
Metroplex TOS Departures, Initial Results and Next Steps Input

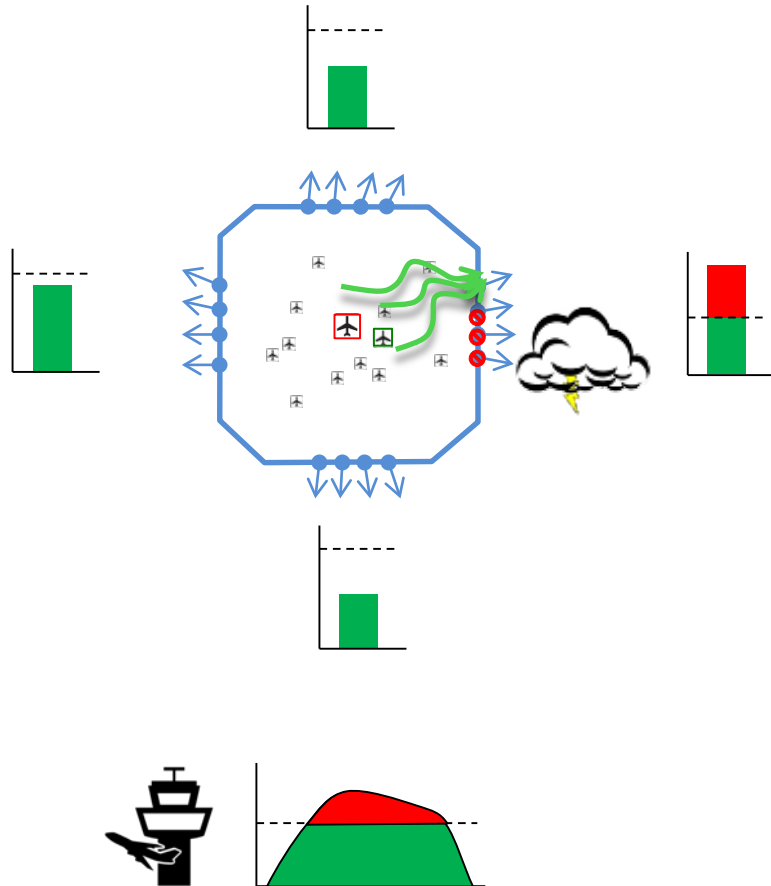
**Breakout Session 8B
September 5, 2019**

Greg Juro and Eric Chevalley

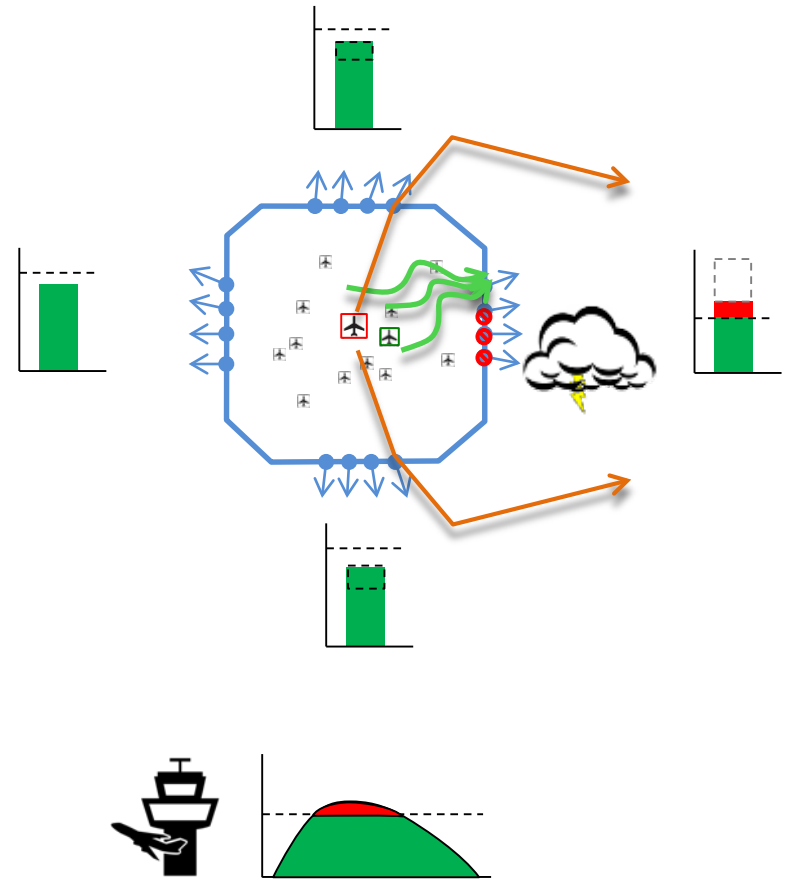
Demand Capacity Imbalances in D10 TRACON Airspace

Fix compression caused by weather events near TRACON airspace

Currently



Load Balancing With TOS
(Trajectory Option Set)

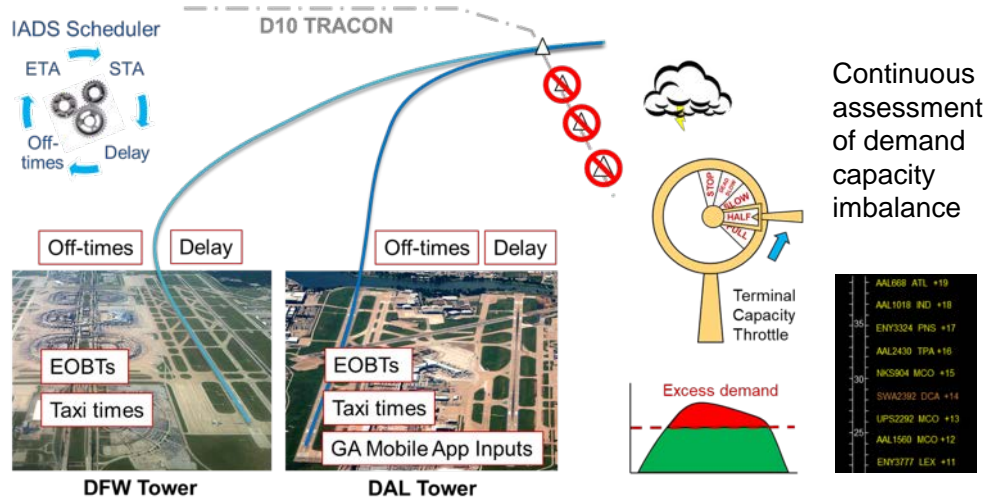


1 Before Day-Of Ops. Formulate 'Static TOS'

- ATC and operators identify acceptable alternative routes to be notified on
- Routes codified in ATD-2 static adaptation
- NASA and operators agree on Relative Trajectory Cost algorithm

```
<TRAJ_OPTION_LIST>
<TRAJ_OPTION>
<TRAJ_INDEX>1</TRAJ_INDEX>
<REL_TRAJ_COST>0</REL_TRAJ_COST>
<ROUTE>DCT IPL J18 GBN DCT PXR J18 SJN DCT TCC J6 PNH
<ALT>F320</ALT>
<SPEED>N0380</SPEED>
</TRAJ_OPTION>
</TRAJ_OPTION_LIST>
```

2 Terminal Predictive Engine Determines Impact



3 'Candidate TOS' are Presented to Operators

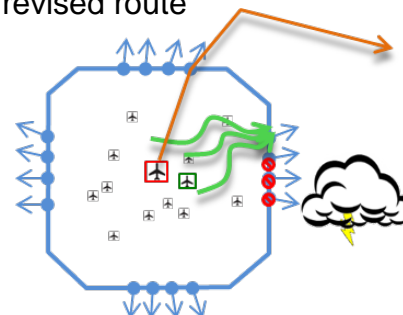
- Assess delay savings on alternative routes
- When the RTC thresholds are met, the operator is informed of 'candidate TOS routes'
- Operators can then submit an acceptable TOS



Delay savings > Relative Trajectory Cost ?

4 Operator Submitted TOS's Presented to ATC

- ATC is notified of the Operator approved TOS route
- ATC evaluates the TOS routes for operational feasibility. If approved, all users are notified, the filed route is amended, and pilots are cleared on the revised route



5 Post Ops Eval



- Benefits
- Lessons
- Refinements
- Data
- Reports

Callsign	Dest	Route	CDR	Dist	+nm	Terminal Gate	RTC	Delay	Delay Savings	Eligibility State	Coordination State	Scratch pad
AAL1500	MCO	KDFW IRSSHZ ZALEA GREEN SEW J2 QHAF OTK PIGLT4 KMCO		880	--	EAST	--	+18	0	N/A	Filed Route	Crew time out 18:10
AAL1500	MCO	KDFW FORCK2 FORCK ELD MEI OTK PIGLT4 KMCO	DFW MCO P	885	+5	EAST	+1	+18	0	Potential	Not Submitted	
AAL1500	MCO	KDFW AKUNAT MLC RZC ARG MEM J41 SEW OTK PIGLT4 KMCO	DFW MCO 1N	1112	+232	NORTH	+15	+0	-18	Candidate	Not Submitted	Coordination
AAL1500	MCO	KDFW DARTZT TNV IAH LCH J2 SZW OTK PIGLT4 KMCO	DFW MCO 1S	898	+118	SOUTH	+30	+2	-18	Potential	Not Submitted	Op. Submit



