FPAW 2016
Summer Meeting

3 August 2016
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Flight Efficiency Vision

Weather

- Paperless Flight Deck
- Airspace and Flight Analytics Tools
- Mobile and Automated Flight Efficiency Advisories
- Automated Flight Planning

2010 -> 2020
Guiding Principles
Efficiency Technology

• Partner with operators to gain immediate feedback to validate weather concepts and value.
• Full Flight Concepts – to include dispatch.
• Merge into current operational procedures and standards (won’t require new standards or certs, etc.).
• Abbreviated/short projects with quick turn around to evaluate initial concepts, operational feasibility & benefit.
• Improve decision making with real-time flight and environment information.
• Provide a platform for networking and sharing of real-time weather information and advisories.
Inefficiencies in the System

- Availability of real-time weather
- Accurate and timely delivery of need to know weather
- Integrated weather
- Recall specific actual weather conditions from historical data
- Ground trajectory prediction accuracy
- Coverage Gaps (In-situ)
- Workload (preflight, and enroute for weather advisories)
Shortfalls

Key Issues:

› Uplinking weather for the complete route (climb, cruise, descent, steps, alternate, etc.).

› Updates to EFB and FMC in flight.

› Applicable and pertinent weather selection for aircraft, AOC and ATC.

› Generic algorithms get created and applied to multiple aircraft types.

› Dynamic weather selection for off-route (direct, PDBs, offsets).

› The significance of temperature isn’t understood.
Gaps?

These are inefficiencies for both flight planning tools and FMCs.

- Currently, weather along a flight plan is identified and evaluated at known flight plan waypoints. The flight plan waypoints are generally defined for purposes of navigation or communication.
- Flight plan tools only evaluate weather at waypoints and not a flight trajectory (offsets, pseudo waypoints).
- In between flight plan waypoints, weather is accounted for using linear interpolation of the entered winds and temperatures at the waypoint.
- What happens when weather doesn’t follow linear interpolation?
- What happens when there is a thunderstorm, or other significant weather in between any 2 flight plan waypoints?
Needs

- Assimilation of in-situ weather will require new quality validation.
- Standards documentation to ensure “weather” includes temperature.
- Integrated weather sources that provide forecast and in-situ.
- Weather for the flight plan, efficiency and schedule.
- Work together with ATC centers to connect them to the airline weather data.
- Weather to improve ground automation predictability. Enables efficiency rather than fixed traffic flows.

A/C Observations
- Increased AMDAR equipage
- New/improved Wx parameters
- AOC Downlinks
- ADS-C Downlinks

ATC Needs
- ???

Flight Crew Needs
- Turbulence awareness
- Flight optimization
- Real-time Weather
- Forecast Weather
Integrating Weather Weather Service

In-situ

Global Forecast

Regional Forecast

Boeing Weather Service

Data Warehouse / Processing
Value of In-situ

Improved Weather Services

Improved Weather Applications

Weather Forecasting Improvements and Related Initiatives

- Mode S EHS In-situ
- ADS-C In-situ
- ADS-B In-situ
- EDR
- AOC In-situ

Better WX Information

Better WX Applications
Optimizing Flight Efficiency

Increased weather and turbulence information sharing is needed for flight optimization.

<table>
<thead>
<tr>
<th>PRE-FLIGHT</th>
<th>FLIGHT</th>
<th>POST-FLIGHT</th>
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<tbody>
<tr>
<td>• Weather Advisories for ATC, Dispatch and Pilot</td>
<td>• Weather Advisories</td>
<td>• Recording and transmitting wx actuals and FP WX deviations</td>
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<tr>
<td>• EFB: Wx OFP, NOTAM, SIGMET, NOTOC, etc.</td>
<td>• In-flight updates to EFB??</td>
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<tr>
<td>• FMC Uplinks: Perf, T/O, Wx, Flt Plan, Alternate FP, Secondary FP</td>
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Predictability
Improving predictability
Weather Advisories

1. CREW: REQUEST EWIS
2. Boeing: UPLINK additional waypoints
3. AIRCRAFT: Auto load Route MOD with no discons
4. Boeing: UPLINK weather on additional waypoints
5. AIRCRAFT: Auto signal waypoints are loaded
6. Boeing: Wind Updates detects new flt plan waypoints

Additional Weather Waypoints and Weather
Wind Updates weather on flight plan waypoints in FMC
Crew will be advised of only those points that cause a loss of efficiency along the planned and predicted trajectory.
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