Flight Optimization Solutions – Flight Planning

Next Generation Flight Planning
- JetPlanner Pro
- FlitePlan Core

Planning / Operations
- Tail Assignment
  - Ops. Data / Rwy
  - NOTAMS, Weatl
  - W&B, Crew Briefing

Fuel
- Dashboard
- Optimizer
- Finance

Winds / Routes
- EFB / EFF
- OPT / EDB

Engagement / Feedback

Flight Plan Results

Feedback Loop

Tail Assignment (System)
Flight Planning Lineup

- Flight Plan Online
- JetPlanner
- JetPlanner Pro

Today
- Graphical User Interfaces
- Optimization Engines

Future
- FlitePlan Core
JetPlanner Pro – Improving Business Outcomes

• Opportunities to Optimize
  – Business Continuity
JetPlanner Pro – Architected for High Availability

JetPlanner Pro is a client-server system

Windows Clients

Standard Ethernet LAN

Application server w/failover

LAN

DB server w/standby

JetPlanner Pro Clients

JetPlanner Pro Server
JetPlanner Pro – Improving Business Outcomes

- Opportunities to Optimize
  - Business Continuity
  - Streamline Routine Processes
• Role/Permission-based management

• Flights assigned to desks via messaging or manually

• Flights reassigned via messaging or manually

Desk creation and flight assignment simplified
Graphical and text alerts streamline situational awareness
JetPlanner Pro – NOTAM Filtering

- Leverages Jeppesen’s NOTAM Management Tool (NMT)
- Multi-level filtering
- Apply ad-hoc user-defined filters in addition to NMT

View NOTAMs of interest efficiently
JetPlanner Pro – Rules-based Automation

- Definable controls to automate routine functions
- Flexibility to tailor automation to fit complex workflows
  - Function
  - Time
  - Flight
  - A/C
- Flight alerting when run

Reduces load on staff – more time for high-priority tasks
JetPlanner Pro – Customizable Layout

Individuals set up screens to match their own preferences minimizing the number of clicks and keystrokes.
JetPlanner Pro – Improving Business Outcomes

• Opportunities to Optimize
  – Business Continuity
  – Streamline Routine Processes
  – Greater Situational Awareness
JetPlanner Pro – Designed for Dual Monitors

- Separate windows for situational awareness and planning
- Same charting engine as other Jeppesen products
- Single monitor configuration – laptop compatible

Separating workspace and at-a-glance WX, airspace, & routes drives up efficiency
JetPlanner Pro – Graphical Weather

With live graphical weather quickly identify areas of concern and quickly build avoid areas for rerouting.
JetPlanner Pro – Selectable Chart Layers

Easily select which attributes are displayed on the enroute chart to fit each flight’s unique operational characteristics
JetPlanner Pro – Rubber-band Routing

- User friendly graphical routing
- Useful for ad-hoc situations requiring dispatcher specified routes

Streamlines process of manual route preparation
JetPlanner Pro – Sneak Peak - NiFP

- NOTAMs in Flight Planning (NiFP)
- JetPlanner Pro and FlitePlan Core factor NOTAM-driven constraints when generating OFP
  - FlitePlan Core – evaluates NOTAMs and optimizes route
  - JetPlanner Pro – provides awareness and ability to override constraints

NiFP streamlines optimized routing even with externally applied restrictions
Advanced optimization

Current optimization only partially accounts for:
- Profile restrictions
- Time variable restrictions
- Altitude dependent restrictions
- Enroute charges
- 4D airspace avoidance

All cost factors considered simultaneously
FlitePlan Core – Optimization Engine

A proprietary, state of the art, trajectory optimizer

- Finding the best path
  - Commonly known in mathematics as “shortest path”
- In a 3 dimensional network
  - Network reduced by advanced algorithms
- Optimizing the **airspeed** at each segment
  - The 4th dimension
- Dynamically loading
  - Navdata, airspace rules, weather, costs
- Deciding
  - Route, airspeed, fuel load, payload, tankering, etc
Advanced Optimization

- **FlitePlan Core (FPC)** is Jeppesen’s new flight planning engine.

- Cutting edge optimization algorithms and rules ensuring the optimal trajectory computation.
Example business value

- ATH-XXX B738
- Comparison FPC vs Competition
- FPC’s route was 30 miles shorter
- Approx fuel saving: 200 kg
- Approx cost saving: 120 EUR
- Utilizing a time dependent RAD & finding a DCT through Austria
Advanced Optimization

Combinations of different factors, with detailed cost models and appropriate rules, leads to interesting possibilities…
Advanced Optimization

Traffic Volume Optimization

3D Network

- Aero Performance
- Enroute Charges
- Costs
- Time Constraints
- Weight Constraints
- Airspace Restrictions
- Weather

Constraints

Costs

Time

Airspace Restrictions

3D Network

Network

Aero Performance

Enroute Charges

Costs

Time Constraints

Weight Constraints

Airspace Restrictions

Weather
Advanced Optimization
Advanced Optimization
SWIM-enabled Flight Optimization (SEFO)
End of Track Demonstration

April 21, 2016
Runway Prediction

Runway Prediction Model

- Discrete-choice model for SFO, EWR and

- Factors included in the
  - Current runway config
  - Difficulty in switching run
  - Weather (wind, visibility)
  - Arrival and departure duplicity
  - Noise abatement procedures
  - Inter-airport coordinations

Current runway in use

Weather

Demand

Runway Prediction Model - Validation

Validated SFO and EWR models using:

