SAIC/NMS TR 00-01

Technical Research in Advanced Air Transportation Concepts & Technologies

Task Order 54

Investigation of Implementation Sites for Multi-center Traffic Management Advisor (McTMA) AATT Decision Support Tool

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Final Report

December 2000

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Operating Under Contract NAS2-98002
National Aeronautics and Space Administration

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1.0 Introduction

1.1 Background

The Advance Air Transportation Technologies (AATT) Project is part of the National Aeronautics and Space Administration's (NASA's) Aviation System Capacity (ASC) Program. The objective of AATT is to improve the overall performance of the National Airspace System (NAS) as a whole. In order to meet this objective, AATT is developing decision support technologies and procedures to aid NAS stakeholders in the near-term, mid-term, and far-term. The mid-term Decision Support Tools (DSTs) are grouped under the category of support to the Federal Aviation Administration's (FAA's) Free Flight Phase 2 (FFP2) program. The Multi-Center Traffic Management Advisor (McTMA) is planned to be a part of the group of our mid-term DSTs.

McTMA will initially be created as a standalone DST. As the design matures, McTMA will be integrated to perform seamlessly with other AATT controller support aids. Benefits assessments, in kind, are performed upon individual DSTs prior to an integrated final assessment of all AATT products in 2004. Performance impacts and resulting benefits are quantified through the use of NAS computer modeling. In order to perform life-cycle cost/benefit studies across the NAS our computer model needs an "implementation" scheme. Sites for this computer implementation are selected based upon the functionality and dependencies of AATT tools. The purpose of this task is to create a deployment site list for McTMA and to document the rationale for the selections.

1.2 Task Requirements

Results from this task will serve at least two groups at NASA Ames: AATT benefits assessors and McTMA tool developers. Therefore the selection criteria for determining which Terminal Radar Approach Control areas (TRACONs) are multi-center needs to be well researched and thoroughly documented.

Task Order 54 was officially started on August 23, 2000, and has a funded life of four and a half months, taking it to January 12, 2001. As part of the initial effort NASA and SAIC conducted a kickoff meeting on September 7, 2000. The main purpose of this meeting was to review the task in detail and refine a methodology for gathering information on Multi-center TRACONs within the FAA.

It was agreed that at a minimum the following fundamental items be considered in identifying which TRACONs may fall into a multi-center environment:

- Facility operational level
- Individual facility/sector boundaries
- Number of operations – especially arrivals
- Traffic flow patterns
- Airspace complexity
- IFR versus VFR days
- Geography associated with the facility

As the task proceeded the criteria was further refined between NASA and SAIC. Initial discussions identified that there are currently twenty-four TRACONs that service twenty-one pacing airports in the United States. Although each of these facilities may not be in a multi-center environment, the essential elements provided by McTMA such as time based metering, may improve the operational posture, thereby allowing them to be included as viable candidates. This type of variable was incorporated into the selection facility list and all TRACON facilities are available to be viewed by manipulating the appropriate category filter within the attached soft copy of the Multi-Center TRACON Microsoft Excel spreadsheet.

As a starting point, SAIC proposed to coordinate with the FAA's Office of Air Traffic Services. It was assumed that the FAA should be able to provide a master facility database of all operational TRACONs, but the proved not to be the case. A variety of data is available, but not in the format required by this task. Considering the importance of operational activity, SAIC intended to work with the FAA

Headquarters and Regional Offices to identity individual facility service levels and host and non-host Air Route Traffic Control Center (ARTCC) for each TRACON. Unfortunately, limitations in our access to FAA resources impacted the timeliness and detail of the final results.

The final list of Multi-Center TRACONs is more detailed than originally thought. Since the maneuvering distance between sector/center boundaries was not readily available to define multi-center TRACONs, the main criteria used to identify these facilities was the automation host and non-host data provided by the FAA's National Terminal Automation Engineering Support Division (AOS-400) at the Technical Center in Atlantic City, NJ.

Both tool developers and benefits assessors at NASA Ames are interested in the most current information possible for this report. Because the NAS is dynamic, SAIC was required to state the source and date of data used to support the results of this study. NASA stated that any substantiated information concerning future trends of multi-center TRACONs is highly desirable for inclusion in this task. SAIC has identified documents by the FAA, RTCA, and interviews with subject matter experts in this report.

