1 # D. INTEGRATION PLAN TRACEABILITY WITH PREVIOUS STUDY GROUPS

2 ## *D-1. REDAC Recommendations and Response*

REDAC Recommendation	Integration Plan Alignment	Comments
Overarching Requirements		
Crosscutting Research Program		
1) Initiate and fund a crosscutting research program in ATM/Weather integration and insure that weather aspects are an integral part of all new ATM initiatives from the beginning.		
Leadership		
2) Establish Senior Leadership over-sight.		
3) Establish REDAC monitoring.		
4) Revitalize joint advisory committee reviews of FAA and NASA joint research such as weather – ATM integration. FAA and NASA should hold joint meetings of their advisory committees and include the identification of current and future cross agency research opportunities in support of integrating advanced aviation weather and air traffic management tools. Furthermore, a Memorandum of Understanding (MOU) or Agreement of Understanding (AOU), between FAA and NASA, and encompassing weather and ATM research, may be needed to clearly elucidate the needed connection between these agencies.		
Requirements Process		
5) Develop requirements for weather ATM integration participation within the AWRP.		
Research Recommendations: Near Term - IOC 2010		
Assessment of Avoidable Delay		
6) Research is needed to identify and quantify avoidable delay. Quantitative research studies of “avoidable” delay, should be conducted each year, based on significant summer or winter storm events, to identify opportunities to reduce delay and to evaluate the performance of weather – ATM integration capabilities as they are developed and		

REDAC Recommendation	Integration Plan Alignment	Comments
fielded.		
7) ATM/TFM/AOC/FOC involvement is needed.		
Translating Weather Data into ATC Impacts		
8) Expand research on the translation of convective weather impacts into ATC impacts so that this information can be used to effectively support decision making. Research should be conducted to address the following elements: a. Improve the models for convective weather impacts, e.g., route blockage and airspace capacity. b. Determine if pilot thresholds for weather conditions that lead to deviations can be reduced, since unexpected deviations around storm regions in high density airspace can lead to prolonged, unnecessary route closures. c. Determine if the data link transfer of ground derived weather and ATC domain information (spatial boundaries acceptable for maneuvering) to the pilot achieve a more consistent pilot response to convective weather. d. Determine if the airspace usage differs between various en route facilities [e.g., the Jacksonville Center (ZJX) appears to have very different procedures for convective weather ATM than many of the ARTCCs in the northeast]. e. Develop models for storm impacts on arrival and departure flows in both en route and terminal airspace.		
Improved Weather Input into Collaborative Traffic Flow Management		
9) Develop a six-eight-ten hour convective forecast for strategic flow management decisions with automatically generated and updated forecasts of flow impacts. This should be a joint program between the AWRP and the TFM R & D programs		

REDAC Recommendation	Integration Plan Alignment	Comments
with involvement by representatives of the CDM Weather Team.		
10) Improve the Traffic Management interaction with AOC/FOC's during weather impacts. Develop collaborative TFM systems that allow operators to better manage risks in meeting their own business objectives. Specifically, collaborative TFM systems should be developed that give operators the following capabilities: - Enable visibility into probabilistic TFM weather mitigation strategies through robust TFM data feeds for integration into their own internal systems via CDMnet and eventually System Wide Information Management (SWIM). - Electronically pre-negotiate multiple trajectory options with Traffic Managers. - Select viable route/altitude/delay options during severe weather impacts. - Integrate and ingest ATC-approved trajectories onto the flight deck for execution consistent with their own corporate infrastructure, business objectives and regulatory requirements. - Expand collaboration to include flight deck capabilities and decision making tools consistent with NextGen and within the corporate infrastructure, business objectives and regulatory requirements of the operator.		

