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?)



Departure Viewer (Relative Time Range)

File Functions View Help

Enter Fix(es): Add Options...

Group by: Fix ARPT Color by: ARPT Fix

Filter by: ARPT: ALL Fix: ALL

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Current Time: 2106
Last Update: 2105
Hold Updates

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
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BIGGY (16)

ACID	PTIME	ETD	ORIG	DEST	ETA FIX
AAL214T	2000	P2105	LGA	DCA	2116
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COATE (11)

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ELIOT (0)

ACID	PTIME	ETD	ORIG	DEST	ETA FIX

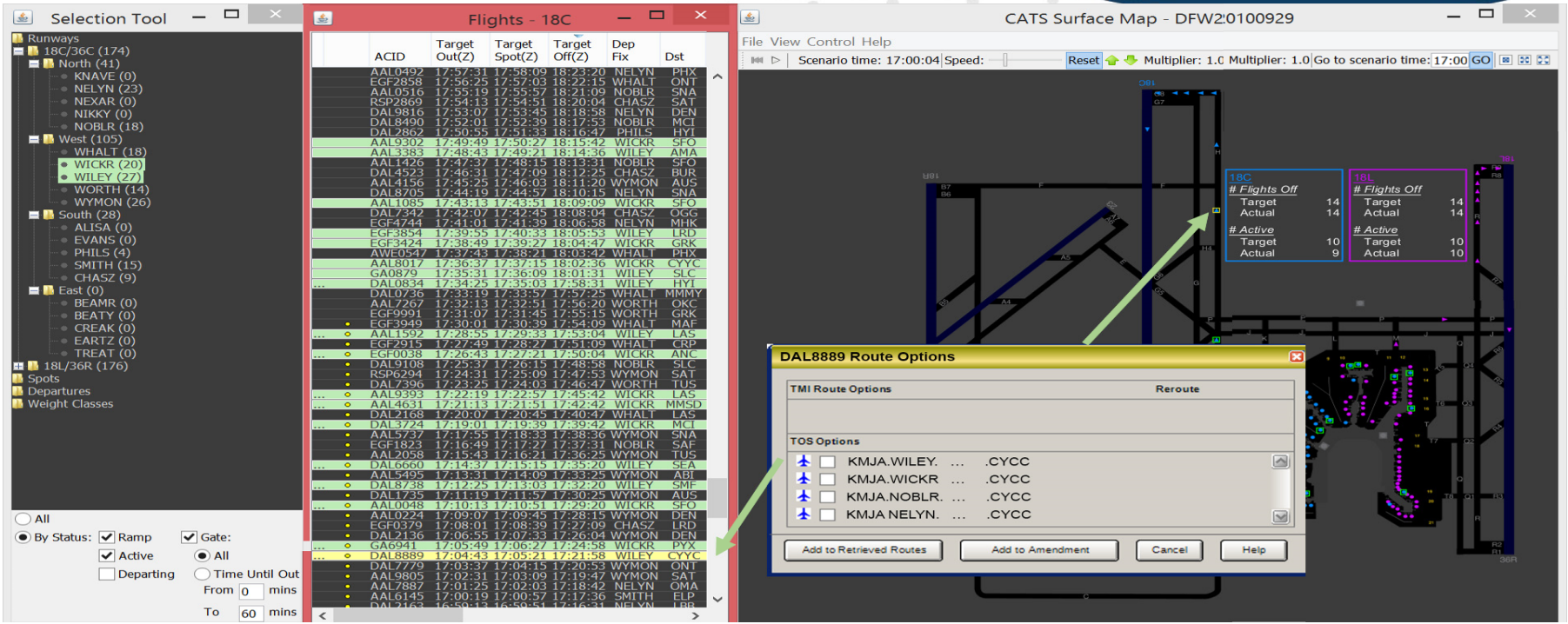
GAYEL (7)

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CCA982	2150	P2200	JFK	ZBAA	2215

ACID	PTIME
EJA200	2039
FLG3980	2110
JBU2534	2126
EJA368	2130
ASQ4335	2130
BER7249	2130
FIN6	2140
DAL46	2026
EIN1TC	2100
EIN104	2130
L0T7	2215
CNS610	2130
EJA602	2000
ASQ3970	2109
TWC417	2100
DPJ70	2145
AWI4044	2035
LXJ579	2030
L0F4196	2111
SKV7641	2130

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Implications from December FET/SCT meeting



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"



Departure Viewer (Relative Time Range)

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Filter by: ARPT: ALL Fix: ALL

