

Long Term Integration and Implementation of ATD-2 Phase 3 Capabilities

Topics - Overview

- Review of December FET/SCT meeting
- Support of alternative work flows
 - * STORMY20 test
 - * Operational system
- Software integration in operational systems
 - * Users
 - Flight operator software support
 - Traffic manager software support





Implications from December FET/SCT meeting

Recommendation 1: Use of Flight Operator (FO) estimates of airtime
(long term implementation – not included in STORMY20)

- Goals
 - * Accuracy
 - estimate if only aircraft in the sky vs. expected value
(discuss use of historical performance data by flight planning systems)
 - * Consistency of estimates used by ATD-2 algorithms with estimates used and displayed by dispatcher software



Implications from December FET/SCT meeting

Recommendation: Use of Flight Operator (FO) estimates of airtime

- Implications – Requirements for flight planning systems
 - * Specify software architecture: Full integration of functionality within flight planning system vs. development of a FO Reroute Assessment “app” that communicates with flight planning system



Implications from December FET/SCT meeting

Recommendation: Use of Flight Operator (FO) estimates of airtime (December meeting)

- Implications – Requirements for flight planning systems
 - Assume STORMY20 architecture and work flow
 - Static TOSs pre-defined for each city pair using CDRs
 - Flight planning system and/or FO Reroute Assessment “app” would need to
 - Locally store and update static TOS in database for each city pair
 - Generate estimates of airtime for each route in the TOS for each flight
(Discuss computation of airtime for “only aircraft in sky” vs. expected value)
 - Send airtime estimates for each route to FAA software

(not part of STORMY 2020 test but necessary for long term implementation of this architecture)



Implications from December FET/SCT meeting

Recommendation 2: Incorporate estimates of aggregate benefit into FO decision making

- Note earlier presentation by Jeremy on aggregate benefits
- Assume STORMY20 architecture and work flow
 - * Specification of richer objective function/decision process for FAA software to identify candidate routes
 - * Specification of information display for FO (ATC coordinator/dispatcher) to evaluate candidate routes identified by FAA software (requirement for flight planning system or FO Reroute Assessment “app”)
 - * Specification of information display(s) for traffic manager and integration with tool(s) to select/create and submit route amendment
(IDRP; Departure Viewer; PDRR; TFDM?)



File Functions View

Enter Fix(es):

Group by: Color by: Filter by: Show: List Time Bins

Fix ARPT ARPT Fix

ARPT:

Fix:

Current Time: 2106
Last Update: 2105

Include: Jet Turbo Prop

Super Heavy Large Small

Active Flights Unknown DFix (0)

18	33	7	24	5	5	2	2	0	1	3	3	1	0	0	0
2100	2115	2130	2145	2200	2215	2230	2245	2300	2315	2330	2345	0000	0015	0030	0045

BIGGY (16)						COATE (11)						ELIOT (0)						GAYEL (7)								
ACID	PTIME	ETD	ORIG	DEST ^	ETA FIX	ACID	PTIME	ETD	ORIG	DEST ^	ETA FIX	ACID	PTIME	ETD	ORIG	DEST ^	ETA FIX	ACID	PTIME	ETD	ORIG	DEST ^	ETA FIX	ACID	PTIME	ETA FIX
AAL214T	2000	P2105	LGA	DCA	2116	AAL609T	1930	P2105	LGA	DFW	2114							AAL909T	1930	P2105	JFK	LAX	2116	EJA200	2039	P211
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AAL310T	2000	P2105	LGA	DCA	2116	AAL610T	2030	P2105	LGA	DFW	2114							AAL910T	2030	P2105	JFK	LAX	2116	JBU2534	2126	P21
AAL810T	2030	P2105	LGA	DCA	2116	AAL111T	2100	P2110	LGA	DFW	2119							AAL411T	2100	P2110	JFK	LAX	2121	EJA368	2130	P21
AAL311T	2100	P2110	LGA	DCA	2121	AAL611T	2130	P2140	LGA	DFW	2149							AAL911T	2130	P2140	JFK	LAX	2151	AS04335	2130	P21
AAL811T	2130	P2140	LGA	DCA	2151	UAL800T	1930	P2105	EWR	SFO	2113							WM161	2030	P2105	TEB	SLK	2113	BER7249	2130	P21
UAL142	2217	P2107	EWR	FLL	2122	UAL818T	1930	P2105	EWR	SFO	2113							CCA982	2150	P2200	JFK	ZBAA	2215	FIN6	2140	P21
UAL1065	2337	P2201	EWR	MHMK	2216	UAL819T	2000	P2105	EWR	SFO	2113													DAL46	2026	P21
UAL118T	1930	P2105	EWR	MHUN	2113	UAL820T	2030	P2105	EWR	SFO	2113													EIN1TC	2100	P21
UAL119T	2000	P2105	EWR	MHUN	2113	UAL821T	2100	P2110	EWR	SFO	2118													EIN104	2130	P21
UAL120T	2030	P2105	EWR	MHUN	2113	UAL822T	2130	P2140	EWR	SFO	2148													LOT7	2215	P22
UAL121T	2100	P2110	EWR	MHUN	2118																			CN5610	2130	P21
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																								LXJ579	2030	P21
																								LOF4196	2111	P21
																								SKV7641	2130	P21



Implications from December FET/SCT meeting

Selection Tool

- Runways
 - 18C/36C (174)
 - North (41)
 - KNAVE (0)
 - NELYN (23)
 - NEVAR (0)
 - NIKKY (0)
 - NOBLR (18)
 - West (105)
 - WHALT (18)
 - WICKR (20)
 - WILEY (27)
 - WORTH (14)
 - WYMON (26)
 - South (28)
 - ALISA (0)
 - EVANS (0)
 - PHILS (4)
 - SMITH (15)
 - CHASZ (9)
 - East (0)
 - BEAMR (0)
 - BEATY (0)
 - CREAK (0)
 - EARTZ (0)
 - TREAT (0)
 - 18L/36R (176)
 - Spots
 - Departures
 - Weight Classes

All
 By Status:
 Ramp Gate:
 Active All
 Departing Time Until Out
 From mins
 To mins

