



# Traffic Flow Management (TFM) in Fast-Time Simulation

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# Objective



*“Identify the current and future state of Traffic Flow Management in Fast-Time Simulation”*



# Focus



- Survey existing models and methods for Traffic Flow Management (TFM)
- Identify future TFM concepts that might be considered for Fast-Time Simulation
- Assess whether existing models can be extended to address these concepts.



# Topics



- Dynamic sectorization
- Multi-sector planner modeling.
- Introduction of an expanded TFM role (future concepts) such as the multi sector planner (how do we support this in modeling)
- Metrics (Limiting Factors) and alerting algorithms such as dynamic density or monitor alert (in the US) to support the traffic flow specialist
- Collaborative Decision Making (CDM) – are we interested in modeling the gaming/collaboration process?
- Cancellation and diversion of traffic – are these logic/decisions robustly represented in our current models?



# Surveys



Aspects covered by current models:

- |                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
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| <ul style="list-style-type: none"><li>•Ground Delay Program</li><li>•Ground Stops</li><li>•ReRoutes</li><li>•SWAP</li><li>•Coded Departure Routes</li><li>•Miles In Trail</li><li>•Slot allocation</li><li>•Departure planning information from CDM airport</li><li>•Workload/Trajectory predictability</li><li>•Strategic ATFCM (pre-defined ATFCM scenarios)</li></ul> | <ul style="list-style-type: none"><li>•CFMU contingency plan, preparation of exceptional events such as OG, transition phase, RVSM), pre-tactical ATFCM (ACC configuration assessment, optimization of regulation plan),</li><li>•Assessment of ACC capacity</li><li>•Calculate most effective way to increase ACC capacity in order to match a target average delay</li><li>•ACC configuration optimization</li><li>•Complexity &amp; Capacity assessment</li><li>•Identification and selection of flows</li><li>•Time based metering</li></ul> |
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# Surveys



Concept	Description
Collaborative Decision Making (Identify Stakeholders)	<ul style="list-style-type: none"><li>• Line of Flight</li><li>• Airline substitutions</li><li>• Flight cancellations</li><li>• Negotiation process between local TFM/Network Flow Manager/Planning Entity</li><li>• Models SWIM</li><li>• Models Air Traffic Controller behavior and exchange data with other ATM actors</li><li>• Manages movement of flight object to meet the needs of all of the ATM system stakeholders (e.g. AOC, FOC, Flight Deck, ATC, TM, etc).</li><li>• FOMS is described by the Target System Description and central to the support of advanced automation in the future ATM environment,</li><li>• Models TFM from ATCSCC, TMU, and AOC perspective. Three actors work collaboratively to resolve flow problems and capacities, models delegation of separation to the cockpit</li></ul>
Dynamic Sectorization	<ul style="list-style-type: none"><li>• ACC configuration optimizer according to user constraints (max number of ATC WP during a time period, known configurations, user preferences for sector opening, min durations of configuration, etc.)</li><li>• Static reconfigurations, can choose different sector configurations during the simulation run.</li><li>• Supports the dynamic sectorization by allowing the dynamic construction of new sectorization from existing elementary building blocks</li></ul>



# Surveys



Concept	Description
Multi-Sector Planning	<ul style="list-style-type: none"><li>• MSP as defined by gate to gate project</li><li>• MSP resolves conflicts ahead of time when the controller's workload is expected to be high.</li></ul>
Flight Cancellations	<ul style="list-style-type: none"><li>• Pseudo TFM simulation</li><li>• AOC negotiates with TFM to swap slots or cancel flights</li></ul>
Flight Diversion	<ul style="list-style-type: none"><li>• Applies any rerouting/FL capping, advancing, ground holding, etc., but during the strategic/pre-tactical ATFCM phases, i.e. not in real time.</li><li>• Used to avoid SUA or bad weather zones</li></ul>



# Surveys



Concept	Description
Alerting Algorithms (i.e. Dynamic Density, Monitor Alert)	<ul style="list-style-type: none"><li>• Sector Loading for Monitor Alert</li><li>• Tactical load monitor</li></ul>
Traffic Metering	<ul style="list-style-type: none"><li>• Traffic management and synchronization. Consists in spacing (MIT, min. in trail, and in merging flows).</li></ul>
Airspace Closure	<ul style="list-style-type: none"><li>• Airspace Flow Programs</li><li>• Implied in a avoid airspace/beacon</li><li>• Mitigate strategically, pre-tactically and tactically the traffic affected by an airspace closure (e.g. radar outage, center closure)</li></ul>



# Surveys



## Future Concepts for Fast-Time Modeling Consideration

- Dynamic Airspace
- 4D-management: Modeling airport and en-route operational/drifts in order to simulate satisfaction of TTO/TTA.
- Operational model of the Network Operations Plan.
- 4D contract
- Coordinated actions of pilot, service providers, and airline dispatch centers in managing flow problems.



# Surveys



Extended Fast-Time Simulation

Component based architectures