1 Before Day-Of Ops. Formulate 'Static TOS'

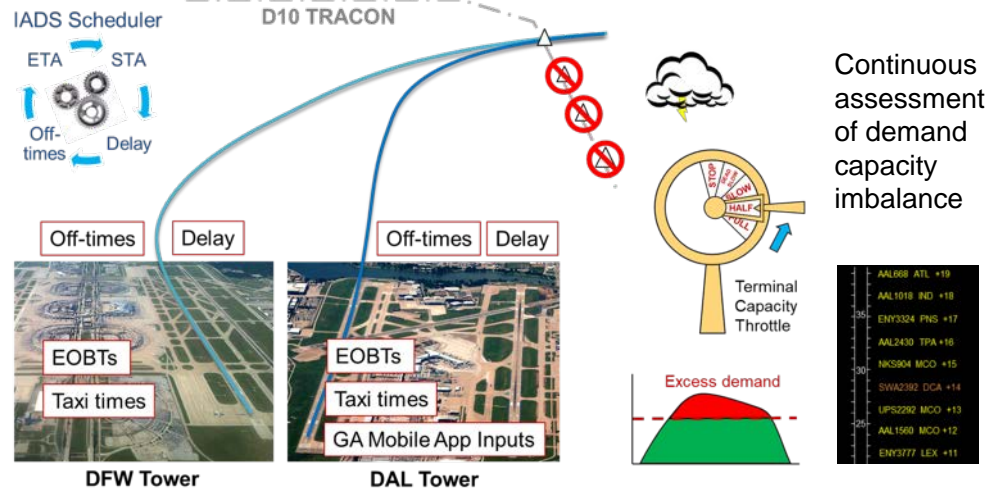
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  </TRAJ_OPTION>
</TRAJ_OPTION_LIST>
```

Step 1 - Added Value

- CDRs used as Static TOS
- CDRs are full procedures that are standard, identifiable, and accessible to both operators and ATC
- CDRs allow for comparison with filed routes and computation of RTC ahead of time
- CDR can be identified as routes that may or may not be available for reroute
- CDR code are eventually used to amend filed routes

2 Terminal Predictive Engine Determines Impact



Step 2 - Added Value

Demand and delays are computed based off:

- Surface model
- Integrated Surface and terminal schedulers

Accounting for:

- EOBTs
- TMI restrictions at the terminal boundary and at the runway
- Other spacing and sequencing constraints

Provides:

- Delays estimates
- Basis to compare delays savings on TOS route and RTC



Step 3 - Added Value

- Candidate TOS are available alternative routes from ATC perspective
- Candidate TOS provide an indication to Flight Operators when flights have opportunities to save delays by flying alternative route(s)
- ATD-2 Client provides awareness of nm difference and RTC for alternative routes, and delay savings on the surface

3 'Candidate TOS' are Presented to Operators

- Assess delay savings on alternative routes
- When the RTC thresholds are met, the operator is informed of 'candidate TOS routes'
- Operators can then submit an acceptable TOS



Delay savings > Relative Trajectory Cost ?

Settings Filter Field Color Alerting												
Flight TOS												
Callsign	Dest	Route	CDR	Dist	+nm	Terminal Gate	RTC	Delay	Delay Savings	Eligibility State	Coordination State	Scratch pad
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AAL1500	MCO	KDFW FORCK2 FORCK ELD MEI OTK PIGLT4 KMCO	DFW MCOOP	885	+5	EAST	+1	+18	0	Potential	Not Submitted	
AAL1500	MCO	KDFW AKUNAT MLC RZC ARG MEM J41 SZW OTK PIGLT4 KMCO	DFW MCO1N	1112	+232	NORTH	+15	+0	-18	Candidate	Not Submitted	Coordination
AAL1500	MCO	KDFW DARTZT TNV IAH LCH J2 SZW OTK PIGLT4 KMCO	DFW MCO1S	898	+118	SOUTH	+30	+2	-18	Potential	Not Submitted	Op. Submit Undo

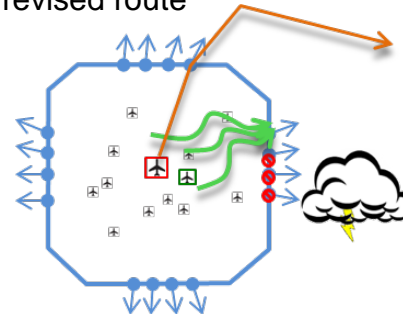
Step 4 - Added Value

- Submitted TOS provide ATC with ability to balance demand at the runway and effectively reduce surface delay
- Approval of reroute is immediately reflected in the scheduler providing feedback about impact of rerouting demand
- Clients provide awareness of submitted, approved reroutes as well as when filed routes are revised in ERAM

4

Operator Submitted TOS's Presented to ATC

- ATC is notified of the Operator approved TOS route
- ATC evaluates the TOS routes for operational feasibility. If approved, all users are notified, the filed route is amended, and pilots are cleared on the revised route



Demonstration of the System with Live Data



- Overview of Field Evaluation
- Main Components of the ATD-2 Graphical User Interface
- Initial Results
- Development and Lessons Learned
 - Handling TMI from NTML entries
 - Modifications to Scheduler and Delay Savings
 - Modifications to Route Distance Computation
 - Global Management of Flights and TOS Route Availability

Stormy 19

Overview of Field Evaluation



A central graphic with a dark teal background. At the top, three logos are arranged horizontally: NASA (left), Federal Aviation Administration (center), and NATCA (right). Below these, the text "ATD2" is prominently displayed in large, bold, white-outlined letters, with the "2" in red. At the bottom, three logos are arranged horizontally: Southwest (left), DFW Dallas Fort Worth International Airport (center), and American Airlines (right). Dotted lines connect the logos in a grid-like pattern.

Surface Meets TOS

- A set of Capability that:
 - Leverages IADS Surface predictive and scheduling technology (Phase 1-2)
 - Expands IADS to the terminal boundary
 - Provides Trajectory Option Set (TOS) to identify when alternative routes are available to reduce surface delay for departures out of the North Texas region
 - Leverages CDM products, such as CDR, Playbook
 - Identify potential solutions to bridge 3T technology gaps



Crawl – Walk – Run

- Stormy 19 (exploratory Research)
 - Identify Requirements through Shadow Sessions
 - Develop an initial capability in an *agile* manner
 - Incremental built of capability (3 micro-phases)
 - Test and use incrementally in operational environment
 - Collect data, observation, feedback
 - Identify monetizable benefits
 - Mature capability
 - Identify goals for Stormy 20
- Stormy 20 (formal test)
 - Implement lessons Learn from Summer 19
