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Guidance on the Evolution of NextGen from the Perspective of Airline and Flight Operations Centers

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Prepared by: **Air Navigation Systems (ANS) Working Group AOC/FOC Subcommittee**

Abstract

The primary focus of this document is on long-term development. However, it also points out some of the short- and mid-term enhancements that are necessary as foundations for such long-term improvements. The goals of this Subcommittee have been to:

- Identify guiding principles that should be considered in designing the evolution of the Next Generation Air Transportation System (NextGen) from the perspectives of Airline Operations Centers (AOCs) and Flight Operation Centers (FOCs).

- Outline key areas for future research and concept exploration that build upon these guiding principles in order to define and implement an effective long-term operational concept. It should be noted that this paper has not focused on the research, and that concept explorations need to better support single piloted aircraft that may not be supported by an AOC/FOC (GA and military). However, in general, an effort has been made to recommend the exploration of future system designs that are compatible with the needs of such aircraft.

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14. ABSTRACT
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AOC/FOC SUBCOMMITTEE MEMBERSHIP

This subcommittee has included broad representation from a wide range of scheduled carriers, as well as the general aviation (GA) community. Participants have included:

Dan Allen (FedEx)
Don Wolford (United Airlines)
Roger Beatty (Self-employed consultant)
Mark Hopkins (Delta Airlines)
Rick Dalton (Southwest Airlines)
Bill Leber (Lockheed Martin)
John Martin (UPS)
Bill Murphy (US Airways)
Ron Ooten (Southwest Airlines)
Ernie Stellings (National Business Aviation Association)
Greg Schroeder (NetJets)
John Schwoyer (Airline Dispatchers Federation and American Airlines)
Loraine Sandusky (Continental Airlines)
Mike Wambsganss (Booz Allen Hamilton)

These individuals have provided a wealth of expertise on the functioning of AOCs and FOCs.

GUIDING PRINCIPLES

Based on the deliberations of this group, the following guiding principles have been identified. These guiding principles identify considerations from an AOC/FOC perspective that should be addressed in completing the research recommended in the following section.

Principle 1. Competing and Complementary Goals

There are a number of goals that need to be considered in evaluating alternative designs. Safety and security are overriding goals at all times, and throughput is a very important goal. However, it is also very important to design NextGen to provide flight operators with the flexibility to make strategic and tactical decisions based on their own objectives and constraints. Overall, in evaluating any future operational concepts, the impacts on the following list of interacting goals need to be considered:

- Improving safety
- Increasing throughput
- Increasing efficiency
- Improving passenger satisfaction
- Increasing predictability for flight operators
- Providing flight operators with the flexibility to make strategic and tactical decisions that support their own objectives and constraints
- Providing equitable treatment of flight operators
- Ensuring security and defense needs
- Reducing environmental impacts

Principle 2. Human-Centered Design

The strategic plans developed by AOCs and FOCs that meet their specific needs in collaboration with traffic managers, as well as the tactical adaptations of these plans, involve dealing with a complex mix of time-varying uncertainties, as well consideration of multiple competing and complementary objectives. Although it is important to make full use of technology to support information access and display, people will continue to play an important decision making role in this strategic planning process for the foreseeable future.

Furthermore, because of the cognitive complexity of these decisions at a systems level, it will continue to be necessary to distribute this decision making across a number of specialists, with some roles and responsibilities allocated to staff working for the FAA and some to staff working for the flight operators. In distributing the work, roles and responsibilities must match the distribution of relevant data, knowledge and expertise, processing capabilities and motivations.

It is also important to recognize that shared situational awareness does not mean that all parties must access the same data with the same information displays and decision support tools. Each party needs to access and view the information necessary to develop an operational picture relevant to his/her tasks in a manner that is consistent with overall system requirements, and that leads to decisions and actions that are effective when combined with the decisions and actions of the other parties that are part of this distributed work system. For example, the most critical element for the operators is to have complete knowledge of the impact of National Airspace System (NAS) constraints on their fleets and the availability of options that enable the mitigation of those impacts.