Flights - 18C

ACID	Target Out(Z)	Target Spot(Z)	Target Off(Z)	Dep Fx	Dst
AAL0492	17:57:31	17:58:09	18:23:20	NELYN	PHX
EGF2858	17:56:25	17:57:03	18:22:15	WHALT	ONT
AAL0516	17:55:19	17:55:57	18:21:09	NOBLR	SNA
RSP2889	17:54:13	17:54:51	18:20:04	CHASZ	SAT
DAL9816	17:53:07	17:53:45	18:18:58	NELYN	DEN
DAL8490	17:52:01	17:52:39	18:17:53	NOBLR	MCI
DAL2862	17:50:55	17:51:33	18:16:47	PHILS	HYI
AAL9302	17:49:49	17:50:27	18:15:42	WICKR	SFO
AAL3383	17:48:43	17:49:21	18:14:36	WILEY	AMA
AAL1426	17:47:37	17:48:15	18:13:31	NOBLR	SFO
DAL4523	17:46:31	17:47:09	18:12:25	CHASZ	BUR
AAL4156	17:45:25	17:46:03	18:11:20	WYMON	AUS
DAL8705	17:44:19	17:44:57	18:10:15	NELYN	SNA
AAL1085	17:43:13	17:43:51	18:09:09	WICKR	SFO
DAL7347	17:42:07	17:42:45	18:08:04	CHASZ	OGG
EGF4744	17:41:01	17:41:39	18:06:58	WILEY	MHK
EGF3854	17:39:55	17:40:33	18:05:53	WILEY	LRD
EGF3474	17:38:49	17:39:27	18:04:47	WICKR	GRK
AWF0547	17:37:43	17:38:21	18:03:42	WHALT	PHX
AAL8017	17:36:37	17:37:15	18:02:36	WICKR	CYCC
GA0879	17:35:31	17:36:09	18:01:31	WILEY	SLC
DAL0834	17:34:25	17:35:03	17:58:51	WILEY	HYI
DAL0736	17:33:19	17:33:57	17:57:45	WHALT	KIRNY
AAL7267	17:32:13	17:32:51	17:56:30	WORTH	OKC
EGF9991	17:31:07	17:31:45	17:55:15	WORTH	GRK
EGF3949	17:30:01	17:30:39	17:54:09	WHALT	MAF
AAL3592	17:28:55	17:29:33	17:53:03	WILEY	LAS
EGF2915	17:27:49	17:28:27	17:51:09	WHALT	CRP
EGF0038	17:26:43	17:27:21	17:50:04	WICKR	ANC
DAL9108	17:25:37	17:26:15	17:48:58	NOBLR	SLC
RSP2994	17:24:31	17:25:09	17:47:53	WYMON	SAT
DAL7396	17:23:25	17:24:03	17:46:47	WORTH	TUS
AAL9393	17:22:19	17:22:57	17:45:42	WICKR	LAS
AAL4631	17:21:13	17:21:51	17:44:36	WICKR	MMSJ
DAL2168	17:20:07	17:20:45	17:40:47	WHALT	LAS
DAL3724	17:19:01	17:19:39	17:39:42	WICKR	MCI
AAL5737	17:17:55	17:18:33	17:38:36	WYMON	SNA
EGF1823	17:16:49	17:17:27	17:37:31	NOBLR	SAS
AAL2058	17:15:43	17:16:21	17:36:25	WYMON	TUS
DAL6660	17:14:37	17:15:15	17:35:20	WILEY	SEA
AAL4965	17:13:31	17:14:09	17:34:14	WYMON	ABI
DAL8748	17:12:25	17:13:03	17:33:09	WILEY	SLC
DAL1735	17:11:19	17:11:57	17:30:25	WYMON	AUS
AAL0048	17:10:13	17:10:51	17:29:20	WICKR	SFO
AAL0274	17:09:07	17:09:45	17:28:15	WYMON	DEN
EGF0379	17:08:01	17:08:39	17:27:09	CHASZ	LRD
DAL2136	17:06:55	17:07:33	17:26:04	WYMON	DEN
GA6941	17:05:49	17:06:27	17:24:58	WICKR	PYY
DAL8889	17:04:43	17:05:21	17:23:53	WYMON	SLC
DAL7779	17:03:37	17:04:15	17:20:53	WYMON	ONT
AAL9805	17:02:31	17:03:09	17:19:47	WYMON	SAT
AAL7887	17:01:25	17:02:03	17:18:42	NELYN	OMA
AAL6145	17:00:19	17:00:57	17:17:36	SMITH	ELB
DAL3183	16:59:13	16:59:51	17:16:31	WYMON	LRB

CATS Surface Map - DFW2:0100929

File View Control Help

Scenario time: 17:00:04 Speed: [Reset] Multiplier: 1.0 Multiplier: 1.0 Go to scenario time: 17:00 GO

18C

# Flights Off	14
Target	14
Actual	14

18L

# Flights Off	14
Target	14
Actual	14

Active

# Active	10
Target	10
Actual	10

DAL8889 Route Options

TMI Route Options Reroute

TOS Options

- KMJA.WILEY. ... CYCC
- KMJA.WICKR. ... CYCC
- KMJA.NOBLR. ... CYCC
- KMJA.NELYN. ... CYCC



Implications from December FET/SCT meeting

Recommendation 3: Present specific recommendations/requirements to SCT/FET for feedback

- Examples discussed above
- Further examples for discussion later



Support of Alternative Work Flows

Goals of discussion:

- Consider impacts on workload, communication load and cognitive complexity
 - * ATC coordinator
 - * Dispatcher
 - * Traffic manager(s)
- Identify incorporation of ATD2 Phase 3 capabilities into alternative workflows
- Discuss implications for FO and FAA software requirements



Support of Alternative Work Flows

Alternatives for discussion

- Example 1. Workflow for STORMY20 test
- Example 2. Workflow based on integration of ATD-2 Phase 3 capabilities within the FET's proposed extension of current operational workflow to support coordination of dispatcher and traffic manager using TOSs
- Other ideas?



Support of Alternative Work Flows

Example 1. Workflow based on **extension** of STORMY20 test architecture
(assuming no surface CDM/TFDM functionality)

- Architecture and associated requirements
 - * FAA software has locally stored set of static routes (CDRs) for inclusion in the TOS for each flight (that will need to be updated periodically)
 - * FO software stores an identical set of static routes (CDRs) for inclusion in the TOS for each city pair (that will need to be updated periodically)
 - * FO software estimates airtime for each flight/TOS route combination
 - * FO software sends estimated airtimes for each flight/TOS route combination
 - How long before EOBT?