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

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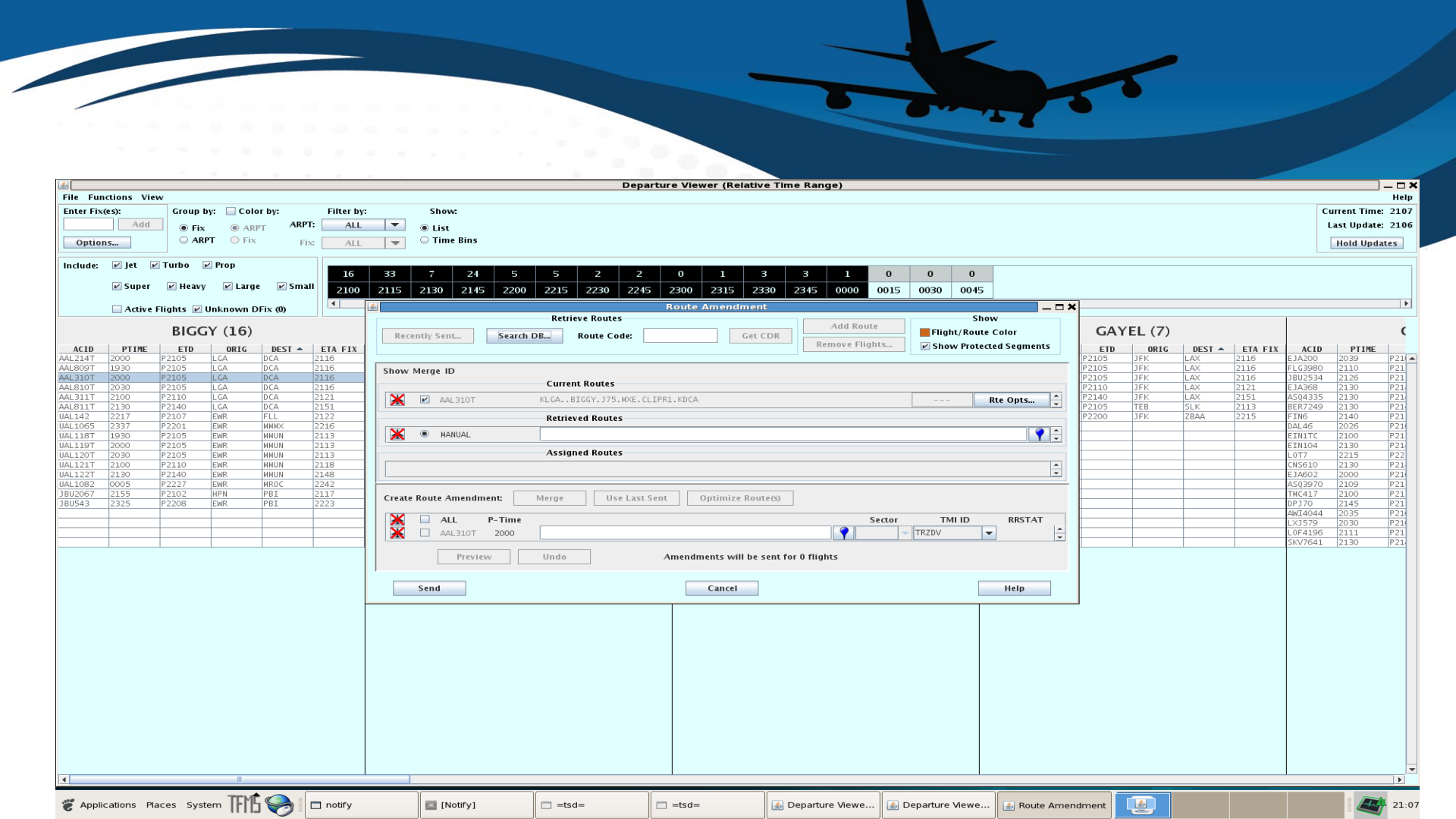
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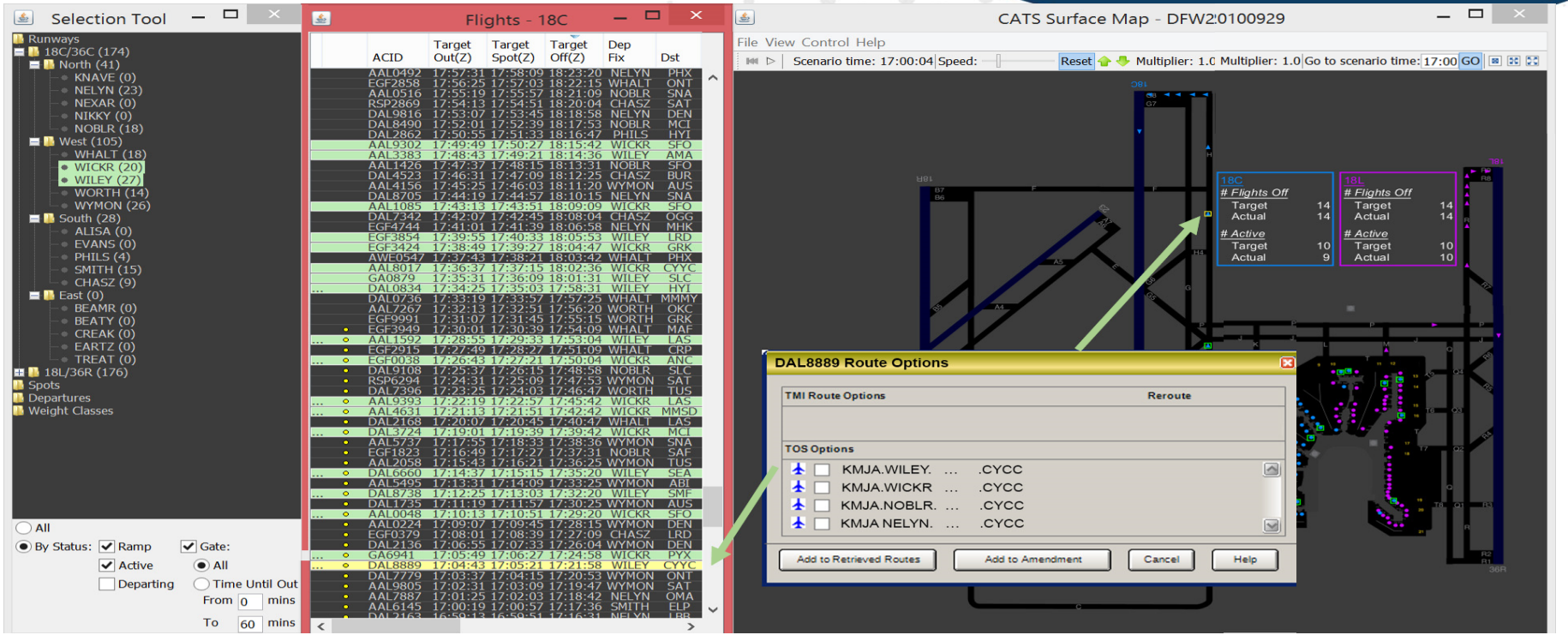
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Departure Viewer (Relative Time Range)
File Functions View
Help
Enter Fix(es):
Add
Options...
Group by:
Color by:
Fix
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Filter by:
ARPT: ALL
Fix: ALL
Show:
List
Time Bins
Current Time: 2107
Last Update: 2106
Hold Updates
Include:
Jet
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Route Amendment
Retrieve Routes
Recently Sent...
Search DB...
Route Code:
Get CDR
Add Route
Remove Flights...
Show
Flight/Route Color
Show Protected Segments
Show Merge ID
Current Routes
AAL310T KLGA..BIGGY.J75.MXE.CLIPR1.KDCA
Rte Opts...
Retrieved Routes
MANUAL
Assigned Routes
Create Route Amendment:
Merge
Use Last Sent
Optimize Route(s)
ALL P-Time Sector TMI ID RRSTAT
AAL310T 2000 TRZDV
Preview
Undo
Amendments will be sent for 0 flights
Send
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GAYEL (7)
ETD ORIG DEST ETA FIX
P2105 JFK LAX 2116
P2105 JFK LAX 2116
P2105 JFK LAX 2116
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SKV7641 2130
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Route Amendment
21:07