Thus, the design of NextGen needs define the allocation of roles and responsibilities, and specify the associated decision-making requirements and information needs for each individual. This design also needs to consider relevant human factors issues, such as cognitive complexity, mental workload, shared situational awareness, the development of expertise, and the distribution of expertise, data, motivations and processing capabilities relative to the assignment of roles and responsibilities.

Principle 3. Dispatchers and Flight Planners as Business Managers

Just as controllers' responsibilities and actions will be enabled by improved technologies to evolve toward more efficient and increasingly pre-planned management of air traffic under NextGen, dispatchers for commercial operations will have an ever-increasing role within their organizations as the focal point for business management.

This evolution is already in progress with the advent of the Air Traffic Control (ATC) Coordinator, and for some operators, the Network Manager. ATC Coordinators and Network Managers have fleet responsibilities, and can make tradeoffs between flights (e.g., through Ground Delay Program (GDP) and Airspace Flow Program (AFP) slot swapping) that mitigate the overall impacts on the operator's network, as compared with dispatchers who typically make flight specific decisions. In addition, Network Managers deal with non-dispatch decision processes such as gate planning and maintenance scheduling that can influence the impacts of delays and NAS constraints.

Note also that, while FOCs for the military consider test and training requirements, as well as economics, they have additional considerations and prerogatives that need to be considered for national defense. Law enforcement has similar additional considerations.

Consideration of these roles has major implications not only for the internal operations and decision support tools for AOCs and FOCs, but also for the design of the strategies, tools, and procedures developed to support Capacity Management (CM) and Contingency Flow Management (CFM) (See Operational Concept for the Next Generation Air Transportation System (NextGen), Version 3, 2010 for more detail on these terms). Thus, for each operational concept proposed under NextGen, the question needs to be asked: Has this been designed to better enable AOCs/FOCs to manage their businesses? Note that this includes military airspace managers, law enforcement agencies, single aircraft operators who are served by various flight service organizations, and those who have legitimate rights to NAS access.

Principle 4. Regulatory Compliance

As a founding principle to ensure safety, the dispatcher has joint responsibility for a flight. This principle needs to continue, with the requirements specified under Federal Aviation Regulation

121 (FAR 121) and maintained in order to ensure the highest level of safety. However, with future enhancements of the role of the dispatcher under NextGen, specific regulatory requirements may need to be refined to reflect the nature of future air traffic operations and the encompassed roles of dispatchers and AOCs/FOCs.

Under these regulations, dispatchers are obligated to plan for what they expect to happen, not what they would like to happen. This is especially true during bad weather or reduced ATC capacity. Whereas today dispatchers do flight plans based upon forecast weather, they find it especially difficult to forecast how ATC decision making will respond to such forecast weather. Under NextGen, ATC decision making will be far more predictable given any particular weather condition, ensuring that dispatchers can more effectively conduct constraint based flight planning.

However, mechanisms that enable operators to express their “unconstrained” flight plan should also be encouraged, as these data can help provide a baseline for performance measurement. Thus, in NextGen, operations will become even more collaborative than they are today. With the advent of System Enhancement for Versatile Electronic Negotiation (SEVEN) and its evolution under Collaborative Airspace Constraint Resolution (CACR), the dispatcher will be “contracting” with the FAA for certain negotiated service expectations, and surprises should occur primarily as a result of a safety action taken by air traffic, not as a result of a response to a constraint. Constraints will be better identified and quantified, and responses will be negotiated (keeping in mind that those who are better equipped may have more response options). Furthermore, there will need to be more emphasis on adaptive, flexible responses as a scenario develops. Such evolving roles for dispatchers need to be compliant with regulations.