Support of Alternative Work Flows

Example 1. Workflow based on extension of STORMY20 test architecture
(assuming no surface CDM/TFDM functionality)

- Architecture and associated requirements (continued)
 - * 20-30 minutes before EOBT(?), FAA software uses ATD-2 software to filter out routes in the default TOS for a flight based on FAA advisories
 - * FAA software uses ATD-2 functionality to predict departure delay (due to surface management constraints and MIT restrictions) for each remaining route in the TOS (considering EOBT, etc.)
 - * FAA software computes aggregate delay impact associated with each route in the TOS



Support of Alternative Work Flows

Example 1. Workflow based on extension of STORMY20 test architecture
(assuming no surface CDM/TFDM functionality)

- Architecture and associated requirements (continued)
 - * FAA software uses ATD-2 capabilities to evaluate predicted delay reduction relative to estimated increase in airtime and identifies candidate reroute(s) for recommendation to FO
 - Refer to earlier discussion by Jeremy regarding incorporation of aggregate delay reductions into the process for generating candidate reroutes
 - Refer to earlier discussion about consideration of the uncertainty associated with estimates of delay reduction
 - * FAA software sends candidate route(s) for a flight to ATC coordinator
 - Information on routes that are not identified as candidates are sent to FO as well



Support of Alternative Work Flows

Example 1. Workflow based on extension of STORMY20 test architecture
(assuming no surface CDM/TFDM functionality)

- Architecture and associated requirements (continued)
 - * ATC coordinator views display based on ATD-2 functionality (information requirements and interface design concepts)
 - * If a reroute candidate looks desirable, ATC coordinator confers with dispatcher
 - * Dispatcher reviews proposed reroute(s) using flight planning system
 - (and display based on ATD-2 functionality?)
 - * Dispatcher indicates approval or disapproval of candidate reroute to ATC coordinator



Support of Alternative Work Flows

Example 1. Workflow based on extension of STORMY20 test architecture
(assuming no surface CDM/TFDM functionality)

- Architecture and associated requirements (continued)
 - * ATC coordinator submits recommendation for reroute to traffic manager
 - Note: In some facilities route amendments are made by the ATCT (DFW; CLT). In others they are made by the Center (ZNY; ZAU)
 - * After pushback (or at some facilities slightly before), the traffic manager views displays based on ATD-2 functionality along with other information displays and makes a tactical decision regarding whether to make the proposed candidate route amendment or not
 - * If an amendment is made, this is sent to the ATCT
 - * ATCT offers amended route to pilots
 - * Pilots accept route clearance (or not)



Support of Alternative Work Flows

Example 2. Workflow based on integration of ATD-2 Phase 3 capabilities within the FET's proposed extension of the current operational workflow to support coordination of dispatcher, flight crew and traffic manager using TOSs (assuming no surface CDM/TFDM functionality)

- Architecture and associated requirements
 - * This variation maintains a process that is **already practiced** by several major carriers to streamline coordination and communication between Dispatch and the flight crew
 - * It extends this existing process to put the traffic manager in the loop regarding pre-coordination between dispatch and flight crew and reroute preferences of the FO (similar to the FET's proposed use of TOSs in PDRR)
 - * This variation incorporates the capabilities demonstrated by ATD-2 Phase 3 to better support this coordination and decision process



Support of Alternative Work Flows

Example 2. Workflow based on integration of ATD-3 Phase 3 capabilities within the FET's proposed extension of current operational workflow to support coordination of dispatcher, flight crew and traffic manager using TOSs

- Architecture and associated requirements (continued)
 - * Proposed variation of workflow for Example 2:
 - When dispatcher is preparing the flight release 75-120 minutes before departure, he/she uses the flight planning system to identify the route to file
 - The dispatcher also can **request** that the flight planning system produce a TOS
 - Upon such a request from the dispatcher, the flight planning system produces a “superset” TOS that includes that includes routes for all of the “reasonable” alternative departure fixes for that city pair (where “reasonable” is defined by a canned list of **generally feasible alternative departure fixes** for that city pair). These **alternative routes may or may not be CDRs** depending on the policy of that FO and the relevant departure airport.



Support of Alternative Work Flows

Example 2. Workflow based on integration of ATD-3 Phase 3 capabilities within the FET's proposed extension of current operational workflow to support coordination of dispatcher, flight crew and traffic manager using TOSs

- Architecture and associated requirements (continued)

- * Proposed variation of workflow for Example 2: The dispatcher evaluates the routes in the "superset" TOS with the benefits of ATD-2 information displays and can:
 - Leave all of the routes in the TOS or only those routes in the TOS that have been marked as tentatively desirable by the ATD-2 software
 - **Manually add or delete routes in the TOS (using an interface that makes this easy)**



Support of Alternative Work Flows

Example 2. Workflow based on integration of ATD-3 Phase 3 capabilities within the FET's proposed extension of current operational workflow to support coordination of dispatcher and traffic manager using TOSs

- Architecture and associated requirements (continued)

- * Proposed variation of workflow for Example 2:

- Along with the information on the route to be filed, the alternate routes in the TOS are included on the flight release for the pilots
 - **With pilot concurrence, the flight plan is filed with the FAA, including the dispatcher approved version of the TOS and other associated information**



Support of Alternative Work Flows

Example 2. Workflow based on integration of ATD-3 Phase 3 capabilities within the FET's proposed extension of current operational workflow to support coordination of dispatcher and traffic manager using TOSs

- Architecture and associated requirements (continued)
 - * From this point in time until the traffic manager chooses to evaluate the flight for a reroute, by exception, the dispatcher or FO software can submit a revised TOS

if, by exception, the dispatcher does look at a flight again to consider changing its TOS, he/she can look at the up-to-date ATD-2 displays to see the benefits associated with alternative routes and can consider other factors like crew time, international connections, etc.

