APPENDIX A. ACRONYMS

Acronym/Abbreviation	Definition
4-D Wx Data Cube	Four Dimensional Weather Data Cube
4-D Wx SAS	Four Dimensional Weather Single Authoritative Source
ADDS	Aviation Digital Display System
AIRMET	Airman's Meteorological Advisories
AMS	Acquisition Management Strategy (FAA)
AMS	American Meteorological Society
ANC	AutoNowCaster
ANSP	Air Navigation Service Provider
AOC	Air and Space Operations Center
ASOS	Automated Surface Observing System
ATC	Air Traffic Control
ATM	Air Traffic Management
ATO	Air Traffic Organization (FAA)
AWC	Aviation Weather Center
AWOS	Automated Weather Observing System
AWRP	Aviation Weather Research Program (FAA)
C&V	Ceiling and Visibility
CCFP	Collaborative Convective Forecast Product
CDM	Collaborative Decision Making
CIP/FIP	Current/Forecast Icing Potential
CIWS	Corridor Integrated Weather System
CMP	Configuration Management Plan
COI	Community of Interest
ConOps	Concept of Operations
CONUS	Continental United States
CoSPA	Consolidated Storm Prediction for Aviation
CRP	Complex Retrieval Process
CSDGM	Content Standard for Digital Geospatial Metadata
DOC	Department of Commerce
DOD	Department of Defense
DODAF	DOD Architecture Framework
DOT	Department of Transportation
DST	Decision Support Tool
EA	Enterprise Architecture
ebXML	Electronic Business using XML
EC	Executive Committee
EI	Environmental Information
ES	Enterprise Service
EXI	Efficient XML Interchange
FAA	Federal Aviation Administration
FAR	Federal Aviation Regulation
FEAF	Federal Enterprise Architecture Framework
FGDC	Federal Geographic Data Committee
FOC	Full Operational Capability
FTE	Full-Time Equivalents
G-AIRMET	Graphical AIRMET
GIG	Global Information Grid
GOES-R	Geostationary Operational Environmental Satellite – Series R
GTG	Graphical Turbulence Guidance
IC4D	Interactive Calibration in Four Dimensions
ICAO	International Civil Aviation Organization
IOC	Initial Operating Capability

Acronym/Abbreviation	Definition
ISO	International Organization for Standardization
IT	Information Technology
ITES	Information Technology/Enterprise Services
IWP	Integrated Work Plan
JMBL	Joint METOC Broker Language
JMCDM	Joint METOC Conceptual Data Model
JMDB	Joint METOC Data Base
JPDO	Joint Planning and Development Office
LAMP	Localized Aviation Model Output Statistics
MDL	Meteorological Development Laboratory
METOC	Meteorology and Oceanography
MITL	Meteorologist-In-The-Loop
MOC	Mid-Term Operational Capability
MOS	Model Output Statistics
MOTL	Meteorologist-Over-The-Loop
NAS	National Airspace System
NASA	National Aeronautics and Space Administration
NCV	National Ceiling & Visibility
NDFD	National Digital Forecast Database
NEO	Net Enabled Operations
NEVS	Network-Enabled Verification Service
NEWP	NextGen Executive Weather Panel
NEXRAD	Next Generation Radar
NextGen	Next Generation Air Transportation System
NNEW	NextGen Net-Enabled Weather
NOAA	National Oceanic and Atmospheric Administration
NPOESS	National Polar-orbiting Operational Environmental Satellite System
NWEC	NextGen Weather Evaluation Capability
NWP	Numerical Weather Prediction
NWS	National Weather Service
OASIS	Organization for the Advancement of Structured Information Standards
OGC	Open Geospatial Consortium
OI	Operational Improvement
OMB	Office of Management & Budget
OSIP	Operations Services Improvement Process
OT&E	Operational Test & Evaluation
PIREPS	Pilot Reports
PMP	Program Management Plan
PNT	Position, Navigation, Timing Services
PPBES	Planning, Programming, Budgeting and Execution System
QA/QC	Quality Assurance/Quality Control
QICP	Qualified Internet Communications Provider
R&D	Research and Development
RMP	Risk Management Plan
SAS	Single Authoritative Source
SIGMETS	Significant Meteorological Information
SOA	System Oriented Architecture
SOAP	Simple Object Access Protocol
SPC	JPDO Senior Policy Committee
STD	Standard
SWIM	System-Wide Information Management
TAF	Terminal Area Forecast
TDWR	Terminal Doppler Weather Radar
TFM	Traffic Flow Management
USAF	US Air Force
WAFC	World Area Forecast Center

Acronym/Abbreviation	Definition
WAFS	World Area Forecast System
WBS	Work Breakdown Structure
WCS	Web Coverage Service
WFS	Web Feature Service
Wx	Weather
XML	Extensible Markup Language