In accordance with the current FAR, the dispatcher must keep flights within strict planning criteria, including the determination of a release fuel. Once the flight departs, new or adapted plans must be adjusted based on the available fuel. Hence the dispatcher’s attention to the details in making sure fuel equals plan and plan equals fuel. This perspective on fuel requirements includes considering how the total fuel load is broken down into planning "buckets," i.e., so much fuel for takeoff delay, so much fuel for en route, so much fuel to get to an alternate airport, etc. If, after departure, the fuel required for one bucket increases (e.g., if there is a longer than planned takeoff delay), it will require some other planning bucket to be reduced (e.g., changing the flight to a closer but possibly less suitable arrival alternate).

Appendix A contains the FAR references that help shape this perspective and establish the legal limitations for the "plan." They are annotated with comments for clarity.

Principle 5. Proprietary Data Exchange

Many of the new procedures proposed under NextGen will require that data be exchanged between the flight operators, the Air Navigation Service Provider (ANSP), and the military. These procedures need to be designed so that:

- There is an incentive for the flight operators to provide accurate information in a timely fashion.

- Data that is considered proprietary is shielded in an effective manner so that competitors do not have undesirable access.
- Classified data is similarly shielded based on security requirements.
- Clarity on how certain proprietary data is used and/or disseminated will also be required.

RESEARCH, CONCEPT EXPLORATION, AND DEVELOPMENT PROJECTS: RECOMMENDED FOCUS AREAS

The above principles provide general guidance to consider in conducting the research and concept exploration necessary to define the long-term operational concept for NextGen from an AOC/FOC perspective. Recommendations of specific areas for research and concept exploration are provided below.

Research Area 1. Adaptive Decision Making to Manage Uncertainty

Both traffic management and AOC/FOC functions need to be highly adaptive, as uncertainty management is a key consideration in dealing effectively with the constraints associated with weather, Special Activity Airspace (SAA) activities, ATC, aircraft, passengers, crews, etc. To help accomplish this, the design of NextGen needs to support a collaborative, adaptive decision making process. Some decisions need to be made relatively early as the associated options will otherwise disappear. Others are best delayed to see if the uncertainties associated with factors such as weather are reduced. Defining such adaptive decision making processes for different scenarios under NextGen is very important. The components of such a continuous adaptive process that need to be explored are outlined below.

Note that one interesting aspect of this research is considering what decisions need to be made right away and which can be postponed if new equipage capabilities are available, not just on a particular airframe, but collectively. If 30% (or 50% or 75%, etc.) of the fleet can do “X”, then it might be possible to postpone the decision to reroute longer (you can wait to see what the weather does). If the controllers have Data Communications (DataComm) and can easily send reroutes to multiple flights, the process of moving aircraft around weather may be less difficult and, because it is more easily done, reroute decisions can be delayed longer.

Component 1. Continuous Collaborative Planning

A new paradigm for collaboration needs to be developed to improve the coordination and collaboration among ANSP staff responsible for Capacity Management (CM) and Contingency Flow Management (CFM), airport operators and flight operator staff (ramp controllers, fixed base operators, dispatchers, military airspace managers, and pilots). This new approach needs to support a more continuous, adaptive approach to planning, enabled by communication and information-sharing tools that support richer asynchronous as well as synchronous real time collaboration, and that provide machine-readable plans in order to take advantage of software support.

In order to effectively support such continuous planning, organizational changes may be required within AOCs, FOCs and the ANSP. To support this new paradigm, AOCs and FOCs can build upon their existing organizational structures for handling GDPs and AFPs. However, given the economic realities within the industry, this new collaborative process needs to be designed with consideration of the staffing implications.