Support of Alternative Work Flows



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 EOBT: 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

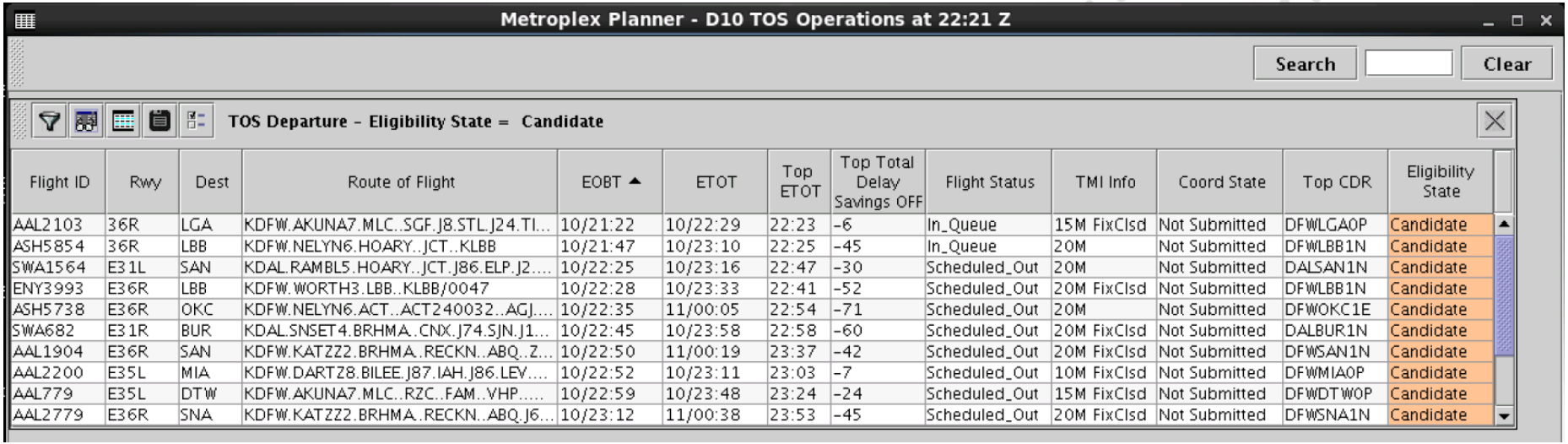
- Architecture and associated requirements (continued)
  - * Proposed variation of workflow for Example 2:
    - The traffic manager makes the route amendment
    - The reroute is automatically sent to ATCT and as an alert to the dispatcher
    - The dispatcher evaluates the reroute and determines that 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