- * At any time before the traffic manager chooses to evaluate the flight for a reroute, the dispatcher also has the ability to mark a flight as "important"



File Functions View

Enter Fix(es):

Group by: Color by: Filter by: Show: List Time Bins

Fix ARPT ARPT Fix

ARPT:

Fix:

Current Time: 2106
Last Update: 2105

Include: Jet Turbo Prop

Super Heavy Large Small

Active Flights Unknown DFix (0)

18	33	7	24	5	5	2	2	0	1	3	3	1	0	0	0
2100	2115	2130	2145	2200	2215	2230	2245	2300	2315	2330	2345	0000	0015	0030	0045

BIGGY (16)						COATE (11)						ELIOT (0)						GAYEL (7)														
ACID	PTIME	ETD	ORIG	DEST ^	ETA FIX	ACID	PTIME	ETD	ORIG	DEST ^	ETA FIX	ACID	PTIME	ETD	ORIG	DEST ^	ETA FIX	ACID	PTIME	ETD	ORIG	DEST ^	ETA FIX	ACID	PTIME	ETD	ORIG	DEST ^	ETA FIX			
AAL214T	2000	P2105	LGA	DCA	2116	AAL609T	1930	P2105	LGA	DFW	2114							AAL909T	1930	P2105	JFK	LAX	2116	EJA200	2039	P211						
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																								LXJ579	2030	P21						
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																								SKV7641	2130	P21						



File Functions View

Enter Fix(es):

Group by: Color by: Fix ARPT ARPT Fix

Filter by: ARPT:

Show: List Time Bins

Include: Jet Turbo Prop Super Heavy Large Small Active Flights Unknown DFIX (0)

16	43	7	24	5	9	2	2	0	1	3	3	1	0	0	0
2100	2115	2130	2145	2200	2215	2230	2245	2300	2315	2330	2345	0000	0015	0030	0045

BIGGY (16)

ACID	PTIME	ETD	ORIG	DEST	ETA FIX
AAL214T	2000	P2105	LGA	DCA	2110
AAL809T	1930	P2105	LGA	DCA	2110
AAL310T	2000	P2105	LGA	DCA	2110
AAL810T	2030	P2105	LGA	DCA	2110
AAL311T	2100	P2110	LGA	DCA	2121
AALR11T	2130	P2140	LGA	DCA	2151
UAL142	2217	P2107	EWB	FLL	2122
UAL1065	2337	P2201	EWB	MWXX	2216
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UAL1082	0005	P2227	EWB	MPOC	2242
JBU2067	2155	P2102	HFN	PBI	2117
JBU543	2325	P2208	EWB	PBI	2222

Route Amendment

Retrieve Routes: Route Code: Flight/Route Color Show Protected Segments

Show Merge ID: AAL310T MANUAL

Current Routes: KLGA, BIGGY, J75, NVE, CLIPR1, NDCA

Retrieved Routes: MANUAL

Assigned Routes:

Create Route Amendment: ALL AAL310T P-Time: 2000 Sector: TRZ0V TMI ID: RRSSTAT

Amendments will be sent for 0 flights

GAYEL (7)

ETD	ORIG	DEST	ETA FIX	ACID	PTIME
P2105	JFK	LAX	2110	EJA200	2039
P2105	JFK	LAX	2110	FLG3080	2110
P2105	JFK	LAX	2110	JBU2534	2126
P2110	JFK	LAX	2121	EJA3988	2130
P2140	JFK	LAX	2151	A504335	2130
P2105	TEB	SLK	2113	BER7340	2120
P2200	JFK	ZBAA	2215	FIN6	2140
				DAL46	2026
				ETH1TC	2100
				ETH104	2130
				L07	2215
				NS610	2130
				EJA602	2000
				AS03970	2109
				TK447	2100
				BP370	2145
				AHI4044	2025
				LX3579	2030
				LOF4196	2111
				SKV7641	2130

Support of Alternative Work Flows

The screenshot displays the CATS software interface, which is used for flight operations management. It consists of several main windows:

- Selection Tool:** A tree view on the left showing various airport categories and their associated flight counts. For example, 'North (41)' includes NNAVE (0), NELYN (23), NEXAR (0), NIKKY (0), NOBLR (18), WHALT (18), WICKR (20), WILEY (27), WORTH (14), and WYMON (26). Other categories include South (28), East (0), and 18L/36R (176).
- Flights - 18C:** A central table listing flight details. The columns are ACID, Target Out(Z), Target Spot(Z), Target Off(Z), Dep Flx, and Dst. A green arrow points from the 'DAL8889' row in this table to the 'DAL8889 Route Options' dialog box.
- CATS Surface Map - DFW20100929:** A graphical representation of the airport's taxiway and runway layout. It includes data panels for specific runways:

Runway	# Flights Off	Target	Actual
18C	14	14	14
18L	10	9	10
- DAL8889 Route Options:** A dialog box titled 'DAL8889 Route Options' with a 'Reroute' button. It contains 'TMI Route Options' and 'TOS Options'. The 'TOS Options' section lists several alternative routes with checkboxes:
 - KMJA.WILEY.CYCC
 - KMJA.WICKR.CYCC
 - KMJA.NOBLR.CYCC
 - KMJA.NELYN.CYCC



Support of Alternative Work Flows

Example 2. Workflow based on integration of ATD-3 Phase 3 capabilities within the FET's proposed extension of current operational workflow to support coordination of dispatcher and traffic manager using TOSs

- Architecture and associated requirements (continued)
 - * Proposed variation of workflow for Example 2:
 - Center/TRACON traffic managers are monitoring conditions and establishing MIT restrictions as needed. **They enter a restriction in NTML for a 2 hour period (or for one hour with a predicted rate for the second hour), updating them every hour**
 - * The traffic manager responsible for reroutes (ATCT or Center?) is evaluating conditions to determine whether there is a need to consider rerouting some flights to expedite departures
 - **As one input: 45-60 minutes before the planned departure time for a flight, the FAA software requests estimated airtimes for routes in its TOS, runs the ADT-2 evaluation and marks flights in the Departure Viewer to indicate which if any have desirable "candidates" for a reroute**



Support of Alternative Work Flows

Example 2. Workflow based on integration of ATD-3 Phase 3 capabilities within the FET's proposed extension of current operational workflow to support coordination of dispatcher and traffic manager using TOSs

- Architecture and associated requirements (continued)

* Proposed variation of workflow for Example 2:

- **20-30 mins. before EOB T:** Taking into consideration the flights in the Departure Viewer (organized by departure fix) that have been marked as having candidate reroutes, and taking into consideration any flights that have been marked by the dispatcher as particularly important for expediting departure, while looking at ATD-2 information displays the traffic manager decides whether to amend a flight to its candidate reroute (or some other reroute)

The traffic manager can choose to look at the “superset” TOS for that flight or its TOS filtered to display only those reroutes that have been identified as candidates by the ATD-2 software



Support of Alternative Work Flows

Example 2. Workflow based on integration of ATD-3 Phase 3 capabilities within the FET's proposed extension of current operational workflow to support coordination of dispatcher and traffic manager using TOSs