Such a continuous adaptive planning process would begin with a collaborative NAS Planning Team made up of a cadre of dispatchers or ATC Coordinators working for the flight operators and traffic managers working for the ANSP. On a daily basis, this collaborative team would identify areas of mutual concern that require continuous planning, reviewing current initiatives and associated contingency plans, modeling possible alternatives and, when necessary, establishing CM and CFM initiatives, which would be disseminated in both human- and machine-readable forms. Participation in this planning process would also help to ensure that initiatives implemented to deal with transient local constraints are disseminated to all of the flight operators, and are implemented in a manner that is consistent with the overall system plan. In order to be effective, significant portions of this adaptive planning process will be performed with automation support.

Note that such collaborative decision-making processes involve coordination and information exchange across competing flight operators as mediated and managed by the ANSP. Such collaborative processes are well established as an effective way to help ensure safety and engender effective system-level performance. Policy decisions and legal guidance should be developed to support and enable expansion of such collaboration and coordination.

Component 2. Modeling of Integrated CM and CFM Initiatives

To support this adaptive planning process, better modeling tools and information exchange are needed to understand the potential impacts of combining different types of traffic management initiatives and the application of trajectory based operations. The continuous planning process would need to be supported by modeling tools that make it easy for FAA, military, and flight operator planners to propose and evaluate different combinations of CM and CFM initiatives in order to assess their collective effectiveness. In addition, clarity regarding which flights are expected to be impacted by multiple Traffic Management Initiatives (TMIs) must be provided to the operators. Post operations analysis is also required to assess whether CM and CFM initiatives are in conflict (e.g., Miles in Trail (MITs) impacting GDP bound flights resulting in capacity underutilization).

The automatic collection and distribution of data on aircraft positions and capabilities while on the surface and while airborne, along with information about the priorities and constraints of the flight operators as reflections of their business models, is a key foundation for such modeling. Knowing what aircraft operators will do in response to a particular constraint is not always intuitive to air traffic. A system that allows operators to declare their preferred response to a constraint will allow better NAS performance predictions and will allow the operators to negotiate better business solutions for their flights.

Note that ultimately, CM and CFM initiatives need to be implemented within a seamless, integrated system, rather than as a collection of independent facilities/initiatives, as contrasted with today's system with flights that are impacted by multiple, seemingly uncoordinated, TMIs.

It should be noted that this goal has significant implications in guiding the design of new types of CM and CFM initiatives, as well as the development of the computational strategies and computing infrastructure necessary to help generate and evaluate such integrated initiatives.

Component 3. CM and CFM Forecasts and Risk Management

Instead of providing a plan based on a single "best guess" as to how a scenario will develop, CM and CFM forecasts need to be disseminated that indicate which control actions are being initiated immediately, but that also indicate the range of possible scenarios that could develop and associated contingency plans. This needs to be communicated in a form that each person can easily work with. Research and concept exploration is needed to determine how to develop such forecasts to deal with uncertainty, and how to communicate these forecasts to all impacted parties, including the integration and display of the information.

In addition, research is needed that focuses on risk management strategies. As information access is improved, and as CM and CFM forecasts are enriched, new approaches to risk management will become possible. These new approaches need to be identified and evaluated. This includes studies focusing on the new roles and responsibilities of dispatchers and flight planners as they are increasingly asked represent a business management perspective.

Component 4. New CM and CFM Strategies that Support Adaptation

New tools and procedures are needed in order to develop a strategic planning system that adapts more effectively to changing constraints over time and distance. Thus, new, more focused, adaptive CM and CFM techniques need to be developed for use as part of this adaptive planning process, along with the development of the information-sharing capabilities necessary to support these techniques. As an example, this could include extensions beyond the current implementation plans for SEVEN and CACR. SEVEN, for instance, allows the flight operator to submit a prioritized list of alternative trajectories/flight plans for a flight. These options allow the ANSP to better manage system constraints and customer needs, considering the priorities of the flight operator before dynamically amending a flight's trajectory before to departure.

Other examples of such adaptive CFM processes are the use of adaptive and dynamic AFPs, and the integrated management of dynamic airspace and airport surface constraints. Additional illustrations focus on the need to support AOC/FOC involvement in trajectory management and trajectory negotiation from gate to gate as constraints and operator priorities evolve over the duration of a flight.