 - Identify technology transfer deliverables
 - Develop larger capability leveraging SWIM components
 - Test and Collect data
 - Measure benefits

3A - June 10



3B - July 15



3C - August 12

Terminal Data Exchange & Integration

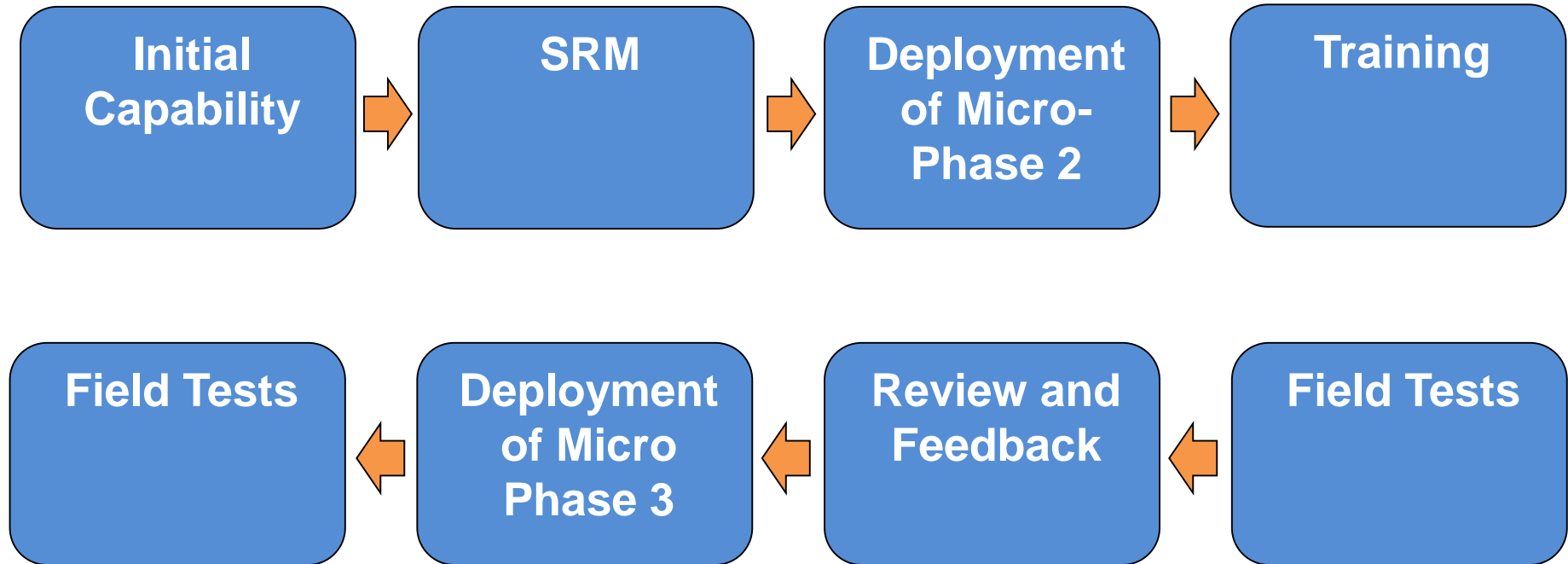
New terminal information in operational areas, but not used for operational decisions. Allows ATC restrictions to be available from NTML and SWIM while users orient to new displays.

Departure Fix Load Balancing With TOS

Core 'Stormy 19' departure fix balancing with TOS concept of operations. Phased in progressively during agreed upon traffic and weather scenarios

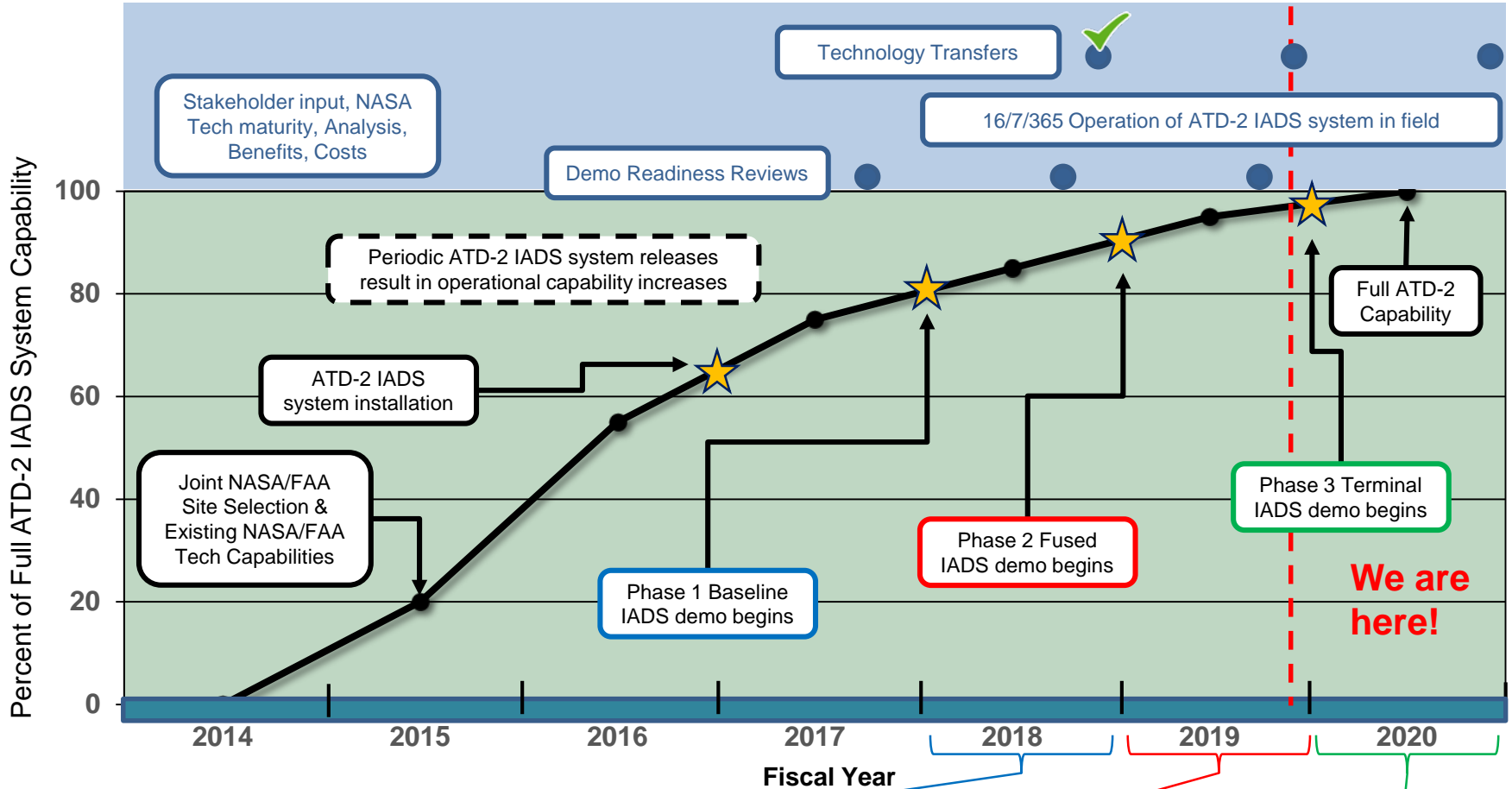
Departure Fix Load Balancing with TOS + Data Comm

Expand upon 3B with Data Comm equipage information to user interfaces. Targets more benefit via use of CPDLC-DCL equipped flights for overall delay reduction.

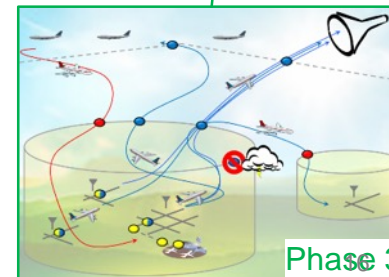


As of Aug 26th, logged 54h during 11 days of scheduled operational tests from Mid-July to Mid-August

ATD-2: Progress Indicator Chart



Field Demo structured in 3 year-long phases with increasing IADS system capabilities.



Stormy 19

Main Components of Graphical User Interface

ATD² Timeline & Graph

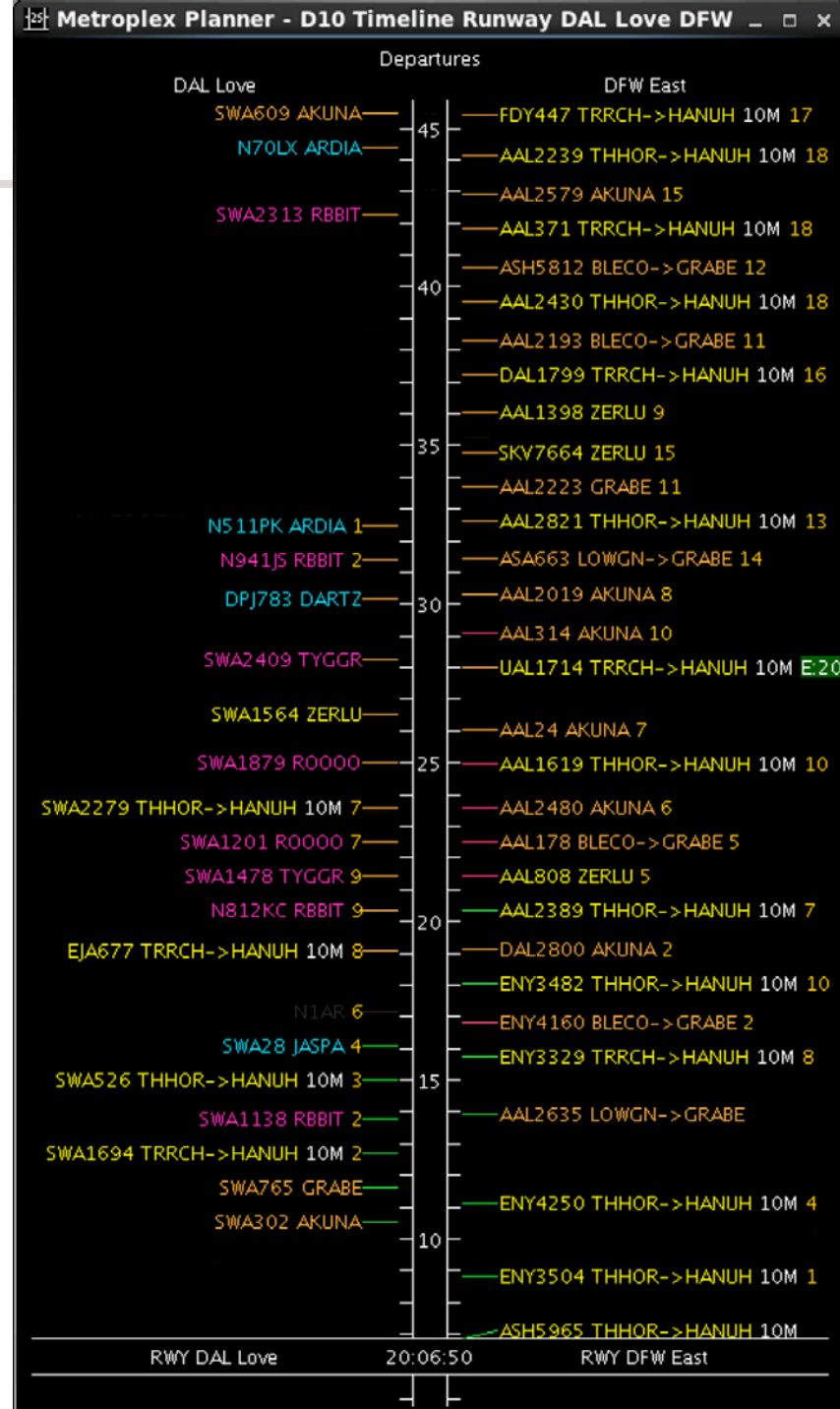
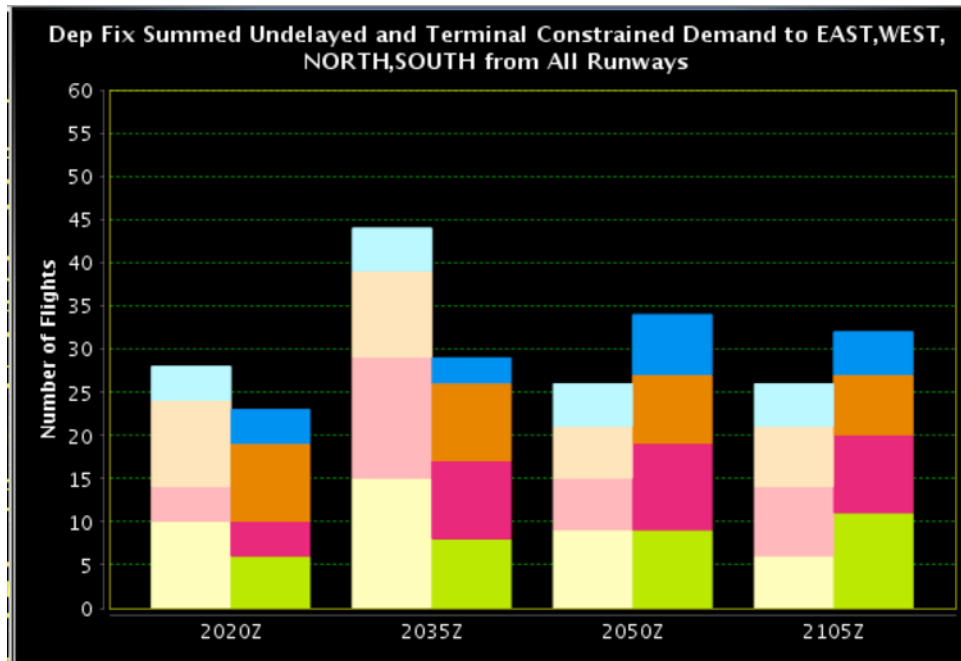
Integrated Arrival/Departure/Surface

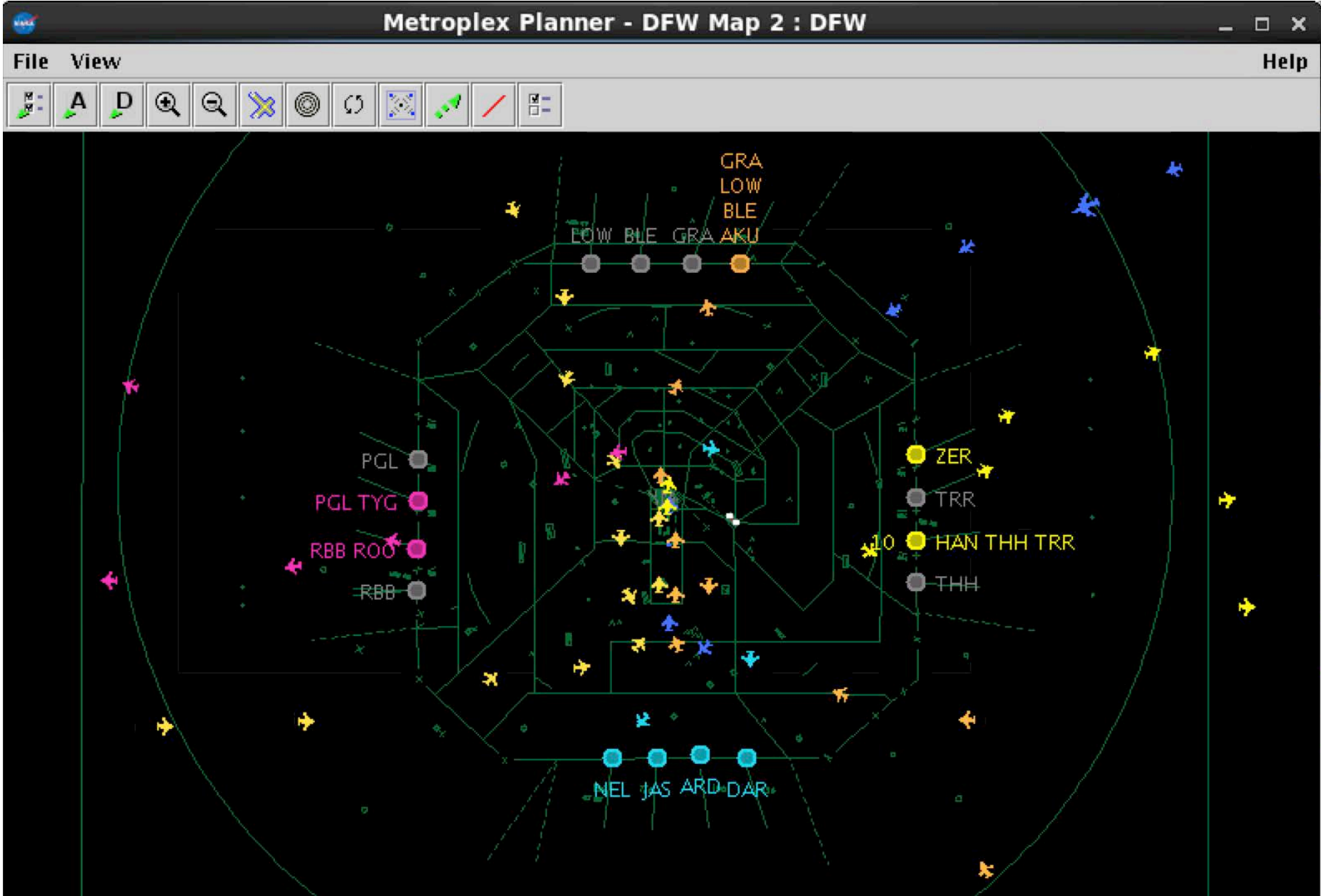
Timelines at Runways or Departure Fixes

- Undelayed and Estimated Times
- Delay
- TMI
- TOS State
- Flight data

Graph at Runways or Departures Fixes

- Undelayed and Estimated demand







Flight Operator - TOS Operations at 20:20 Z

Search Clear

TOS Departure - Eligibility State = Candidate; Coord State != Operator Submitted,ATC Approved

Flight ID	Rwy	Dest	Route of Flight	Dep Gate	Flight Status	EOBT	ETOT ▲	Top ETOT	TMI Info	Top CDR	Top Dep Gate	Top Total Delay Savings OFF	Eligibility State	Coord State	Num TOS Cand	Num TOS Sub
		DEN	ROLLS..LBL..HALEN.BO...	NORTH	Scheduled_Out	27/20:37	27/21:05	20:51	FixClsd		WEST	+15	Candidate	Not Submitted	1	

TOS Departure - Coord State = Operator Submitted

Flight ID	Rwy	Dest	Route of Flight	Dep Gate	EOBT	ETOT	Flight Status	TMI Info	Coord State
		MCO	ZALEA..SWB..HRV.Q105...	EAST	27/20:18	27/20:46	Pushback	10M FixClsd	Operator Sub...

TOS Departure - Coord State = ATC Approved; Coord State = Reroute Filed

Flight ID	Rwy	Dest	Route of Flight	Dep Gate	EOBT	ETOT	Flight Status	TMI Info	Coord State
		MIA	NY..IAH.J86.LEV.Y29...	SOUTH	27/20:12	27/20:39	Taxiling_AMA		ATC Approved

Add Table

TOS Flight Menu -

All Search Clear

Flight ID	Route	CDR	Dep Gate	Rwy	Dist nm	Add nm	RTC	Term Delay OFF	Total Delay OFF	Total Delay Savings OFF	ETOT	Eligibility State	Coord State
	..HUDAD....		WEST		1463			+1	+3		21:18		
	..ROLLS.J5...	SEA1N	NORTH		1472	+9		+1	-3	+6	21:12	Candidate	Operator Sub.
	HOARY..J...	SEA1S	SOUTH		1747	+284		+2	+4	-1	21:19	Potential	Not Submitted
	SAT..DLF....	SEA2S	SOUTH		1835	+372		+2	+4	-1	21:19	Potential	Not Submitted

Stormy 19 Initial Results

Since the start of Micro-Phase 3c (8/15 to 8/26)

Candidate State when Flights at OUT vs in Queue

Out \ Queued	Candidate	Potential	Excluded	Total	% Out
Candidate	66	238	5	309	20%
Potential	71	983	6	1,060	70%
Excluded	15	86	49	150	10%
Total	152	1,307	60	1,519	100%
% Queued	10%	86%	4%	100%	

Destinations and TOS Gates for Flights with Candidate routes at OUT

Dest \ Gates	TOS East	TOS North	TOS South	TOS West	Total	% Dest
KLGA	35	16			51	17%
KORD	18	21		1	40	13%
KPHL	8	11			19	6%
KEWR	6	6	1		13	4%
KBOS	8	5			13	4%
KSEA		11			11	4%
KDCA	4	6			10	3%
KMIA			8		8	3%
KJFK	6	2			8	3%
KSNA			4	4	8	3%
KDEN		4		3	7	2%
KMKE	5	2			7	2%
KPIT	4	2			6	2%
KSTL	3	3			6	2%
KPHX			3	2	5	2%
KDTW	4	1			5	2%
KSAN			3	2	5	2%
KLAX			3	2	5	2%
...
Total	117	128	38	26	309	100%
% Gates	38%	41%	12%	8%	100%	

Note: Candidate flights may be subject to other constraints outside of D10:

- TMIs (EDCT, APREQ)
- AND/OR be already filed to avoid WX
- AND/OR to comply to reroute restrictions

- As of Aug 26th, we logged 54h during 11 days of operational tests from 7/22 to 8/26
- 23 alternative routes for 23 flights were SUBMITTED by Flight Operators
 - 8 times when 10-15 MIT (with and without fix closed)
 - 15 times when no TMI
- 3 routes were then unsubmitted
- 16 alternative routes were APPROVED by ATC
 - 7 times when 10-15 MIT (with or without fix closed)
 - 9 times when no TMI
- 10 reroutes were filed (amended) by ATC
- 8 flights actually flew the alternative routes
 - Total of 49.5min of estimated delay savings (avg 6.1min)
 - 3 times when MITs – total of **28.5min of estimated delay savings** (avg 9.5min)