1.3 Task Description

Task #1 was an initial meeting at NASA Ames to further refine the methodology for data collection proposed in the response to the statement of work (SOW). This meeting was used to help define sources and areas where NASA may be able to facilitate or coordinate access to information.

Task #2 was the application of a methodology to the search for multi-center TRACONs in the NAS. A preliminary list of sites, selection criteria for each, and supporting data was delivered to the Task Manager as the next deliverable for this task.

Task #3 is this report, the final iteration applying lessons learned from Tasks #1 and #2 to refine the list of multi-Center TRACONs in the NAS. The results include the selection criteria and both a hard and soft copy of all data collected. An informal oral presentation of the final results will be scheduled following NASA acceptance of the final report.

2.0 Selection Criteria for Free Flight Phase 2 Implementation of TMA at multi-center TRACONs

The purpose of this task is to create a deployment site list for McTMA and to document a rationale for the selecting these facilities as part of an implementation scheme for Free Flight Phase 2. The following items should be considered as the baseline selection criteria. The selection criteria and supporting evidence has been provided for each element to include an investigative data source. It has been a significant challenge to gather this information considering the constraints that NASA imposed with regard to coordinating directly with FAA personnel and facilities. As a result, minor gaps may exist in providing an all-inclusive list of those TRACONs that qualify as multi-center facilities. The primary area of concern resides with the capabilities and limitations associated with the various types of Automated Radar Terminal Systems (ARTS) used by the TRACONS to control air traffic in assigned airspace.

2.1 Facility Operational Requirements

The FAA assigns a numerical rating or classification level to all of its air traffic facilities. All types of flight operations are used to compute an average weighted hourly index that correlates, by facility type, to a specific level for any particular air traffic function, e.g., tower with radar, tower without radar, or a TRACON. This numerical value represents the functionality of these facilities across a broad spectrum of different operational postures for terminals, en route, and combined control facility operations. This classification directly reflects the controller skill application and complexity differences between facilities.

This classification is based on a number of weighted variables that directly relate to the volume of air traffic operations that a particular facility handles within a designated period of time. Although the growth in domestic air traffic is largely dependent on a variety of economic and political issues that are in a continual state of change, it directly impacts individual facility operability. Current forecasts predict an annual average growth rate of approximately 2.8 percent for the period 2000 through 2011. This increase will have a significant bearing on the individual "facilities service level" for each FAA facility, especially in terminal areas, where the TRACONs are the key air traffic control element.

In general terms, the higher the service level rating the more air traffic the facility handles. In developing a selection criterion for implementing Traffic Management Advisors (TMAs) in multi-center TRACONs, the facilities with the high numerical rating should be considered in advance of those facilities with a lower numerical rating.

Data Source – Individual facility service level as defined and designated by the FAA. A complete listing of facility grade service levels dated 10/15/00, was obtained from the both the FAA and the National Air Traffic Control Association (NATCA). Additional source Web Page: http://www.atpay.faa.gov/, FAA Order 7210.3 Facility Operation and Administration. Forecast data is from the FAA's Office of Aviation Policy and Plans (APO-110), Aerospace Forecasts Fiscal Years 2000 – 2011. Additional source Web Page: http://api.hq.faa.gov/foreca00/tabofcon.html

2.2 ARTCC/TRACON Boundaries

An additional selection criterion that was discussed both in the proposal and at the kickoff meeting was the relationship between the ARTCC and TRACON airspace. No specific parameters were established with regard to either lateral or longitudinal distances between boundaries or sectors. It was suggested that those multi-center TRACONs whose airspace is within two En Route Centers or those TRACONs whose boundaries are within 90 nautical miles (nm) of another center's airspace that provides arrival air traffic, should be considered a potential candidate for the McTMA DST.