To more effectively support such adaptive processes to deal with dynamic weather, SAA and traffic constraints, concept exploration and system development is needed in a variety of areas, including:

- Predicting constrained NAS resources (including the impact of uncertain weather constraints) for both the departure and en route phases of flight.
- Alerting ANSP and flight operator staff when there is actual or forecast changes in these constraints over time.

- Evaluation of alternative recommendations for addressing the impact of combined (multiple traffic management initiatives affecting a single flight) capacity and contingency flow management initiatives.
- Providing procedures and tools that support the development of plans and preferences by commercial, general aviation, and military flight operators in response to capacity management and contingency flow management plans.
- Providing procedures and tools for use by both the FAA and military ANSP and the flight operators to support the implementation of strategies and tactics to resolve the impacts of constraints.
- Providing procedures and tools for post analysis. Under NextGen, such tools will enable the correlation of delays, diversions, route changes, etc. to the underlying causes. This will help us to isolate where improvements can be made in the system.
- Providing information and supporting processes that enable operator technology providers to build the technology and tools needed for CM and CFM.

Component 5. Information Access and Use

In order to enable such a continuous adaptive planning process, an effective communication system needs to be in place that handles FAA and military flight data with appropriate security levels, building upon SWIM and datalink capabilities and based on an understanding of human factors engineering.

This information access includes suspicious activity reporting (SAR), which is applicable to safety and security, in that indications and reporting may illuminate a situation, but until a SAR is reported and clarity made evident, the SAR may be a safety of flight matter, or a security or defense matter.

This communication infrastructure needs to support a much broader and dynamic approach to NAS status information. Individuals need to know how constraints and options are changing if they are relevant to the specific decisions they are making.

However, in order to avoid information overload, it is critical that each person have access to the information relevant to his/her specific tasks without being overwhelmed with “noise” or task-irrelevant data. Thus, while the communications infrastructure provided by SWIM will make it possible to provide more people with greater access to more information, implementation of this high-bandwidth communication infrastructure increases the importance of considering human factors issues concerned with information access and use.

Operational staff need access to effective displays of the information relevant to their tasks, not access to (and certainly not continuous presentation of) all possible information about the status of the NAS. Furthermore, it must be possible to integrate this information into the other tools that these individuals are using to complete these tasks, while still making it possible to communicate time critical information in a timely and effective manner.

One important aspect of such communication requirements is the need for AOCs/FOCs to be acknowledged as major participants in flight data exchange using the DataComm process, rather than considered primarily as recipients of information communicated via Data Comm. AOCs/FOCs will continue to be a major source of information, plans, and other communications. This role needs to be given additional consideration in future DataComm discussions, expanding upon currently existing protocols (FANS I/VDL II).

Finally, AOCs/FOCs need to be able to choose (subscribe) to be notified of selected information so they can make choices or decide to let automation decide certain things for them.

Research Area 2. Integrated Management of Airport Surface and Airspace Constraints

Improved airport surface management needs to continue to be a major focus area for research and concept exploration for the foreseeable future, and needs to be integrated with new strategies for managing airspace and trajectory based operations (TBO). There are a number of different, potentially complementary approaches to improving airport surface and metroplex management which need to be addressed (RTCA Task Force 5, 2009), and which are briefly described below. Note also that part of the research needs to deal with which of these approaches are applicable to a given airport.

