Federal Aviation Administration

Traffic Management Initiative Interaction

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Background

Traffic Management Initiatives (TMI) have evolved over several decades from being primarily tactical to becoming more proactive and strategic. The Collaborative Decision Making process of data exchange facilitates a shared approach between the FAA and Flight Operators in managing constraints within the National Airspace System (NAS). However, the automation developed to support this shared data is not a completely integrated process. The primary focus of TMI tool development has been to address near-term concerns that produce significant savings and improved efficiencies to Flight Operators through improved NAS management. This non-integrated TMI tool development at times produces undesirable results from TMI interactions. Particular automation decisions were intentional due to the complexity of programing out the interaction issues was not practical. With these decisions and later understanding of interactions realized, the impact is currently managed through procedures and training. Current and future automation development is focused on resolving the interaction issues into more integrated TMIs.

This document is designed to describe and detail the more common TMI interactions. It is developed from the "Traffic Management Initiative Interaction Reference" that was published in Sept 2012 and amended to include the new Collaborative Trajectory Options Program (CTOP) deployed on March 22, 2014.

There are many types of Traffic Management Initiatives. This document is focused on the automation and procedural application to manage the known interaction impacts.
Delay Programs – Ground Delay Program, Airspace Flow Program, Ground Stops, Time Based Flow Metering.

Route Programs – Create Reroute, ReRoute monitor,

Integrated Program – Collaborative Trajectory Options Program

The order of implementation of a TMI determines the type of interaction impact that may be encountered. There are several variations between CTOP, GDP, AFP, GS, TBFM, Reroutes application, and MIT which are described in the following examples.

Airspace Flow Program followed by Ground Delay Program
The automation prioritization makes the GDP a higher priority for control of the common flights between AFP and GDP. This will cause the control element to change from the AFP to the GDP, i.e. flight controlled by FCAA05 will be moved from the AFP to the GDP, i.e. airport program EWR. There are two methods to how the flights currently controlled by the AFP will be managed in the initial issuance of the GDP.

Not exempt the AFP flights in an initial GDP.
This option is the default setting in the FSM setup panel when issuing a GDP that has flight(s) controlled by an AFP. This approach will take the flights from the AFP and assign CTD/CTA (new EDCT) to the flight based on the available slots. This process is accomplished by FSM in how the flights are distributed in the queue (Q) order. The flights from the AFP will be allocated slots in the GDP prior to the flights not included in the AFP (i.e. Previously controlled). This order is; Q1 – Exemptions, Q2 – AFP flights, Q3 – Newly controlled flights.

The impact will be to the AFP. The flights previously controlled by the AFP are assigned slots to the airport GDP which changes the entry time into the AFP, this could be earlier or later than previous FCA entry time based on the GDP rate/delays. The delay distribution tends to be more equitable between the GDP flights. The flights that were not previously controlled by a delay program will tend to have a higher delay assignment due to the ordering of flights in the FSM slot assignment logic.

The AFP may need to be revised after the GDP(s) have been issued due to the change in FCA entry times. The observed impact being, increased delays to the remaining AFP controlled flights due to the number of slots taken through the AFP by the GDP controlled flights.

Exempting the AFP flights in an initial GDP
This option will put the priority on AFP slot allocations. Flights in the AFP will preserve their entry time to the FCA and will maintain their EDCT. This is done by placing the AFP controlled flights in Q1 – Exemptions during the slot allocation; and could cause an over delivery to the GDP. The flights not part of an AFP will be assigned the remaining slots. This could be less delay or greater delay than the AFP flights, depending on the GDP rate. The delay distributions may be skewed, i.e. avg delay for AFP exempted flights 30 minute, avg delay for newly controlled flights 90 minutes.

This option favors the AFP by maintaining the current entry time into the FCA.

Once the GDP is in place, there are no AFP exemption options for a flight if a GDP revision is issued. Any changes to the GDP will change the FCA entry time due to the GDP slot allocation. Any AFP revisions will not have an impact to the GDP CTAs.

Ground Delay Program followed by Airspace Flow Program
GDP controlled flights will always remain part of the program, an AFP that is issued after a GDP will not have influence on the current or future GDP assignment. Issuance of an AFP after the GDP exempts the GDP flights, FSM will work around the slots taken by the GDP flights in distributing the AFP ASLOTS.