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APPENDIX B. LEXICON

VERBS

Term	Definition
Accept	To receive or contain.
Acquire	To come into the possession of something concrete or abstract.
Analyze	To examine carefully and in detail so as to identify causes, key factors, possible results, and so on.
Archive	To place or store in an archive; see definition under Nouns.
Assimilate	To become absorbed or incorporated into the system.
Average	To find an average value for (a variable quantity); reduce to a mean.
Backup	To make copies of weather information to protect against loss of needed data.
Calculate	To determine or ascertain by mathematical methods; compute.
Catalog	To accept measurements of atmospheric conditions and associate the time and location of the observation with the measurement data.
Collect	To bring together in a group or mass; gather.
Compare	To examine in order to note the similarities or differences of.
Derive	To arrive at by reasoning; deduce or infer.
Detect	To discover or ascertain the existence, presence, or fact of.
Determine	To establish or ascertain definitely, as after consideration, investigation, or calculation.
Forecast	To estimate or calculate in advance, especially to predict (weather conditions) by analysis of meteorological data.
Fuse	To unite or blend into a whole, as if by melting together.
Generate	To produce something according to an algorithm or program or set of rules.
Impact	To affect aviation in either a positive (e.g., tail wind) or negative (e.g., hazardous weather) manner.
Ingest (Weather)	To take in weather data (or product) for the purpose of integration and/or processing.
Initialize	To set (as a computer program counter) to a starting position, value, or configuration.
Integrate	To make into a whole by bringing all parts together; unify. To make part of a larger unit.
Interpolate	To estimate mathematically the value of a weather parameter in between two known values on a grid.
Interpret	To determine or ascertain something in understandable terms from that which is not intuitively obvious (e.g., possible limit on who can perform—for weather, a meteorologist).
Issue	To put forth or distribute, usually officially.
Manage	To handle, direct, govern, or control in action or use.
Measure	To ascertain the extent, dimensions, quantity, capacity, etc., of, especially by comparison with a standard.
Merge	To combine or unite into a single enterprise, organization, body, etc.
Observe	To watch, view, or note for a scientific, official, or other special purpose.
Observe (Detect)	To evaluate or measure, by human or automated means, one or more meteorological parameters (e.g., temperature, wind speed/direction, visibility, precipitation) that describe the state of the atmosphere either at the Earth's surface or aloft.
Overlay	To superimpose one or more images over a common background.
Perform	To carry out; execute; do.
Predict	To determine 4-D state of an atmospheric parameter(s).
Prepare	To manufacture, compound, or compose.
Present	To convey information.
Process	To handle (e.g., papers, records) by systematically organizing them, recording or making notations on them, following up with appropriate action, or the like.
Protect	To secure or preserve against encroachment, infringement, restriction, or violation.
Provide	To make available; furnish.
Publish	To issue (as, a product) for public distribution or access. The act of publishing often includes the addition or updating of an entry in a data directory or catalog that is accessible to the user

Term	Definition
	community. Such directory or catalog entries publicize the availability of data to subscribers or other potential users, and occasionally even instruct them on where the product can be acquired.
Quality Control (QC)	To use a system for verifying and maintaining a desired level of quality in a product or process by careful planning, use of proper equipment, continued inspection, and corrective action as required.
Quantify	To express as a number or measure or quantity.
Receive	To have delivered or brought to one.
Refine	To improve the result by increasing product resolution or accuracy, or increasing product detail.
Reformat	To reshape, resize, or alter the form or appearance of data or product.
Request	To inquire for (information).
Request/Reply	To ask for an unscheduled weather product (or information) and receive it in a timely manner.
Respond	To act in return or in answer.
Retain	To store or archive for future use. (Note: see definition of “store” or “archive” for amount of time retained.)
Retrieve	To locate and read (data) from storage.
Run	To process, refine, manufacture, or subject to an analysis or treatment.
Select	To choose or make a choice.
Standardize	To establish agreed-on criteria or values governing the accepted use of data or information.
Store	To copy (data) into memory or onto a storage device (short trend as opposed to archiving).
Store (Weather)	To retain for short time (< 2 days) for purpose of enhancing interpretation (e.g., weather image looping, trending).
Subscribe	To establish an ongoing agreement whereby the user (subscriber) receives one copy of each edition or version of one or more data products, or receives one version of a data product at some agreed-on frequency.
Sum	To combine into an aggregate or total.
Support	To maintain (e.g., a person, family, establishment, institution) by supplying with things necessary to existence.
Tailor	To adapt product or information output for a particular use.
Update	To incorporate new or more accurate information in, for example, a database, program, or procedure.
Verify	To determine the accuracy of a weather forecast by comparing the predicted weather with the observed weather of the forecast period.

NOUNS AND OTHER TERMS

Term	Definition
4-Dimensional State (4-D) (Weather)	In the context of weather, the three dimensions of space, plus that of time (forecast value of a parameter in the future).
4-Dimensional Weather Data Cube (4-D Wx Data Cube)	All unclassified weather information used directly and indirectly for aviation decisions. It contains all relevant aviation weather information formed from the collection of observations, automated gridded products, models, climatological data, and human forecasters from public and private sources. The 4-D Wx Data Cube is composed of text products, graphic products, and machine-readable products. It contains products in the public domain and products that are proprietary. It also contains domestic and nondomestic weather information. The production of the 4-D Wx Data Cube and its utilization by NAS users' applications operationally is the essence of NextGen weather capabilities.