REDAC Recommendation	Integration Plan Alignment	Comments
Weather Information and Pilot Decision Making		
11) Initiate a research program to develop procedures and guidance on the integration of weather and airspace congestion information for preflight and in-flight decision making tools. The program should include the following objectives: Develop appropriate rule sets for weather avoidance decision making in both non congested and, highly congested airspace. Develop ways to incorporate the same rule set into preflight, cockpit, AOC/FOC, and ATM decision support tools. Develop methods to integrate or display current and forecast weather impact to flight profile, airspace congestion information, and weather decision support information in preflight and cockpit systems to enable greater shared situational awareness and improved collaborative decision making. Conduct research on the direct, machine to machine, information transfer among cockpit, AOC/FOC, and ATM computing systems and determine whether this will facilitate consistent and expeditious decision making. This will place the users more “over the loop” than “in the loop” with respect to weather decision making.		
Integrating Weather Impacts with Airport Surface and Terminal Management Systems		
12) Expand the use of route availability tools to integrate airport and terminal area weather data and ATM tools. Expand the deployment of integrated tools, such as route availability, to additional airports and terminal regions to improve NAS performance at the largest airports impacted by convective activity.		

REDAC Recommendation	Integration Plan Alignment	Comments
13) Conduct research on enhancing the Traffic Management Advisor (TMA) to achieve a weather sensitive arrival planning tool.		
14) Integrate RAPT, ITWS, DFM, and TMA with surface management systems to provide a singular terminal management tool spanning departures, arrivals, and surface movement. Consider common use by air traffic and operators for collaborative decisions.		
15) Support CDM and other efforts to provide meaningful and integrated terminal and TRACON specific weather forecast information.		
Research Recommendations: Mid Term - IOC 2015		
Adaptive Integrated ATM Procedures for Incremental Route Planning		
16) Develop Weather Impact Forecasts versus Time (for different planning horizons). Develop weather forecasting capabilities that incorporate representations of the uncertainties associated with different weather phenomenon for different planning horizons. This should be included in the research recommended in Section 6 B, translating weather into ATM impacts.		
17) Develop Adaptive ATM/TFM Procedures. Develop TFM procedures that are adaptive, and that take advantage of changes in uncertainty over time. These procedures should incorporate distributed work strategies that match the focus of control for a specific decision with the person or group that has access to the knowledge, data, motivation and tools necessary to effectively make that decision. Such adaptive procedures require an integrated approach to strategic planning and tactical adaptation.		

REDAC Recommendation	Integration Plan Alignment	Comments
18) Manage at the Flight Level Take advantage of trajectory-based management so that control actions and their impacts can be more directly and precisely localized at the points in the system where they are required to deal with a given scenario. In particular, this means that tools and procedures need to be developed to adaptively manage at the flight level instead of traffic flows, and that the air traffic management user does not need detailed meteorology experience.		
19) Translate weather information and forecasts to parameters relevant to decision support tools. Develop decision support tools that translate the implications of probabilistic weather forecasts into the decision parameters that are relevant to the application of particular TFM procedures and in a way that the air traffic management user does not require significant meteorological training.		
20) Develop human-centered designs. Develop human-centered designs for these decision support tools that enable their users to understand the current state of the relevant parts of the NAS, and that support these users in understanding the basis and implications of recommendations generated by their decision support tools that automatically generate options for users to consider.		

REDAC Recommendation	Integration Plan Alignment	Comments
21) Develop tools and automation enabling operations and implementation. Develop computer-supported communication tools and automated decision support tools that enable effective coordination and collaboration in this distributed work system, and that enable timely implementation of the decisions that are made.		
Weather Impacts and Tactical Trajectory Management		
22) Implement Tactical Trajectory Management with integrated weather information. Develop a highly automated advanced Tactical Trajectory Management (TTM) decision support capability integrated with convective weather and turbulence to decrease controller and pilot workload, and increase safety. This would be a mostly automated system. This capability would assist the controller in a shared severe weather separation responsibility with the pilot.		
23) Investigate the human factors (see C-5) issues (communication, information display, safety nets, cognitive complexity, and mental workload) associated with new paradigms for tactical trajectory management.		

REDAC Recommendation	Integration Plan Alignment	Comments
Airspace Designs for Weather Impacts		
24) Airspace designs should enable route flexibility during adverse weather conditions. If the vision of 4D trajectories is to become a reality, the airspace must be designed to support seamless adjustments of the route of flight in all four dimensions, as required by weather impacts. The development of ATM decision support tools must be done jointly with the weather research community so that decisions will adequately address impacts of adverse weather. Foundational efforts that reach across the disciplines of airspace design, weather translation into ATM impact and ATM decision support are required to achieve effective integration.		
25) Investigate the human factors (see C-5) issues associated with the dynamic reconfiguration of airspace, including issues associated with information display, training, and cognitive complexity.		
Research Recommendations: Far Term - IOC Post 2015		
Advanced Weather-ATM Integration Concepts		
26) Develop methods which combine the use of both probabilistic and deterministic forecasts and observations, to maximize throughput using multiple dynamic flight lanes or “tubes” in weather impacted areas.		
27) Develop methods to transition from a probabilistic trajectory or flight envelope to a 4D trajectory which is useable for separation and safety assurance. Establish an independent bi-annual review of this work to determine the potential benefits and costs to aviation.		
28) Conduct research into replacement of surrogate		