The following are items to consider when applying this process:

- Delays could be lower/higher on the AFP depending on program rate(s) for the AFP and GDP(s).
- It is possible, depending on GDP rate and AFP rate, that the AFP program rate could be exceeded by the GDP controlled flights.
- GDP may need to be implemented earlier than normal, i.e. 4 to 6 hours prior to first controlled hour. This may cause challenges on GDP rate with forecast conditions.
- Airports with GDP, Flight Operators have an easier time maintaining connectivity between arrival/departure banks
    - Flight Operators can Sub based on airport program, not AFP(s).

The use of Integrated Program Modeling (IPM) should be considered when evaluating AFP or GDP to manage the constraint. IPM allows an evaluation between three different scenarios. If modeling the use of GDP and AFP in the same scenario, the GDP will be modeled prior to the AFP in the scenario.

If the GDP is a small percentage of the AFP flights, or the AFP controlled flights are a small percentage of the airport demand, then the interaction impact will be minimal. When the demand at the airport is significantly controlled by the AFP and there is concern for the airport to have constraint limitations, then the better practices would be implementing the GDP prior to the AFP. The program start time does not need to be the same between AFP and GDP(s).

Time Based Flow Metering (TBFM) and Delay Traffic Management Initiative (TMI)- (GDP, AFP, CTOP)
TBFM is a separate traffic management system from TFMS and there is no direct data communications from TBFM to TFMS. Delay times issued by TBFM for scheduled departures or airborne delay are only known to TBFM and ERAM. TFMS does not receive updates on a flight's ETE from TBFM. TFMS does supply the EDCT from a delay program to HOST/ERAM, which updates the estimated departure time used by TBFM for scheduling flights.

When a flight calls to taxi to an airport that is Adjacent Center Metering, the tower personnel request a departure time from the Center, the Center TMC schedules the flight in TBFM which generates the scheduled departure time. This is accomplished without regard to the TFMS Delay TMIs assigned EDCT that has been provided. When the TBFM scheduled departure time exceeds the EDCT time, this is referred to as a double penalty delay; one from TFMS Delay TMI, second from TMA.

TMA is a good tactical TMI to get the best efficiency at the runway threshold based on many factors, including spacing requirement between aircraft class (i.e. Heavy, Large, and Small). TFMS ground delay TMIs provide a longer range planning capability and are good strategic TMIs. The limitation of each TMI needs to be considered when developing the strategy to manage the constraint involved. The concept being, setup a good plan/flow with TFMS to feed the TBFM.

The interaction is one way, TFMS TMI into TBFM, and it is important that the two TMIs are coordinated to achieve the same objective.

Required Reroutes and Delay programs (GDP/AFP)
The Required Reroutes (RR) TMI is often applied in conjunction with delay programs to move flows around enroute constraints. The impact of the reroute is dependent on how it is implemented and what type of delay program it is interacting with. Required reroutes are issued by Departure (ETD), Arrival (ETA) or FCA entry time.

Airspace Flow Program:
When a RR is issued by **ETD or ETA**, all flight trajectories within the start and end time of the RR are adjusted to model the flight on the RR. Only flights with filed flight plans are left on their original route. Flight planned flights require manual action to re-clear the flight onto the RR. The impact on an AFP can be significant to the demand and Flight Operator subbing capabilities.

Example 1 – A flight that is modeled/filed to avoid the FCA would not have an EDCT (or ASLOT) for the AFP. If a RR is issued that put the flight into the FCA, the flight will now receive an EDCT and a Pop-up (DAS or UPD) delay assignment. This DAS assigned flights will be limited on how the flight can be subbed/swapped by the Flight Operator, this flight can only have delay reduced. The additional demand of Flight(s) being moved into the AFP could cause a revision.
Example 2 – A flight that is modeled/filed through the FCA would have and EDCT assigned and may be used by the FO in substitutions. If the RR is issued that pulls this flight out of the FCA,

they may receive a longer reroute and the FO will lose the ASLOT the flight was assigned. This flight is flagged as a Drop Out (DO) in the FCA. This will remove demand from the AFP, which could create a need to revise the AFP.