Clearly defining the arrival profile is a key element where more than one center may be involved in the arrival process. The operational posture that certainly identifies a facility as a McTMA candidate is where arrival traffic is at or near the top of its descent in one center and then proceeds into an adjoining center for descent (e.g., STL), or where a TRACON is on the boundary of two centers (e.g., PHL). Distances of up to 200 nm are routinely used for single-center TMA alignments. If similar distances are required in the development of McTMA software, then the overlapping airspace boundaries between a center and a TRACON may be considerable, especially in the constrained airspace in the Northeastern United States.

Although geographical boundaries and decent profiles are a consideration in identifying potential McTMA candidates, they are only two elements in establishing the overall implementation scheme. A final multi-center TRACON list as been provided with this report, however, assessment of the dimensional boundaries between center and TRACON was not available through the designated FAA points of contact. More important is the information provided by the FAA's National Terminal Automation Engineering Support Division (AOS-400) at the Technical Center in Atlantic City, NJ. In general terms if a TRACON has an air traffic input from both a host and non-host automation source, then it should be assumed that an overlap in geographical boundaries and decent profiles exist between facilities. This is the primary reason more that one input data source exists within the TRACON. Operational authority is being shared between facilities based on the arrival or departure corridors and/or profiles; hence the boundaries must overlap at some point.

The data that has been provided in the final list was primarily derived from discussions with a variety of FAA personnel and their support contractors. Despite the data provided in this report it must be mentioned that it is evident that there is a certain level of confusion with regard to which TRACONs are truly "multi-center" facilities. There still is confusion between the capabilities or limitations of the installed ARTS and whether specific ARTS can handle multiple adaptations from more than one center. Apparently limitations in certain ARTS restrict the adaptation and only allow connections to one center. This adaptation between the ARTCC and TRACON is transparent to the controller. Even though the transition profile allows the aircraft to penetrate airspace in more than one center, the actual software adaptation is actually in series from the TRACON to the host-center then to the non-host center, and therefore not a true multi-center environment. Based on the information provided, SAIC elected to list the data as provided by the FAA's Automation Branch. This issue has not been resolved and a final determination cannot be provided as part of this report. SAIC will keep the NASA TM apprised of its status if more information becomes available prior to the oral presentation.

Based on the data that is required to develop a TMA, whether single- or multi-center, geographical information is an important variable in a long list of items, but to identify a facility as a multi-center TRACONs requires more than just geographic information. There is no single measure that can absolutely qualify all candidates.

Data Source – This boundary data was not readily available from either the FAA Headquarters or the Regional Offices sources that were suggested. Data complied in the Multi-Center TRACON list was provided by the FAA's National Terminal Automation Engineering Support Division (AOS-400) at the Technical Center in Atlantic City, NJ. SAIC also verified the data through other internal SAIC sources that support the FAA in a variety of areas.

2.3 Airspace Complexity

The operational posture of any parcel of airspace in is an important element in assessing McTMA candidates. However, the posture of today's airspace should not be a basis for determining airspace complexity for the installation of McTMA at multi-center TRACONs as part of FFP2 in 2003. The implementation strategy should focus on the level of complexity that is projected for any one facility during the initial FFP2 timeframe, 2003. This should be the leading factor for complexity, but the weighted measures must also include projections beyond the initial implementation date of FFP2. The complexity equation for McTMA implementation requires serious consideration of air traffic projections beyond FFP2.

Airspace complexity is a continually evolving issue that requires an assumption to be made at some point to qualify what variables should be included. Of the various documents that have been reviewed and discussions that have occurred as a result of this task, it is evident that no one clear definition exists with regard to what airspace complexity is. Issues such as increases in demand, airspace redesign, air traffic procedures, supports systems, logistics, labor negotiation, and certification all play an increasingly important role in defining airspace complexity, but assigning an order of precedence will most likely vary as a result of what airspace and airports are served by the TRACON in question.