- Architecture and associated requirements (continued)
 - * Proposed variation of workflow for Example 2:
 - The traffic manager makes the route amendment
 - The reroute is automatically sent to ATCT and as an alert to the dispatcher
 - The dispatcher evaluates the reroute and determines that it is acceptable, looking at ATD-2 displays to help with this assessment
 - The dispatcher concludes that the reroute is ok and informs the flight crew to expect this reroute
 - ATCT clears the flight to depart on the reroute and the flight crew accepts the clearance



Support of Alternative Work Flows

Examples 1 and 2. Impacts on workload, communication load and cognitive complexity

- Users
 - * ATC coordinator
 - * Dispatcher
 - * Traffic manager
- ATD-2 Phase 3 capabilities
 - * Supporting algorithms (also FO vs. FAA software)
 - * Information requirements
 - * Interface design concepts

Software Integration in Operational Systems



Metroplex Planner - D10 TOS Operations at 22:21 Z

Search Clear

TOS Departure - Eligibility State = Candidate

Flight ID	Rwy	Dest	Route of Flight	EOBT ▲	ETOT	Top ETOT	Top Total Delay Savings OFF	Flight Status	TMI Info	Coord State	Top CDR	Eligibility State
AAL2103	36R	LGA	KDFW.AKUNA7.MLC..SGF.J8.STL.J24.TI...	10/21:22	10/22:29	22:23	-6	In_Queue	15M FixClsd	Not Submitted	DFWLGAOP	Candidate
ASH5854	36R	LBB	KDFW.NELYN6.HOARY..JCT..KLBB	10/21:47	10/23:10	22:25	-45	In_Queue	20M	Not Submitted	DFWLBB1N	Candidate
SWA1564	E31L	SAN	KDAL.RAMBL5.HOARY..JCT.J86.ELP.J2....	10/22:25	10/23:16	22:47	-30	Scheduled_Out	20M	Not Submitted	DALSAN1N	Candidate
ENY3993	E36R	LBB	KDFW.WORTH3.LBB..KLBB/0047	10/22:28	10/23:33	22:41	-52	Scheduled_Out	20M FixClsd	Not Submitted	DFWLBB1N	Candidate
ASH5738	E36R	OKC	KDFW.NELYN6.ACT..ACT240032..AGJ....	10/22:35	11/00:05	22:54	-71	Scheduled_Out	20M	Not Submitted	DFWOKC1E	Candidate
SWA682	E31R	BUR	KDAL.SNSET4.BRHMA..CNX.J74.SJN.J1...	10/22:45	10/23:58	22:58	-60	Scheduled_Out	20M FixClsd	Not Submitted	DALBUR1N	Candidate
AAL1904	E36R	SAN	KDFW.KATZ22.BRHMA..RECKN..ABQ..Z...	10/22:50	11/00:19	23:37	-42	Scheduled_Out	20M FixClsd	Not Submitted	DFWSAN1N	Candidate
AAL2200	E35L	MIA	KDFW.DARTZ8.BILEE.J87.IAH.J86.LEV....	10/22:52	10/23:11	23:03	-7	Scheduled_Out	10M FixClsd	Not Submitted	DFWMIAOP	Candidate
AAL779	E35L	DTW	KDFW.AKUNA7.MLC..RZC..FAM..VHP.....	10/22:59	10/23:48	23:24	-24	Scheduled_Out	15M FixClsd	Not Submitted	DFWDTWOP	Candidate
AAL2779	E36R	SNA	KDFW.KATZ22.BRHMA..RECKN..ABQ.J6...	10/23:12	11/00:38	23:53	-45	Scheduled_Out	20M FixClsd	Not Submitted	DFWSNA1N	Candidate



Software Integration in Operational Systems

Search Clear

TOS Departure - Eligibility State = Candidate

Flight ID	Rwy	Dest	Route of Flight	Dep Gate	EOBT ▲	ETOT	Top ETOT	Top Total Delay Savings OFF	Flight Status	TMI Info	Coord State	Top CDR	Top Dep Gate	Eligibility State
ENY3898	36R	ABI	KDFW.NELYN6.SAT..KABI/0040	SOUTH	10/21:17	10/23:44	22:58	-46	Taxiling_AMA	20M	Not Submitted	DFWABI1N	NORTH	Candidate
AAL2460	36R	LAX	KDFW.NELYN6.HOARY..JCT..J86.ELP..J5...	SOUTH	10/21:27	10/22:52	22:41	-12	In_Queue	20M	Not Submitted	DFWLAX1N	NORTH	Candidate
AAL1885	36R	PHX	KDFW.NELYN6.HOARY..JCT..J86.ELP..D...	SOUTH	10/22:22	10/23:11	22:58	-13	In_Queue	20M	Not Submitted	DFWPHX1N	NORTH	Candidate
ASH5738	E36R	OKC	KDFW.NELYN6.ACT...ACT240032..AGJ...	SOUTH	10/22:35	10/23:57	22:50	-68	Pushback	20M	Not Submitted	DFWOKC1E	EAST	Candidate
AAL1904	E36R	SAN	KDFW.KATZ22.BRHMA..RECKN..ABQ..Z...	SOUTH	10/22:51	11/00:39	23:42	-57	Scheduled_Out	20M FixClsd	Not Submitted	DFWSAN1N	NORTH	Candidate
AAL779	E35L	DTW	KDFW.AKUNA7.MLC..R2C..FAM..VHP.....	NORTH	10/22:56	10/23:35	23:22	-13	Scheduled_Out	15M FixClsd	Not Submitted	DFWDTWOP	EAST	Candidate
AAL2779	E36R	SNA	KDFW.KATZ22.BRHMA..RECKN..ABQ..J6...	SOUTH	10/23:12	11/00:48	23:42	-66	Scheduled_Out	20M FixClsd	Not Submitted	DFWSNA1N	NORTH	Candidate
AAL2471	E36R	ONT	KDFW.KATZ22.BRHMA..CNX..DRYHT.....	SOUTH	10/23:20	11/00:51	23:42	-69	Scheduled_Out	20M FixClsd	Not Submitted	DFWONT1N	NORTH	Candidate
ASH5795	E36R	PHX	KDFW.WSTEX2.CIKAN..EWM..DRRVR.PL...	SOUTH	10/23:25	11/00:54	00:09	-46	Scheduled_Out	20M FixClsd	Not Submitted	DFWPHX1N	NORTH	Candidate