Term	Definition
4-Dimensional Weather Single Authoritative Source (4-D Wx SAS)	Single, standardized source of a parameter of weather information used for making air transportation management decisions. The source is designated by the domain authority as the authoritative source so that service providers and users will access common weather information for making air traffic management (ATM) decisions. Each type of information can have its own authoritative source. For example, information taken directly from a numerical model may be the authoritative source for forecast winds and temperatures, whereas airport wind and temperature sensors may be the authoritative sources for current terminal winds and temperatures. The authoritative source provides the information used by default. Users *other than ATM* personnel may occasionally decide to use information other than that from the authoritative source (e.g., an airline may use a forecast from its own meteorology department); however, in so doing, they are aware of the authoritative source and they are opting to override and deviate from the default. The 4-D Wx SAS data are in the public domain and available to all users.
Accuracy	Ability of a measurement to match the actual value of the quantity being measured.
Advisory (Weather)	Abbreviated plain-language product or a statement from a federal actor concerning the occurrence or expected occurrence of weather phenomena that may be hazardous or that may affect the safety of aircraft operations.
Air Traffic Management (ATM)	Dynamic, integrated management of air traffic and airspace—safely, economically, and efficiently—through the provision of facilities and seamless services in collaboration with all parties.
Analysis	Projection of the state of the atmosphere (or any system) as known from a finite set of imperfect, irregularly distributed observations onto a regular grid, or to represent the atmospheric state by the amplitude of standard mathematical functions.
Availability	Readiness for use; that is, degree to which a system, subsystem, or equipment is operable and in a committable state for a mission or purpose. The proportion of time a system is in a functioning condition. Typical availability objectives are specified either in decimal fractions, such as 0.9998, or sometimes in a logarithmic unit called “nines,” which corresponds roughly to a number of nines following the decimal point, such as “five nines” for 0.99999 availability.
Climatology	Thorough, quantitative descriptions of climate, particularly with reference to tables and charts that show characteristic values of weather parameters at a station or over an area. In this paper, we often refer to aeronautical climatology, which is the application of the data and techniques of climatology to aviation meteorological problems.
Common Operating Picture (COP)	Single identical collection of relevant information shared by more than one command. A COP facilitates collaborative planning and helps all echelons to achieve situational awareness.
Consistency	Coherent representation of the physical atmosphere.
Critical Service	Function or service which, if lost, would prevent the National Airspace System (NAS) from exercising safe separation and control over aircraft.
Data (Generic)	Facts, concepts, or instructions represented in a formalized manner suitable for communication, interpretation, or processing by human or automated means.
Data (Model)	Output from a weather computer model (e.g., analyses and forecasts of weather parameters).
Data (Weather)	Data (weather) acquired directly from a sensor (or observed by a human) that has had minimal processing, only formatting or QC; can be in human-readable (text) form or can require additional processing (e.g., radar imagery, gridded data) to be useful.
Data (Weather) (Historical)	Archived weather data that relates characteristic values for meteorological parameters with respect to a particular time (day or hour), place, and season, as opposed to (and distinct from) climatology, which represents an average over time.
Data (Weather) (Trend)	Recent weather data (observations) or weather products arranged/displayed chronologically for viewing to readily discern patterns or behavior
Decision Support Tool (DST)	Tool that incorporates observations, forecasts, model/algorithm data, and climatology, including surface observations and weather aloft, to allow full integration of weather into traffic flow decision-making.
Diagnosis	See entry entitled “Analysis.”
Digital	Expressed in numerical form, especially for use by a computer.

Term	Definition
Domain Authority	Lead office or position sanctioned to define the authoritative weather parameter data sources for a given domain, such as the continental United States (CONUS) atmospheric, European atmospheric, or space domains. To prevent potentially conflicting weather information from being provided to various decision-makers (within the ATM community), the domain authority defines and implements clear operating rules for determining the data source to be used for a given time, location, and application. The domain authority will implement operating rules, which could change with time (e.g., seasonally or during phases of the solar cycle) and with model upgrades. Examples include selecting the numerical model or ensemble with the best performance statistics for a given location and season. The end goal is to ensure that all decision-makers who request weather information from the 4-D Wx SAS for a similar location, time, and application receive consistent information.
Efficiency	Ratio of the effective or useful output to the total input in any system.
Essential Service	Function or service that, if lost, would reduce the capability of the NAS to exercise safe separation and control over aircraft.
Flexibility	Ability to change (or be changed) to fit changed circumstances.
Forecast	Prediction of the future state of the atmosphere, with specific reference to one or more associated meteorological parameters.
Forecast (Deterministic)	Forecast governed by and predictable in terms of definite laws (e.g., dynamic equations), with the notion that there is at any instant exactly one future outcome (forecast). A deterministic forecast might be based on one specific outcome of a numerical weather prediction model (versus a probabilistic forecast, which might be based on an ensemble member set).
Forecast (Probabilistic)	Forecast arrived at using stochastic processes and represented in probabilistic terms, such as in a probability density function (i.e., a statistical function that shows how the density of possible observations or forecasts in a population is distributed) or a probability distribution function (i.e., a mathematical description of a random variable in terms of its admissible values and the probability associated, in an appropriate sense, with each value). In the field of numerical weather prediction, probabilistic forecasts are often arrived at based on evaluations or analyses of model ensembles.
Forecast Confidence	Confidence in a forecast, which is sometimes inferred or provided by ensemble forecasts, where a model run, in which members diverge, often corresponds to a lower forecast certainty, whereas member convergence implies or indicates a higher forecast certainty.
Function (System Engineering)	Characteristic action or activity that must be performed to achieve a desired objective or stakeholder need.
Geo-Referenced	Defined or specified in physical space. Related (e.g., via one or more coordinate systems or map projections) to a position relative to the Earth. In a geographic information system (GIS), a system for capturing, storing, analyzing, and managing data and associated attributes that are spatially referenced to the Earth. The association of geophysical data (e.g., image data or grid points) to some geographic control framework (e.g., specifying the location by its latitude, longitude, and altitude above mean sea level).
Geosynchronous	Any equatorial satellite with an orbital velocity equal to the rotational velocity of the Earth. The net effect is that the satellite is virtually motionless with respect to an observer on the ground.
Impact	Effect of weather on NAS safety or capacity.
Input (Weather)	Weather data (usually formatted) “ingested” by an algorithm or computer model.
Latency	In information processing and dissemination, the time required for an event to occur. This event might be attributed to database access times, computer processing times, and network or communication lags (e.g., time taken for a data packet to be sent by an application and received by another application). Such events might include, for example— 1. The time elapsed between the moment a user requests a product and the moment the product is delivered to that user’s system. 2. The time elapsed between the moment a new product is available on some central server and the moment that a subscriber of that product receives a complete copy of that product. 3. The time elapsed between the moment a central database is updated and the moment a user is informed that new information is available. 4. The time elapsed between the moment an observation is taken by a sensor system (e.g., a surface observation or a weather radar) and the moment that observation is available to a user.

