Linking Traffic Management to the Airport Surface: Departure Flow Management and Beyond

Nathan A. Doble, John Timmerman, Ted Carniol, and Mark Klopfenstein
Metron Aviation

Midori Tanino and Ved Sud
Federal Aviation Administration

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Outline

Departure Flow Management (DFM) Motivation

DFM Prototype
• Interfaces
• System Architecture

DFM Field Trials
• Locations
• Organization
• Results

DFM Next Steps
Motivation

NextGen Goals

- Shared situational awareness
- Distributed decision-making
- Trajectory-based operations
- Surface operations integrated into ATM

Departure Flow Management (DFM)

- Interim step in evolution to NextGen
- Improves management of tactical departure time constraints
  - Approval Request (APREQ): Tower must get departure time approval from Center for individual flights
### APREQ: Current Procedure vs. DFM

#### Current APREQ Procedure
- Center Traffic Management Coordinator (TMC) disseminates flow restriction for constrained NAS resource via General Information message
  - E.g., 20 MIT for ZOB internal departures transiting SAYRS, jets only, 1500-1730Z
- Tower identifies APREQ flights
- Tower calls Center via telephone with desired release time
- TMC verbally assigns release time

#### DFM Procedure
- Center TMC defines flow restriction for constrained NAS resource within DFM
- Tower DFM interface displays flights needing release times
- Tower selects desired departure time using DFM
- DFM system instantly assigns first available time at or after desired time

#### APREQ Limitations
- Time-consuming
- No Tower situational awareness
- Inflexible

#### DFM Benefits
- Decreased workload
- Shared situational awareness
- Increased agility
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Prototype Center Interface

Individual flows on timelines
- Shown with respect to crossing time
- Multiple flows per display
- Restricted / non-restricted time periods
- Available / unavailable departure times

Color-coded flights
- Departure status
- Departure Tower DFM participation

TMC interaction
- Set flow constraints
- Monitor departure time assignments & modify if necessary
- Drag & drop flights from DFM non-participant Towers
Prototype Tower Interface

Flight lists
- Departure time required
- Departure time assigned

Single flow timeline
- Shown with respect to departure time for individual aircraft and flow constraint

“Thermometers” (not shown) which indicate congestion of relevant flows

Tower controller interaction
- Drag & drop flights to desired departure times
- Record assigned time
- Set runway configuration
Prototype System Architecture

DFM servers at Air Traffic Control System Command Center (ATCSCC)

Thin-client web interfaces at Center and Towers

Architecture leverages existing ETMS Flow Evaluation Area capability
  • List of flights crossing constrained NAS resource
  • Crossing times

Advantages
  • Minimal infrastructure requirements
  • Minimal site adaptation
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Two field trials conducted to date

Cleveland Center (ZOB): August – October 2007
- ZOB uses APREQ daily for internal departures into congested overhead flows between Chicago and New York
- Participating airports: CLE, DTW, PIT

Los Angeles Center (ZLA): January – March 2008
- ZLA uses APREQ to schedule arrivals to LAS & PHX
- ZLA imposes independent MIT restrictions on SoCal TRACON airports to manage departure sector congestion
- Participating airports: BUR, LAS, LAX, ONT, SAN

Field trials organized into 3 Phases, each ~ 1 week
Field Trial Phases

Phase 1: Baseline Data Collection
- Researchers noted flows and times of MIT restrictions, recorded call durations and assigned delays
- Goals
  - select flows and time periods for Phases 2 & 3
  - identify needed software changes

Phase 2: Shadow Testing
- Researchers used DFM to request / assign same times as Tower / Center
- Goals
  - validate prototype software & algorithms
  - verify applicability of DFM concept to facility

Phase 3: Operational Testing
- Center and Tower personnel used DFM prototype instead of telephone to request, assign, and revise departure times
- Goals
  - validate DFM communications concept
  - provide qualitative and quantitative data regarding DFM usability and benefits
Results: Processing & Lead Times

APREQ Processing Times
- ZOB DFM usage reduced processing times by 24%
  - primarily used manual mode at ZOB

APREQ Lead Times
- ZLA DFM usage reduced lead times by 1 minute
- SAN lead times (highest of Phase 1 airports) reduced by 3.6 minutes
Results: Compliance & Sector Loading

APREQ Compliance

- ZLA uses -2/+1 min. compliance window
- DFM usage increased average compliance from 68% to 75% at ZLA
  - Airport with highest baseline lead times and lowest baseline compliance (SAN) saw largest increase

Sector Loading

- ZLA typically uses independent MIT for departures over GMN to control Sector 27 volume
- Sector occupancy 10% higher when DFM used
## Results: Questionnaire Responses

<table>
<thead>
<tr>
<th>Statement</th>
<th>Mean Response (1 = strongly disagree, 7 = strongly agree)</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>ZOB Center (n=5)</td>
</tr>
<tr>
<td><strong>DFM is useful.</strong></td>
<td>4.2</td>
</tr>
<tr>
<td><strong>DFM is easy to use.</strong></td>
<td>4.6</td>
</tr>
<tr>
<td><strong>DFM creates more time for me to manage other issues and/or procedures within the Center/Tower.</strong></td>
<td>4.2</td>
</tr>
<tr>
<td><strong>DFM provides access to the information that I need to manage the APREQ process.</strong></td>
<td>4.4</td>
</tr>
</tbody>
</table>
Results: Controller Feedback

Center Users

• “DFM should reduce the ‘unnecessary’ and allow us to concentrate on the important.”
• “With DFM, we can see what’s happening and still be on the phone doing other things.”

Tower Users

• “DFM is extremely progressive and something that we really need. It is easy to be trained on and it is intuitive.”
• “Situational awareness and flexibility and planning [are] vastly improved. The fact that we’re able to see what is available and what is not instead of the [Center] TMU being the only ones who really know what’s going on was something I’m very pleased with.”
• “After the [ZLA] field trial, DFM was rated for functionality, usefulness and effectiveness. No one gave it a rating less than 80-100% positive in any area. Unheard of for a first field system trial.”
Summarized DFM Benefits

Reduced Tower-Center coordination workload
  • TMCs and controllers can focus on other aspects of their jobs

Greater Tower visibility into flow constraints
  • Results in greater flexibility, higher compliance

More efficient traffic flows
  • Potential for capacity increases
**DFM Next Steps**

**Extended Field Evaluations**
- Center: Los Angeles (ZLA)
- TRACON: Southern California (SCT), Las Vegas (L30)
- Towers: Los Angeles (LAX), Las Vegas (LAS), San Diego (SAN), Santa Ana / John Wayne (SNA), Ontario (ONT), Burbank (BUR)

**Future Plans**
- **Extended Field Evaluations (beginning in 2009)**
- **DFM Prototype**
- **DFM Capability**
- **IDAC/TMA/TBFM (beginning in 2013)**
- **Tower Flight Data Manager (TFDM)**
- **Refinement and validation of requirements and operational procedures**
- **Early Accrual of Benefits**
Prototype interfaces and decision support being developed by MIT Lincoln Laboratory

- Arrival/Departure Management Tool (A/DMT)

Current Work

- Functional requirements specification
- Initial display design
- Information management architecture development
- Simulation environment development

TFDM will further link the airport surface environment into TFM

- Integration of departure flow management with surface flow optimization, en route and arrival constraints, weather, and routing decisions
Questions?