TOS Departure - Coord State = EQ Submitted

Software Integration in Operational Systems



TOS Departure - Eligibility State - Candidate														
Flight ID	Rwy	Dest	Route of Flight	Dep Gate	EOBT ▲	ETOT	Top ETOT	Top Total Delay Savings OFF	Flight Status	TMI Info	Coord State	Top CDR	Top Dep Gate	Eligibility State
ENY3898	36R	ABI	KDFW.NELYN6.SAT..KABI/0040	SOUTH	10/21:17	10/23:30	22:58	-31	Taxing_AMA	20M	Not Submitted	DFWABI1N	NORTH	Candidate
AAL2460	36R	LAX	KDFW.NELYN6.HOARY..JCT.J86.ELP.J5...	SOUTH	10/21:27	10/22:53	22:42	-11	In_Queue	20M	FO Submitted	DFWLAX1N	NORTH	Candidate
AAL1885	36R	PHX	KDFW.NELYN6.HOARY..JCT.J86.ELP..D...	SOUTH	10/22:22	10/23:11	22:58	-13	In_Queue	20M	Not Submitted	DFWPHX1N	NORTH	Candidate
ASH5738	E36R	OKC	KDFW.NELYN6.ACT..ACT240032..AGJ...	SOUTH	10/22:35	10/23:57	22:47	-70	Pushback	20M	Not Submitted	DFWOKC1E	EAST	Candidate
AAL1904	E36R	SAN	KDFW.KATZ22.BRHMA.RECKN..ABQ..Z...	SOUTH	10/22:51	11/00:39	23:38	-60	Scheduled_Out	20M FixClsd	Not Submitted	DFWSAN1N	NORTH	Candidate
AAL779	E35L	DTW	KDFW.AKUNA7.MLC..RZC..FAM..VHP.....	NORTH	10/22:56	10/23:38	23:20	-18	Scheduled_Out	15M FixClsd	Not Submitted	DFWDTW0P	EAST	Candidate
AAL2779	E36R	SNA	KDFW.KATZ22.BRHMA.RECKN..ABQ.J6...	SOUTH	10/23:11	11/00:48	23:42	-66	Scheduled_Out	20M FixClsd	Not Submitted	DFWSNA1N	NORTH	Candidate
AAL2471	E36R	ONT	KDFW.KATZ22.BRHMA.CNX..DRYHT.....	SOUTH	10/23:20	11/00:51	23:42	-69	Scheduled_Out	20M FixClsd	Not Submitted	DFWONT1N	NORTH	Candidate
ASH5795	E36R	PHX	KDFW.WSTEX2.CIKAN..EWM..DRRVR.PI...	SOUTH	10/23:25	11/00:54	00:05	-49	Scheduled_Out	20M FixClsd	Not Submitted	DFWPHX1N	NORTH	Candidate
AAL347	E35L	TPA	KDFW.DART28.BILEE.JB7.IAH.J86.LEV....	SOUTH	10/23:47	11/00:05	00:00	-4	Scheduled_Out	10M FixClsd	Not Submitted	DFWTPA0P	EAST	Candidate

TOS Departure - Coord State - FO Submitted																		
Flight ID	Rwy	Dest	Route of Flight	Dep Gate	EOBT	ETOT ▼	Flight Status	TMI Info	Scratch Pad	Eligibility State	Coord State	Num TOS Cand	Num TOS Sub	Top CDR	Top Dep Gate	Top RTC	Top Total Delay Savings OFF	Top Rwy
AAL2460	36R	LAX	KDFW.NELYN6.HOARY..JCT.J86.ELP.J5...	SOUTH	10/21:27	10/22:53	In_Queue	20M		Candidate	FO Submitted	1	1	DFWLAX1N	NORTH	+5	-11	36R

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	Scratch Pad	Eligibility State	Coord State	Num TOS Cand	Num TOS Sub	Top CDR	Top Dep Gate	Top RTC	Top Total Delay Savings OFF	Top Rwy

Metronlex Planner - D10 Demand Graph

Software Integration in Operational Systems

Flight Operator - SWA TOS Operations at 23:33 Z

Search Clear

TOS Departure - Eligibility State = Candidate

Flight ID	Rwy	Dest	Route of Flight	Dep Gate	EOBT ▲	ETOT	Top ETOT	Top Total Delay Savings OFF	Flight Status	TMI Info	Top CDR	Top Dep Gate	Eligibility State	Coord State
SWA400	E31R	MDW	KDAL EMMTT 4.BSKAT..LIT.J101.IGLOO...	EAST	10/23:35	11/00:01	23:48	-13	Taxiing_AMA	15M FixClsd	DALMDWOP	NORTH	Candidate	Not Submitted
SWA971	E31R	MSY	KDAL EMMTT 4.ZALEA.SWB.LSU.AWDA...	EAST	10/23:39	11/00:08	23:47	-21	Scheduled_Out	15M	DALMSY15	SOUTH	Candidate	Not Submitted
SWA1261	E31R	BNA	KDAL EMMTT 4.LOOSE..MEM.CHSNE2.K...	EAST	10/23:50	11/00:39	23:59	-40	Scheduled_Out	15M FixClsd	DALBNA1N	NORTH	Candidate	Not Submitted
SWA1385	E31L	LGA	KDAL EMMTT 4.LOOSE..MEM.J42.GVE....	EAST	11/00:41	11/01:49	00:50	-59	Scheduled_Out	15M FixClsd	DALLGAJ3	NORTH	Candidate	Not Submitted
SWA1161	E31R	MDW	KDAL EMMTT 4.BSKAT..LIT.J101.SPI.P...	EAST	11/00:46	11/01:56	00:53	-62	Scheduled_Out	15M FixClsd	DALMDWOP	NORTH	Candidate	Not Submitted
SWA44	E31L	MSY	KDAL RAMBL5.BILEE.J87.IAH..LCH.AW...	SOUTH	11/00:50	11/01:05	01:01	-4	Scheduled_Out	10M	DALMSYOP	EAST	Candidate	Not Submitted

TOS Departure - Coord State = FO Submitted



Sample use of PDRR: Selecting a single flight to reroute using the RAD

The screenshot displays the Traffic Situation Display (Dynamic Projection) Departure Viewer (Relative Time Range) interface. The interface is divided into several sections:

- Top Panel:** Includes file functions, filters (Group by, Color by, Filter By, Show), and a 'Hold Updates' button. The current time is 2107.
- Left Panel:** Shows flight filters (Include: Jet, Turbo, Prop, Super, Heavy, Large, Small) and a table for flight 'BIGGY (16)'. The table has columns for ACID, PTIME, ETD, ORIG, DEST, and ETA FIX.
- Center Panel:** The 'Route Amendment' window is open for flight AAL310T. It shows:
 - Retrieve Routes:** Search DB, Route Code, Add Route, Remove Flights, and Get CDR buttons.
 - Show Merge ID:** AAL310T (checked) and MANUAL (selected).
 - Current Routes:** LGA, .BIGGY, J75, NKE, CLIPR1, KDCX.
 - Retrieved Routes:** A list of alternative routes.
 - Assigned Routes:** A list of assigned routes.
 - Create Route Amendment:** Merge, Use Last Sent, Optimize Route(s) buttons.
 - Options:** ALL (checked), P-Time (2000), Sector (TRZDV), TMI ID, and RRRSTAT.
- Right Panel:** Shows a table for flight 'GAYEL (7)' with columns for ETD, ORIG, DEST, ETA FIX, ACID, and PTIME.