 - 5 times when no TMI – total of **21.1min of estimated delay savings** (avg 4.2min)
- 6 procedural tests were conducted without executing any reroute
- 2 flight crew rejected the reroute based on mx and wx issues

Stormy 19 Development And Lessons Learned

- Graphical User Interface: Metroplex Planner
 - Multi-airports system
 - New TOS Table and Demand and Delay Graphics
 - Enhancement of Map with TMI information
 - Enhancement of Timeline information with TOS information
- Data
 - Multi-airport Fuser
 - Ingestion of SWA's EOBT and Gate information
 - Addition of SFDPS data to ingest additional flight plan, in particular CPDLC-DCL information
- Services
 - Creation of TOS Service
 - Handling of CDRs, flights included/excluded, route and RTC distance computation
- Predictive and Scheduler Engine
 - Creation of terminal scheduler
 - Reconciliation between airport surfaces and terminal scheduler

- Handling and parsing NTML restrictions
 - Update TMI Service to parse TfmFlow Data from NTML entries
 - Standardization of NTML entries with ZFW partners
 - Fix closures (incl. SWAP) and MIT
 - Handling of cancellations
- Predictive and Scheduler Engine
 - Rules for handling spacing and restrictions at runway and terminal boundary
 - Modification of delay savings computation
 - Exemption of flights that are uncertain to push
- Modification of Route Computation
 - Accounting for flow direction of the airport
- User's Management of Exclusions of flights and TOS routes
 - ATC TMC
 - Global exclusion of TMI flights (EDCT, APREQ, GS)
 - Global exclusions of destinations and CDR
 - Flight Operators
 - Individual exclusion (MX)

Handling TMI From NTML Entries



- ZFW TMC personnel enters the restriction in NTML
 - ATD-2 system parses the TfmFlow data (SWIM)
Looks for restrictions for given requesting and providing facilities
 - ATD-2 system then populates the clients with the restriction information
- When needed, TMC personnel enter or modify the restriction in the NASA ATD-2 client
- Restrictions are an essential input into the schedulers
- Provide Situation Awareness to multiple users

TMI Type	Possible Sources
Runway Utilization	User, Model
APREQs	User, TFM, OIS
Surface Metering Programs	Scheduler
Departure Fix Closures	User, TFM, OIS
Departure Gate Closures	User, TFM, OIS
Ground Delay Programs	TFM
Ground Stops	User, TFM
MITs	User, TFM, OIS
Ramp Closures	User
Runway Closures	User
Scheduled Metering Modes	User
Taxiway Closures	User

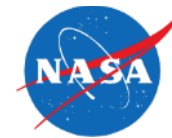
Typical
Terminal
Restrictions

TMI	OIS	TFM Flow	NTML
Airport Information	NO	YES	YES
Airspace Flow Programs	NO	YES	YES
Ground Delay Programs	NO	YES	YES
Ground Stops	NO	YES	YES
Miles/Minutes in Trail	YES	YES	YES
Altitude Restrictions	YES	YES	YES
APREQs	YES	NO	YES
Advisories	NO	YES	YES
Closures (Fixes, etc.)	YES	YES	YES
FADT	NO	YES	NO
RAPT	NO	YES	NO
CTOP	NO	YES	NO
DICE	NO	YES	NO
REROUTEs	NO	YES	NO
TMI FLIGHT LIST	NO	YES	NO



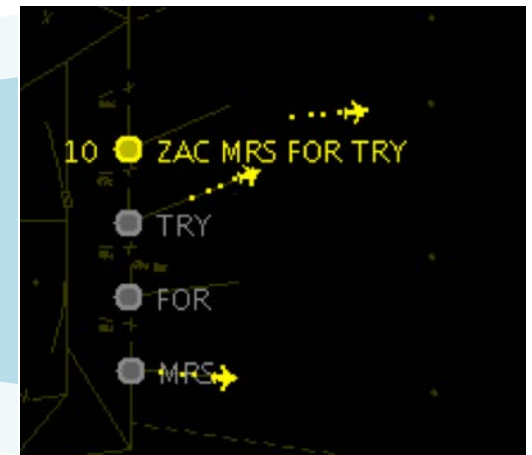
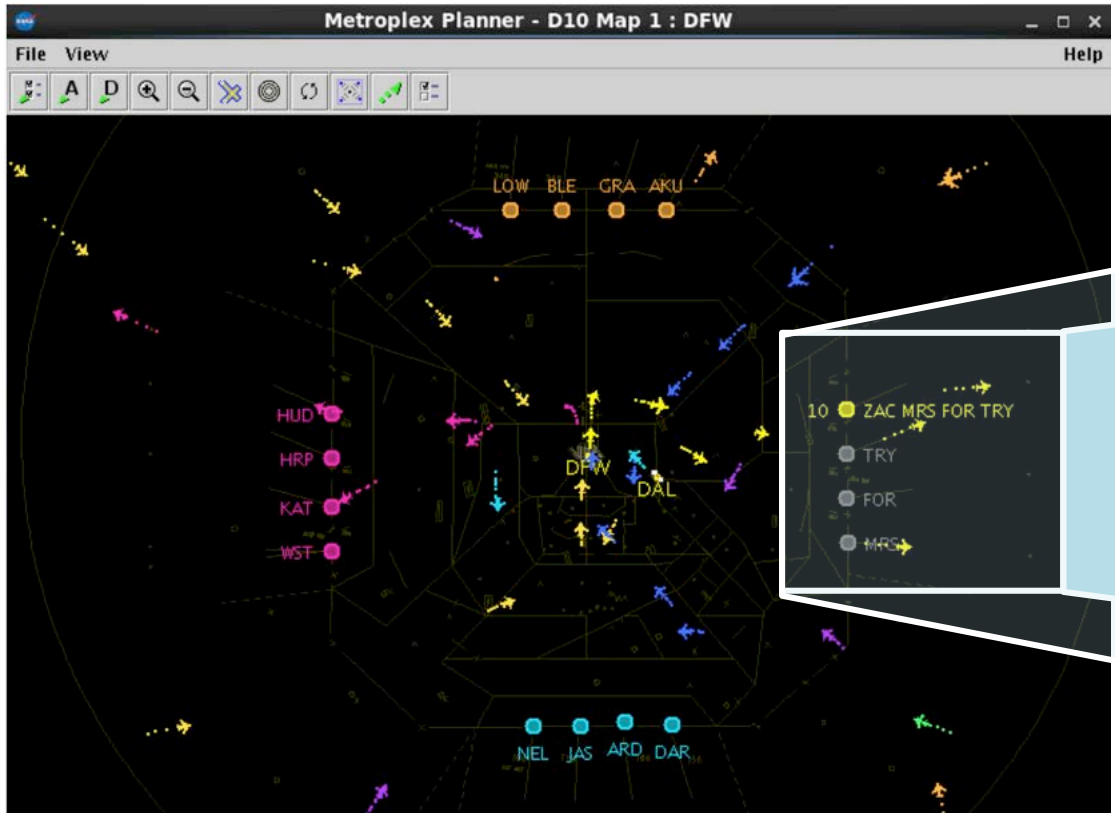
- Not all NTML restriction entries make to Tfm Flow Data
 - RSTN do
 - SWAP, MISC don't
- Standardization of entries is required to have consistent data parsing
 - Manual entries can be prone to errors
- Requires the use of qualifier and remarks fields to provide additional information
 - Qualifier
 - When fixes are closed they need to be listed under "Via" in NTML client (NasResources in Tfmflow data)
 - While the Alternate/combined fix needs to be indicated in the "Qualifier" field
 - Qualifiers are free text that can be set in an adaptation file
 - Requires syntactic convention to parse correctly (i.e. OTG, SWAP EAST, INNERS ON OUTERS)
 - Remarks have been used to provide inclusion or exclusion information (also requires syntactic convention)

National Traffic Management Log (NTML) Restriction



<ul style="list-style-type: none"> Misc RSTN MIRSTN Delay RWY Sum EQ Log MyEntry SISO Count ICE INFO MA PIREP SUA SWAP Telcon Pending 	<p>Request Type: <input checked="" type="radio"/> Initiate <input type="radio"/> Modify <input type="radio"/> Cancel <input type="radio"/> Delete</p>	
	<p>Entry Time: <input type="text" value="2255"/> <input checked="" type="checkbox"/> Clear on Submit</p>	
	<p>Type: <input type="text" value=""/> MIT: <input type="text" value="10"/></p>	
	<p>Aircraft Type:</p> <p><input checked="" type="radio"/> All <input type="radio"/> Jet <input type="radio"/> Prop <input type="radio"/> Other: <input type="text"/></p>	
	<p>Requesting: <input type="text" value="ZFW"/></p>	
	<p>Providing (I): <input type="text" value="D10"/></p>	
	<p>Start Time: <input type="text" value="2300"/> End Time: <input type="text" value="0000"/></p>	