Term	Definition
Machine-Readable	Suitable for feeding directly into a computer. Information encoded in a form that can be read (i.e., scanned/sensed) by a machine/computer and interpreted by the machine's hardware and/or software. Common machine-readable data storage and data transmission technologies are processing waveforms, optical character recognition (OCR), and barcodes.
Meta Tag	Commonly used to describe the contents of a Web page. May be either description or keyword meta tag. Most search engines use this data when adding pages to their search index.
Metadata	Structured information that describes, explains, locates, or otherwise makes it easier to retrieve, use, or manage an information resource. Metadata is often called "data about data."
Model (Weather)	Description or analogy used to help visualize something that cannot be observed directly (generic). For Weather—See entry entitled "Weather Model."
National Airspace System (NAS)	Common network of U.S. airspace; air navigation facilities, equipment and services, airports, or landing areas; aeronautical charts, information, and services; rules, regulations, and procedures; technical information; and manpower and material. Included are system components shared jointly with the military.
Need	User stated capability necessary to accomplish a task or mission.
Network-Enabled Operations (NEO)	Decision support and other applications using NEI for information transfer and retrieval.
Operational Decision-maker	Within FAA, an air traffic controller, traffic management specialist, or flight service specialist. Outside the FAA, a pilot or dispatcher.
Output	Products or information from a computer (e.g., weather model, algorithm) generated for dissemination.
Position	Position represents the location of an object in space. Position can be represented via coordinates (e.g., xyz, for East-West, North-South, and altitude) or via various GIS representations (e.g., shape files).
Predictability	Extent to which future states of a system may be predicted based on knowledge of current and past states of the system. Because knowledge of the system's past and current states is often imperfect, as are models that use this knowledge to produce a prediction, predictability is inherently limited. Even with arbitrarily accurate models and observations, limits to the predictability of a physical system may still exist.
Private Weather Providers	Business organizations that supply weather information, generally for a profit. Such organizations are outside the public (government) and voluntary sectors. Weather information from such private weather providers may occasionally have restrictions on access, use, and redistribution.
Process (Weather)	Series of actions or functions (e.g., data assimilation, analysis, and product generation).
Product (Weather)	Output tailored for use by a meteorologist or a decision-maker; may not require meteorological training to interpret.
Representative	Serving as a typical or characteristic example.
Requirement (Weather)	Weather need that has undergone a validation process, such a requirement to support a FAA decision-maker function.
Resolution	1. Degree to which nearly equal values of a quantity can be discriminated. 2. Smallest measurable change in a quantity. 3. Least value of a measured quantity that can be distinguished. 4. Formal inference rule permitting computer programs to reason logically.
Resolution (Spatial)	Degree to which nearly equal values of a quantity can be discriminated in space. The smallest measurable change in a quantity. The least value of a measured quantity that can be distinguished. For gridded products, the distance between two grid points (e.g., in the horizontal and vertical dimensions).
Resolution (Time)	Degree to which nearly equal values of a quantity can be discriminated in time. The smallest measurable change in a quantity. The least value of a measured quantity that can be distinguished. For gridded products, the temporal difference (e.g., in seconds or hours) between two successive grids.

Term	Definition
Risk (in relation to vulnerability, threat probability, and impact)	Concept that denotes a potential negative impact to an asset or some characteristic of value that may arise from some present process or future event. The probability of a known or plausible harm or loss. The possibility of an event occurring that will have an impact on the achievement of objectives. Risk is measured in terms of impact and likelihood. For large information technology systems, there are potentially numerous risks. A few examples of risk areas are security threats (e.g., system intrusion, malicious software, denial of service), physical or facilities risks (e.g., related to power, environmental controls, physical access), maintainability risks (e.g., availability of hardware equipment replacement parts, software maintenance or operator support), and business/administrative risks (e.g., organizational and management support for system functions).
Service Provider	For FAA, an air traffic controller, traffic management specialist, or flight service specialist; also meteorological personnel providing aviation support (government or vendor).
Statistical Reliability	Consistency of a set of measurements or forecasts. The extent to which the forecasts remain consistent over repeated simulations with permutated initial conditions or with variable (plausible) model physics. Reliability does not necessarily imply validity. That is, a reliable measure is measuring something consistently, but not necessarily what it is supposed to be measuring. The expected reliability of weather forecasts shows drastic variations depending on the daily flow configuration. On certain days, a 10-day forecast might have highly predictable features in it; on other days, a 3-day forecast might have features that have very little or no predictability. Ensemble forecasts can identify at the time a forecast is prepared how much predictability a particular weather feature has, given the initial uncertainty in the analysis and the time evolution of the possible atmospheric states up to a particular lead time of interest.
Sufficiency	Quantity (enough) or quality of data for processing leading to product generation.
Threshold	Value that, when passed, from below or above, initiates or limits an action For example, if a temperature goes above a preset threshold level, it might trigger an automated surface observing system [ASOS] to make a special observation; or if the RVR goes below a preset threshold level, a pilot may not be able to land at a specific airport.
Time	Value in the non-spatial dimension associated with an event. The non-spatial dimension describes a continuum in which events occur in apparently irreversible succession from the past through the present to the future. Time is used to synchronize activities throughout the NextGen.
Time Referenced	Associated with a particular moment in time or a time period. For example, temperature analysis grid valid at 1200 UTC on a particular day; radar image time valid over a 1-minute period between 1200 and 1201 UTC; model forecast temperature grid valid at 48 hours in the future (relative to a reference time).
User	Service provider or end user that needs weather product(s) or information to perform an aviation-related function.
User Access	User's ability to communicate with, especially by computer, products, information, and other users.
Warning	Issued when a hazardous weather or hydrologic event is occurring, is imminent, or has a very high probability of occurring. A warning is used for conditions posing a threat to life or property.
Watch	Issued when the risk of a hazardous weather or hydrologic event has increased significantly, but its occurrence, location, and/or timing are still uncertain. It is intended to provide enough lead time so that those who need to set their plans in motion can do so.
Weather	Category of individual and combined atmospheric phenomena that must be drawn on to describe the local atmospheric conditions at a specific time.
Weather Data	See entry entitled "Data (Weather)."
Weather Element	Any one of the observable properties of the atmosphere (i.e., temperature, humidity, precipitation), which together specify the physical state of weather or climate at a given place for any particular moment or period of time
Weather Information (classified)	Data withheld (i.e., of strictly limited availability and distribution) for national security reasons.