A flight from LGA to DCA has been selected for a reroute using the Departure Viewer, opening up the RAD as a pop-up and displaying the current route for that flight.

The available TOS route options can be displayed by clicking on the RTE Options button.

16	33	7	24	5	5	2	2	0	1	3	3	1	0	0	0
2100	2115	2130	2145	2200	2215	2230	2245	2300	2315	2330	2345	0000	0015	0030	0045

Retrieve Routes

Recently Sent... Route Code:

Show

Flight/Route Color

Show Protected Segments

Show Merge ID

Current Routes

<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	AAL310T	KLGA..BIGGY.J75.MXE.CLIPR1.KDCA	---	<input type="button" value="Rte Opts..."/>
-------------------------------------	-------------------------------------	---------	---------------------------------	-----	--

Retrieved Routes

<input checked="" type="checkbox"/>	<input type="radio"/>	MANUAL	<input type="text"/>	<input type="button" value="Location"/>	<input type="button" value="Up"/>	<input type="button" value="Down"/>
-------------------------------------	-----------------------	--------	----------------------	---	-----------------------------------	-------------------------------------

Assigned Routes

	<input type="button" value="Up"/>	<input type="button" value="Down"/>
--	-----------------------------------	-------------------------------------

Create Route Amendment:

<input checked="" type="checkbox"/>	<input type="checkbox"/>	ALL	P-Time	Sector	TMI ID	RRSTAT
<input checked="" type="checkbox"/>	<input type="checkbox"/>	AAL310T	2000	<input type="button" value="Location"/>	TRZDV	<input type="button" value="Up"/>

Amendments will be sent for 0 flights

Zoomed in view of RAD for making route amendment.
To see the route options, the button to the right for that flight can be clicked.

fppt.com

Sample use of PDRR: Viewing the available TOS route options

Traffic Situation Display (Dynamic Projection)
Departure Viewer (Relative Time Range)

File Functions View
Enter Fix(es): [Add] [Options...]
Group by: [] Color by: []
Filter by: [ALL] Show: [List] [Time Bins]
Include: [x] Jet [x] Turbo [x] Prop [x] Super [x] Heavy [x] Large [x] Small [] Active Flights [x] Unknown DFIX (0)

Route Amendment
Retrieve Routes: [Recently Sent...] [Search DB...] [Route Code:] [Get CDR] [Add Route] [Remove Flights...]
Show: [x] Flight/Route Color [x] Show Protected Segments [Rte Opt...]

AAL310T Route Options
Reroute
No TMI Route Options are available.
TOS Options:
[x] KLGA., KLGA., BIGGY, J75, MXE, CLIPR1, KDCA
[x] KLGA., KLGA., JFK, V16, DIXIE, V1, LEEAH., CHOPS., BILIT., CAPKO., KDCA., KDCA
[x] KLGA., KLGA., WHITE, V1, ATR, V308, LAFLN, DEALE2, KDCA
[x] KLGA., KLGA., BIGGY, V3, MXE, CLIPR1, KDCA
[Add to Retrieved Routes] [Add to Amendment] [Cancel] [Help]

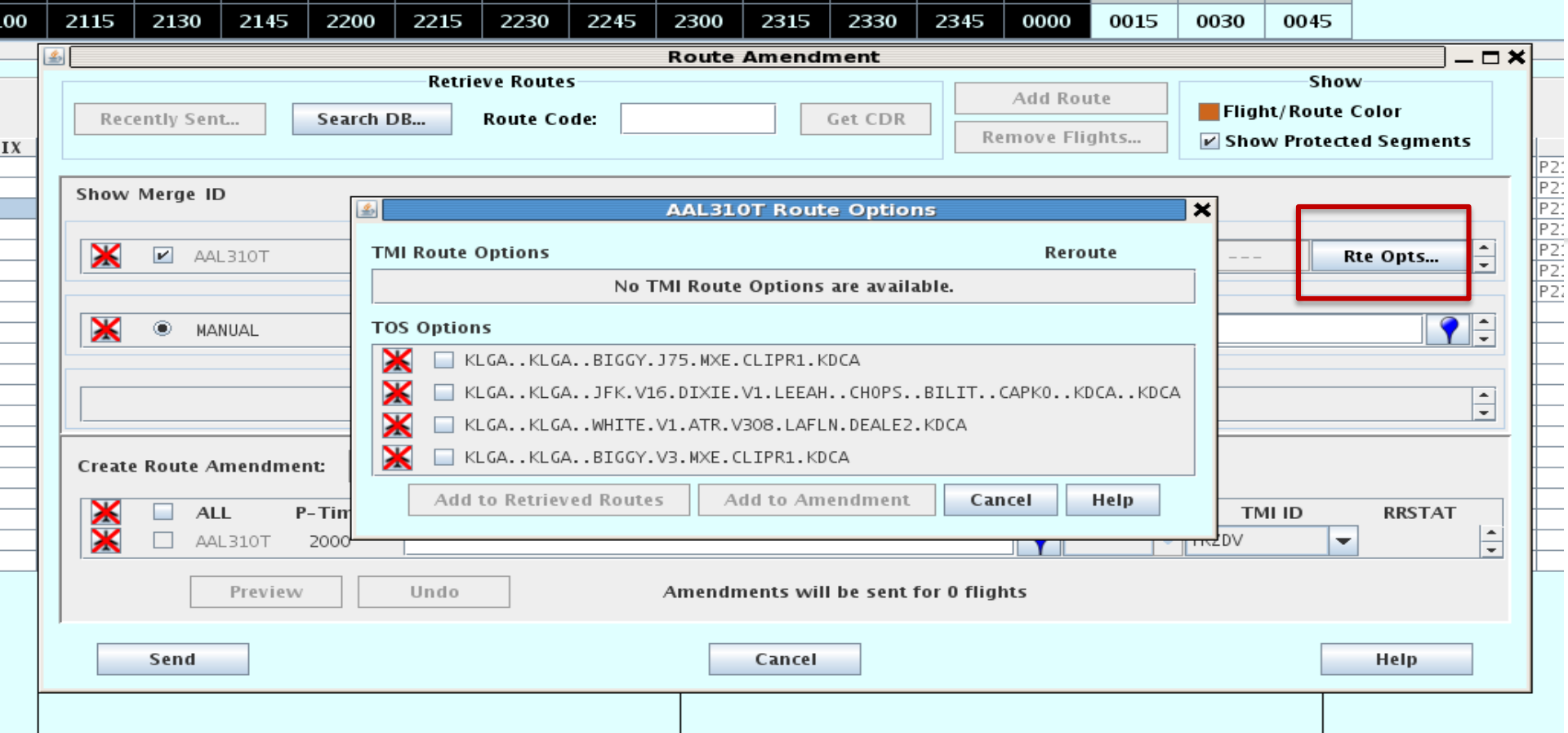
BIGGY (16)

