National Aeronautics and Space Administration

Surface Management System

Overview
The Surface Management System (SMS) is a decision support tool that will help controllers, traffic managers, and NAS users manage the movements of aircraft on the surface of busy airports, improving capacity, efficiency, and flexibility. The Advanced Air Transportation Technologies (AATT) Project at NASA is developing SMS in cooperation with the FAA's Free Flight Phase 2 (FFP2) program. SMS consists of three parts: a traffic management tool, a controller tool, and a National Airspace System (NAS) information tool.

Traffic Management Tool
SMS supports traffic management functions in the ATC tower, Terminal Radar Approach Control (TRACON) and Center. Accurate information about future departure demand and the resulting impact on surface operations is not currently available. SMS uses surface and airborne surveillance, along with updated air carrier pushback schedules, to predict the future demand and how that demand will affect the airport surface (e.g., what delays and queues will result and when). Shared awareness of these predictions support various traffic management decisions. For example, at airports where arrival and departure capacities are interdependent and must be coordinated, SMS predictions can be used to compare various possible traffic management actions. Interoperability between SMS and the CTAS Traffic Management Advisor (TMA) was studied during a January 2002 simulation, demonstrating the ability of TMCs to reduce arrival and departure delays when provided with better information.

Controller Tool
SMS helps Local and Ground controllers in the ATC tower construct efficient departure queues by providing runway departure advisories. SMS likewise helps ramp tower controllers in improving the efficiency with which runways are utilized by aiding in the creation of improved departure sequences and schedules. SMS also enables coordination between the ATC tower and ramp towers, for example, when a departure needs to exit an alley on the ramp before an arrival enters the ramp.

NAS Information Tool
SMS will provide surface predictions to the Enhanced Traffic Management System (ETMS) for use in traffic flow management (TFM) applications and further dissemination to NAS users. These highly accurate predictions of when aircraft will take off will result in more accurate demand predictions and will improve NAS-wide predictability. SMS landing and gate arrival time predictions support NAS user decision making.

Accomplishments
Two SMS simulations were conducted in NASA's Future Flight Central ATC tower simulator in September 2001 and January 2002. FAA controllers and air carrier representatives provided feedback to SMS researchers on the SMS concept, user interfaces, and algorithm performance, all of which was used to refine SMS.

Operational demonstrations were conducted at the FedEx ramp tower at Memphis International Airport in August and October 2002. An operational trial was conducted at Memphis Air Traffic Control Facilities (Tower, TRACON, and Center) and at the FedEx ramp tower in September 2003. During these events, the FAA's SafeFlight 21 surface surveillance prototype was used for real-time aircraft location and identification.

EDA

En Route Descent Advisor

Purpose:
Provide controllers with advisories for precision arrival metering

Capabilities:
- Displays "meet-time" advisories involving speed, altitude, and heading maneuvers

- Integrates with TMA arrival schedule for precise arrival performance and uses TMA timeline display for metering conformance feedback

- Displays advised routing along with top-of-descent location

- Incorporates strategic conflict avoidance into advisories for metering

Users:
En route sector controllers

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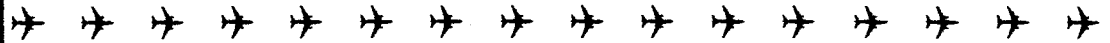
Overview
The En Route Descent Advisor (EDA) is a CTAS tool that assists the R-side sector controller with managing arrival traffic subject to time-based metering constraints. Working in conjunction with the CTAS Traffic Management Advisor (TMA), EDA generates speed, altitude and heading advisories that satisfy arrival constraints at the meter fix, while reducing the likelihood of downstream separation conflicts. By taking advantage of accurate CTAS trajectory prediction capabilities, EDA computes strategic maneuver solutions that simultaneously resolve complex metering and separation problems early in the arrival process, well upstream of the targeted meter fix located at the TRACON boundary. Upon demand, EDA advisories are presented to controllers on their plan view displays through the aircraft flight-data block, as early as 30 minutes prior to an aircraft's anticipated arrival at the meter fix.

Benefits
Studies suggest that EDA can lead to substantial benefits in capacity, fuel efficiency, and controller productivity. Capacity benefits are achieved through accurate TRACON delivery in accordance with a TMA plan that is optimized for maximum throughput to the runway. Fuel efficiency is achieved through EDA's minimum-fuel trajectory planning algorithms, similar to those found in aircraft Flight Management Systems. Fuel and workload benefits also result from the strategic capabilities of EDA, which reduce the probability of further required action by ATC once an EDA clearance has been issued. With EDA automation, controllers can avoid the more tactical, less efficient techniques that are commonly employed today for solving combined separation and meet-time problems. These existing techniques often include frequent temporary altitude assignments, excessive vectoring, and airborne holding. Results from recent simulation studies suggest that EDA can reduce controller workload and allow for better conformance monitoring of descent trajectories, regardless of whether metering conditions are present.

Research & Development
EDA research is supported by NASA's Airspace Systems Program. EDA is being implemented within CTAS through a series of prototype builds. An initial capability has been implemented within the CTAS research baseline. Through 2005, the EDA prototype will continue to be refined through a series of controller-in-the-loop simulation activities. Beyond 2005, a pre-production prototype will be completed through ARTCC field-test evaluation and integration with the FAA Display System Replacement (DSR). Following initial deployment, EDA will be augmented with air/ground data-link capabilities in order to achieve additional benefits for controllers and airspace users.

TOD
Cruise Speed,
Cruise Altitude
Descent Mach
Descent CAS
BOD
Meter Fix

Vertical advisories involve cruise speed, descent speed, and altitude

Turn-back point
Turn-out heading
Capture point
Meter Fix

Horizontal advisories involve path stretching