Term	Definition
Weather Information (unclassified)	4-D Wx Data Cube data (used directly and indirectly for aviation decisions) that is not classified. Note that this includes freely available public domain weather information, as well as data restricted for reasons other than a classified rating (e.g., regulatory or proprietary information).
Weather Information (proprietary)	Information over which private ownership and control are exercised. This information may still be in the 4-D Wx Data Cube, but in general, access to it and/or its dissemination is controlled.
Weather Information (public domain)	Weather information in the 4-D Wx Data Cube whose access is unrestricted. This includes information whose visibility and use is not limited because it is unclassified, proprietary, or restricted regulatory.
Weather Model	Software program or application that uses algorithms generally used for numerical weather diagnosis and prediction (e.g., RUC, AVN, ETA).
World Area Forecast System (WAFS)	Program developed by the International Civil Aviation Organization (ICAO) and the World Meteorological Organization (WMO) to improve the quality and consistency of en route guidance provided for international aircraft operations. Currently, two World Area Forecast Centers (WAFC), one in the United States and one in the United Kingdom, are providing en route wind and temperature forecasts and some significant weather charts. In the final phase of the WAFS, en route significant weather forecasting responsibilities also will be fully transferred to the two WAFCs. WAFC-Washington is responsible for satellite data broadcasts to the Americas, the Atlantic, the Pacific, and Eastern Asia Backup. WAFC-London is responsible for broadcasts to Europe, Africa, and western Asia.

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APPENDIX C. DETAILED PROGRAM PLAN FOR 4-D WEATHER DATA CUBE INITIAL OPERATIONAL CAPABILITY

1. Program Management

Reference: WBS 1

Description: This task defines the execution of the necessary management activities that support and guide the WBS. This includes coordination within and interagency coordination, as well as coordination with other JPDO working groups. The team will ensure agency tasks are aligned with the plan and there is no duplication between agencies. It includes the coordination and oversight of contract staff and all procurement activities.

Objectives

- FY09
  - Stand-up rigorous program management structure
- FY10
  - Formalize execution processes
  - Develop acquisition strategies
  - Complete supporting management plans
- FY11
  - Interface control documents approved and base-lined
- FY12
  - Test plan complete
- FY13
  - Manage deployment and development of follow on capabilities

Time frame: Ongoing

Deliverables: Deliverables under this task include, but are not limited to, the following:

i. Quarterly Status reports
ii. Budget reports
iii. Budget updates and inputs to the budget planning process
iv. Tasking for contractors and staff for all sub-tasks
v. Earned Values reports.
vi. Supporting Management Plans

Agency roles and responsibilities: Each agency will maintain a separate management structure responsible for planning and executing the tasks assigned by this plan. The overarching management structure is governed by the Cube Team, which is chaired by representatives from NOAA, FAA, DoD and Industry.

1.1 4-D Weather Data Cube IT Conops

Reference: WBS 1.1

Description: This document shall describe Information Technology (IT) aspects of the operation of the Cube, including the functional portion known as the Single Authoritative Source (SAS) for ATM decision-making These aspects include but are not limited to synchronization of distributed data sets, insertion and extraction services with respect to the Cube and the SAS, management of its metadata, domain authority methods including that which allows Meteorologists in the Loop (MITL)/Meteorologists over the Loop (MOTL) (see Appendix C, section 3.4.2), flexibility to accept new data sets, quality control operations, operational security, archiving requirements, and performance management.

Timeframes: July 2008 – April 2009

Inputs: Concept of Operations for the Next Generation Air Transportation System, version 2.0

Deliverables: 1) Final 4-D Weather Data Cube IT ConOps, 2) Adjudicated list of comments and questions from the previous iterations with action taken and reason that action was taken.

Exit Criteria: Publication of the Final 4-D Weather Data Cube IT ConOps.

Agency Roles and Responsibilities: NOAA will be the lead agency for this effort but the document will be developed with input from FAA and DoD. DoD will contribute their net centric IT operations expertise. Supporting input will come from R&D Community and Industry.

1.2 IT Requirements

Reference: WBS 1.2

Description: This activity will develop the detailed IT requirements for the Cube

Timeframes: June 2009 – December 2009

Inputs: 4-D Weather Data Cube IT ConOps, Four Dimensional Weather Functional Requirements for NextGen Air Traffic Management, NNEW/RWI Preliminary Portfolio Requirements, Performance Requirements

Deliverables: IT Requirements Document

Exit Criteria: Completed set of IT requirements

Agency Roles and Responsibilities: IT Requirements will be developed jointly by NOAA and FAA. DoD will assist.

1.3 Governance

Reference: WBS 1.3

Description: This task defines the overall Governance activities necessary to insure a successful IOC. Governance is a critical activity that spans multiple domains. Governance is applied to multiple levels with respect to the Cube. There is the overall governance of the Cube infrastructure, especially with respect to the physical configuration. There are also unique Governance issues associated with management of a Service Oriented Architecture (SOA).

1.3.1 Development of 4-D Weather Data Cube Governance Model

Reference: WBS 1.3.1

Description: This task defines the activities with defining the overall Governance Model of the Cube. The Governance Model defines the different domains and scope of Governance, the governing authorities, scope of decision making and escalation procedures.

Time Frame: February 2009 – April 2009

Inputs: None

Deliverables: White paper defining the Cube Governance Model.

Exit criteria: Acceptance of the white paper

Agency roles and responsibilities: This is a joint task, conducted jointly by the management and policy teams from each agency.

1.3.2 4-D Weather Data Cube Governance Structure

Reference: WBS 1.3.2

Description: This task defines the activities with defining The Governance Structure of the Cube. This includes definition of the membership, domain authority and scope of the decision making.

Time Frame: April 2009 – December 2009

Inputs: Governance Model White Paper.

Deliverables: White paper defining the Governance Structure

Exit criteria: Acceptance of the white paper

Agency roles and responsibilities: This activity is joint inter-agency activity. Participants include the NNEW IOC leadership Team, the Policy Team and representatives from the NCO Division.