	<p>Causal Factor... <input type="text"/></p>	
	<p>Altitude: <input type="text"/></p>	
	<p>Speed: <input type="text"/></p>	
	<p>Qualifier (I): <input type="text" value="ON ZACHH"/></p>	
	<p>Exclusions: <input type="text"/></p>	
	<p><input type="checkbox"/> Severe Weather Reroute</p>	
	<p>Restriction:</p> <p><input type="radio"/> En Route <input checked="" type="radio"/> Departure <input type="radio"/> Arrival</p>	
	<p>Airport (I): <input type="text"/></p>	
<p>Via (I): <input type="text" value="TRYTN/FORCK/MRSSH"/></p>		
<p>Location (I): <input type="text"/></p>		
<p>Justification/Remarks: <input type="text"/></p>		
<p>ATCSCC Remarks/Critique: <input type="text"/></p>		
<p>Send To... ESIS: <input type="text"/> Coordination Complete <input type="checkbox"/></p>		
<p>Pos: <input type="text"/> Reminder (Z): <input type="text"/></p>		
<p>Fac: <input type="text"/> Entry #: <input type="text"/></p>		
<p>Submit Spelling Clear Save As</p>		

Notifications					
Reported	Event Type	Description	Event Start	Event End	Details
8/27/19 2255	Fix	ZERLU 10MIT	8/27/19 2300	8/28/19 0000	
8/27/19 2255	Fix	HANUH CLOSED	8/27/19 2300	8/28/19 0000	TFM / ZFW ON ZERLU
8/27/19 2255	Fix	TRRCH CLOSED	8/27/19 2300	8/28/19 0000	TFM / ZFW ON ZERLU
8/27/19 2255	Fix	THHOR CLOSED	8/27/19 2300	8/28/19 0000	TFM / ZFW ON ZERLU



Metroplex Planner - D10 TM Actions

Runway Utilization | APREQ Schedule | MIT Restrictions | **Dep Fix Closures** | Runway Closures | Ground Stops | TOS Operation

Add Dep Fix Closures

Departure Fix Departure Gate

Departure Fix:

CDR Flights To:

Start Time: (dd/hhmm) Start Now

End Time: (dd/hhmm) No End Time

Constraints:

Dep Fix Closures

Fix Closure	Flights to	Start	End	Source
HANUH	ZERLU	27/2300	28/0000	USER
THHOR	ZERLU	27/2300	28/0000	USER
TRRCH	ZERLU	27/2300	28/0000	USER

Metroplex Planner - D10 TM Actions

Runway Utilization | APREQ Schedule | **MIT Restrictions** | Dep Fix Closures | Runway Closures | Ground Stops | TOS Operation

Add MIT Restrictions

Airport Departure Fix Departure Gate Jet Route

Departure Fix:

MIT Restriction:

Start Time: (dd/hhmm) Start Now

End Time: (dd/hhmm) No End Time

Constraints:

MIT Restrictions

Resource	MIT	Start	End	Source
ZERLU	10	27/2300	28/0000	USER

Modifications to the Scheduler and Delay Savings

Exclude Uncertain flight from the Surface scheduler
Delay Savings Computation with filed route as
benchmark



- Surface Scheduler assigns flights in an Uncertain group of flights when the flight passes its EOBT time by pre-determined amount of time.
- What-if scheduler is assessing the ETOT for alternative routes
- The what-if scheduler is agnostic of the surface scheduler handling of the Uncertain flights
- This resulted in TOS route with earlier ETOT than the filed route, and the system falsely detecting candidate routes
- Solution: temporary exclude flights in Uncertain group until AOBT

With Spacing and sequencing at RWY (Surface delay)

With Terminal restriction applied at the runway (Surface + Terminal delay)

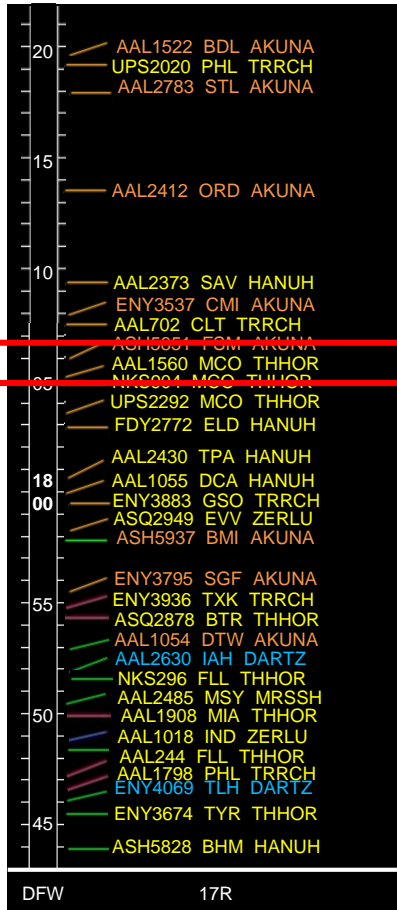
Earlier ETOT for an alternative TOS Route (delay savings)

Delay
AAL1560 = 0min

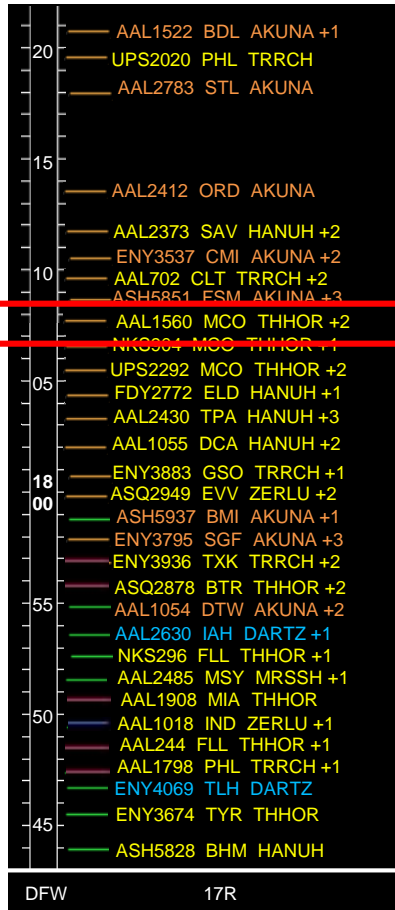
Delay
AAL1560 = 2min

Delay
AAL1560 = 12min

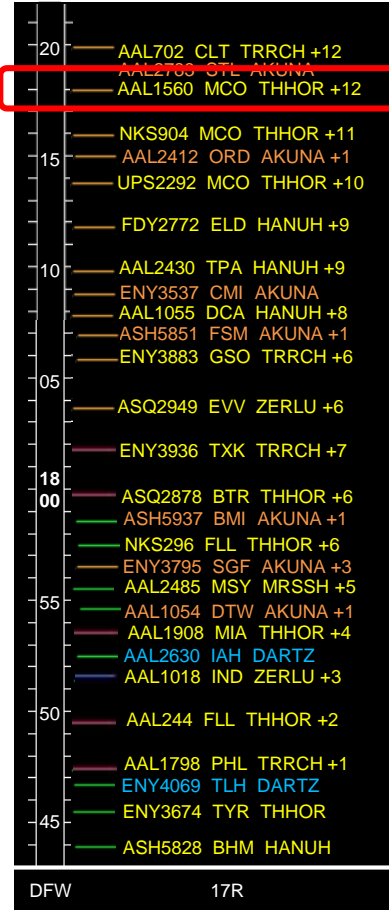
Delay AAL1560 = 0min
Delay Savings = 10min



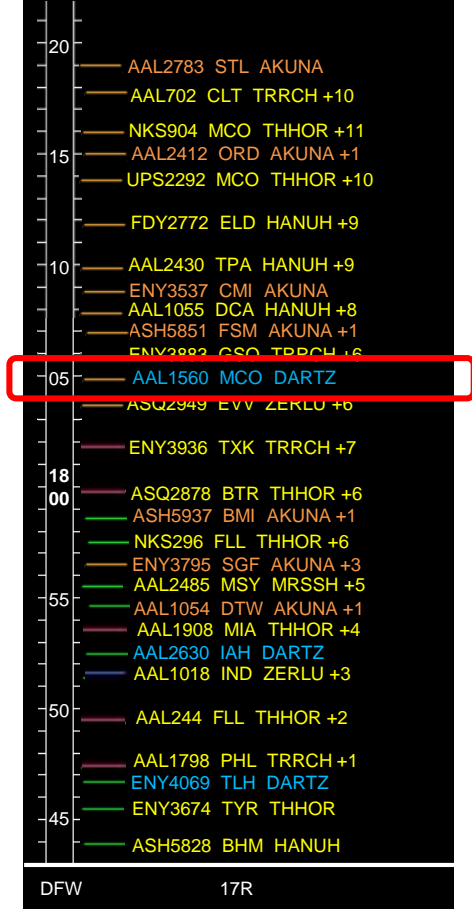
Undelayed TakeOff Times



Target TakeOff Times



Estimated TakeOff Times



TOS Estimated TakeOff Times



- ATD-2 computes delay and delay savings using a delay basis between
 - Delay on filed route = $ETOT_{\text{filed}} - \text{delay basis}$
 - Delay on TOS route = $ETOT_{\text{TOS}} - \text{delay basis}$
 - Delay savings on TOS route = (delay on filed route) – (delay on TOS route)

- Delay Basis Change
 - From Flight's $UTOT_{\text{TOS}}$
 - To Flight's $UTOT_{\text{filed}}$

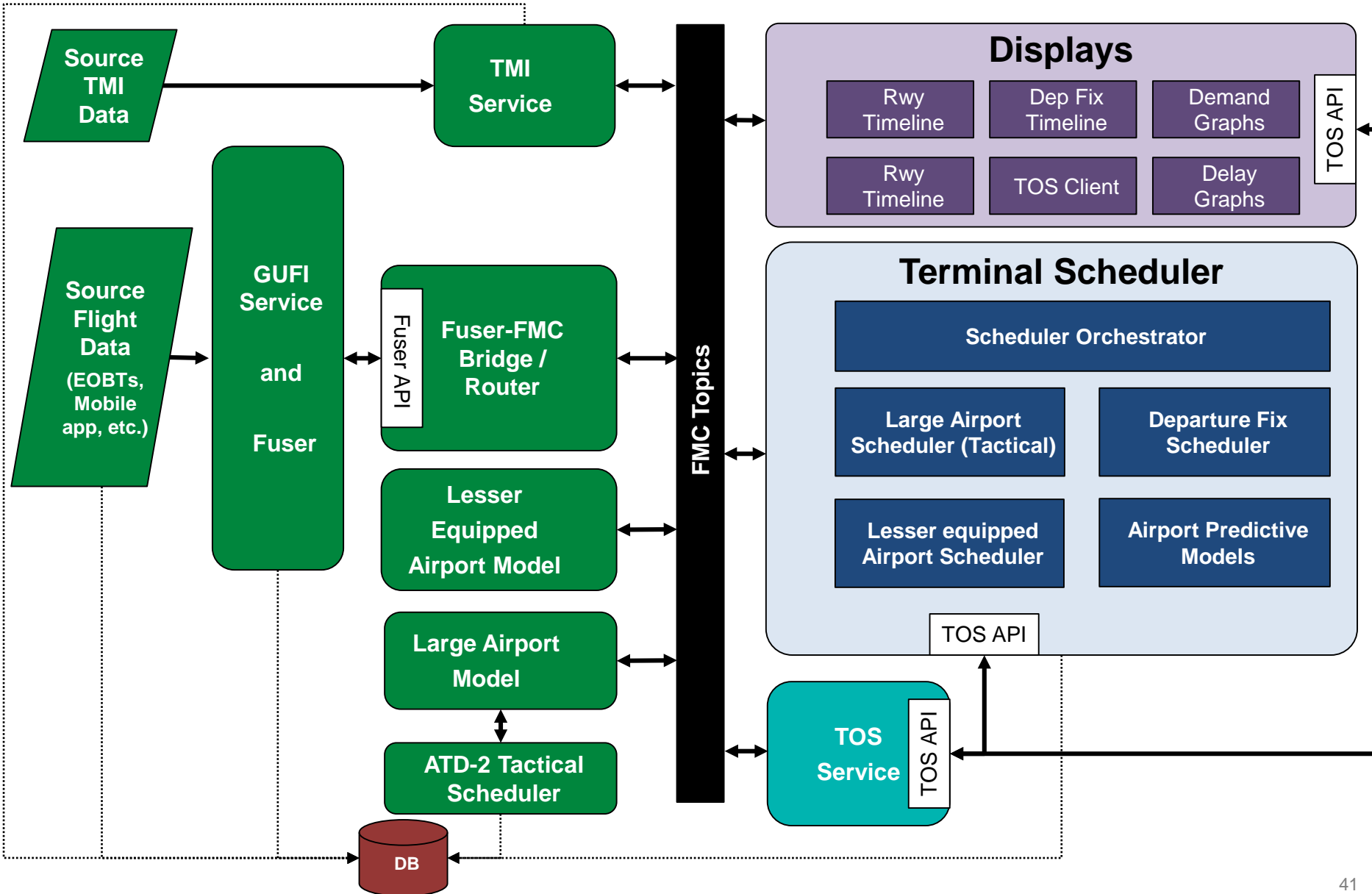
Route ID	1 (filed)	2	3
Gate	EAST	NORTH	SOUTH
Runway	17R	17R	18L
EOBT	12:30	12:30	12:30
UTOT	12:45	12:45	12:55
ETOT	13:00	12:50	12:55
Delay _{UTOT}	15 min	5 min	0 min
Delay Savings _{UTOT}	-----	10 min	15 min

15min of savings?

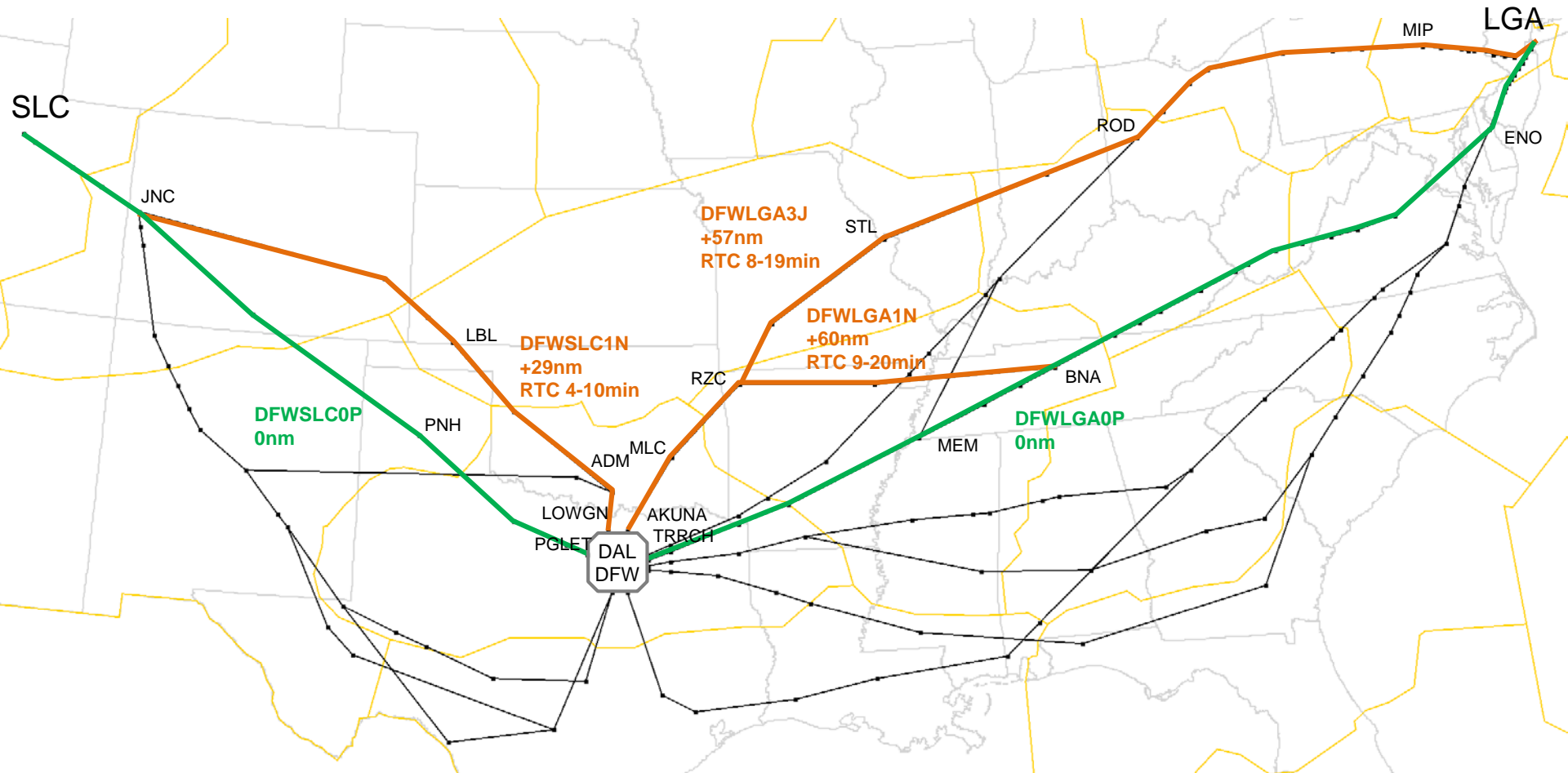
Route ID	1 (filed)	2	3
Gate	EAST	NORTH	SOUTH
Runway	17R	17R	18L
EOBT	12:30	12:30	12:30
UTOT	12:45	12:45	12:55
ETOT	13:00	12:50	12:55
Delay _{UTOT}	15 min	5 min	0 min
Delay Savings _{UTOT}	-----	10 min	15 min
Delay _{filed UTOT}	15 min	5 min	10 min
Delay Savings _{filed UTOT}	-----	10 min	5 min

5min of savings?

Terminal Scheduler Software Architecture



Modification to the Route Distance Computation



- Computed for each operator for their own flights based on agreed upon formula (operator specific)