When a RR is issued by **FCA**, all flights with trajectories that intersect with the FCA are adjusted to model the flight on the RR. Only flights with filed flight plans are left on their original route. Flight planned flights require manual action to re-clear the flight onto the RR. This method will have less of an impact on an AFP as only the flight passing through the FCA would be assigned the RR. The benefit to the FO has a choice on filing to avoid the FCA for the AFP and the RR. They are not forced through the AFP and they can take action to manage the ASLOTs issued by the AFP before routing to avoid the AFP.

Ground Delay Program followed by a Required Reroute

The impact of a RR may not seem significant in a GDP, but depending on the added flying time, it can require a revisions to the GDP. The GDP issued ASLOTS/EDCT based on the ETE of the flight at the time of issuance, when a RR is issued that increases the ETE, the flights will not receive a new EDCT assignment from the RR issuance. The flights would then depart on their EDCT and arrive late. This will create an under delivery in some time periods and over delivery in others. Additionally this could create higher demand on the arrival gate; further delaying the flights due to additional TMI's to meet the airspace capacity at an arrival fix.

After issuance of a RR, the demand shift will become apparent; the only solution is a program revision to reflect the new ETEs of the RR flights.

Mile-In-Trail (MIT) during a Ground Delay Program

A GDP is designed to deliver a programed number of flights to an airport. The GDP does not meter multiple points of delivery and will not know if all the flights are over a single arrival fix. This automation design causes the need for facilities to apply MIT to the stream of flights through the airspace to maintain an efficient stream to the arrival fix. There are impacts to the GDP caused by the application of MIT:

- Airborne delays cause flights to miss their assigned arrival slot time. This will cause an under delivery in some time periods, pushing the demand back into flights that may not have airborne delay from MIT. This will create an over delivery period in the GDP that may require a Ground Stop or airborne holding to manage.
- Flights in the 1st tier center or overlying center may receive added ground delay through a call for release to meet overhead stream volume and MIT spacing requirements. The additional delay will push the flights later in the program and cause an under delivery in one time period and an over delivery in a following time period. This may also cause a flight to taxi back if the extra call for release delay is lengthy.

Ground Stop into Ground Delay Program

There are two options in the Ground Delay Program Setup panel for transitioning from a Ground Stop (GS) into a Ground Delay Program (GDP). Depending on the scope of the GS and timing of the GDP issuance with the end time of the GS, the impacts on the GS flights and the GDP can be different. This assumes the GS has been put into the automation through FSM and is reflected in the FSM.

- **By Time +(XX minutes):** Airborne and international flights are exempt by default. The number of minutes becomes important. This application may be used when the number of GS flights is

low, i.e. single center GS. ***Note: this is XX minutes from the ADL time being used to develop the GDP not the current clock time on the TSD***

- If using the default 45 minutes, and you are less than 45 minutes from the end time of the GS, then this will make all the GS flight be exempt by departure time. This could cause the GDP to over deliver in the first couple hours.
- If the GS flights are more than 45 minutes (or the time value put into the dialog box) the flights will not be exempt and will be ordered in Q2 ahead of the flights that were not part of the GS. (*This assumes a new program and not a revision to the GDP.*) The GS will receive additional delay based on the Program rate of the GDP.

- **By Status:** Only flights that are active or international are exempt in the GDP. *(Recommended method for transitioning from a Ground Stop into a GDP when there is a significant number of flights in the GS, ie. 1st tier GS, as it provides proper ordering of the Ground Stopped flights in the slot allocation)*
  - All Flights will be eligible receive additional delay assignment, the GS flights will be ordered in Q2 with the non GS flights in a GDP revision. If this is a GS into a new GDP, then the GS will be ordered in Q2 and all other flights in Q3.
  - If the flights are at the gate, they may not be able to meet a new EDCT, this method assumes the GS flights are ready to depart and are being held close to the runway.

Diversion recovery in a GDP

Recovery of diverted flights into an existing GDP requires action by the flight operator and the specialist managing the GDP. A recovery flight retains the assigned ASLOT (CTA) until the GDP is revised. This will ensure proper priority is provided to the recovery flight in ASLOT assignment in Q2.

1. The first step is the change in destination from the original flight plan destination, this sets the divert flag in TFMS.
2. To complete the process, the flight operator needs to file a new flight plan from the airport diverted to back to the original destination with the same callsign. This will automatically set the flight as a priority flight in the FSM; match the flight to its CTA and IGTA at the time of diversion.
3. The last part is for the TMS managing the GDP to run a revision; this will allocate slots for the diversion flights giving them the highest priority in Q2.