Component 1. Provide Access to Displays Based on Airport Surface Surveillance and Terminal Area Airspace Constraint Data

The simplest initial step is to improve situational awareness regarding the current state of the airport and surrounding airspace based on airport surface and airspace surveillance data. This includes data on such things as:

- A flight's position in the departure queue and the estimated queue length
- The flight's position on the surface, including detail such as in or out of hanger
- A flight's position in the de-icing queue and the estimated de-icing queue length
- Out to Off times by route and airport configuration
- Departure fix constraints

Component 2. Distribute Access to Resource Status Updates

In order to increase the usefulness of such airport surface management displays, another approach is to support new forms of information sharing between the FAA, flight operators, and airport operators. This information should be made available in digital form. This could include a variety of information from:

- The flight operator regarding the status of a flight (such as access to the close-out message for a flight indicating it is ready to push back)
- Traffic Flow Management System (TFMS) or En Route Automation Modernization (ERAM), such as the TMA-assigned runway arrival time for a flight
- The airport operator regarding plans for snow removal, etc

Component 3. Distribute Access to Plans, Priorities and Constraints

In order to work in a coordinated manner, plans, priorities, and constraints often need to be shared. For example, the ATC Tower may want to communicate to ramp control regarding how they plan to make use of the different runways in order to expedite departures. Timely and actionable information will allow the ramp control personnel to stage flights at the most appropriate spots and, if required, in a certain sequence prior to transfer of control to ATC. Note that this could include more efficient and effective communication of priorities for arrivals versus departures, as well (i.e., indicating whether or not a departure or arrival should be moved to a holding area). Similarly, flight operators may want to communicate prioritizations for their flights, which may change over time.

Component 4. Provide Access to Predictions

In some cases, a simple description of the current state of the airport surface is not sufficient. The available data needs to be used to generate predictions about the future. This could include predictions about when a flight will be ready to push back, when it will arrive at the spot, what taxi path it will take, or when it will be wheels-up. Note that such a prediction could include information about the associated level of uncertainty.

Note further that prediction data could be of value to ATC, the flight operators, and the airport operator even when there is no procedure in place to meter access to key transition points (such as the spot for transition from ramp control to ATC for those airports with ramp control facilities). Explicit predictions can reduce the mental workload for everyone trying to manage some aspect of the airport surface operation and support more effective coordination.

Component 5. Manage Access Times and Aircraft Sequences for Departure Queues

Because most airports support competitive operations, in order to achieve some of the objectives identified earlier (such as reducing taxi-out times), it may be necessary to manage access to spots or runway queues when demand exceeds capacity through some form of metering of departures on the airport surface. There are several points where such metering could in principle be introduced, assigning each flight a time (or time window) for:

- Pushback from the gate or stand
- Starting the engine (for an aircraft that is either at a gate or some holding area) or
- Arrival at the spot

When it is necessary to implement airport surface metering, it will need to be integrated with airspace and trajectory management, closely coupled with strategies for TBO and taking into account uncertainties about the development of weather and traffic constraints, and the ability of flights to achieve target metering windows for departure.

Substantial research is needed in this area that considers the implications of a wide range of relevant factors, including whether some form of metering should be managed by the FAA or some other organization (such as an airport authority), how to integrate management of flights that are subject to a traffic management initiative such as an AFP, GDP, MIT restriction, or some other form of metering resulting from the implementation of metering associated with TBO, how to support the integrated management of arrivals and departures, how to manage flights across a metroplex, and how to handle aircraft that file flight plans very close to operating times (pop ups).

These types of considerations mean that, although there are likely to be procedures and decision support tools that are useful across a number of different airports, the details for whether and how to best manage access to airport surface queues will need to be negotiated at a local level from airport to airport. They also highlight the need to carefully consider human factors concerns when deciding how to distribute roles and responsibilities and how to design the tools necessary for effective information exchange and decision support.

Component 6. Allow Flight Operators to Prioritize Flights

If access to departure queues is metered (Approach 5), flight operators have indicated that, analogous to the use of GDPs and AFPs to meter arrivals, they want to be able to adjust the order of such queues so that their high priority flights can depart more expeditiously. It should be noted that there are potential tradeoffs between the ability for flight operators to prioritize flights and the ability to manage the final departure line-up in order to maximize departure throughput. Policies and procedures will need to be developed to appropriately balance such tradeoffs.