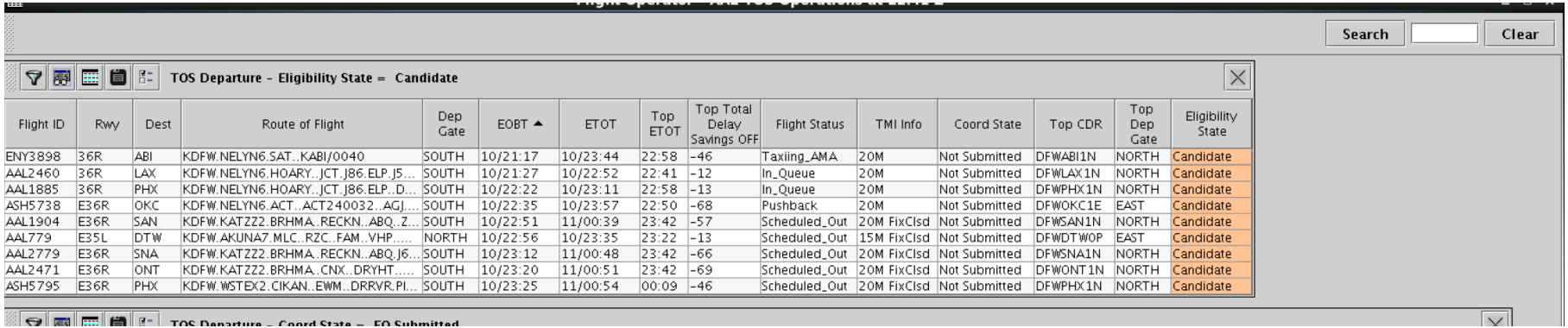
- Users
    - * ATC coordinator
    - * Dispatcher
    - * Traffic manager
- ATD-2 Phase 3 capabilities
    - * Supporting algorithms (also FO vs. FAA software)
    - * Information requirements
    - * Interface design concepts

Software Integration in Operational Systems



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	DFWLGA0P	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.KATZZ2.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	DFWMIA0P	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	DFWDTW0P	Candidate
AAL2779	E36R	SNA	KDFW.KATZZ2.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