1.3.3 Weather Information Regulatory Structure

Reference: WBS 1.3.3

Description: This task defines the regulatory structure governing the contents of the Cube, particularly the SAS.

Time Frame: December 2009 – August 2010

Inputs: None

Deliverables: White paper defining the Cube Governance Model.

Exit criteria: Acceptance of the white paper

Agency roles and responsibilities: This task will be lead by the FAA with support by the NOAA members of the EI team.

1.3.4 Develop SOA Governance

Reference: WBS 1.3.4

Description: This task defines the activities with defining the Governance of the SOA of the Cube. The SOA Governance first starts with defining the Community of Interest (COI), which includes users and owners of the systems that will contribute to the IT infrastructure of the Cube. Rules defining how services within the architecture will evolve, configuration management, and decision making authority will be defined during this task.

Time Frame: February 2009 – March 2010

Inputs: 4-D Cube Governance Model

Deliverables: White paper defining SOA, Governance, membership, domain and decision-making authority.

Exit criteria: Acceptance of the white paper

Agency roles and responsibilities: This is a joint interagency activity. Participation will be between members of the NCO Division, the ITEST and the NNEW IOC leadership team.

1.4 Program Management Plan

Reference: WBS 1.4

Description: This task will include all activities necessary to develop the 4-D Weather Data Cube Program Management Plan (PMP). The PMP will clearly define the roles, responsibilities, procedures, and processes required to execute, monitor, and control the Program. The PMP will address the program management processes to be used, how work will be executed to accomplish Program objectives, and the required performance measures to be used by participating organizations. The PMP will also address interagency coordination and support to ensure there is not duplication and that tasks are aligned.

Time frame: April 2009 - December 2009

Inputs: NextGen Weather Plan, agency specific management processes and requirements

Deliverables: Completed and approved Program Management Plan

Exit criteria: Baseline Program Management Plan approval

Agency roles and responsibilities: Each agency will maintain a separate management structure responsible for planning and executing the tasks assigned by this Plan. The overarching management structure is governed by the NextGen Network Enabled Weather (NNEW) IOC team, which is chaired by representatives from NOAA, FAA, DoD, and Industry. The overall management structure for the NextGen Weather Plan is shown in Figure 2.1.

1.5 Risk Management Plan

Reference: WBS 1.5

Description: This task will include all activities necessary to develop the 4-D Weather Data Cube Risk Management Plan (RMP). The RMP will define how risks are identified, managed and mitigated. The initial development of a risk register, which will be used to identify, track and resolve risks, is also included in this task.

Time frame: June 2009 – Jan 2010

Inputs: NextGen Weather Plan, agency specific risk management processes

Deliverables: Completed and approved Risk Management Plan and preliminary risk register

Exit criteria: Baseline Risk Management Plan approval

Agency roles and responsibilities: Each agency will participate in and contribute to the development of the RMP.

1.6 Configuration Management Plan

Reference: WBS 1.6

Description: This task will include all activities necessary to develop the 4-D Weather Data Cube Configuration Management Plan (CMP). The CMP will define the processes and procedures for managing required changes to the Cube Program. The CMP will include procedures for identifying needed changes, reviewing and approving changes, updating the plan baseline, and determining and documenting the impact of requested changes. The CMP will provide a clear, standardized process for managing changes in this Plan, requirements, cost estimates, and schedules.

Time frame: July 2009 – March 2010

Inputs: Program Management Plan, agency specific management processes and requirements

Deliverables: Completed and approved Configuration Management Plan

Exit criteria: Baseline Configuration Management Plan approval

Agency roles and responsibilities: Each agency will provide input to the Configuration Management Plan. The Configuration Management Process will be governed by the Cube Team. Consultation and approval for any major changes impacting the Program completion date or significant cost overruns will be provided by the WWG Executive Council and the NEWP.

1.7 Integrated Science Roadmap

Reference: WBS 1.7

Description: This task formulates an Integrated Science Roadmap of all sponsored activities within the participating agencies and contributors from private Industry. The roadmap will align activities enabling or directly related to aviation weather elements required for IOC, MOC, and FOC. Included will be the current, programmed, and out-year activities necessary to reach FOC as defined by the JPDO. This document will be updated annually to adjust for available funding and changing requirements.

Time frame: January - September 2009

Deliverables: Deliverables include an iterative approach to achieving a completed roadmap.

i. Retrospective science infusion to current state (three year retrospective), May '09
ii. Proposed IOC research, development, and operations July 1, 2009
iii. Proposed MOC research, development, and operations August 1, 2009
iv. Proposed FOC research, development, and operations September 1, 2009
v. Final assembled report September 30, 2009

Exit criteria: Completed and approved Integrated Science Roadmap.

Agency roles and responsibilities: DOC/NOAA will lead the development of an integrated roadmap with input from all partner agencies. Each agency will be required to maintain a separate science roadmap disclosing all current science plans including state of funding profile and risks.

1.8 Define Initial Operational Capabilities

1.8.1 Sources of IOC Content

Description: Data and information for the Cube arise from a number of sources, e.g., satellites, radar, automated weather observing systems, numerical weather prediction models of varying resolution and geographical coverage, algorithms for specific forecasts, and human-generated forecasts. This task is to determine which sources of weather information are to be included in the Cube.

Timeframes: January 2009 – June 2009

Inputs: Four-Dimensional Weather Functional Requirements for NextGen Air Traffic Management; FAA Performance Requirements; space-based measurements from Geostationary Operational Environmental Satellite – Series R (GOES-R) and National Polar-orbiting Operational Environmental Satellite System (NPOESS) capabilities; ground-based sensor direct-measurement capabilities, such as Automated Surface Observing System (ASOS)/Automated Weather Observing System (AWOS); ground-based remote sensing systems, such as Weather Surveillance Radar 88D (Also called the Next Generation Weather Radar (NEXRAD), Terminal Doppler Weather Radar, National Lightning Detection Network; aircraft measurements of weather; modeling capabilities from the National Centers for Environmental Prediction; forecast capabilities from centralized and dispersed locations.