- If flight operators do not update the ERTD or ERTA, the flight could be assigned and EDCT they cannot achieve. Flight Operators should consider turnaround time and appropriately set the ERTD to assure they receive achievable EDCT/ASLOT times.
- Until the revision is accomplished, the diversion airport does not have an EDCT to apply. Towers may have questions as to release times for the diverted flights.

CTOP interaction and other Traffic Management Initiatives (TMI)

The issues of TMI interaction between Delay programs (GDP, AFP) and CTOP continues to be an item that must be understood by traffic managers. The interaction between CTOPs has been managed by the Rank of a CTOP. This section will look at the interaction between CTOP and other TMIs, not at the rank management within CTOP.

CTOP program in place, GDP program implemented.

- Control shifts from CTOP to GDP. (same as AFP to GDP)

- New EDCT is defined by the GDP using the current assigned route ETE.
    - Flight is previously controlled by CTOP which will place the flight in Q2 of GDP.(Same behavior as an AFP followed by a GDP)
- Flight will retain their current CTOP assigned route until the next CTOP revision
    - Flights will be assigned Least Cost Option route by CTOP for those controlled by the GDP.
    - Flights without a TOS will remain on their Flight Planned route. This remains the assigned route in TFMS for conformance monitoring.

    Note: *If a flight operator does not desire a route change from the current assigned route when a GDP is issued, the TOS should be updated to a single line TOS with the current assigned route.*
    Note: *GS behave similar to GDP in the area of route assignment by CTOP*

GDP program in place, CTOP implemented.

- GDP controlled flights will be assigned Least Cost TOS option by CTOP program
- GDP flights will be exempt in CTOP; they will use available airport capacity and could exceed CTOP capacity.
- Flight Operators are **required** to file CTOP assigned route.
  Note: *GS behave similar to GDP in the area or route assignment by CTOP*
- Flights without a TOS will have their flight plan route as the required route for conformance monitoring.

CTOP and Required Route by DCC Advisory.

When mixing the application of CTOP and Required Routes, the interaction and impacts can be significant. The preferred method would be to publish the ReRoutes based on FCA, this would allow flights options for other routes. There are a couple interactions that traffic managers need to be aware of:

- A CTOP will only award from the current TOS.
    - If the Flight Operator does not include the required route as part of the TOS, the flight could receive an award/assignment that is non-conformant to the required route.
- Route Monitor will show both the CTOP and Required Route, measuring conformance against both.
    - The flight could be conformant to the CTOP assigned route, but be Non-Conformant to the Required ReRoute, or reversed.
- ATCSCC Traffic Manager Override of the CTOP assigned route and apply the Required Route.
    - This will make the flight ineligible for other TOS options in a CTOP revision. This exempts the flight from route consideration and is only available for delay adjustment in the CTOP Revision
    - ATCSCC Traffic Manager must uncheck the override during a CTOP manual revision to have the current TOS considered.

Conclusion

The choice of TMI(s) type and the order of issuance is part of managing the NAS. Each TMI has various implications depending on the order of implementation, available capacity, accuracy of the flight data, and forecasted impact to the NAS. Identification of the most constrained (or forecasted most constrained) NAS element is important to selecting and understanding how the TMIs will interact

together. While there is a lot of information to consider that influence a decision on TMI selection, the facts should be used to drive the decision, and not how it ran yesterday.

Supplemental Information
Other considerations of TMI application. A couple of the GDP/GS applications are highlighted.

Early Ground Delay program on forecast

- Predictability for customers to plan flight operations
- Missed capacity with bad forecast, difficult to generate tactical demand for available capacity
- TFMS sector demand predications reflect effects of EDCT

Low rate/Zero Rate Ground Delay Program

- Flights may encounter air borne holding or diversion
- Reactive revision of the program will increase program delays significantly
- Zero Rate may be too impactful pushing demand too far into the future
- Proactive issuance may cause loss of capacity if the forecast is inaccurate
- Proactive issuance allows flight operators EDCT to plan operation

Multiple Ground Stops (rolling GS)

- Customers do not know when they are going to depart
- Pushes demand causing greater need for GDP to recover demand
- NAS demand predictions are inaccurate
- Departure delays possible when recovering from backed up departure demand

The following section provides information on TFMS Historical Route processing through a CTOP, TOS submission after CTOP Implementation.
This information is provided for an understanding of how the CTOP automation works with known and updated Flight information.