REDAC Recommendation	Integration Plan Alignment	Comments
weather indicators such as radar reflectivity with reflectivity with actual indicators such as turbulence, icing, lightning, or wind shear, and an estimate of ATM impact. For example, radar reflectivity can be translated to ATM impact by estimated airspace pilots will avoid and the associated airspace capacity loss.		
29) Develop methods to use gridded and scenario based probabilistic weather data for ATM decision making. Develop methods to translate deterministic and probabilistic convective forecasts to ATM impact for use in network based capacity estimate models. Determine the reduction in capacity of an airspace region due to convective weather using a network model.		
30) Investigate the human factors (see C-5) issues associated with the integration of such probabilistic modeling into decision support tools.		

REDAC Recommendation	Integration Plan Alignment	Comments
Human Factors Considerations for Integrated Tools		
31) Develop advanced information sharing and display concepts for the design of integrated decision- support tools. Develop strategies for information representation and display that enable people to maintain situation awareness regarding weather and traffic impacts, develop shared mental models, and evaluate inputs to the decision process provided by technology. Of particular importance is the need to conduct research on strategies for representing integrating and displaying probabilistic information about uncertainty regarding weather and traffic constraints and its predicted impacts as a function of look-ahead time. Equally important is the need to research new strategies for risk management that make use of such information. Research on the effective use of probabilistic information by ATC, TFM, and AOC/FOCs is a major challenge that needs to commence in the near term in order to obtain short term benefits and to enable more powerful solutions in the longer term. This research need to consider human factors (see C-5) as well as technology development challenges.		

REDAC Recommendation	Integration Plan Alignment	Comments
32) Develop new approaches and strategies for effective distributed decision making and cooperative problem solving. Develop effective strategies and technologies (decision support and communication tools) to enable distributed decision making to address the interaction of weather and traffic constraints, and to adaptively respond to situations as they evolve. This requires consideration of cognitive complexity, workload, and the ability of people to develop and maintain necessary levels of skill and expertise. It requires consideration of the need to design a resilient system that provides effective safety nets. And it requires system engineering decisions concerning when to design the system to provide coordination as a result of the completion of independent subtasks and when to design the system to support collaboration in order to ensure that important interactions occur. Develop technologies that support cooperative problem solving environments that allow people to work interactively with decision support technologies and with each other to assess situations as they develop, and to interactively generate and evaluate potential solutions.		
33) Develop methods for implementing human-centered designs for decision support tools. Develop effective procedures and technologies to ensure effective communication and coordination in the implementation and adaptation of plans in this widely distributed work system that includes meteorologists, traffic managers, controllers, dispatchers, ramp controllers and pilots.		

REDAC Recommendation	Integration Plan Alignment	Comments
34) Proactively enable new training on integrated tools. The FAA and aviation industry should proactively develop training curricula for controllers, traffic managers, pilots, dispatchers, and weather personnel which cover - The new roles and responsibilities in the use of supporting technologies. - The roles, responsibilities and expectations of other decision makers with whom each group must interface. - The training doctrine, developed in concert with the integrated tools development, leveraging that real-world experience to maximize early benefits and refinements. - The training cadre, deployed to all major new facilities as the tools are deployed to both assist in training and to maximize early benefits and identify problems. The resulting procedures and rules must be translated into controlling documents such as the Federal Air Regulations (FARs), the Airman Information Manual (AIM), Air Traffic Manuals, Flight Manuals, and Aircraft Manuals.		