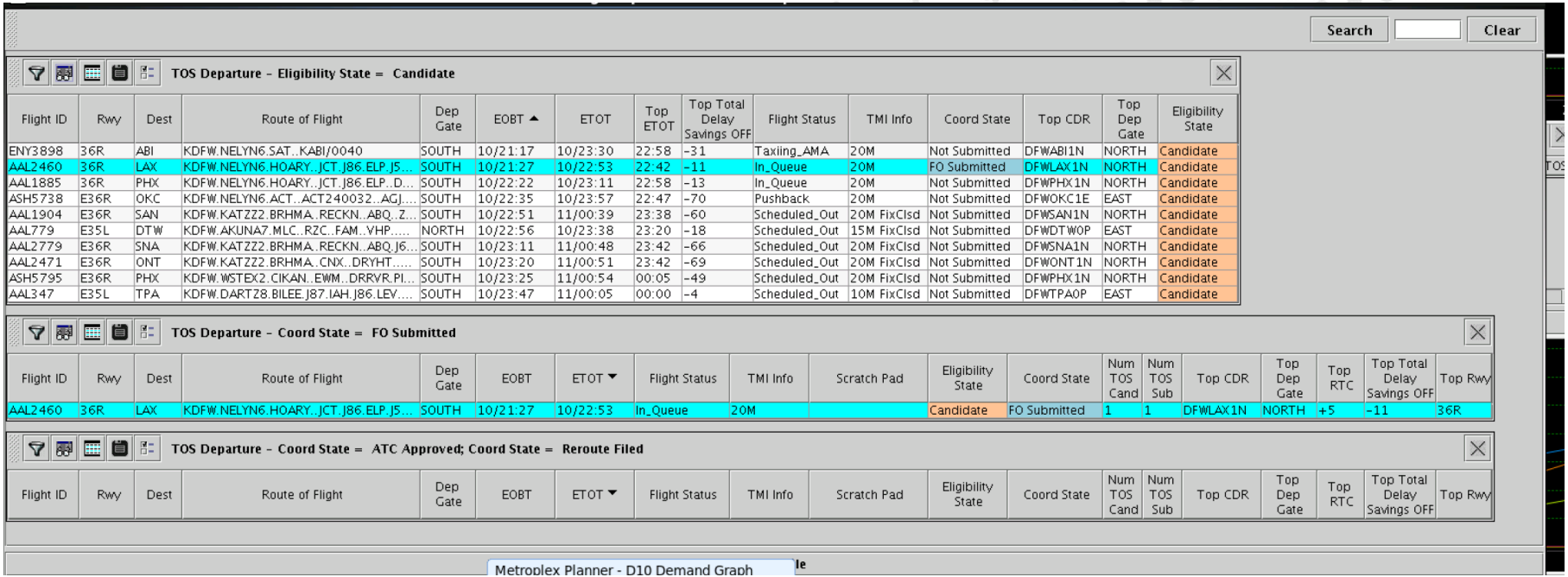
Search | Clear

TOS Departure - Eligibility State = Candidate

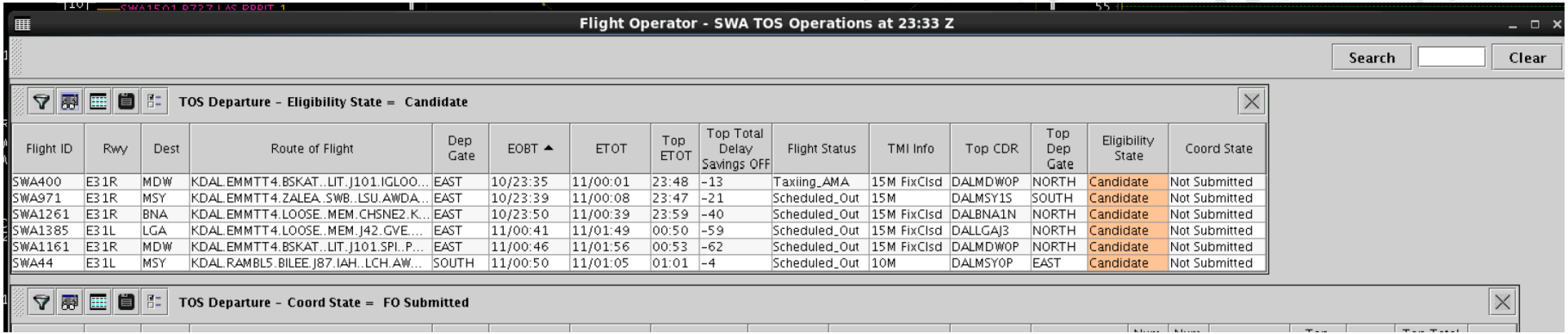
Flight ID	Rwy	Dest	Route of Flight	Dep Gate	EOBT ▲	ETOT	Top ETOT	Top Total Delay Savings OFF	Flight Status	TMI Info	Coord State	Top CDR	Top Dep Gate	Eligibility State
ENY3898	36R	ABI	KDFW.NELYN6.SAT..KABI/0040	SOUTH	10/21:17	10/23:44	22:58	-46	Taxiing_AMA	20M	Not Submitted	DFWABI1N	NORTH	Candidate
AAL2460	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.KATZZ2.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..RZC..FAM..VHP.....	NORTH	10/22:56	10/23:35	23:22	-13	Scheduled_Out	15M FixClsd	Not Submitted	DFWDTW0P	EAST	Candidate
AAL2779	E36R	SNA	KDFW.KATZZ2.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.KATZZ2.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	00:09	-46	Scheduled_Out	20M FixClsd	Not Submitted	DFWPHX1N	NORTH	Candidate

TOS Departure - Coord State = FO Submitted

Software Integration in Operational Systems



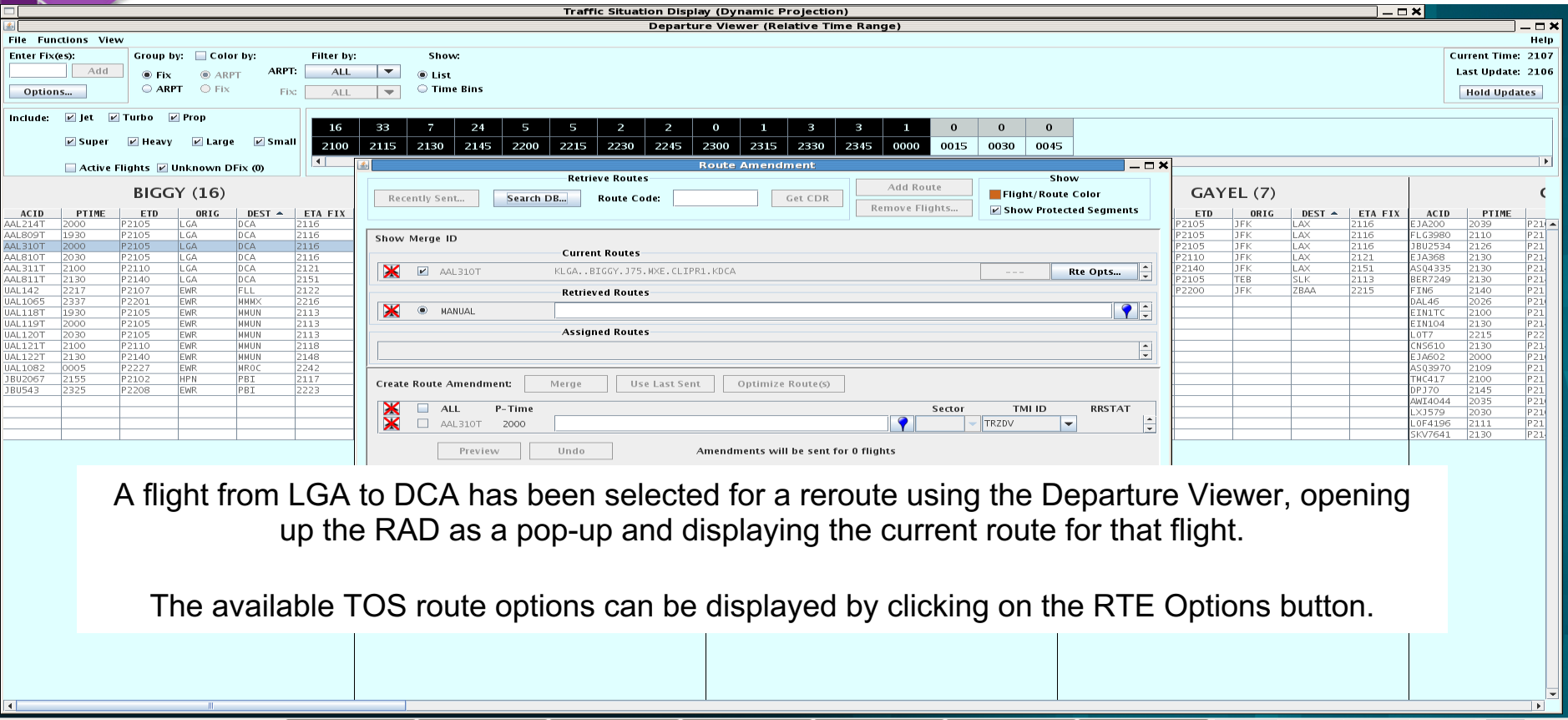
Software Integration in Operational Systems



