Decision Support Technologies for Next Generation Aviation Weather

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Introduction

• Harris Corporation is proud of our 45 year heritage providing weather solutions for the Government and Commercial marketplace.

• We are especially proud NOAA selected us as the provider of the Ground Segment for GOES-R.

• For nearly 20 years we have provided weather systems in support of aviation decision support in a mission critical setting-
  – ARTCC Meteorologist Weather Processor (MWP)
  – ARTCC Weather and Radar Processor (WARP)
  – FAA FSS OASIS
Overview

- Harris has developed and is integrating four weather related decision support capabilities into a Service Oriented Architecture similar to the one planned for the Next Generation Air Traffic Control System
  - Aviation Weather Avoidance Service (AWAS)
  - Aviation Weather Impact Service (AWIS)
  - Weather Data Volume Service (WDVS)
  - SmartTAF (Automated Terminal Forecast Service)
• DEX - At the heart of the Harris Lab is a Service Oriented Architecture (SOA) framework called DEX (Data Exchange) that simulates FAA’s future System Wide Information Management.
• Harris’ four decision support capabilities - AWAS, AWIS, WDVS & SmartTAF – highlighted in blue.
• ERAM – Enroute Automated Modernization, source of flight data for controllers.
• AWAS, WDVS – Harris developed end-user visualization tools.
Aviation Weather Avoidance Service (AWAS)
AWAS Overview

- Evaluates 4D weather impacts on 4D flight trajectories (4DT)
  - Thunderstorms
  - Turbulence
  - Icing
  - IFR
- Provides alternative trajectories
  - If impacted by weather
- Subscriber/publisher to DEX
AWAS Processing

- Evaluates each planned or active trajectory with respect to:
  - Each projected aircraft position in space and time
  - Current or forecast weather from the 4D Weather Cube
  - Weather rules specific to that 4DT regarding allowable exposure to aviation hazards.

- Results of this evaluation are:
  - Weather impact
    - Favorable, marginal, unfavorable
  - Alternative trajectory, if impact is marginal or unfavorable

- AWAS is designed to process thousands of flight trajectories that may be active or planned at a given time
  - Operates on high-availability, high-performance grid of up to 40 servers
  - Uses gaming technologies to avoid adverse weather impacts
**AWAS Under the Hood**

- Evaluates each potential aircraft position in 3D grid
- Evaluates impact of 4D weather
  - Matches time of aircraft position to valid time of forecast weather
- Selects optimal route
  - that meets weather rules
  - that results in lowest cost in distance and weather impact
  - Original route is preferred
AWAS Under the Hood

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AWAS 2D View
Planned Route
With Thunderstorms
**AWAS Under the Hood**

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**AWAS 2D View**

*Alternative Route*

*Avoiding Thunderstorms*
- Original route blue,
- Alternative route red
- Rules: avoid TS prob > 10%
AWAS Operational Use Scenarios

• Plan Flight
  – Flight operator submits proposed trajectory and AWAS provides weather impact and alternative trajectory if necessary

• Manage impacted trajectories
  – A flight management decision-support service publishes trajectory data and subscribes to AWAS for weather impacts and alternate trajectories

• Monitor Active Flight Query
  – 4DT identifier submitted to AWAS, and while flight and query remain active, updated weather impacts and alternative trajectories are provided
  – Could be provided to in-flight operators via data stream from weather service provider

• Impacted Flight Query
• Impacted Fix Query
• Impacted Sector Query
Aviation Weather Impact Service (AWIS)
**AWIS Overview**

- Evaluates 4D Weather impacts on complex geospatial objects *(a core functional weather requirement for NextGen)*
  - Points
  - Polygons
  - Volumes
  - Trajectories

- Publish weather impacts
AWIS Under the Hood

• Functionality is essentially a subset of AWAS

• Subscribes to simulated 4D Weather Cube
  – FBWTG (FAA Bulk Weather Telecommunications Gateway)
  – HWDS (Harris Weather Data Service)
  – NCWD, NCWF2 (National Convective Weather Diagnostic, Forecast)
  – SmartTAF (automated aviation terminal forecasts)

• Subscriber provides geometry, rules, time

• AWIS publishes impacts to network
AWIS Screen Shot (Jet routes, TS)

Weather Impact Simulation Tool
AWIS Screen Shot (Airports)

Airports color-coded by impact

TS probabilities at mouse location
AWIS Screen Shot (Hub Airports)
Weather Data Volume Service (WDVS)
WDVS Overview

- Extracts a subset of NWP model data for user-specified geospatial object
- Subscriber provides model, geometry, valid time
- Publishes output to network
WDVS Screen Shot
WDVS Screen Shot

RUC Temp Contours
SmartTAF

Automated Aviation Forecast Service
**SmartTAF Overview**

- Generates automated “first guess” TAF-like forecasts

- Forecasts for All CONUS TAF locations
  - Based on fuzzy systems utilizing
    - latest METAR
    - GFS MOS, LAMP
    - RUC model
    - National Convective Weather Forecast (NCWF-2)
  - Generated upon arrival of new METAR

- Currently used by a Harris partner to support a major U.S. air carrier
  - Well suited for ‘forecaster over-the-loop’ operations
Typical comparative forecast verification…
- Forecasts issued at same time and valid at same time

SmartTAF compares well with TAF proving that “first guess” automated forecasts can be useful.

Important to note…
- TAFs are issued every 6 hours, excluding amendments, and may be up to 6 hours old
- SmartTAFs are issued upon METAR arrival and are therefore at most 1 hour old
SmartTAF Verification for ‘Next 6 Hours’

Verification--TAF & SmartTAF
Jan 2004 – Apr 2008
7,715,163 forecasts

- For possible hours 00z – 23z
  - TAFs are 0-6 hours old
  - SmartTAFs are 0-1 hour old

- This difference in forecast age makes a difference in the very important next 6 hours...
  - SmartTAFs with average age 0-1 hour verified more favorably than TAFs with average age 0-6 hours, for each valid hour 1-6

- Automation and forecaster-over-the-loop operations can handle more forecast locations with existing resources
Summary

• Harris has developed an IR&D environment leveraging over 20 years of aviation weather experience to focus on the application of weather in the Next Generation national airspace system.

• Weather plays a critical role in the NAS and Harris has technologies waiting to be exploited to make it more useful to all NAS users including the flying public.

• These are just a few of the types of services that need to be employed to assist in the design, development and deployment of the NAS weather infrastructure.
Thank you.

For more information or questions concerning this presentation, please visit the Harris booth in the Exhibit Hall.