FACET
Future Air traffic management Concepts Evaluation Tool

Today's air traffic management (ATM) system is evolving into a more demanding and complex airspace environment than when it was first designed. As air traffic demand continues to grow, it is projected that there will be increases in terms of passenger delays, impact to the environment, and costs to the airlines, as well as higher and more complex workload demands to air traffic service providers. Consequently, ATM researchers and service providers must find ways to increase airspace capacity and flexibility. The *Future ATM Concepts Evaluation Tool (or FACET)* equips ATM researchers and service providers with a way to explore, develop and evaluate advanced air transportation concepts before they are field-tested and eventually deployed.

FACET is a flexible software tool that is capable of quickly generating and analyzing thousands of aircraft trajectories. It provides researchers with a simulation environment for preliminary testing of advanced ATM concepts. Using aircraft performance profiles, airspace models, weather data, and flight schedules, the tool models trajectories for the climb, cruise, and descent phase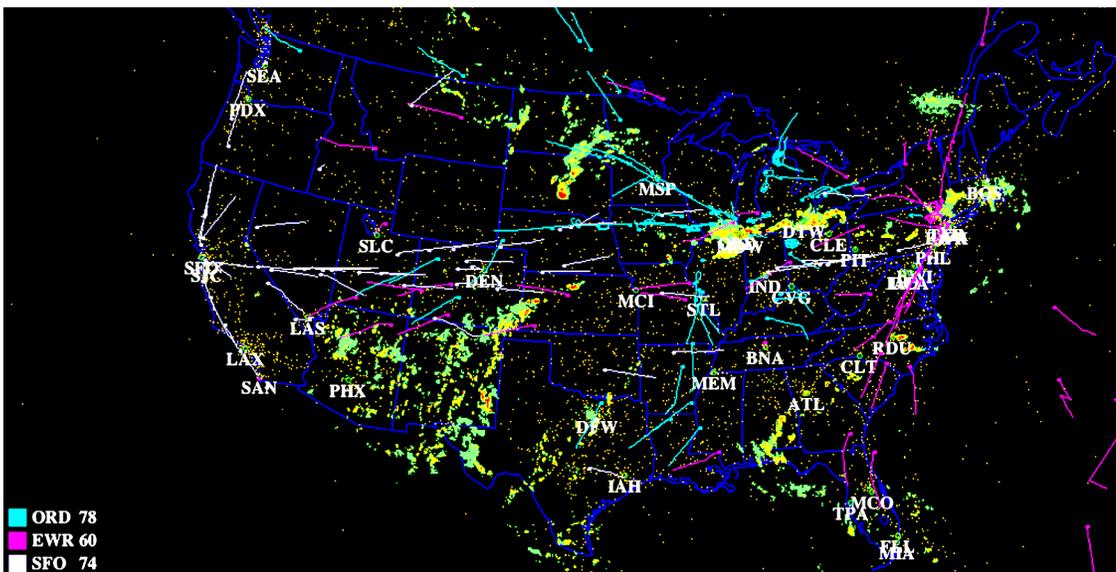s of flight for each type of aircraft. An advanced graphical interface displays traffic patterns in two and three dimensions, under various current and projected conditions for specific airspace regions or over the entire continental United States. The system is able to simulate a full day's dynamic national airspace system (NAS) operations, model system uncertainty, measure the impact

