TFM Decision Support Capabilities for “Constrained” En route Airspace

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Outline

• “Transition” vs. “Constrained” Airspace Problems
• Overview of Constrained Airspace TFM Activities
• Severe Weather Needs
• Severe Weather Requirements
• Plans
Transition and Constrained Airspace
Overview of Constrained Airspace Activities

- **FY96 - Complementary Activities**
  - CTAS TMA (transition airspace arrival metering) at ZFW
  - Initiate joint (NASA/NOAA/MITLL) ATM-wind-prediction R&D

- **FY97 - Initiated Constrained airspace activities**
  - Formulated concept of Constrained vs. Transition problems
  - Focussed effort on Airspace Complexity (Dynamic Density)

- **FY99-00 - Progress**
  - Published Constrained Airspace Concept
    - Mid-term: improve local/regional TFM decision making
    - Distributed Air Ground (DAG) Traffic Management (user-ATM Integration)
  - Developed Future ATM Concepts Evaluation Tool (FACET) for rapid prototype and evaluation of en route DST capabilities.
  - Advanced Dynamic Density validation studies

- **FY01+ - Next slide**
Overview of Constrained Airspace Activities (cont’d)

- FY01+ - Planned Activities
  - Better TFM
    - Local / regional TFM (1-3 hour time scales)
      - Advanced Constrained-airspace problem detection (NAS state)
        - Airspace complexity (Dynamic Density)
        - Dynamic access to Special Use Airspace (SUA)
        - Wx state and prediction (looking to leverage collaborative partnerships)
        - Coupling of Wx and Dynamic Density (acceptable levels of DD)
      - Advanced Constrained-airspace problem resolution
        - Best utilization/combination of TFM controls (e.g., routing, spacing,...)
        - Concept exploration/development of TFM DST capabilities
        - Integration of Transition and Constrained-airspace capabilities
  - National (ATCSCC) applications
  - DAG / CDM applications
    - Integration with user systems / procedures
      - Flight planning / re-planning (airline operations)
      - Flight deck
Constrained Airspace Focus (NAS State)

Dynamic Density:
An objective measure of Sector Complexity / Workload

Key NAS States:
• Airspace complexity / dynamic density (sector congestion)
• Weather

Dynamic Density
Acceptable Level
TFM control actions reduce Dynamic Density

Time horizon
T₀
T₁
Constrained Airspace Focus (TFM Decisions)

TFM “controls” (degrees of freedom)
- Re-routing
- Spacing
  - En route
  - Departure control
- Dynamic access to SUA
- Dynamic re-sectorization
DAG Aspects

Preemptive User Action
NWA321
USA789
AAL456
UAL123

Collaboration on local-TFM Initiatives

TFM Action

TFM Conformance Time of Arrival

ETA to Constrained Airspace

Current Time

Timeline of Sector 1 Traffic Demand

Constrained En route Airspace

SUA

Sector 1

En route Air Route Traffic Control Center

Local Departure
Severe Weather Needs

In addition to the points in the CRCT presentation,

- **Weather has direct and indirect impact on TFM**
  - Direct (lost airspace)
  - Indirect (reduced capacity airspace)
    - Coupling with Dynamic Density
- **Need for products on a continuum of time scales**
  - Support local, regional, and national TFM decision making
- **TFM-based Wx requirements**
  - We need a marriage of Meteo and ATM expertise to focus on the key issues related to ATM applications (a la wind)
    - Common identification of applications and problems
    - Common lexicon
    - Key metrics
Severe Weather Needs (cont’d)

• **Weather capabilities for ATM applications:**
  - Less advanced than winds
  - Need advances in:
    • Prediction
    • Validation
    • Understanding of “penetrable” weather
      - Leverage related work in terminal ATC and AWIN
      - Longer time horizon than current terminal applications/focus
  • Probability over space/time of:
    - Forecast accuracy
    - Metrics of interest to ATM (e.g., probability of flight penetration)

• **Common situational awareness**
  - Across TFM facilities
  - User-TFM (DAG) … “the common flick”
    • AOC - TFM (a la CCFP)
    • Flight deck - TFM
CRCT Severe Weather Requirements

In addition to the points in the CRCT presentation,

• Type(s) of severe weather forecast data required
  – Weather characteristics that impact path planning/execution
    • Convective weather, turbulence, ...
    • What about icing?

• Need further work to establish ATM requirements
NASA Plans (relative to other ATM activities)

Potential Benefit, Risk

System Readiness

NASA (DAG)

FFP2

FFP1
DAG TFM Plans
Technology & Implementation Readiness Levels

Prove System in Operation
Qualify System by Demonstration
Prototype in Operational Setting
Prototype in Relevant Setting
Validate Components in Relevant Setting
Validate Components in Lab
Perform Proof-of-Concept
Formulate Concept or Application
Observe/Report Basic Principles

Operate Implementation Capability
Qualify Implementation Capability
Develop Implementation Capability
Define Requirements & Transfer Technology
Develop Plans & Procedures
Conduct Functional Demonstrations
Define Operational Concept
Define schedule, infrastructure, and Op Environment
Describe Proposed Capability

TRL
IRL

R&D Program Goal
FAA Investment Decision

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