Routing
CRCT	Collaborative Routing Coordination Tools
DAL	Delta Airlines
ETMS	Enhanced Traffic Management System
FAA	Federal Aviation Administration
FCA	Flow Constrained Area
FDX	Federal Express
FEA	Flow Evaluation Area

FFP2	Free Flight Phase 2
GENOT	General Notice
HCI	Human-Computer Interface
NAS	National Airspace System
NATCA	National Air Traffic Controller's Association
NCP	NAS Change Proposal
NCWF	National Convective Weather Forecast
NGOMSL	Natural Language Goals, Operators, Methods, and Selection
NWA	Northwest Airlines
PMR	Program Management Review
R&D	Research and Development
RAT	Reroute Advisory Tool
RNP	Required Navigation Performance
TFM	Traffic Flow Management
TFM-I	TFM Infrastructure
TIM	Technical Interchange Meeting
TRACON	Terminal Radar Approach Control
TSD	Traffic Situation Display
TUT	TFM User Team
UAL	United Airlines
USA	U.S. Airways
VNTSC	John A. Volpe National Transportation Systems Center
WJHTC	William J. Hughes Technical Center
ZID	Indianapolis ARTCC
ZKC	Kansas City ARTCC