Deliverable: Output is a description of data and information sources containing at minimum the following:

- Catalog of current agency observational systems with potential to contribute data to IOC capability
- Catalog of numerical weather prediction models with potential to contribute information to IOC capability
- Description of emerging data and information sources expected to be operational and able to contribute to IOC

- Estimates of product/data size

Exit Criterion: Weather data and information sources identified for integration into a network-enabled Cube.

Agency Roles and Responsibilities: NOAA will lead the collection of information regarding the disparate data sources available to the Cube for IOC with coordination from FAA, DoD, NASA, and members of the R&D community, including those from Industry.

1.8.2 IOC Content Definition

Description: The IOC state requires agency-coordinated definition to facilitate planning, programming, and budgeting. This task will define the aviation weather impact variables that will be present at IOC.

Timeframes: June 2008 – September 2012

Inputs: NextGen Integrated Work Plan (IWP), Four-Dimensional Weather Functional Requirements for NextGen Air Traffic Management, FAA Performance Requirements

Deliverables: Output is a yearly updated document containing at minimum the following:
- Identification of threshold IOC content, current or in development but approaching maturity. Threshold content represents the minimum environmental information committed for IOC.
- Identification of objective IOC content, current or in development but approaching maturity. Objective content represents additional environmental information that is desired or required in future builds of the net-enabled Cube but is not committed for IOC.
- Baseline of current agency capabilities to contribute aviation weather hazard information selected for IOC
- Identification of Research and Development (R&D) required to permit emerging techniques to mature for IOC

Milestones:
- Initial definition COMPLETED September 19, 2008
- Update September 30, 2009
- Update September 30, 2010
- Update September 30, 2011
- Final September 30, 2012

Exit Criteria: Each year, a plan detailing IOC content is finalized, approved by the Cube Team and each agency.

Agency Roles and Responsibilities: Participating agencies and the WWG will approve IOC content. Support and additional input will come from individual agencies and other NextGen working groups composed of members of the R&D community, including those from Industry.

1.9 Investment Analysis

Reference: WBS 1.9

Description: Agency specific investment analysis processes will be required to ensure stable funding and submission of NextGen Weather budget requests to the appropriate agency processes. Activities include cost-benefit analyses, OMB Exhibit 300s, budget narratives and defense documentation, and the preparation of materials required for appropriate key decision points.

1.9.1 FAA Investment Analysis

Reference: WBS 1.9.1

Description: The FAA Acquisition Management System (AMS) mandates a series of phases and decision points for FAA acquisitions. The FAA Program, NextGen Network Enabled Weather (NNEW), which will establish the FAA's portion of the Cube, has completed the Concept and Requirements Definition Phase and is now beginning the Investment Analysis Phase. There are two parts of this phase, Initial Investment Analysis and Final Investment Analysis. Approval at Final Investment Analysis provides authority for the Program to proceed with the acquisition and fielding of the necessary assets to establish FAA's portion of the Cube.

Timeframes: March 2008 – September 2011

Inputs: Artifacts developed in Concept and Requirements Definition

Deliverables: Various artifacts associated with Investment Analysis (e.g., OMB Exhibit 300)

Exit Criteria: Approval to proceed with acquisition

Agency Roles and Responsibilities: FAA will conduct its Investment Analysis, but must ensure that documents are consistent with this Plan and appropriately support partner activities and investments.

1.9.2 NOAA Investment Analysis

Reference: WBS 1.9.2

Description: This task will include all activities necessary to support NOAA's Planning, Programming, Budgeting and Execution System (PPBES) and NWS' Operations and Service Improvement Process (OSIP).

Time frame: January 2008 – December 2011

Inputs: NextGen Weather Plan, NextGen Weather Concept of Operations V1.0, NextGen Integrated Work Plan, V1.0, agency specific management processes and requirements

Deliverables: PPBES and OSIP required documentation (e.g., ConOps/Operational Requirements Document, Business Case Analysis, Annual Budget Narratives, OMB Exhibit 300

Exit criteria: NOAA 4-D Weather Data Cube Final Deployment Decision (OSIP Gate 4) complete

Agency roles and responsibilities: NOAA will be responsible for the generation and submission of all required documentation, but must ensure that documents are consistent with the NextGen Weather Plan and appropriately support partner activities and investments.

2.0 IT Services

The IT Services tasks encompass IT-related hardware and software lifecycle elements from specification of the multiagency, high-level architecture through operational test and evaluation (OT&E).

Security planning, implementation, and review will be ongoing tasks involving all participating agencies throughout design, development, deployment, and OT&E.

The architecture tasks will be carried out on two levels: A high-level architecture which will apply to all participating agencies, identifying interfaces and categories of data flows between them as well as components of the central Cube; and lower-level architectures for each agency which are relatively independent of each other in keeping with the nature of a SOA.

One category of software design and development encompasses the central Cube infrastructure and framework components. Those include a scalable registry system to enable registration, exposure, and discovery of services and an associated repository to persist the metadata defining the addresses and interfaces of those services. Translators and adapters to support seamless data request/response transactions between participants using possibly different data transfer languages also fall into this category.

Another category of software includes the underlying capabilities, services, and clients that participants will use and provide. Design and development of this software requires less coordination among participants in different agencies and offices. Definition and development of data formats and data transfer languages are included in this category.

One of the significant research and development efforts included in the IT Services category will be complex retrieval processing (CRPs). In traditional retrieval of gridded data, a gridded data set covering a rectangular parallelepiped bounded by specified maximum and minimum values of latitude, longitude, and altitude is requested. Such grids are requested for time steps throughout the period of interest. If a decision maker requests such a data set to cover the time and path of a flight plan covering a thousand kilometers or so, the amount of data requested is very large; and most of it is of no value to the decision maker. CRP will allow the decision maker to retrieve only the data along the aircraft's planned four-dimensional trajectory.