- Cost (in surface delay minutes) to fly an alternative route, **relative** to the filed route

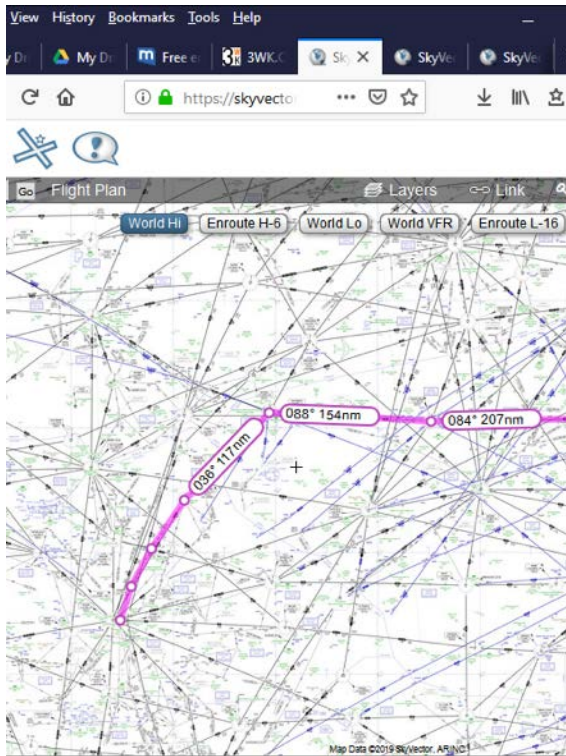
$$\text{RTC (in minutes)} = \frac{\text{CDR distance } \textit{minus} \text{ Filed route distance} \times \text{Air-surface cost ratio} \text{ Pre-determined by Operator}}{\text{Filed speed}} \times 60$$

Additional nm * Cost Ratio

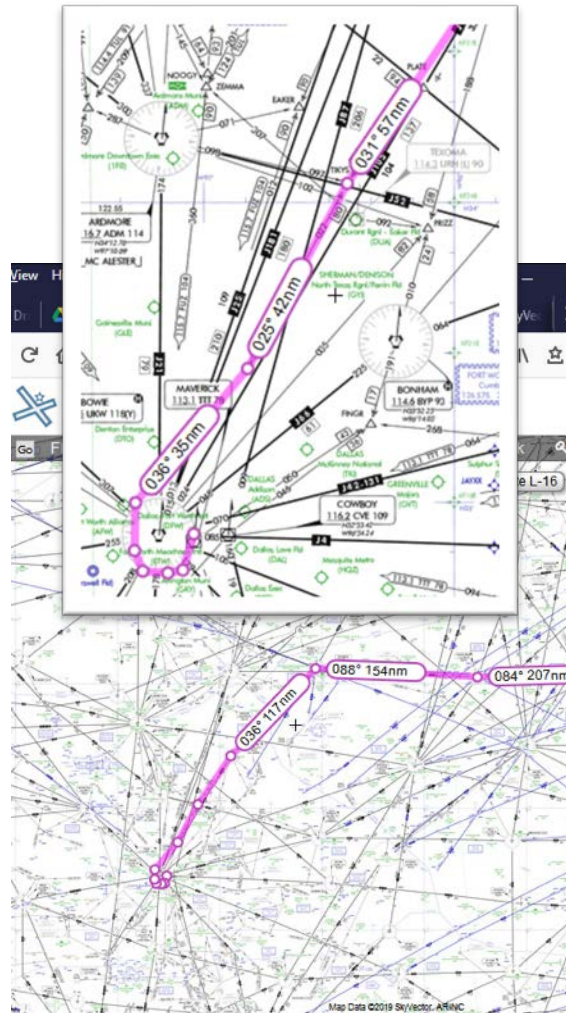
- RTC threshold value is used to determine when an escape route becomes more advantageous to fly than the filed route
 - **RTC is compared to predicted surface delay savings**
 - Surface Delay Savings
 - 20 min surface delay on the filed route via the East Gate
 - 2 min surface delay on the alternative route via the North Gate
 - Delay Savings = 18 min
= surface delay that the flight will save on the alternative route
 - **When predicted surface delay savings is equal or higher than RTC, Then the escape route becomes a candidate for rerouting the flight**
 - When Delay Savings > RTC = alternative route has lower estimated delay
 - KDEP to KSLC
 - Filed route: 20min surface delay + transit time of 60min = total 80min
 - Alternative route: 2min surface delay + transit time of 64min = total 66min



- Main nm difference between CDRs are driven by the En Route portion of the route
- Initial route computation was from from Center of Airport to Departure Fix
- New route computation accounts for runway utilization at the airport
 - Supports runway balancing strategies
- DFWWRJ3 (example of reference route)
 - KDFW.AKUNA7.MLC..RZC..STL..VHP..ROD..KLYNE.Q29.DORET.J584.SLT.FQM3.KEWR
 - Default SID : 1,274
 - 18L : 1,304
 - 35L : 1,275
- DFWWR1N
 - KDFW.AKUNA7.MLC..RZC..ARG..BNA.J42.GVE.PHLBO3.KEWR
 - Default SID : 1,301 | Extra nm = 27 | Minutes longer = 4 (rough approx 7 miles per minute)
 - 18L : 1,331 | Extra nm = 27 | Minutes longer = 4
 - 35L : 1,302 | Extra nm = 27 | Minutes longer = 4
- DFWWR1S
 - KDFW.DARTZ7.TNV..IAH..LCH.J138.SJI.J37.CATLN.Q22.BEARI..FAK.PHLBO3.KEWR
 - Default SID : 1,509 | Extra nm = 235 | Minutes longer = 34
 - 18L : 1,510 | Extra nm = 206 | Minutes longer = 29
 - 35L : 1,530 | Extra nm = 255 | Minutes longer = 36



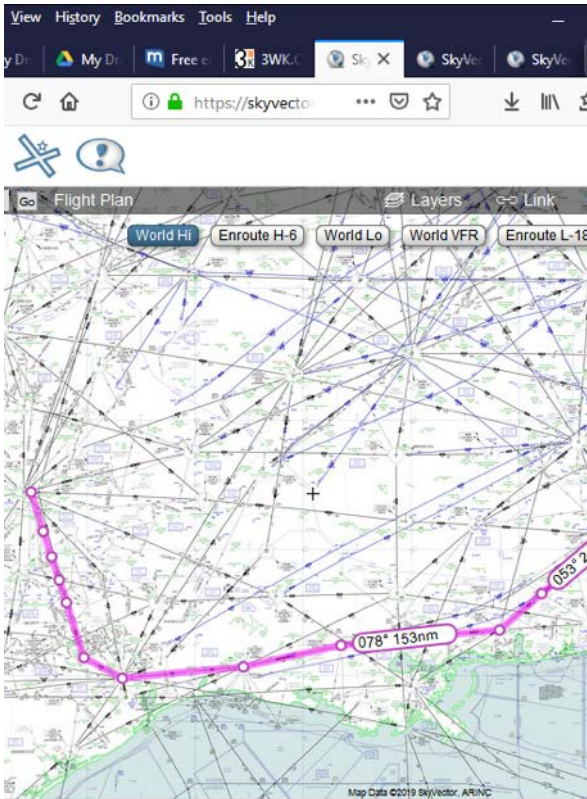
Default



18L



35L



Default



18L



35L

Global Management of Flights and TOS Route Availability

TOS Reroute Advisory



- Provide the Center the ability to communicate and constrain routes and flights that are not eligible for TOS reroute, based on the following Filters:
 - Destinations that that are subject to other TMI restrictions
 - CDR route status
 - Indicate when CDRs are available or not
 - Set inclusions an exclusions for destinations (as needed)
- Provide all users the ability to see
 - Status of TOS Reroute Advisory
 - List of excluded destinations and CDR list in the advisory
 - Show availability of CDRs on the Map

Metroplex Planner TOS Reroute Advisory

APREQ Schedule
MIT Restrictions
Dep Fix Closures
Ground Stops
TOS Operation

TOS Submissions

Active Inactive

Note: turning TOS inactive would reset all filters to default

CDR Availability - Filter
List
Reset

NW	Yes	No	CDR	Remark	Constr.
	<input type="radio"/>	<input checked="" type="radio"/>	1N	Excl: AMA	Set
	<input checked="" type="radio"/>	<input type="radio"/>	1W		Set

Excluded Destinations - Filter

Airport: Select

LGA, EWR, JFK, PHL, ORD, DEN

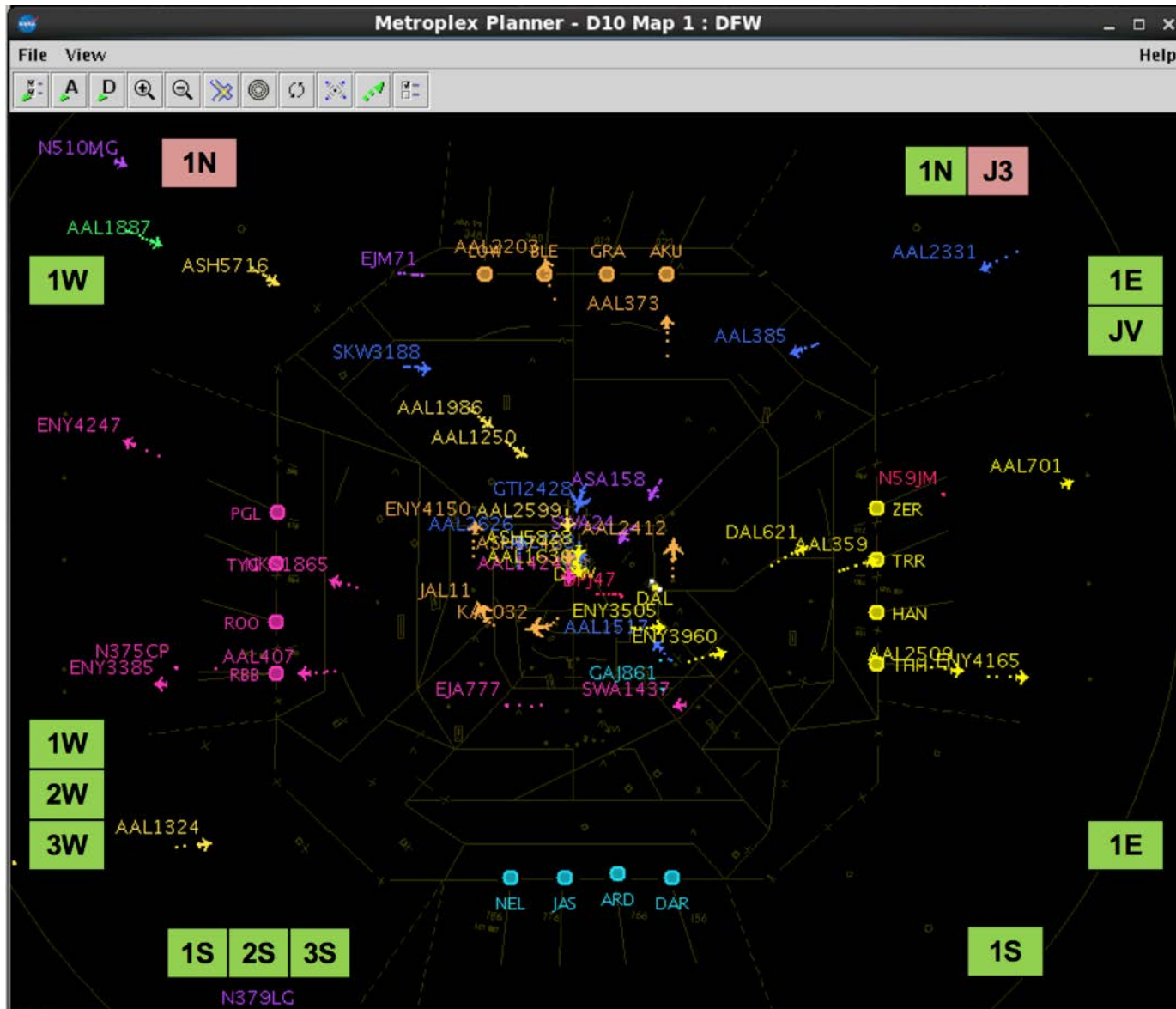
Add
List

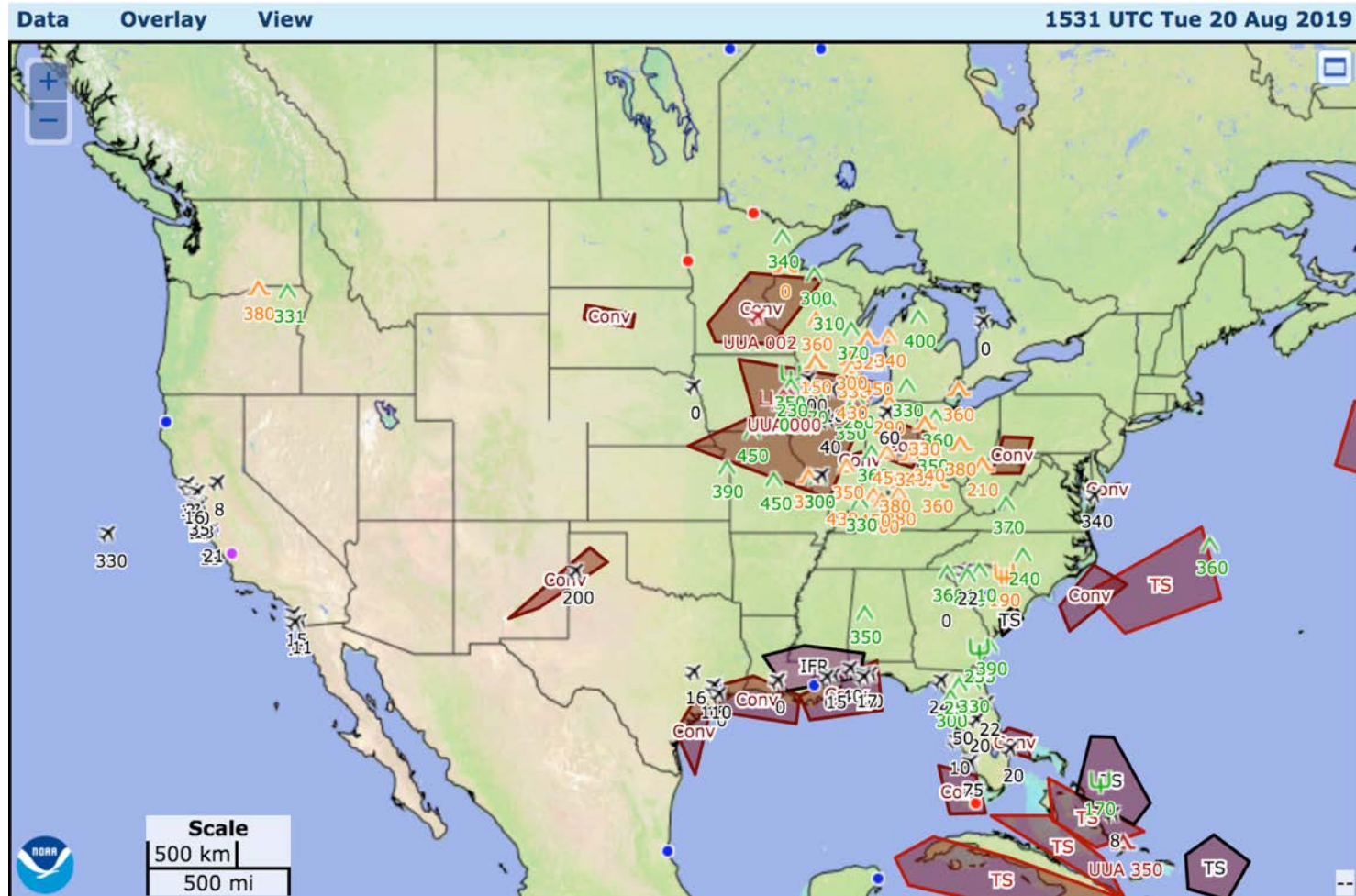
NE	Yes	No	CDR	Remark	Constr.
	<input checked="" type="radio"/>	<input type="radio"/>	1N		Set
	<input type="radio"/>	<input checked="" type="radio"/>	J3	Incl. EWR, JFK, LGA, PHL	Set
	<input checked="" type="radio"/>	<input type="radio"/>	1E		Set
	<input checked="" type="radio"/>	<input type="radio"/>	JV		Set

SW	Yes	No	CDR	Remark	Constr.
	<input checked="" type="radio"/>	<input type="radio"/>	1W		Set
	<input checked="" type="radio"/>	<input type="radio"/>	2W		Set
	<input checked="" type="radio"/>	<input type="radio"/>	3W		Set
	<input checked="" type="radio"/>	<input type="radio"/>	1S		Set
	<input checked="" type="radio"/>	<input type="radio"/>	2S		Set
	<input checked="" type="radio"/>	<input type="radio"/>	3S		Set

Cancel Submit

Restrictions on CDR Displayed on Map (Mock-up)





ATCSCC Advisory

ATCSCC ADVZY 035 DCC 08/20/2019 FCA RQD

MESSAGE: NAME: FCAJFK:WIND_ROUTE_JFK_PARTIAL
 CONSTRAINED AREA: ZMP ZAU ZID
 REASON: WEATHER
 INCLUDE TRAFFIC: KMSP/ZKC DEPARTURES TO KJFK
 FACILITIES INCLUDED: ZAU/ZID/ZKC/ZMP/ZNY/ZOB
 FLIGHT STATUS: ALL_FLIGHTS
 VALID: FCA ENTRY TIME FROM 201700 TO 210430
 PROBABILITY OF EXTENSION: MODERATE
 REMARKS: SEE DYNAMIC LIST FOR UPDATES.
 ASSOCIATED RESTRICTIONS:
 MODIFICATIONS:
 ROUTES:

ORIG	DEST	ROUTE
----	----	----