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.EMMTT4.BSKAT..LIT.J101.IGLOO...	EAST	10/23:35	11/00:01	23:48	-13	Taxiing_AMA	15M FixClsd	DALMDW0P	NORTH	Candidate	Not Submitted
SWA971	E31R	MSY	KDAL.EMMTT4.ZALEA..SWB..LSU.AWDA...	EAST	10/23:39	11/00:08	23:47	-21	Scheduled_Out	15M	DALMSY1S	SOUTH	Candidate	Not Submitted
SWA1261	E31R	BNA	KDAL.EMMTT4.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.EMMTT4.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.EMMTT4.BSKAT..LIT.J101.SPI..P...	EAST	11/00:46	11/01:56	00:53	-62	Scheduled_Out	15M FixClsd	DALMDW0P	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	DALMSY0P	EAST	Candidate	Not Submitted

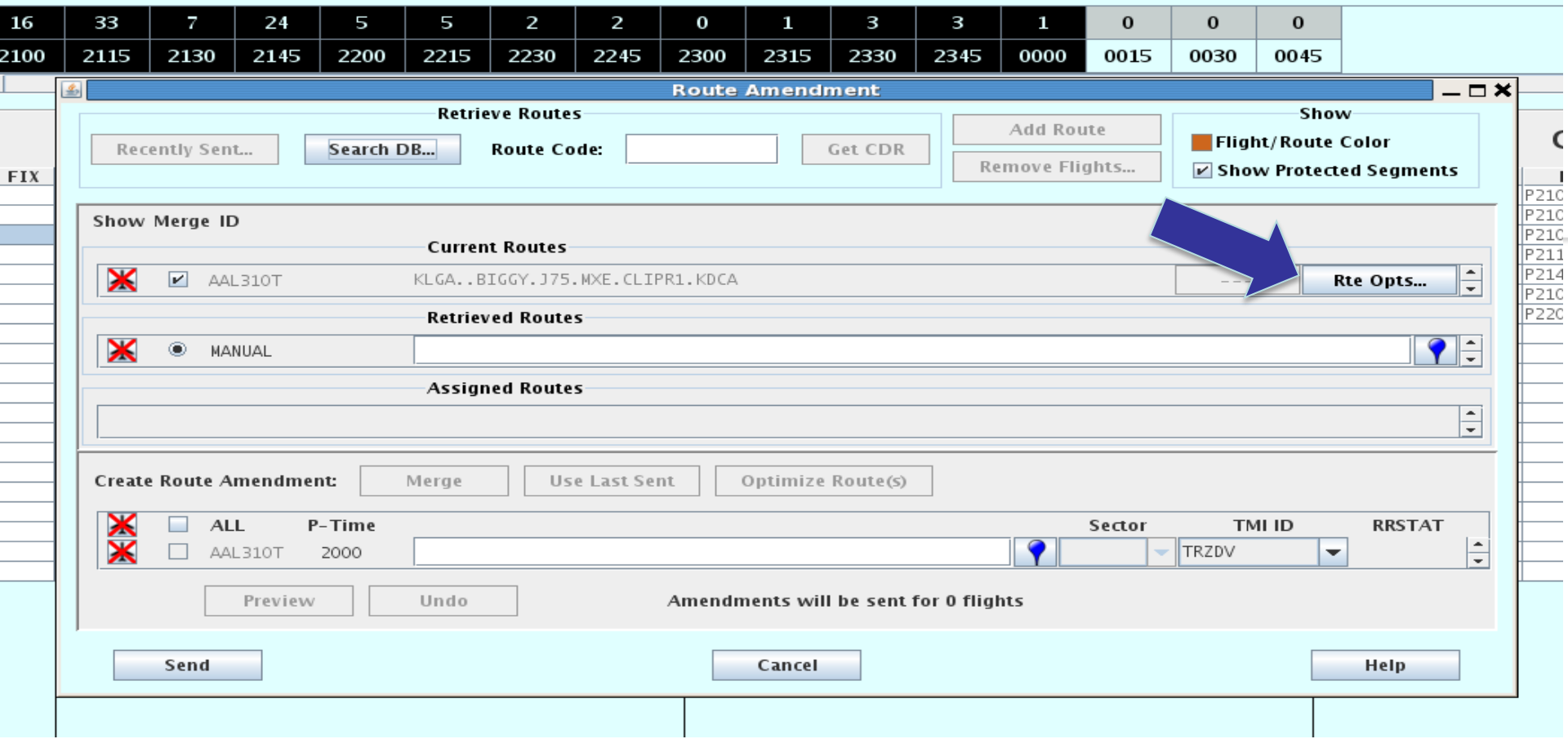
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Sample use of PDRR: Selecting a single flight to reroute using the RAD



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.