REDAC Recommendation	Integration Plan Alignment	Comments
35) Identify best weather practices of air traffic facilities and train these practices system wide. Identify facilities with superior performance and develop best practices guidance for use by other facilities. Do not limit benchmarking to NAS facilities only. Seek global examples and new visions of innovative weather management techniques. Develop and train ARTCC and TRACON ATC and TFM staff on "best practices" during the introduction and first five years of all new weather and weather-ATM integrated tools. Establish metrics which compare alternative processes.		
Implications on Airline Operations Centers		
36) Ensure strong industry participation in CDM and NextGen concept development and implementation and consider expanding industry participation on review boards. Industry must have voice and buy-in to future developments to ensure that internal corporate infrastructure and business systems can support, blend with and interact effectively with the NAS service provider systems. Joint development of these systems is possibly the key component of a successful future capability.		

REDAC Recommendation	Integration Plan Alignment	Comments
Implications on FAA and NextGen Enterprise Architectures		
37) Ensure that direct ATM automation-weather integration is a key focus of the development of OEP/NAS Enterprise Architecture operational and technical views for the transition to NextGen. To achieve the capacity and safety goals for NextGen, weather and ATM automation developments must become aligned and focused to define the operational and system views for the evolution to highly automated weather impact analysis and solution-generation system, where the human operators are no longer the "glue" for trajectory level decisions. This is a necessary and fundamental shift from today where weather display and human interpretations the norm. The resultant operational and technical views must be reflected in the OEP and companion NAS EA in order to enable timely investment decision on deploying these needed integrated automation-weather capabilities. This information must also be (constantly) coordinated with NextGen concept and EA development to ensure consistency.		

REDAC Recommendation	Integration Plan Alignment	Comments
Implications on FAA Aviation Weather Research Program		
38) Support for the AWRP should be increased beyond previous levels. Support for the AWRP should be increased to enable further improvements in the 0-8 hour forecast time frame, and to allow the weather research community to enter into joint collaborations with the automation research community in integration of weather information into ATM DSS. Additionally, the FAA ATO-P organization should reexamine the R&D goals for AWRP in light of the needs of NextGen. Support for the National Ceiling and Visibility Program should be restored. Related efforts to support and benefit individual sectors of the industry should be prioritized and addressed. For example: 1. Development of the Helicopter Emergency Medical Evacuation System (HEMS) tool. 2. Rewriting FAR 121 limitations regarding Ceiling and Visibility such as FAR 121.619 (also known as the “1, 2, 3 Rule” for alternate fuel specifications		
39) Conduct research to develop improved methods of sensing turbulence taking advantage of a multi-sensor approach using radar, profilers, anemometers, satellite imagery, GPS, and instrumented aircraft to improve the forecasting and now casting of convective and non-convective turbulence.		

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D-2. Integration Plan Alignment with Weather ATM Integration Conference Recommendations

Wx ATM Integration Conference Recommendation	Integration Plan Alignment	Comments
NextGen Weather Group		
Policy Issues		
1) Develop an information paper that describes the 4-D Wx SAS and 4D Wx Data Cube and their relationship.		
2) A dedicated team needs to focus on the scope and content of the 4-D Wx SAS.		
Research and Development		
3) Encourage industry to participate in NextGen Weather IOC development team efforts to identify domain authority, standards, catalogs, ontologies, etc.		
4) Work with non-federal organizations to identify how to incorporate their sensor information into the 4D Wx Data Cube.		
Simulations and Demonstrations		
5) Accomplish a demonstration to see if we can collect additional weather data from on-board and ground sensors and transfer it to government system(s) in a net-centric manner.		
6) Have the NEO, Aircraft, and Weather Working Groups sponsor a team to identify options of how we get information into the cockpit		
Performance Metrics		
7) Have weather SMEs review how the reliability of the cube can be demonstrated to operational users		
8) Task the Airport and Air Navigation Services Working Groups to set DST quality and reliability as they identify new tools that will be developed.		