Component 7. Support Post-Operations Analysis

In order to learn from past experience, tools should be developed that make it easy to review and evaluate past performance. Measurements should include items such as surface delay, fuel burn, environmental impacts, and throughput in order to help reduce unnecessary fuel burn, reduce carbon emissions, and improve departure time predictability. Such analyses can be used to support process improvement concerning airport and airspace usage. They can also be used to develop and illustrate best practices that can be shared across different airports and flight operators, to support training and to guide the improvement of procedures and support tools NAS-wide.

Component 8. Support Global Harmonization

Other countries around the world are also developing and refining their airport surface management systems. Where appropriate, efforts should be made to identify performance parameters, procedures, and metrics that apply across all of these countries, and to establish standardized definitions and labels that are consistent with International Civil Aviation Organization (ICAO) standards where applicable.

Research Area 3. Providing Guidance on the Development of New Flight Planning Systems

Many AOCs/FOCs are developing new flight planning systems and associated technologies either themselves or in collaboration with vendors. In order to develop a software architecture and to incorporate the functionality necessary to assure compatibility with future NextGen requirements, they need to know how NextGen is likely to evolve in the mid- and long-term. They also need cost-benefit assessments.

In order for NextGen to function in an efficient, seamless manner, it is essential that many of the flight operators have the tools necessary to participate. Flight planning systems represent a core capability for supporting such interaction with ANSP software.

Research Area 4. NextGen as a Process Control System Supported by Post-Operations Analysis and Feedback

A more effective process control perspective needs to be developed, providing timely, effective feedback to the ANSP, airport operators, flight operators and military airspace managers. This requires the development of much more detailed data analysis and reporting tools that provide feedback to the right people at the right times. The ability to reconstruct operational events and measure outcomes in a manner that enables both the service provider and the operators to improve their underlying decision processes is essential. Without such feedback, it will be difficult to learn how to take advantage of the flexibility provided by NextGen.

Research Area 5. Supporting Greater Flexibility and Equitable Treatment for Flight Operators

One of the weaknesses of the current traffic flow management system is that it supports only very limited flexibility for the flight operators to prioritize across flights and has only limited support for military airspace managers to meet their requirements while integrating with the NAS planning process. While GDPs and AFPs illustrate how flight operators can be given increased flexibility to distribute delays across their fleets, these specific initiatives limit such flexibility (accomplished by rerouting and/or slot swapping) to flights within a single traffic management initiative.

Furthermore, there are some TMI and ATM tools (examples: MITs, the use of TMA and reroute advisories) that have flight specific impacts with no slot swapping capability through which operators can mitigate the impacts on their overall network. In NextGen such flight specific initiatives that lack flexibility should be avoided.

In addition, some tools, such as TMA, do not provide advance notification to operators even when this is possible, making it difficult for them to plan and make adjustments. Longer lead times on significant impacts (such as pre-departure delays) enable operators to execute options that can reduce network delays and minimize cancellations.

Another weakness, again resulting from the current practice under which flexibility is limited to flights within a single TMI, is that it is sometimes necessary to assign less than equitable treatment to specific flight operators or airports in order to increase overall throughput.

Many of these weaknesses result from the current "memoryless" process, which does not provide mechanisms for flight operators to swap delays or other costs among their flights across different TMIs (GDPs, AFPs, ESP Delays, Required Reroutes, etc.) on the same day or across different days. While this is a complex issue, advances in this area could greatly increase the ability of both AOCs/FOCs and single aircraft operators to make better business decisions, and to provide more equitable treatment across different flight operators and airports.

CONCLUSION

The goal of this white paper has been to identify key guiding principles that need to be considered in developing and evaluating potential directions for the long-term evolution of NextGen, and to identify key focus areas for future research and concept exploration in order to define and implement an effective long-term operational concept. As such, it is not meant to provide a detailed plan, but rather is intended to be a stimulus to encourage and guide thinking about the current and future research, concept exploration and development necessary from an AOC/FOC perspective in order to meet the long-term needs of the National Aviation System.