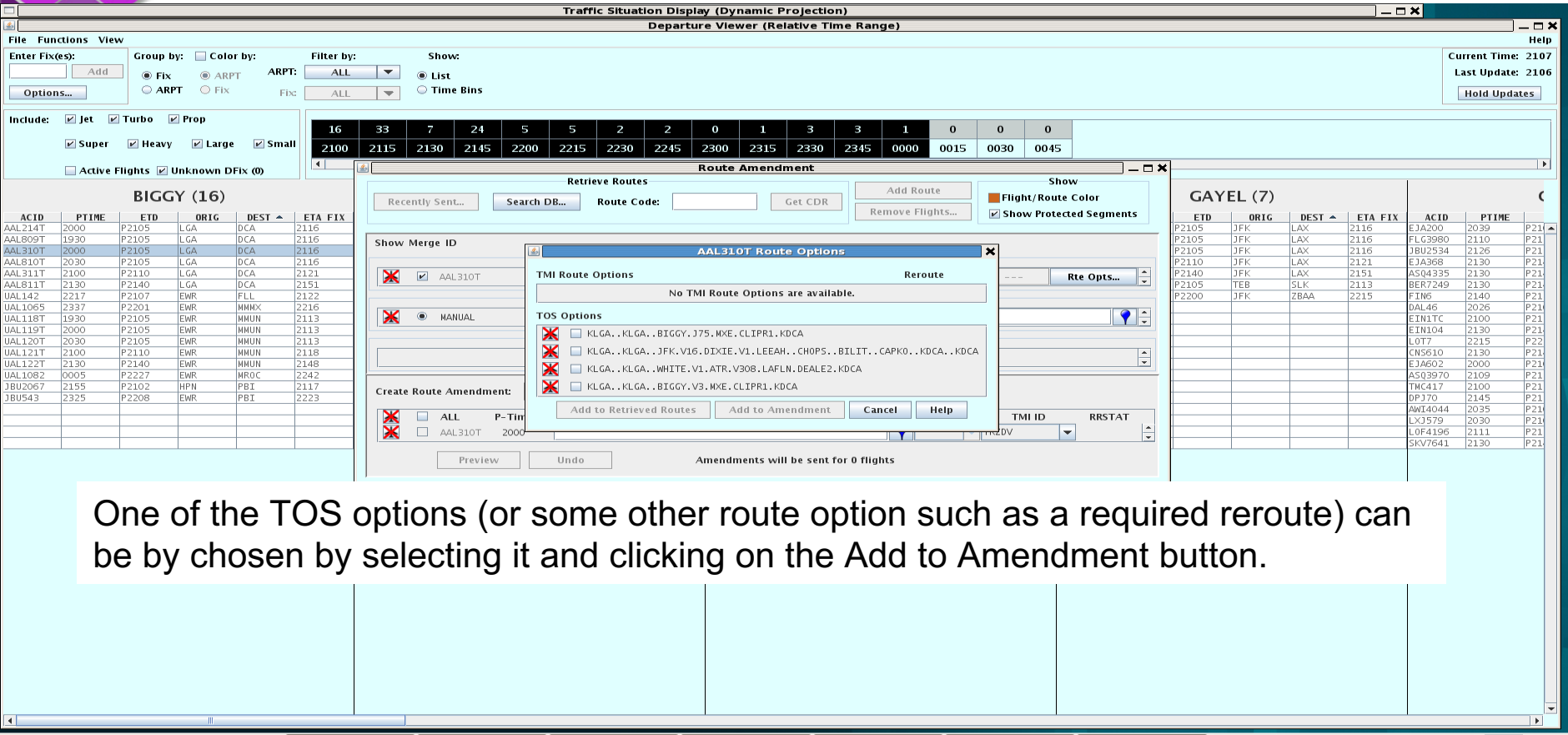
The available TOS route options can be displayed by clicking on the RTE Options button.



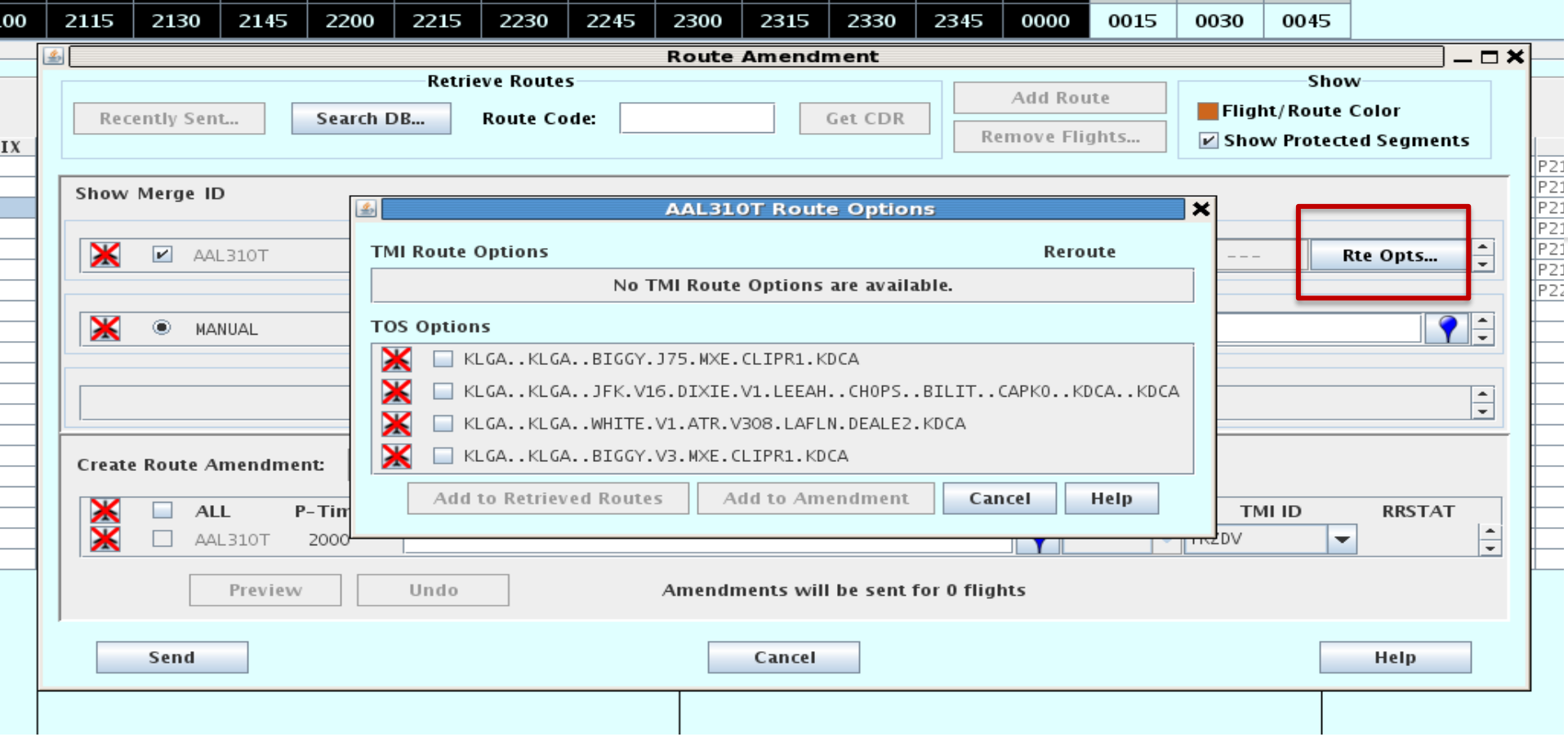
Zoomed in view of RAD for making route amendment.
To see the route options, the button to the right for that flight can be clicked.

