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DEVELOPMENT OF THE SURFACE MANAGEMENT SYSTEM INTEGRATED WITH CTAS ARRIVAL TOOLS

Yoon C. Jung
NASA Ames Research Center
Moffett Field, CA 94035

Dave Jara
San Jose State University Foundation
NASA Ames Research Center
Moffett Field, CA 94035

Abstract

The Surface Management System (SMS) developed by NASA Ames Research Center in coordination with the Federal Aviation Administration (FAA) is a decision support tool to help tower traffic coordinators and Ground/Local controllers in managing and controlling airport surface traffic in order to increase capacity, efficiency, and flexibility. SMS provides common situation awareness to personnel at various air traffic control facilities such as airport traffic control towers (ATCT's), airline ramp towers, Terminal Radar Approach Control (TRACON), and Air Route Traffic Control Center (ARTCC). SMS also provides a traffic management tool to assist ATCT traffic management coordinators (TMCs) in making decisions such as airport configuration and runway load balancing. The Build 1 of the SMS tool was installed and successfully tested at Memphis International Airport (MEM) and received high acceptance scores from ATCT controllers and coordinators, as well as airline ramp controllers.

NASA Ames Research Center continues to develop SMS under NASA's Strategic Airspace Usage (SAU) project in order to improve its prediction accuracy and robustness under various modeling uncertainties. This paper reports the recent development effort performed by the NASA Ames Research Center: 1) integration of Center TRACON Automation System (CTAS) capability with SMS and 2) an alternative approach to obtain airline gate information through a publicly available website. The preliminary analysis results performed on the air/surface traffic data at the DFW airport have shown significant improvement in predicting airport arrival demand and IN time at the gate. This paper concludes with recommendations for future research and development.

Introduction

As air traffic demand grows beyond the level that the National Airspace System (NAS) can handle, delays, in addition to passenger inconvenience, will be increased. It is obvious that the airport surface becomes the bottleneck simply because airports cannot accept more aircraft than they can hold. Even under the current demand level, airport throughput is often limited due to the lack of efficiency and flexibility in controlling/managing surface traffic. Issues that currently impact airport surface operations are: controller/pilot communication limitations, procedural constraints, lack of information availability, and planning limitations[1].

In an effort to improve efficiency, flexibility, and increase capacity of airport surface traffic management, NASA Ames Research Center began the research and development of the Surface Management System (SMS) in coordination with the Federal Aviation Administration (FAA) in early 2000. The Build 1 SMS was developed under NASA's Advanced Air Transportation Technologies (AATT) project, and its capabilities were successfully demonstrated through controller-in-the-loop simulations and field testing. SMS is currently in daily use for ramp operations of FedEx and Northwest Airlines at the Memphis International Airport (MEM)[2]. The technology transfer of Build 1 SMS to FAA has been completed for future development and deployment at airports in the US.

NASA continues to develop capabilities of SMS under NASA's new Strategic Airspace Usage (SAU) project. Among the major development efforts is the integration of SMS with other air traffic management (ATM) decision support tools such as the Center-TRACON Automation System (CTAS)[3] Traffic Management Advisor (TMA)[4] in order to exchange traffic information to and from adjacent domains, and therefore improve the overall efficiency and capacity of NAS. This paper describes the development effort for the Build 2 SMS.

Integration of SMS with CTAS Arrival Tools

Through the integration of the CTAS TMA and the Final Approach Spacing Tool (FAST)[5], SMS receives accurate arrival flight information necessary for it to accurately predict future events of traffic that is both on the surface and in the terminal airspace. The existing CTAS Collaborative Arrival Planning (CAP) tool[6], originally developed to provide air carriers with real-time information drawn from TMA and/or FAST, was modified in order to provide SMS with necessary information required for airport surface traffic control. The integrated system provides SMS with a single track and flight plan of individual arrival aircraft generated from mosaicking the Aircraft Situation Display for Industry (ASDI), Center Host, and TRACON ARTS data. TMA provides both Estimated Times of Arrivals (ETAs) and Scheduled Times of Arrival (STAs) of each aircraft at metering fixes and runways through the accurate 4-D trajectory computations. STAs are especially useful for SMS in predicting arrival times and in future demand during arrival rushes when demand exceeds the airport capacity. FAST provides SMS with accurate estimation of runway arrival times of aircraft that are inside the TRACON airspace. SMS will also receive actual arrival runway assignments for each aircraft from the FAST connection, which is conveyed from the TRACON approach controller's scratch pad input. Figure 1 shows an illustration of the system architecture of the integrated CTAS/SMS system.

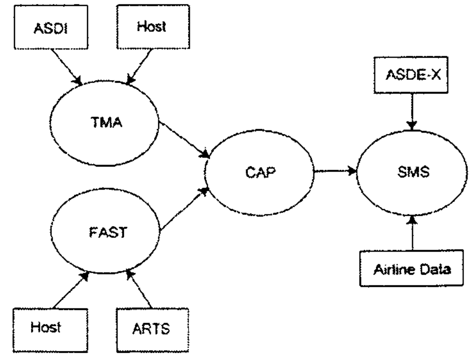

Figure 1. A High-Level Architecture of the Integrated CTAS/SMS System

An Alternative Approach to Obtain Gate Information

SMS requires airline data regarding parking gates and predicted pushback times in order to calculate taxi time and conflicts between arrival and departure flights. In Build 1 SMS, the airline specific information was provided through a direct connection of the airline's gate management system, such as the Ramp Management Automation System (RMAS) of FedEx at MEM airport. It turned out that the interfaces between such systems and SMS were airline specific and a standardized interface had not been developed yet. It was recommended that airline data should eventually be provided to the Enhanced Traffic Management System (ETMS). It was also advised for the standardized interface (across which they send data to SMS) to be established[2].