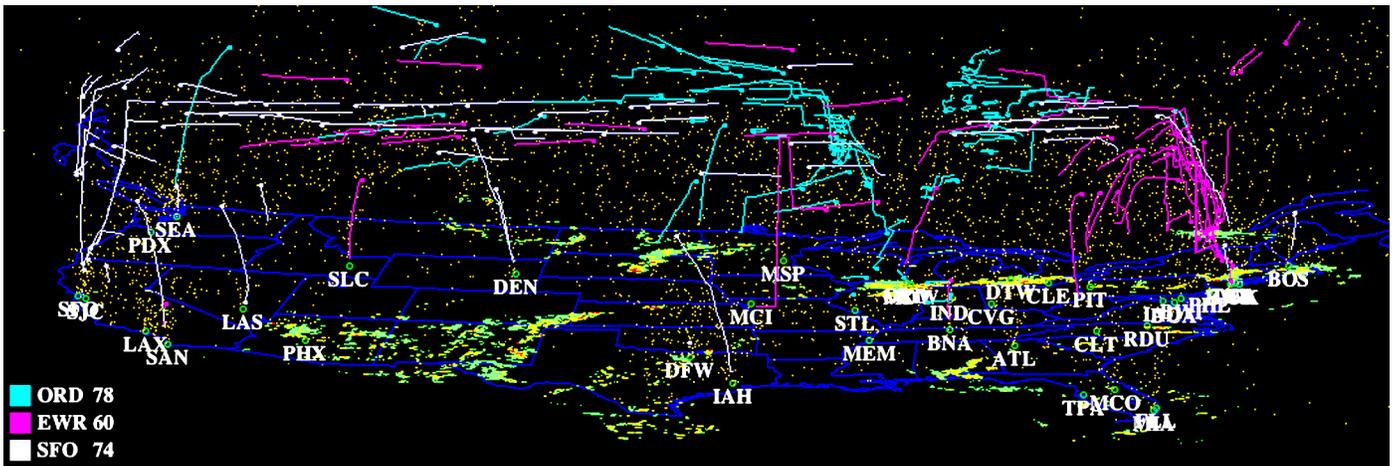### Using FACET Benefits...

Our Environment. Helping create more efficient flight trajectories means less fuel burned per flight, thereby minimizing environmental emissions and noise pollution.

Our Economy. Accommodating higher levels of traffic helps increase the nation's mobility, which is essential for economic progress. Reducing delays and improving flight schedule integrity improves air traffic efficiency, which in turn benefits the U.S. economy.

Our Education. Realistically simulating a large complex system helps to educate the public and motivates and trains students in solving complex science and engineering problems.

FACET integrates weather and air traffic information, which enables system operators to reroute flights to maintain safety and minimize delay. Here, FACET shows convective weather (green, yellow, orange, and red regions) around Chicago O'Hare International Airport on July 23, 2010.

NASAfacts

FACET is also able to provide a 3D view of the same weather and traffic situation as seen on the previous page to display the climb, cruise, and descent phases of select flights.

of different decision-makers in the NAS, and provide analysis of the results in graphical form, including sector, airport, fix, and airway usage statistics. NASA researchers test and analyze the system-wide impact of new traffic flow management algorithms under anticipated air traffic growth projections on the nation's air traffic system. Studies have estimated industry benefits of hundreds of millions of dollars each year for the implementation of advanced traffic flow techniques being developed by NASA using FACET.

In addition to modeling the airspace system for NASA research, FACET has also successfully transitioned into a valuable tool for operational use. Federal Aviation Administration (FAA) traffic flow managers and commercial airline dispatchers have used FACET technology for real-time operations planning. FACET integrates live air traffic data from FAA radar systems and weather data from the National Weather Service to summarize NAS performance. This information allows system operators to reroute flights around congested airspace and severe weather to maintain safety and minimize delay. FACET also supports the planning and post-operational evaluation of reroute strategies at the national level to maximize system efficiency. For the commercial airline passenger, strategic planning with FACET can result in fewer flight delays and cancellations.

FACET is also a powerful demonstration tool to educate the public and students who are researching air traffic management. FACET's impressive graphical displays have been showcased at the National Air and Space Museum in Washington, DC to illustrate the incredible complexity and sophistication of the nation's air transportation system. Academic departments which conduct air traffic management research use FACET to test new algorithms for analyzing and solving traffic management problems.

The success of FACET as a tool for research, operations, and education led to FACET winning NASA's prestigious Software of the Year Award in 2006, which recognized the technology for its impact on NASA's mission and its significance to science and technology. FACET was also honored with the American Institute of Aeronautics and Astronautics (AIAA) Aerospace Software Engineering Award in 2009 as a significant breakthrough in simulation capabilities.

The performance capabilities of FACET are largely due to its architecture, which strikes a balance between flexibility and fidelity. FACET is capable of modeling the airspace operations for the continental United States, processing thousands of aircraft on a single computer. FACET was written in Java and C, enabling the portability of its software to a variety of operating systems. In addition, FACET was designed with a modular software architecture to facilitate rapid prototyping of diverse ATM concepts. Several advanced ATM concepts have already been implemented in FACET, including aircraft self-separation, prediction of aircraft demand and sector congestion, system-wide impact assessment of traffic flow management constraints, and wind-optimal routing.

For more information on the Future ATM Concepts Evaluation Tool (FACET), please visit:
www.aviationsystems.arc.nasa.gov.