Wx ATM Integration Conference Recommendation	Integration Plan Alignment	Comments
Airport Operations Group		
Policy Initiatives		
9) Data sharing agreements need to be reviewed and updated. Effective communication and information/data sharing, across all levels, is critical.		
10) Weather information needs to be translated into impact information specific to user needs.		
11) Operational users need to be involved in the entire requirements process		
12) Use liquid equivalent water instead of visibility to determine deicing needs and holdover times.		
Research and Development		
13) Legacy system integration is very important. Prioritize legacy system value according to NextGen requirements		
14) Improve runway forecasts accuracy and reliability. Address runway sensors that are non-representative of actual conditions.		
15) Need to take into account an integrated approach to weather impacts on airport parking, terminal and ramp areas, surface maneuvering of all vehicles, as well as aircraft. Develop and validate a requirements matrix to address user needs for weather as integrated with various surface movement operations.		
Simulations and Demonstrations		
16) Investigate use of the “Theory of Serious Games” for simulation development.		
17) Demonstrate integrated weather for winter operations at ORD		
18) Derive and validate metrics from operational users. Determine metrics of value from operational personnel		

Wx ATM Integration Conference Recommendation	Integration Plan Alignment	Comments
Trajectory Operations Based Group		
Policy Issues		
19) Establish a weather data standard that is compliant with ICAO standards and use this standard in TBO.		
20) Bring stakeholders together early in the development of TBO implementation roadmap to ensure weather integration at the inception. Do not follow the path of treating weather as an "add-on" in later phases of TBO development, as this will delay or negate the value of a fully-integrated solution that assimilates weather information.		
21) Establish policy that allows flexible trajectory re-negotiation as weather information is updated throughout the NAS.		
22) There is a need to establish policies that encourage NextGen users to incorporate capabilities that meet or exceed new performance-based standards. Develop an agency policy for user performance capabilities in parallel with policy that supports incentives across all stakeholders to meet or exceed performance standards.		
23) Develop agency policy that is adaptive to system performance increases as equipage evolves.		
24) Support efforts (including funding) devoted to the development of the single authoritative source concept, implementation, human factors (see C-5) and governance to enable NextGen TBO.		

Wx ATM Integration Conference Recommendation	Integration Plan Alignment	Comments
25) Existing policies are inadequate to support TBO including a number of factors such as the use of probabilistic weather forecasts, conflict resolution and data sharing. Develop policy for the use of probabilistic weather as it pertains to decision support tools and NextGen system users.		
26) Develop appropriate precedence and procedures to determine proper course of action an operator must make when conflicting weather information is presented.		
27) Make ATM data available to the research community at large to facilitate research and development efforts supporting NextGen.		
28) Find ways to test and implement new science and innovation into the NAS in an expedient manner to incorporate the latest technology.		
29) Carefully consider the affects of implementing NextGen concepts in terms of organizational changes. Identify "cross boundary" issues that affect more than one organization, and determine whether a new division of responsibilities is necessary prior to implementing NextGen concepts and systems.		
30) Define a transition strategy, but do not perpetuate traditional organizational responsibilities and relationships unless they clearly benefit the governance and operation of NextGen.		
31) There is a need to establish a certification or validation process for weather information that will be used in TBO. Develop a certification or validation process for weather information and forecasts used in the 4-D Wx SAS that test for reliability and recognized safety and traffic flow management conventions.		

Wx ATM Integration Conference Recommendation	Integration Plan Alignment	Comments
Research and Development		
32) Human reaction, response and risk of product use that contain integrated weather must be examined. Human factors (see C-5) research is needed to quantify the effects of inherent human conservatism and caution and the effect of inconsistent forecast skill on operational decision making.		
33) Conduct human factors (see C-5) research to understand how controllers will handle air traffic in a TBO world – specifically their reactions to weather that affects sector loading, controller workload, transition to dynamic sectors and delegation of separation responsibilities to the flight deck.		
34) Continue research to quantify predictions of pilot/controller actions when faced with current weather impacts.		
35) Understand the human-machine interface role for each stakeholder, including weather information integrated into a single display. Related research should eventually embrace the transition to complex technological systems designed for use with NextGen constructs.		
36) There is a need for research into how forecast uncertainty can be ‘partitioned’ into spatial and temporal elements as a possible way to quantify and reduce risk and impact of uncertainty and forecast errors.		
37) There is a need to determine who has the authority to take the risk and what are the allowed levels of action for both systemic approaches Traffic Management Initiative and individual trajectory negotiations (e.g., go/no go, red/green, or shades such as red/yellow/green, etc.).		
38) A weather translation model could be developed to select different convective forecast and now-cast products and assess how they help achieve a more accurate airspace capacity estimate – separately and as an ensemble forecast.		