- Weather and Demand from masFlight
  - Jan to July 2015
  - All flights to/from SFO and EWR

- Runway configuration from FAA ASPM (Aviation System Performance Metrics)
  - Aggregated Jan to Dec 2011

<table>
<thead>
<tr>
<th>EWR Runway Configuration Validation</th>
<th>Observed</th>
<th>Predicted</th>
</tr>
</thead>
<tbody>
<tr>
<td>2L, 1R</td>
<td>22L, 22R</td>
<td>13%</td>
</tr>
<tr>
<td>2L22L, 29</td>
<td>50%</td>
<td>41%*</td>
</tr>
<tr>
<td>4R, 4L, 1L</td>
<td>1%</td>
<td>1%</td>
</tr>
<tr>
<td>4L</td>
<td>2%</td>
<td>2%</td>
</tr>
<tr>
<td>4R, 1L</td>
<td>5%</td>
<td>5%</td>
</tr>
<tr>
<td>4L, 1L</td>
<td>31%</td>
<td>30%</td>
</tr>
</tbody>
</table>

* Due to change in Wind speed

<table>
<thead>
<tr>
<th>SFO Runway Configuration Validation</th>
<th>Observed</th>
<th>Predicted</th>
</tr>
</thead>
<tbody>
<tr>
<td>1R, 1L</td>
<td>2%</td>
<td>3%</td>
</tr>
<tr>
<td>2R, 2L, 1R, 1L</td>
<td>74%</td>
<td>74%</td>
</tr>
<tr>
<td>2R, 2L, 2R, 2L</td>
<td>5%</td>
<td>9%</td>
</tr>
<tr>
<td>2R, 1R, 1L</td>
<td>1%</td>
<td>1%</td>
</tr>
<tr>
<td>2L, 1R, 1L</td>
<td>13%</td>
<td>13%</td>
</tr>
</tbody>
</table>
Advanced Optimization

For Flight 123 @ 0600 local: Apply On-Time High settings

For Flight 123 @ 2100 local: Apply Time Lower settings

For Flight 234: Apply Fuel High settings

For Flight 345: Apply Fuel Tanker
Business Drivers:

1) Migrate engine to new technology platform
2) Offline/Portable engine
3) Better Optimization & New Features
BD 1) Replace JetPlan – Itanium End of Life

- Current JetPlan HPUX servers announced EOL
- JetPlan Engine only runs on this platform
- Critical business need to migrate to another platform before support for HPUX platform ceases
BD 2) Offline Portable Engine

New Market Opportunity:
Initial functionality for Military market demand - Milplanner 6.x with Offline flight plan computational capability:
• Embedded BDS/Military program opportunities (e.g. P8)
• Requires engine to be portable onto Windows device (laptop/tablet)
• Provide flight planning capability while disconnected from the internet (MA disconnected and CA back-up modes)
BD 3) Better Optimization/Features

Enhanced Market Opportunity
Innovate around architecture and features in order to position product as “market leading” – 4D

• Leverage Jeppesen optimization techniques for better plan
• Implement Rules layer
• Innovate around Cost models in optimization
• Responsive to fast changing network (e.g. Europe airspace)
• Improve aero performance models
FlitePlan Core Release Milestones

- FlitePlan Core Development broken into Development Packages
  - 2016: Provide 4D optimized routing via the existing JetPlan solution
  - 2017: Complete Flight Planning in FlitePlan Core, enhance offline capability
  - 2018: Full Replacement of the JetPlan Engine Capabilities

All dates and capabilities are subject to change
FlitePlan Core Release Milestones

• Next Release: Initial Offline Flight Planning Capabilities and 4D Optimized Routing
  – Business Drivers:
    • Meet offline flight planning commitments
    • Realize incremental business value of 4D optimization via the existing JetPlan infrastructure .... General improvement in routing results
  – Flight Planning Capabilities:
    • Navigational rules for airspaces
    • Dynamic route to alternate
    • NOTAMs in flight planning
    • Optimization enhancements

All dates and capabilities are subject to change
FPC Roadmap – September 2016

Release Plan
- NOTAMs in Flight Planning
  - Initial Release
    - Runways, Airports, Procedures, Airways, SUAs, Overriding
  - Aircraft Performance Files
    - Airbus Aircraft
    - Military Aircraft
    - Business Aviation Aircraft
  - Runway to Runways Functionality
    - Optimization Enhancements
    - Initial World-Wide Routing Capabilities
      - Europe
      - North America

FPC and Flight Planning Services Development Backlog
- Complete World-Wide Routing
- Complex Operations
  - Essential ETOPS
  - Re-clear
  - Engine-out
  - Terrain
  - Depressurization
  - Escape Routes
- Polar Ops Special Policies
- Fuel Policies
- Enhance Alternate Selection
- MEL Degradation
- Flight Plan Filing
- Flight Plan Formatting
- Forward and Messaging
- Consolidated Customer Data Management Tool
  - NavManager
  - Customer Data Manager
  - NOTAM Manager
  - Customer Rules Mgmt
  - Post MVP Capabilities
    - Predictive Fuel Temperature
    - Traffic Volume Optimization
    - Runway Prediction

Future Development
- Customer Constraints in FP
  - Company NOTAMs and restrictions
- Advanced ETOPS Optimization
  - Auto Alternate
  - Route Bending
- Negotiated ATC Trajectories
  - CTOP replacement (US)
  - CFMU (Europe)
- Enhanced Data Analysis
  - Integration with AHM and Fuel products
  - Automatic Cost Models

All dates and capabilities are subject to change