At the moment, the FAA is in the midst of a monumental restructure of the NAS with a prime objective of improving operational efficiency as elements of Free Flight are placed in motion. Improvements to en route flows will most certainly impact the terminal airspace and increase the level of complexity both within the TRACON and the individual airports involved. The RTCA Select Committee for Free Flight Implementation has provided an excellent example of airspace complexity in a pending report[1]. The report states that although airports with large numbers of operations may not have major problems to resolve, the committee believes it important to have a better understanding of the locations with the most operations, which in turn could provide an indication of possible problems. Fundamentally, this isolates airspace as a function of geographical area rather than treating each airport as an independent unit. In essence, this approach is looking at the whole and not the individual parts. Using data provided by the FAA, the committee examined the airports with the greatest number of operations[2] during the FY95 to FY97 period. The busiest airports include DFW, ORD, ATL, and LAX and additional locations that complete the top 10 included PHX, DTW, MIA, STL, OAK, and LAS. It is noteworthy that none of the New York or Washington metropolitan area airports appear individually in the top 10, but that the total operations[3] for EWR, JFK, and LGA exceed DFW operations by 30 percent and that the total BWI[4], DCA, and IAD operations exceed DFW operations by 2 percent. The committee concluded that this type of information is very beneficial in understanding that it may be useful to consider airports in the same geographic area as one unit rather than as individual airports. This reinforces the premise that depending on the operational environment, airspace complexity should be a significant element in establishing an implementation scheme for McTMA.

Data Source – Individual facility service level as defined and designated by the FAA and the number of metropolitan/regional airports that are serviced by the TRACON in question. Data obtained from Carlton Wine, carlton.wine@faa.gov, at (202) 267-3350.

2.4 Airport Capacity/Delay

One measure of assessing airport capacity is to examine aircraft delay with regard to air carrier operations. If the service providers for a particular airport are routinely experiencing delays, this usually relates directly to high volumes of air traffic. During this past year delays of fifteen minutes or more have increased. These delays routinely range from 7 to 13 percentage of the total air traffic count for most medium to large size metropolitan airports. This is a common problem associated with increases in air traffic demand especially at certain capacity-constrained airports. Aside from the system capacity goals and the initiative identified in the FAA's Aviation Capacity Enhancement Plan, the number of aircraft that can be managed safely varies with the airspace geometry and the type of operations that occur within a specific sector of airspace. The introduction of McTMA at selected TRACONs could notably improve system operability at designated airports.

Data Source – Individual airport statistics published by the FAA's Office of Aviation Policy and Plans (APO-110). Aerospace Forecasts Fiscal Years 2000 – 2011. Additional source Web Page: http://api.hq.faa.gov/foreca00/tabofcon.html. The Office of System Capacity (ASC) addresses the issues associated with capacity of the National Airspace System (NAS). Additional source Web Page: http://www.faa.gov/ats/asc/

2.5 Weather Phenomena

Weather phenomena is a variable that has an apparent impact on the air traffic systems but cannot be specifically forecasted. Using the statistics for previous years, a very comprehensive prediction can be generated to indicate what percentage of IFR versus VFR days can be expected for a particular airport or geographical area. Applying these predictions to the available arrival and departure data can derive an assessment impact.

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[1] Documentation of 2003 - 2005 Capabilities Working Group Deliberations and Recommendations, RTCA Select Committee for Free Flight Implementation, August 2000

[2] Based on 1997 data

[3] Does not include Teterboro operations

[4] 1997 BWI operations were 276,477

Not all weather issues can be circumvented by improved DSTs, but current statistics support that a significant number of airport delays are directly associated with weather. Generally speaking, the inclusion of DSTs could enhance the operability and maintain an airports runway acceptance when these conditions prevail. In short, those multi-center TRACONs that have a greater percentage of predicted IFR or weather related days should be higher on the implementation schedule than those that do not.

The primary geographic focus for this type of problem is centered the Eastern and Northeastern regions of the United States, where there are a number of the multi-center TRACONs. According to the RTCA committee, due to the fact that severe weather cannot be eliminated, the congestion and delays that it generates in these areas must be resolved across a much wider geographic area that extends well into mid-America. The impact that severe weather has on the NAS has a rippling effect that transcends the particular airspace in which it occurs. This impact must be included in the assessment equation for establishing the McTMA implementation strategy.

Data Source – Individual statistics published by the FAA Office of Aviation Policy and Plans that reflect aviation activity forecasts in conjunction with FAA workload measures for instrument operations. Weather data for 11 medium to large metropolitan size airports was obtained from Carlton Wine of the FAA, carlton.wine@faa.gov, at (202) 267-3350.