As an alternative approach, gate information, predicted pushback times, and pushback status can all be extracted from publicly available flight information websites, and can be used for SMS purposes (Figure 2). The websites are maintained by major airports, and flight information is updated as frequently as every minute. Considering the difficulty in obtaining airline proprietary data, and the fact that the flight information provides almost all of the passenger flights regardless of the size of their respective airlines, the alternative can be regarded as very reasonable.

AIRLINE	FLT #	ORIGIN	TIME	REMARKS	GATE	BAGS	TRACK IT
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		TRACK IN BROWSER TRACK VIA EMAIL
American Airlines	1337	Washington-Dul	8:40P	ON TIME	C22		TRACK IN BROWSER TRACK VIA EMAIL
American Airlines	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		TRACK IN BROWSER TRACK VIA EMAIL
American Airlines	1697	Wichita	5:56P	ON TIME	C25		TRACK IN BROWSER TRACK VIA EMAIL
American Airlines	[illegible]	[illegible]	[illegible]	ON TIME	[illegible]		TRACK IN BROWSER TRACK VIA EMAIL
American Airlines	3262	Wichita Falls	4:25P	Claim 15	A2N		TRACK IN BROWSER TRACK VIA EMAIL
American Airlines	[illegible]	[illegible]	[illegible]	ON TIME	[illegible]		TRACK IN BROWSER TRACK VIA EMAIL
ATA	953	Chicago/Midway	5:16P	ON TIME	B25		TRACK IN BROWSER TRACK VIA EMAIL
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		TRACK IN BROWSER TRACK VIA EMAIL
ATA	497	Indianapolis	9:44P	ON TIME	B25		TRACK IN BROWSER TRACK VIA EMAIL
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		TRACK IN BROWSER TRACK VIA EMAIL
Continental	4071	Boston	8:35P	2	E13		TRACK IN BROWSER TRACK VIA EMAIL
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		TRACK IN BROWSER TRACK VIA EMAIL

Figure 2. A Sample Arrival Flight Information obtained from DFW Airport Website

Initial Analysis Results on Prediction Accuracy

The existing Build 1 SMS is under modification to incorporate the functionality mentioned above. A SMS simulation lab has been established at NASA Ames Research Center, where live ASDI, Host, TRACON ARTS, and ASDE-X surface surveillance data feeds are available. Figure 3 shows the screen shot of the SMS map display of DFW airport.

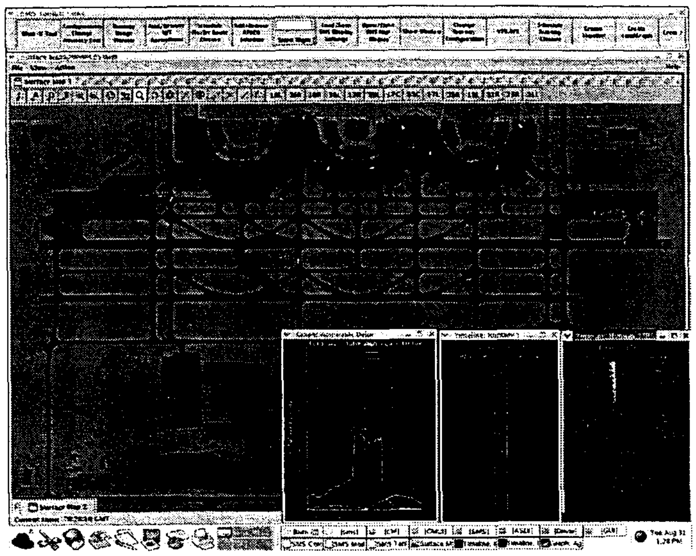

Figure 3. SMS Map Display of DFW Airport (East side only)

The preliminary analysis results performed on the air/surface traffic data at the DFW airport have shown significant improvements in predicting airport arrival demand and IN time at gates (Figure 4 for a sample plot). Such accurate predictions of arrival flight information will enable air traffic controllers and coordinators to manage complex surface traffic more efficiently and therefore increase the airport throughput. The accurate gate IN time prediction will also improve the performance efficiency of airline personnel in managing ramp operations.

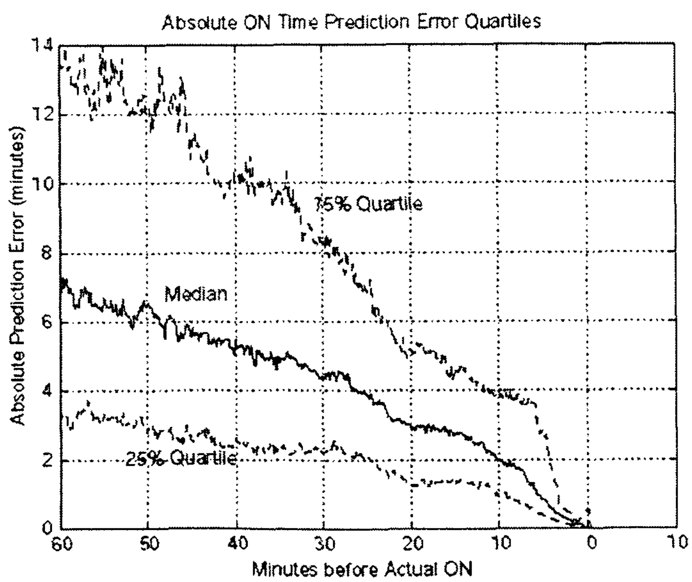

Figure 4. A Sample Plot of ON Time Prediction Error

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