ACID	PTIME	ETD	ORIG	DEST	ETA FIX
AAL214T	2000	P2105	LGA	DCA	2116
AAL809T	1930	P2105	LGA	DCA	2116
AAL310T	2000	P2105	LGA	DCA	2116
AAL810T	2030	P2105	LGA	DCA	2116
AAL311T	2100	P2110	LGA	DCA	2121
AAL811T	2130	P2140	LGA	DCA	2151
UAL142	2217	P2107	EWR	FLL	2122
UAL1065	2337	P2201	EWR	MHMX	2216
UAL118T	1930	P2105	EWR	NHUN	2113
UAL119T	2000	P2105	EWR	NHUN	2113
UAL120T	2030	P2105	EWR	NHUN	2113
UAL121T	2100	P2110	EWR	NHUN	2118
UAL122T	2130	P2140	EWR	NHUN	2148
UAL1082	0005	P2227	EWR	NROC	2242
JBU2067	2155	P2102	HPN	PBI	2117
JBU543	2325	P2208	EWR	PBT	2223

GAYEL (7)

ETD	ORIG	DEST	ETA FIX	ACID	PTIME
P2105	JFK	LAX	2116	EJA200	2039
P2105	JFK	LAX	2116	FLG590	2110
P2105	JFK	LAX	2116	JBU2534	2126
P2110	JFK	LAX	2121	EJA968	2130
P2140	JFK	LAX	2151	A504335	2130
P2105	TEB	SLK	2113	8ER7249	2130
P2200	JFK	ZBAA	2215	FIN6	2140
				DAL46	2026
				ETH1TC	2100
				ETN104	2130
				L077	2215
				CNS610	2130
				EJA602	2000
				ASQ3970	2109
				THC417	2100
				DP370	2145
				AW4044	2035
				LX3579	2030
				L0F4196	2111
				SKV7641	2130

One of the TOS options (or some other route option such as a required reroute) can be chosen by selecting it and clicking on the Add to Amendment button.



Zoomed in view of RAD for making Route Amendment showing TOS options available for selection

Sample use of PDRR: Preparing to use one of the TOS options as a reroute

Traffic Situation Display (Dynamic Projection)
Departure Viewer (Relative Time Range)

File Functions View

Enter Fix(es): Add

Group by: Color by: Filter by: Show: List Time Bins

ARPT: ALL ARPT Fix

FIX: ALL

Current Time: 2108
Last Update: 2108

Include: Jet Turbo Prop
 Super Heavy Large Small
 Active Flights Unknown DFIX (0)

16	33	7	24	5	5	2	2	0	1	3	3	1	0	0	0
2100	2115	2130	2145	2200	2215	2230	2245	2300	2315	2330	2345	0000	0015	0030	0045

BIGGY (16)

ACID	PTIME	ETD	ORIG	DEST	ETA	FIX
AAL214T	2000	P2105	LGA	DCA	2116	
AAL809T	1930	P2105	LGA	DCA	2116	
AAL310T	2000	P2105	LGA	DCA	2116	
AAL810T	2030	P2105	LGA	DCA	2116	
AAL311T	2100	P2110	LGA	DCA	2121	
AAL811T	2130	P2140	LGA	DCA	2151	
UAL142	2217	P2107	EWR	FLL	2122	
UAL1065	2337	P2201	EWR	MMX	2216	
UAL118T	1930	P2105	EWR	MMUN	2113	
UAL119T	2000	P2105	EWR	MMUN	2113	
UAL120T	2030	P2105	EWR	MMUN	2113	
UAL121T	2100	P2110	EWR	MMUN	2118	
UAL122T	2130	P2140	EWR	MMUN	2148	
UAL1082	0005	P2227	EWR	MROC	2242	
1BU2067	2155	P2107	HPN	PBI	2122	
1BU543	2325	P2208	EWR	PBI	2223	

Route Amendment

Retrieve Routes: Search DB... Route Code: Get CDR Show: Flight/Route Color Show Protected Segments

Show Merge ID

Current Routes

- AAL310T KLGA..BIGGY.175.WXE.CLIPR1.KDCA

Retrieved Routes

- NANUA

Assigned Routes

Create Route Amendment:

ALL P-Time Sector TMI ID RRSTAT

AAL310T 2000 KLGA..KLGA..JFK.V16.DIXIE.V1.LEEAH..CHOPS..BILIT..CAPK0..KDCA..KDCA

Amendment will be sent for 1 flight

GAYEL (7)

ETD	ORIG	DEST	ETA	FIX	ACID	PTIME
P2105	JFK	LAX	2116		EJA200	2039
P2105	JFK	LAX	2116		FLG3980	2110
P2105	JFK	LAX	2116		JBU334	2126
P2110	JFK	LAX	2121		EJA368	2130
P2140	JFK	LAX	2151		AS04395	2130
P2105	TEB	SLK	2113		BER7249	2130
P2200	JFK	ZBAA	2215		FIN6	2140
					DAL46	2026
					EIN1TC	2100
					EIN104	2130
					LOT7	2215
					CNS510	2130
					EJ4602	2000
					AS03970	2109
					THC417	2100
					DP170	2145
					AWI4044	2035
					LXJ579	2030
					L0F4196	2111
					SKV7641	2130

The selected TOS option is displayed as the intended amendment for this flight.

Image Credit



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