KMSP	KJFK	>MSP DLL HASTE DAFLU J70 LVZ< LENDY6
ZKC	KJFK	>PXV ROD DJB JHW J70 LVZ< LENDY6

Flight Plan

Aircraft: TAIL # [] Spd: 110 Alt: 080 Fuel: 0

Departure: []

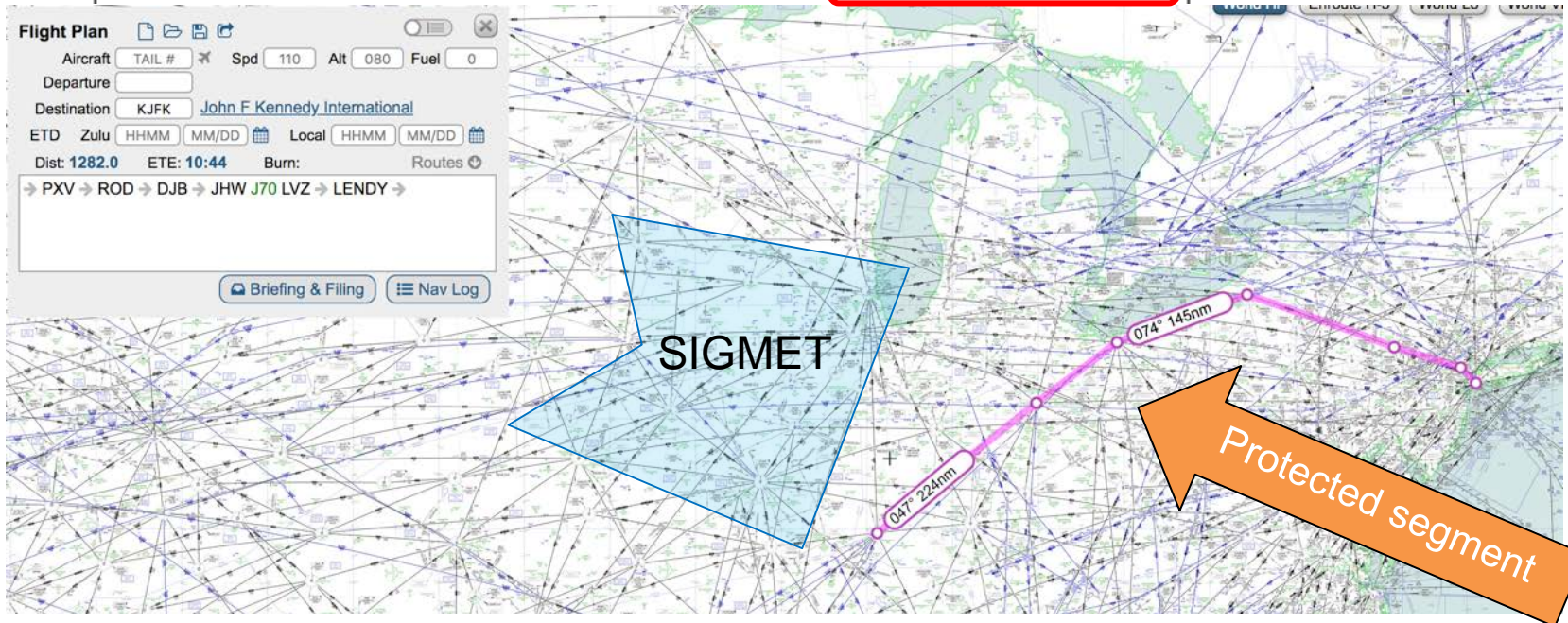
Destination: KJFK John F Kennedy International

ETD Zulu: HHMM MM/DD Local: HHMM MM/DD

Dist: 1282.0 ETE: 10:44 Burn: [] Routes: []

→ PXV → ROD → DJB → JHW J70 LVZ → LENDY →

Buttons: Briefing & Filing, Nav Log



1	CDR	Orig	Dest	Fix	Procedures
304	DFWJFK0P	KDFW	KJFK	LOOSE	KDFW TRYTN3 LOOSE MEM J42 MOL J24 HCM SAWED J121 SIE CAMRN4 KJFK
305	DFWJFK1N	KDFW	KJFK	MLC	KDFW AKUNA7 MLC ARG BNA J42 MOL J24 HCM SAWED J121 SIE CAMRN4 KJFK
306	DFWJFK1S	KDFW	KJFK	TNV	KDFW DARTZ7 TNV IAH LCH J138 SJI J37 CATLN Q64 TYI ORF J121 SIE CAMRN4 KJFK
307	DFWJFKJ3	KDFW	KJFK	MLC	KDFW AKUNA7 MLC RZC STL VHP ROD KLYNE Q29 JHW J70 LVZ LENDY6 KJFK
308	DFWJFKLT	KDFW	KJFK	BSKAT	KDFW ZACHH3 BSKAT LIT J131 PXV ROD KLYNE Q29 JHW J70 LVZ LENDY6 KJFK
309	DFWJFKM3	KDFW	KJFK	FORCK	KDFW FORCK2 FORCK ELD MEI J4 MGM J40 TWINS PANDY BARTL J121 SIE CAMRN4 KJFK
310	DFWJFKRD	KDFW	KJFK	LOOSE	KDFW TRYTN3 LOOSE MEM Q29 JHW J70 LVZ LENDY6 KJFK
311	DFWJFKVS	KDFW	KJFK	TNV	KDFW DARTZ7 TNV J87 IAH J2 LCH J138 SJI J37 CATLN Q64 TYI ORF J121 SIE CAMRN4 KJFK
312	DFWJFKWC	KDFW	KJFK	ZALEA	KDFW MRSSH2 ZALEA SWB MCB CEW JEFOI TEEEM Q109 PANDY BARTL J121 SIE CAMRN4 KJFK
313	DFWJFKWM	KDFW	KJFK	FORCK	KDFW FORCK2 FORCK ELD MEI J4 MGM FIGEY Q64 TYI ORF J121 SIE CAMRN4 KJFK
314	DFWJFKWV	KDFW	KJFK	FORCK	KDFW FORCK2 FORCK ELD SQS J52 VUZ J14 ATL FIGEY Q64 TYI ORF J121 SIE CAMRN4 KJFK

Flight Plan

Aircraft: TAIL # [] Spd: 110 Alt: 080 Fuel: 0

Departure: []

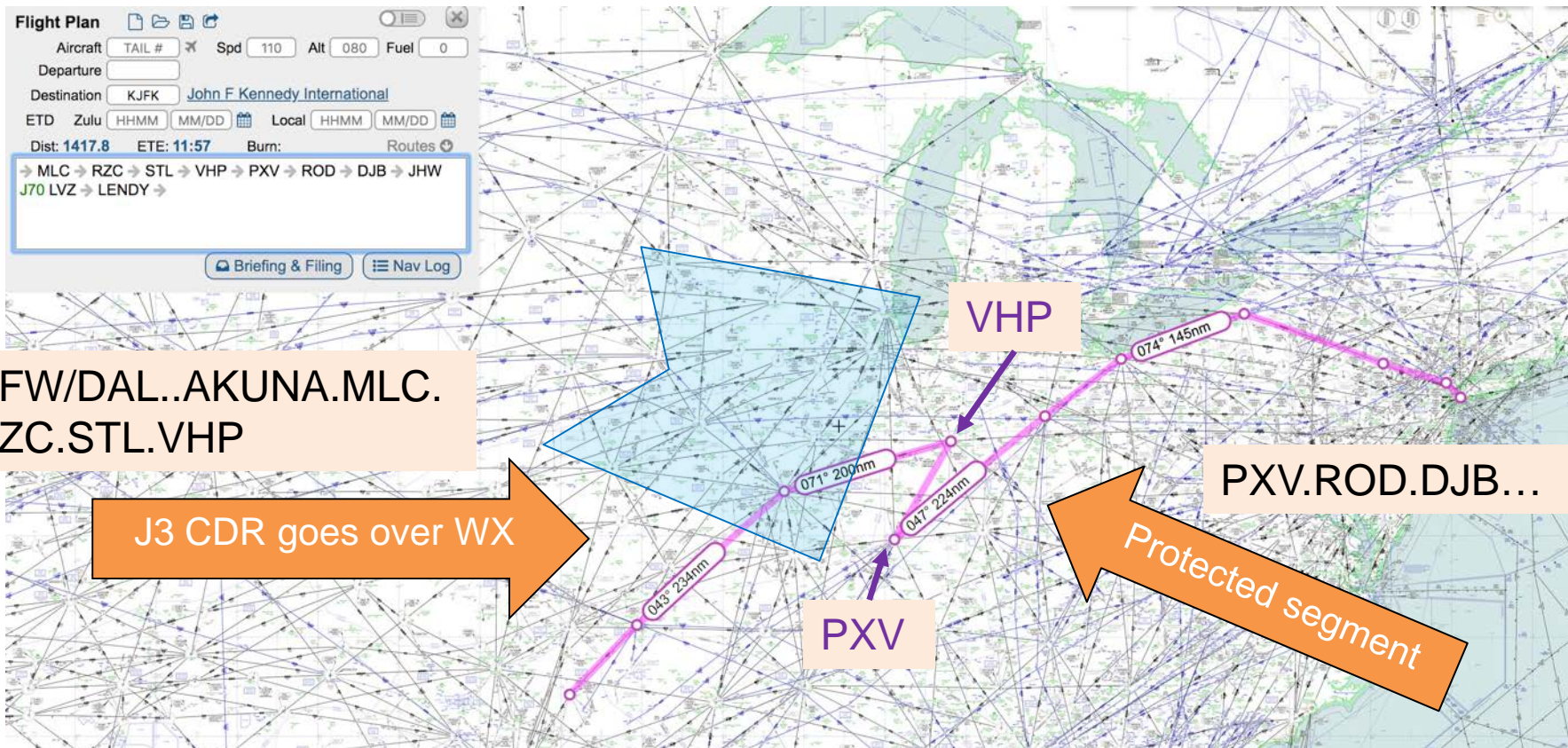
Destination: KJFK John F Kennedy International

ETD: Zulu [] Local []

Dist: 1417.8 ETE: 11:57 Burn: [] Routes: []

→ MLC → RZC → STL → VHP → PXV → ROD → DJB → JHW
J70 LVZ → LENDY →

Briefing & Filing | Nav Log



DFW/DAL..AKUNA.MLC.
RZC.STL.VHP

J3 CDR goes over WX

PXV.ROD.DJB...

Protected segment

1	CDR	Orig	Dest	Fix	Procedures
304	DFWJFK0P	KDFW	KJFK	LOOSE	KDFW TRYTN3 LOOSE MEM J42 MOL J24 HCM SAWED J121 SIE CAMRN4 KJFK
305	DFWJFK1N	KDFW	KJFK	MLC	KDFW AKUNA7 MLC ARG BNA J42 MOL J24 HCM SAWED J121 SIE CAMRN4 KJFK
306	DFWJFK1S	KDFW	KJFK	TNV	KDFW DARTZ7 TNV IAH LCH J138 SIL J37 CATLN Q64 TYI ORF J121 SIE CAMRN4 KJFK
307	DFWJFKJ3	KDFW	KJFK	MLC	KDFW AKUNA7 MLC RZC STL VHF ROD KLYNE Q29 JHW J70 LVZ LENDY6 KJFK
308	DFWJFKLT	KDFW	KJFK	BSKAT	KDFW ZACHH3 BSKAT LIT J131 PXV ROD KLYNE Q29 JHW J70 LVZ LENDY6 KJFK
309	DFWJFKM3	KDFW	KJFK	FORCK	KDFW FORCK2 FORCK ELD MEI J4 MGM J40 TWINS PANDY BARTL J121 SIE CAMRN4 KJFK
310	DFWJFKRD	KDFW	KJFK	LOOSE	KDFW TRYTN3 LOOSE MEM Q29 JHW J70 LVZ LENDY6 KJFK
311	DFWJFKVS	KDFW	KJFK	TNV	KDFW DARTZ7 TNV J87 IAH J2 LCH J138 SJI J37 CATLN Q64 TYI ORF J121 SIE CAMRN4 KJFK
312	DFWJFKWC	KDFW	KJFK	ZALEA	KDFW MRSSH2 ZALEA SWB MCB CEW JEFOI TEEM Q109 PANDY BARTL J121 SIE CAMRN4 KJFK
313	DFWJFKWM	KDFW	KJFK	FORCK	KDFW FORCK2 FORCK ELD MEI J4 MGM FIGEY Q64 TYI ORF J121 SIE CAMRN4 KJFK
314	DFWJFKWV	KDFW	KJFK	FORCK	KDFW FORCK2 FORCK ELD SQS J52 VUZ J14 ATL FIGEY Q64 TYI ORF J121 SIE CAMRN4 KJFK

Flight Plan

Aircraft: TAIL # [] Spd: 110 Alt: 080 Fuel: 0

Departure: []

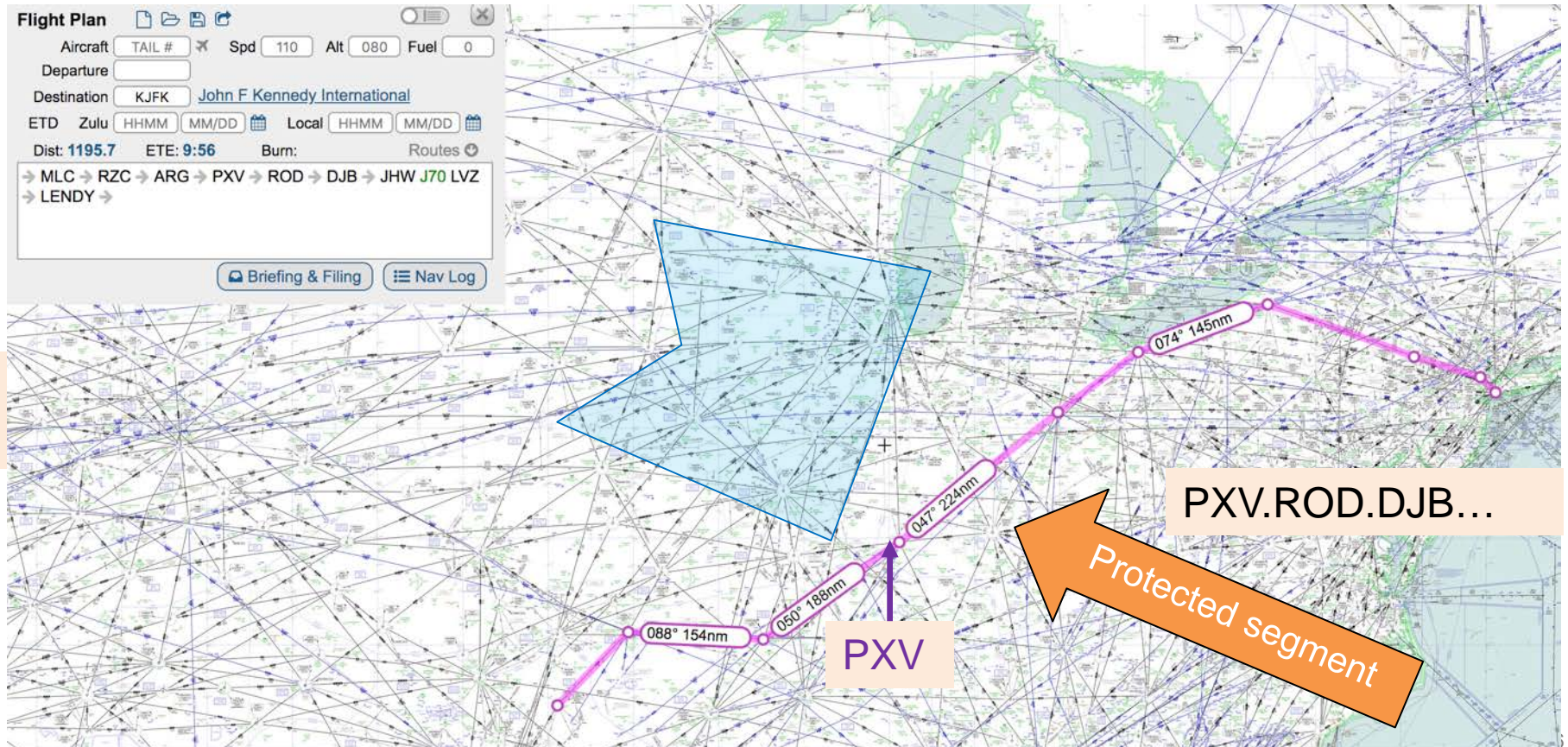
Destination: KJFK John F Kennedy International

ETD: Zulu [HHMM] Local [HHMM] MM/DD []

Dist: 1195.7 ETE: 9:56 Burn: [] Routes []

→ MLC → RZC → ARG → PXV → ROD → DJB → JHW J70 LVZ → LENDY →

Briefing & Filing | Nav Log

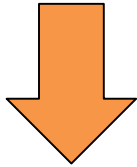




Full or Partial
Playbook route
restrictions

ATCSCC Advisory	
ATCSCC ADVZY 042 DCC 08/20/2019 ROUTE RQD /FL	
RAW TEXT:	NAME: VUZ_PARTIAL
	CONSTRAINED AREA: ZAU ZMP ZID ZKC
	REASON: WEATHER
	INCLUDE TRAFFIC: KBUR/KLAS/KLAX/KLGB/KONT/KSAN/KSNA/ZAB/ZFW/ZHU/ZME DEPARTURES TO KBWI/KDCA/KIAD/KPHL
	FACILITIES INCLUDED: ZAB/ZDC/ZFW/ZHU/ZLA/ZME/ZNY/ZTL
	FLIGHT STATUS: ALL_FLIGHTS
	VALID: ETD 201400 TO 201900
	PROBABILITY OF EXTENSION: MODERATE
	REMARKS: REPLACES ADVZY 37
	ASSOCIATED RESTRICTIONS:
	MODIFICATIONS: ROUTE SHOULD INCLUDE DC METS + PHL FOR DEST.
	ROUTES:
FROM:	
ORIG	ROUTE - ORIGIN SEGMENTS
----	-----
KLAS	>INW J86 ELP J50 ABI J4 FUZ UIM ELD SQS VUZ
KLAX KBUR KSNA KLGB KONT	>BLH J169 TFD J50 SSO J4 EWM J66 ABI J4 FUZ UIM ELD SQS VUZ
KSAN	>IPL J2 GBN J50 SSO J4 EWM J66 ABI J4 FUZ UIM ELD SQS VUZ
ZAB	>EWM J66 ABI J4 FUZ UIM ELD SQS VUZ
ZFW	>ELD SQS J52 VUZ
ZFW	>TNV J87 IAH J2 LCH J138 SJI
ZHU	>SJI
ZME (-BNA)	>VUZ
TO:	
DEST	ROUTE - DESTINATION SEGMENTS
----	-----
KBWI	VUZ ATL KBLER Q56 KELLN Q58 PEETT THHMP< RAVNN6
KBWI	SJI J37 CATLN Q56 KELLN Q58 PEETT THHMP< RAVNN6
KDCA	VUZ ATL KBLER Q56 KIWII WAVES< CAPSS3
KDCA	JI J37 CATLN Q56 KIWII WAVES< CAPSS3

Origin Route