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Sample use of PDRR: Viewing the available TOS route options



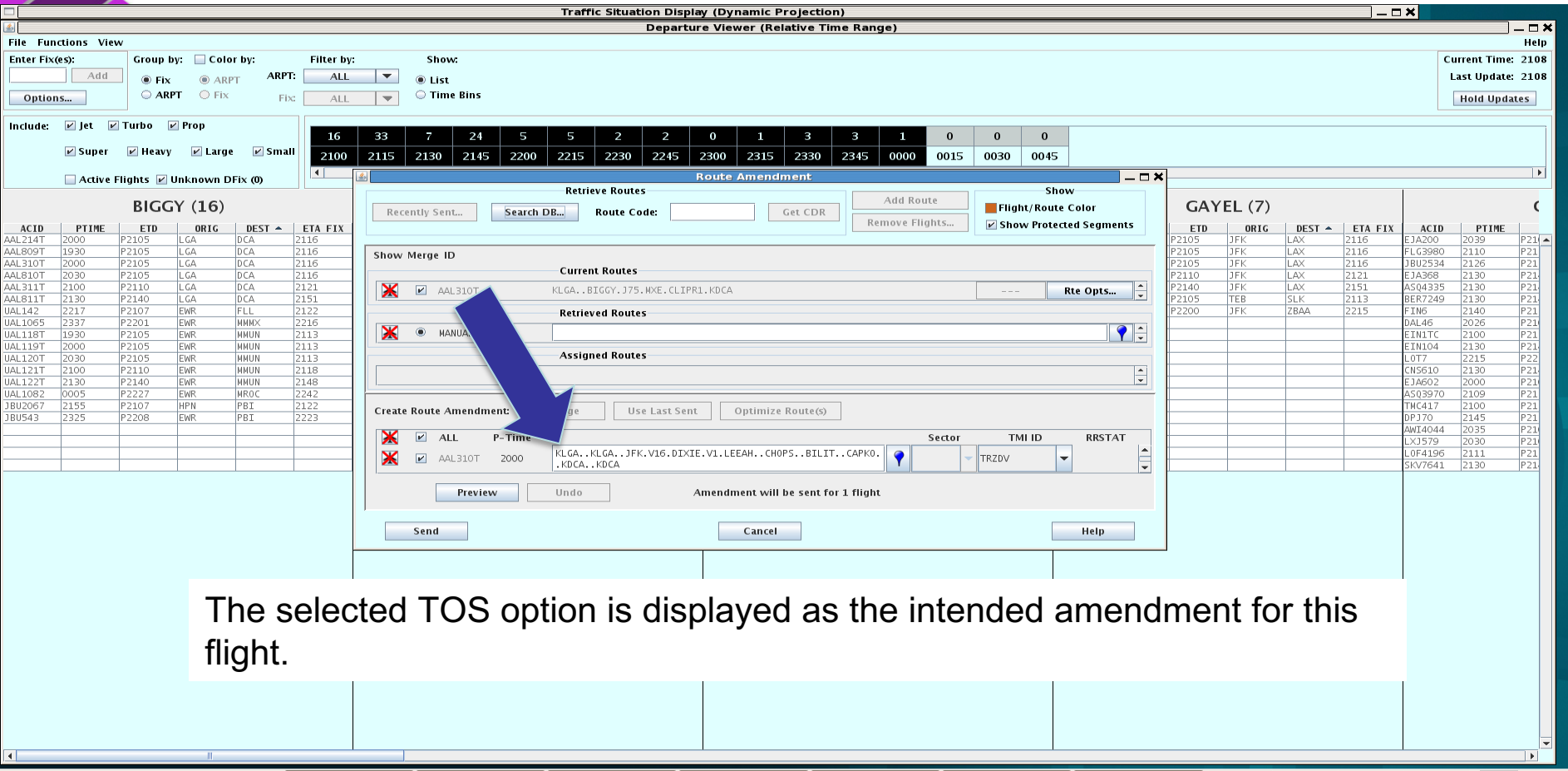
One of the TOS options (or some other route option such as a required reroute) can be by chosen by selecting it and clicking on the Add to Amendment button.



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

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



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

Image Credit



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