Future ATM Concepts Evaluation Tool (FACET)  
Background, Capabilities and Plans

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TIM on Fast-time Simulation Models and Tools  
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Background

- Conducting research in En Route and TFM as part of AATT and VAMS
- Developed a modeling and simulation capability: Future ATM Concepts Evaluation Tool (FACET)
- Capability useful for both real-time applications and off-line analysis
- FACET has been provided to FAA, industry, small companies and universities
- Working with the airlines and FAA to customize the capability for specific uses
Outline

- FACET Simulation and Modeling Capability
- Applications
- Current Plans
- Research Directions
Future ATM Concepts Evaluation Tool (FACET)

- Simulation tool for exploring advanced ATM concepts
- Balance between fidelity and flexibility
  - Model airspace operations at U.S. national level (~10,000 aircraft)
  - Modular architecture for flexibility
  - Software written in “C” and “Java” programming languages
    » Easily adaptable to different computer platforms
    » Runs on Sun, SGI, PC and Macintosh computers
- Used for visualization, off-line analysis and real-time planning applications
FACET Architecture

- NOAA
- Weather
- ETMS/ASDI
- Other Info. Sources
- Aircraft Performance Data
- Adaptation Data
- Winds
- Flight plans & Positions
- Climb Cruise Descent
- Centers Sectors Airways Airports
- Flight Deck Based Conflict Detection & Resolution
- Direct-To Routing Analysis
- Air and Space Traffic Integration
- System-Wide Evaluation Tool
- System-Level Optimisation

Route Parser & Trajectory Predictor
Traffic & Route Analyser
User Interface
FACET Display
FACET Display
West Watertown Playbook Reroutes
Alternative effects of TFM actions

Nominal

Playbook

MIT

Local Reroute

Local Reroute

Sector Count

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Integrated traffic counts in ZMP Sector 16


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<th>Aircraft Count</th>
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Traffic Management Scenario

- Each day volume at Chicago (ORD) airport leads to Chicago ARTCC (ZAU) and Cleveland ARTCC (ZOB) to place restrictions on all aircraft landing at O’Hare at specified times
- Restrictions passed on to New York ARTCC (ZNY)
- ZNY passes the restriction to New York TRACON (N90)
- Scenario uses all restrictions in effect 6/27/02
  - Focus on traffic from ZNY to ORD, CLE, and ATL

**Alternative Impact Assessment Capabilities**

[A] Rerouting + Nominal Departure Rates
Total Delay = 10361 sec.

[B] Rerouting + Optimal Departure Rates
Total Delay = 5986 sec.

System demand is met with minimum delay
FACET-AOC

- March 2001: request by ADF team to increase NASA research
- FACET modified to work with ASDI data
- Working with ADF and Ohio State University to develop requirements and identify research issues
  - Dispatcher input on functionality (October 21-23 at OSU)
  - Interviews/Training for dispatchers at NWA, SWA

- Develop functional requirements for a version of FACET for AOC use
- Integration of FACET with CWIS weather at NWA
- Working with Flight Explorer to transfer the technology to the users
HITL simulation environment to examine new CDM concepts and support the collaborative process

Working with Metron and FAA to provide the en route and TFM modeling, analysis and display capabilities using FACET
Research Directions/
Lessons from FACET Development

- Standardization and accuracy of data
- Integration with other tools/systems
- Dealing with Uncertainty
- Traffic Flow Models


Additional Slides
FACET Applications

- Conflict Detection and Resolution
- Direct-to Benefits Study
- Dynamic Density Studies
- Regional Metering
System-Wide Evaluation and Planning Tool (SWEPT)

- SWEPT = FACET + Requirements and Modifications for FAA use
- Conducted interviews with TFM specialists to assess the feasibility of using FACET capabilities
- SWEPT envisioned to be a research capability for evaluating, monitoring, and analysing TFM initiatives, operational procedures, and traffic flow scenarios.
- SWEPT has been demonstrated to SCC and CDM; FAA has recommended setting up a conformance monitoring user group for SWEPT.
- Working with Volpe in the development of SWEPT
  - Integration with “Live” ETMS
  - Re-organization of functions from a user’s perspective
  - Modifications to enable a “plug-and-play” with TFM infrastructure
  - Real-time reroute conformance monitoring
### Impact of alternative ELIOT and PARKE Restrictions from 10:30 - 13:30 UTC

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Actual Restriction on June 26, 2002: ELIOT-15 MIT, PARKE-15 MIT
FACET-POET Integration

- Phase 1 SBIR Project with Metron Aviation, Inc.

- Leverage Existing Technologies to Perform New Tasks
  - POET provides Operational Analysis and Historical Database.
  - FACET provides Modeling and Simulation Capabilities.

- Integrated system can be used for real-time decision making or post-operations analysis.
  - Allows assessment of alternative TFM initiatives before implementation.
  - Historical events can be re-evaluated with alternative constraints.
Collaborative Routing Resource Allocation Tool (CRRAT)

- Phase 2 SBIR Project with Metron Aviation, Inc.
- CRRAT will add en route resource allocation functionality to NASA’s FACET.
- Goal of the project is to perform and evaluate proposed en route resource rationing schemes.
  - Grover-Jack
  - Time-Ordered Accrued Delay (TOAD)
  - Ration-By-Schedule (RBS)
- CAART will utilize the following control actions for alleviating en route congestion:
  - Rerouting
  - Altitude Changes
  - Departure Delays
  - Speed Adjustments
Collaboration in the development of FACET/SWEPT

- **FAA**
  - Access to ETMS feed, facilities and operations people, Analysis using FACET (AOZ-40, ASD-130, ACT-540)

- **Volpe**
  - ETMS expertise, review of user interface, requirements

- **Metron**
  - Use of FACET for TFM tasks; Analysis using FACET

- **CSC**
  - Integration with DSP

- **ADF and Ohio State University**
  - AOC requirements, Research issues in PTFM

- **MIT Lincoln Laboratory**
  - Use of CWIS in tactical and strategic planning

- **CAASD**
  - General interaction as part of IAIPT- review of sources of prediction errors, evaluating FACET for OEP analysis