```

ZFW >ELD SQS J52 VUZ
ZFW >TNV J87 IAH J2 LCH J138 SJI
ZHU >SJI
ZME (-BNA) >VUZ

TO:
DEST ROUTE - DESTINATION SEGMENTS
-----
KBWI VUZ ATL KBLER Q56 KELLN Q58
      PEETT THMP< RAVNN6
KBWI SJI J37 CATLN Q56 KELLN Q58
      PEETT THMP< RAVNN6
      VUZ ATL KBLER Q56 KIWII WAVES<
      CAPSS3
    
```

Restricted route

CDR	Origin	Dest	Fix	Procedures
DALDCA0P	KDAL	KDCA	LOOSE	KDAL LNDRE4 LOOSE MEM J42 BKW TRUPS4 KDCA
DALDCALT	KDAL	KDCA	BSKAT	KDAL LNDRE4 BSKAT LIT J131 PXV ROD APE J30 BUCKO FRDMM4 KDCA
DALDCAM3	KDAL	KDCA	FORCK	KDAL LNDRE4 FORCK ELD MEI J4 MGM J40 TWINS BLAAN Q99 POLYY TUBAS J52 RDU FUUFF WAVES CAPSS3 KDCA
DALDCARD	KDAL	KDCA	LOOSE	KDAL LNDRE4 LOOSE MEM Q29 CREEP OTMAN J30 BUCKO FRDMM4 KDCA
DALDCAVS	KDAL	KDCA	TNV	KDAL CURLO4 TNV J87 IAH J2 LCH J138 SJI J37 CATLN Q56 KIWII WAVES CAPSS3 KDCA
DALDCAWB	KDAL	KDCA	LOOSE	KDAL LNDRE4 LOOSE MEM J42 BNA J42 BKW TRUPS4 KDCA
DALDCAWC	KDAL	KDCA	ZALEA	KDAL LNDRE4 ZALEA SWB MCB CEW JEFOI TEEEM Q99 POLYY TUBAS J52 RDU FUUFF WAVES CAPSS3 KDCA
DALDCAWM	KDAL	KDCA	FORCK	KDAL LNDRE4 FORCK ELD MEI J4 MGM KBLER Q56 KIWII WAVES CAPSS3 KDCA
DALDCAWV	KDAL	KDCA	FORCK	KDAL LNDRE4 FORCK ELD SQS J52 VUZ ATL KBLER Q56 KIWII WAVES CAPSS3 KDCA

This advisory matches the CDR DALDCAWV

Crawl – Walk – Run

- Stormy 19 (Exploratory Research)
 - Identify Requirements through Shadow Sessions
 - Develop an initial capability in an *agile* manner
 - Incremental built of capability (3 micro-phases)
 - Test and use incrementally in operational environment
 - Collect data, observation, feedback
 - Identify monetizable benefits
 - Mature capability
 - Identify goals for Stormy 20
- Stormy 20 (Formal Evaluation)
 - Implement lessons Learn from Summer 19
 - Identify technology transfer deliverables
 - Develop larger capability leveraging SWIM components
 - Test and Collect data
 - Measure benefits

Stay Tuned for More...

Thank You

Questions or comments, please contact:

Field Demo Lead - Greg Juro - greg.juro@cavansolutions.com

Research Lead - Eric Chevalley - eric.chevalley@nasa.gov