APPENDIX A. FARs RELEVANT TO DISPATCHING

Below is a list of FAR references relevant to proposals that impact dispatching in the future. They are annotated with comments for clarity.

Sec. 121.533. Responsibility for operational control: Domestic operations.

(a) Each certificate holder conducting domestic operations is responsible for operational control.
(b) The pilot in command and the aircraft dispatcher are jointly responsible for the preflight planning, delay, and dispatch release of a flight in compliance with this chapter and operations specifications. *[You MUST create a plan not based on what you want, but based on what you expect to happen.]*
(c) The aircraft dispatcher is responsible for--
(1) Monitoring the progress of each flight;
(2) Issuing necessary information for the safety of the flight; and
(3) Canceling or re-dispatching a flight if, in his opinion or the opinion of the pilot in command, the flight cannot operate or continue to operate safely as planned or released. *[If you cannot execute your plan or adapt a new one, you CANNOT operate*.]

Sec. 121.631. Original dispatch or flight release, redispatch or amendment of dispatch or flight release.
(a) A certificate holder may specify any regular, provisional, or refueling airport, authorized for the type of aircraft, as a destination for the purpose of original dispatch or release.
(b) No person may allow a flight to continue to an airport to which it has been dispatched or released unless the weather conditions at an alternate airport that was specified in the dispatch or flight release are forecast to be at or above the alternate minimums specified in the operations specifications for that airport at the time the aircraft would arrive at the alternate airport. However, the dispatch or flight release may be amended en route to include any alternate airport that is within the fuel range of the aircraft as specified in Secs. 121.639 through 121.647.

(f) No person may change an original destination or alternate airport that is specified in the original dispatch or flight release to another airport while the aircraft is en route unless the other airport is authorized for that type of aircraft and the appropriate requirements of Secs. 121.593 through 121.661 and 121.173 are met at the time of re-dispatch or amendment of the flight release. *[You must stay within the original planning limitations.]*
(g) Each person who amends a dispatch or flight release en route shall record that amendment.

Sec. 121.639. Fuel supply: All domestic operations. *[Your flight plan must answer the question: "What is enough" fuel. This is a legal and a practical requirement.]*

No person may dispatch or take of an airplane unless it has enough fuel -
(a) To fly to the airport to which it is dispatched;
(b) Thereafter, to fly to and land at the most distant alternate airport (where required) for the airport to which dispatched; and

(c) Thereafter, to fly for 45 minutes at normal cruising fuel consumption or, for certificate holders who are authorized to conduct day VFR operations in their operations specifications and who are operating non-transport category airplanes type certificated after December 31, 1964, to fly for 30 minutes at normal cruising fuel consumption for day VFR operations.

Sec. 121.647. Factors for computing fuel required.

Each person computing fuel required for the purposes of this subpart shall ["*Shall" is a legal imperative and includes your consideration of "traffic delays" and "any other condition that may delay landing."*] consider the following:
(a) Wind and other weather conditions forecast.
(b) Anticipated traffic delays.
(c) One instrument approach and possible missed approach at destination.
(d) Any other conditions that may delay landing of the aircraft.
For the purposes of this section, required fuel is in addition to unusable fuel.

Sec. 121.663. Responsibility for dispatch release: Domestic and flag operations.

Each certificate holder conducting domestic or flag operations shall prepare a dispatch release for each flight between specified points, based on information furnished by an authorized aircraft dispatcher. The pilot in command and an authorized aircraft dispatcher shall sign the release only if they both believe that the flight can be made with safety. The aircraft dispatcher may delegate authority to sign a release for a particular flight, but he may not delegate his authority to dispatch. [*The fact that "he may not delegate his authority to dispatch." is why dispatchers cannot just "file the pref" and let ATC take care of revisions to the plan.*]