Wx ATM Integration Conference Recommendation	Integration Plan Alignment	Comments
Additional research would be needed to determine how to validate and to determine the granularity (e.g., ARTCC/Sector/Flow/Airway/Gate/Fix).		
39) There is a need for operationally relevant research that translates and integrates weather forecast probability into language (e.g., triggers or sliding scales or time smears, etc.) that can be used by ATM tools.		
40) There is an overall need to determine weather performance requirements/characteristics for all stakeholders and decision support tools. There is a need to conduct applications research to identify and then match the performance of the weather information with user functional needs for TBO		
41) There is a need to conduct research that identifies the weather performance requirements for the entire environment in which TBO-based systems act (e.g., TBO performance changing triggers, how they change and by how much).		
42) There is research needed to quantify how to develop higher fidelity and standardized trajectory predictions with lower fidelity weather (i.e., what is good enough weather for a trajectory prediction and how does such fidelity change from operation to operation).		
43) There needs to be research conducted to determine if there are significant benefits (consistent with 5.2.6) in obtaining more accurate weather forecasts. There is a further need to identify tools, models (e.g., Numerical Weather Prediction), techniques, etc., that validate and measure the real or perceived improvements.		
44) There is a need to conduct TBO and weather research (e.g., time-based research) that overlaps with airport surface movement and weather research to understand and categorize wheels off departure/wheel on arrival times. This could be enhanced through the combined use of ground vehicles and aircraft sensors to determine position.		

Wx ATM Integration Conference Recommendation	Integration Plan Alignment	Comments
45) Research is needed to establish a set of agreed-upon thresholds that are not based on operations as described earlier, but based on aircraft performance and requirements for safe operation for weather phenomena such as icing for deicing, lightning for refueling, etc. Similar issues as previously identified emerge, such as what are the risk factors, who have authority to take the risk, levels of action (go/no go) or can there be shades (red/yellow/green).		
46) In the first (departure) or final (arrival) stages of TBO, research is needed to quantify the affects of weather on aircraft performance in 4DT SDO with regard to trajectory and arrival times in space and the ability to penetrate weather when there are the fewest options available for safe flight.		
47) Research is needed to understand the capabilities of the aircraft with respect to weather factors to reduce the uncertainty of meeting TBO objectives. In the worst-case weather scenarios, research is needed to define airspace which cannot be accessed based on high weather impact phenomena.		
48) In the (legacy) en route portion of TBO, research is needed to quantify the effects of aircraft trajectory performance based on convective (especially) and other (e.g., icing) weather characteristics. There is a need to know what aspects (echo tops, storm tops, cloud/visibility tops, turbulence, vertical impact altitudes, etc) most significantly affect aircraft performance from meeting time and space TBO objectives. There is a need to determine how much equipage and differing agency operations (civil vs. military) will play a role in meeting this objective.		
49) Research is needed to identify how weather forecast uncertainty and associated operational risks change over the entire course of the trajectory		
50) There is a need to conduct fundamental weather research regarding specific weather phenomena, over specific areas, occurring or lasting over a		

Wx ATM Integration Conference Recommendation	Integration Plan Alignment	Comments
range of times, and achieving and/or maintaining specific levels of magnitude that can impact TBO		
51) Applications research is additionally needed to identify important weather thresholds that trigger trajectory-based operation changes.		
Simulations and Demonstrations		
52) CDM between all decision makers (pilots, dispatchers, controllers) needs to be simulated under varied weather conditions and varied TBO activities to quantify relative workload on each, quantify response differences/reactions, and to quantify the relative flexibility (or not) to combined operations/impacting weather scenarios.		
53) Conduct simulations to explore information overload		
54) Simulations are needed to quantify TBO sensitivity to weather. This should include modeling or simulating the value of DST's over a range of weather fidelity or outcomes		
55) This also includes the simulation of weather probability translation upon TBO constructs (i.e., how each probability 'level' is translated and weighted within the DST components).		
56) The value of the integrated weather needs to be simulated and measured in terms of the metrics highlighted in question 6 or from a cost/benefit perspective. In this regard, the value of continued 'improvement' in weather information fidelity needs to be modeled against real or perceived 'improvement' in DST outputs.		
57) Simulations of NAS users operating in a mixed equipage mode need to be conducted to determine consequences and relative sensitivity of continued mixed equipage towards achieving TBO objectives.		
58) The cost/benefit of optimal or minimal equipage needs to be simulated		
59) There needs to be simulations performed that		