No TOS, Multiple FCAs in CTOP, Flight Plan is filed after the CTOP is issued
Example 1:

- CTOP has Three FCAs, Historical Route of flight is through FCA001, and Flight receives an EDCT to meet the slot time at FCA001.
- Flight operator supplies a Flight plan that matches the historical route through FCA001, Flight will keep its assigned EDCT

Example 2:

- CTOP has Three FCAs, Historical Route of flight is through FCA001, and Flight receives an EDCT to meet the slot time at FCA001.
- Flight Operator supplies a Flight Plan that goes through FCA002, Flight will receive a new EDCT based on available capacity through FCA002

This flight is not considered a **Popup** flight because the historical route was used to create an EDCT for the flight; therefore the flight is not subject to the **Max Delay limit** set in the program. If the program is at a low rate with large amount of demand, the flight could be pushed to a time past the end of the program.

Note: The Historical route used is viewable in the Route Monitor on the TSD

No TOS, Multiple FCAs in CTOP, TOS is provided after the CTOP is issued

Example 1 – Historical route causes flight to be included in the CTOP TMI:

- CTOP has Three FCAs, Historical Route of flight is through FCA001, and Flight receives an EDCT to meet the slot time at FCA001.
- Flight operator supplies a TOS that contains an option whose route matches the historical route through FCA001.
    - All TOS options will be evaluated against available capacity (which includes the slot the flight previously "owned" in FCA001).
    - The flight will not receive an assignment with an adjusted cost that is greater than the adjusted cost of the option through FCA001 using the previously assigned EDCT.
    - If no lower adjusted cost solution is available, the flight will keep its EDCT, route assignment through FCA001 and its FCA001 slot.

Example 2 – Historical route causes flight to be included in the CTOP TMI:

- CTOP has Three FCAs, Historical Route of flight is through FCA001, and Flight receives an EDCT to meet the slot time at FCA001.
- Flight operator supplies a TOS that **does not** contain an option with a route that matches the historical route through FCA001.
    - All TOS options will be evaluated against available capacity (which includes the slot it "owned" in FCA001).
    - The flight will receive an assignment (and EDCT, if needed) that has the lowest adjusted cost.
    - If the flight does not have an option that can use the previously assigned FCA001 slot (and associated EDCT) and there are no other slots are available due to high demand, the flight will be assigned to either an option that avoids the controlled time periods of all of the CTOP's FCAs or an option through one of the CTOP's FCAs and a delay so that the flight crosses the FCA after the end its controlled time period

Note: In the latter case, since the flight was already in the CTOP, it is not considered a pop-up; so, its delay is not limited to the pop-up maximum delay.

Example 3 – Historical route **does not** cause the flight to be included in the CTOP TMI:

- CTOP has Three FCAs, Historical Route of flight does not intersect the controlled time periods of any of the CTOP's FCA; the flight is not included in the CTOP TMI.
- Flight operator supplies a TOS that contains at least one option that does intersect the controlled time period of one of the CTOP's FCAs.
    - The flight is treated as a pop-up. All TOS options will be evaluated against available capacity.
    - The flight will be assigned to either its;
        - **lowest adjusted cost** option if the flight's delay using that option is less than the **maximum pop-up delay**

        - or to its **least cost option** with an EDCT that includes the maximum pop-up delay.
    - In the latter case, the pop-up does not receive a slot assignment; it cannot be subbed until it receives a slot assignment during the next revision of the program.

Note: If a flight becomes a "pop-up" too close to its departure time, its Initial Arrival Time (IAT) may be assessed a pop-up penalty. A flight's IAT is used to determine the flight's position in the order of selection for assignment during subsequent program revisions.

Submitting a replacement TOS after CTOP has been issued

When a TOS is replaced (updated) by the flight operator, the existing TOS is erased. The New TOS is evaluated against the current demand on the CTOP and the Adjusted Costs are calculated for each option. This will generate a new EDCT and Awarded/Assigned route.

To prevent getting a new EDCT and route award/assignment worse than what the flight currently has, the flight operator should include the currently awarded/assigned route as part of the replacement TOS. The CTOP automation will not awarded a route/EDCT worse than the current route since the flight already owns this slot through the FCA. If there is a better option for the flight, it would award the new route/EDCT.