Wx ATM Integration Conference Recommendation	Integration Plan Alignment	Comments
describe the cost to benefit of further improvements in weather products and forecasts beyond those so matched in informational integrity to TBO constructs. In this regard, there may be, for example trending routines that could be designed that allow more frequent weather updates to be time-based averaged before integrating.		
60) Simulate value of integrated weather with TBO by simulating various NAS performance measures (e.g., route timing, fuel savings, operational options, etc.) to determine sensitivity to weather.		
61) An approach to initial transition in general is to capture the experience of successful recent trials (e.g., ADS-B in Alaska) and extrapolate or leverage to achieve perceived NextGen benefits.		
62) There is a need to demonstrate both tactical and strategic use of probabilistic convective impacts under various levels of uncertainty		
63) There is a need to demonstrate the operational effectiveness of weather integrated DST's under various levels of uncertainty.		
64) There is a need to demonstrate operational value (tactical) to using predicted convection locations rather than planning based on current convection locations		
65) For more strategic assessment, there is a need to demonstrate effective risk management both for strategic TFM approaches and at the individual flight or trajectory level		
66) In the spirit of leveraging from current operations, demonstrations could be designed to use existing systems and begin rolling in new 'numeric' systems for integration of convective uncertainty forecasting.		
67) There is a need to demonstrate automation of dispatcher/controller/pilot/traffic manager actions – especially to demonstrate the optimization of routing around a weather obstruction. This could be demonstrated using a variety of weather information to determine the most optimal set for		

Wx ATM Integration Conference Recommendation	Integration Plan Alignment	Comments
final integration.		
68) There is a need to separately demonstrate then integrate the value of specific weather information – not just convection – as integrated into automated tools. The demonstrations needs to be separate for each stakeholder – cockpit, AOC/FOC, ATC, etc		
69) There is a need to demonstrate a sufficient number of off-nominal (bad weather) scenarios to test the boundaries of NextGen system adaptability		
70) There needs to be demonstrations that incorporate scenario-based research initiatives to help quantify, in a more strategic way, the potential risks prior to entering into these more tactical scenarios		
71) Related to both tactical and strategic focus, there needs to be follow-on demonstrations to illustrate what kinds of safety nets (i.e., fall back or alternative operations) are available when weather reaches such triggers (tactically) – or in a more strategic sense, at what point is the commitment made to continue a TBO given an availability of alternate (operational) options that will exist in the future.		
72) There needs to be various demonstrations that highlight the relative effects of weather forecast errors with trajectory prediction studies. This could be performed using canned wind forecasts having increasing degrees of error.		
73) There is a need to demonstrate the viability of the 4D Wx Data Cube and 4-D Wx SAS and to show the risks (costs/safety) associated with *not* having “NextGen Weather”.		
74) Trajectories in the NAS should ultimately satisfy two objectives: - Separation from other trajectories by the minimum separation standard of the occupied airspace. Satisfaction of this objective is generally best defined by the ANSP. - The user-preferred trajectory provides optimum		

Wx ATM Integration Conference Recommendation	Integration Plan Alignment	Comments
cost and satisfaction of other operator defined objectives such as safety of flight, passenger comfort and emissions. These are generally objectives best defined by the system user.		
Super Density Operations		
Policy Issues		
75) Re-examine the ADS-B 'IN' timeline. It may need to be accelerated if we are going to more fully realize NextGen benefits, including NextGen Weather integration, by 2025.		
Research and Development		
76) Perform analysis/research to determine SDO weather and weather translation requirements for NextGen. Near-term efforts should include: - Analyze all NextGen SDO operational improvements to see how weather impacts them - Analyze sensitivity of NextGen SDO procedures and decision support tools to winds aloft in order to establish weather observation and forecast requirements - Determine how SDO differ with location (e.g., major airports, Metroplexes) in order to better understand their unique NextGen requirements		
77) Send weather integration researchers into the field to learn current deterministic SDO strategies, so that they are better able to develop more strategic SDO weather integration concepts/capabilities.		
Simulations and Demonstrations		
78) Establish a mechanism to solve SDO problems (through joint community involvement). This could include the use of integration laboratories (to include weather integration) and computer simulations to better understand the problems we need to address in implementing NextGen.		

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