The usability of the Cube will depend critically on its performance, so performance analysis, testing, monitoring, and enhancement will be an important part of the IT Services development effort. Part of that will be the investigation of efficient Extensible Markup Language (XML) technologies, whereby the bandwidth and CPU cycle impact of verbose ASCII tags and data can be mitigated without sacrificing the rich capabilities for XML processing and transformation offered by existing, mature COTS and open source software packages.

2.1 Architecture

Description: ANSI 1471-2000 defines architecture as "the fundamental organization of a system embodied in its components, their relationships to each other, and to the environment, and the principles guiding its design and evolution."

The Cube system architecture will identify and describe:

- The major hardware components of the system;
- The major software components of the system;
- How the software components map to the hardware components;
- Data paths between constituent systems;
- The major system interfaces.

Development of the architecture will proceed at two levels. The high-level architecture will describe the interagency aspects of the Cube including net-centric access and net-centric interfaces with the architectures of each agency. The Cube architecture is a subset of the NextGen Architecture.

The lower level architectures will describe the systems within each participating agency. In keeping with the loosely coupled nature of a SOA, those lower-level architectures will be largely independent of each other.

The SAS, including net-centric access and net-centric interfaces for NAS weather information, is by definition a portion of the Cube. Due to its direct operational use by all stakeholders of NextGen, its requirements are expected to be different, and in most cases more stringent than the rest of the Cube. As such the SAS architecture is a primary consideration of both the interagency and agency Cube architectures.

2.1.1 Develop High-Level Architecture

Reference: WBS 2.1.1

Description: A high-level architecture that describes the Cube in the context of the larger NextGen Enterprise will be developed. It will identify the boundaries of the Cube, components that comprise the Cube, and interfaces with external and internal systems and users. It will provide a means for defining high-level system requirements tied to the needs of users.

Timeframes: March 2009 – October 2009

Inputs: IWP, Four-Dimensional Weather Functional Requirements for NextGen Air Traffic Management, FAA Enterprise Architecture artifacts

Deliverables: 4-D Weather Data Cube High-Level Architecture

Exit Criteria: Complete and approved High-Level Architecture

Agency Roles and Responsibilities: FAA will lead development of the High-Level Architecture with participation from NOAA. The Weather Working Group will coordinate with the JPDO's Net-Centric Task Force to ensure that the weather architecture conforms to the larger, NextGen architecture.

2.1.2 FAA Detailed Architecture

Reference: WBS 2.1.2

Description: A detailed architecture will be developed for the FAA portion of the Cube that structures the components, both hardware and software, in a way that demonstrates how the assembled components interoperate to deliver value. It provides a means for defining detailed system requirements.

Timeframes: September 2009 – September 2010

Inputs: 4-D Weather Data Cube High-Level Architecture, IWP, Four-Dimensional Weather Functional Requirements for NextGen Air Traffic Management, NNEW/RWI Preliminary Portfolio Requirements, Performance Requirements.

Deliverables: FAA Detailed Architecture

Exit Criteria: Detailed Architecture accepted

Agency Roles and Responsibilities: FAA will develop its Detailed Architecture

2.1.3 NOAA Detailed Architecture

Description: Recommend framework for System Architecture Description (e.g., DODAF, FEAF). Investigate standard model architectures (e.g., OASIS Reference Architecture for SOAP) as candidates for models for NOAA Cube architecture. Set up distributed-access configuration management system for architectural artifacts. Utilize input from the development of the NOAA Cube reference implementation to develop and document detailed architecture for the NOAA Cube. Identify architecturally important data storage and transfer issues (e.g., translation between different data transfer languages, forensic archiving requirements, performance implications, etc.) and develop architectural solutions.

Reference: WBS 2.1.3

Timeframes: October 2009 – April 2011

Inputs: Report on prototype JMBL server (due at end of FY2009)
Report on JMBL gap analysis (due at end of FY2009)
Progress reports on development of 4-D Weather Data Cube reference implementation (throughout FY2010)

Deliverables: System Architecture Description

Exit criteria: Delivery of final System Architecture Description

Agency Roles and Responsibilities: NOAA is lead agency. FAA and DoD will collaborate and consult on data transfer language issues.

2.2 Services and Format Standards

In the context of a SOA, a "service" includes an underlying capability (for example, a set of gridded data with a local data extraction mechanism) and the tools that expose that capability and make it available to users, possibly across organizational boundaries. The participant providing the underlying capability may provide some or all of those tools, or they may be provided by other participants.

The participating agencies have varying degrees of previous investment in and varying degrees of current operational dependence on different data formats and data transfer languages. In keeping with the loosely-coupled SOA approach, some of those different formats and languages will be accommodated within the Cube by software translators and adaptors while others will be replaced by more widely shared alternatives.

Tasks in this category will include definition and development of the services to be offered by the Cube, identification of the various formats and data transfer languages involved, and development of translators, adaptors, and data caches to fully enable the underlying capabilities as services.

Open, nonproprietary service standards that will support "public" and private Cube operations such as store, merge/blend/assimilate, access (e.g., extract via subset), and replace will be developed. This will include any necessary interpreters or templates for adopted standards.

2.2.1 FAA Weather Specific Services Design Standards

Reference: WBS 2.2.1

Description: Develop, document and adopt open nonproprietary service standards that will support "public" and private Cube operations such as store, merge/blend/assimilate, access (e.g., extract via subset), and replace. The FAA is adopting Open Geospatial Consortium (OGC) standards, principally the Web Feature Service (WFS) and Web Coverage Service (WCS) standards, for use within FAA. The OGC standards are broadly used across many domains and form a good baseline for domain-agnostic data interchange. This cross-domain capability is especially useful given that weather data will be integrated with aeronautical, topographical, and other geospatial information for use in decision making. By developing needed extensions to the OGC standards, a large degree of commonality is preserved while enabling the weather data exchange capabilities required in the Cube.

Timeframes: January 2008 – September 2010

Inputs: Concept of Operations for the Next Generation Air Transportation System, version 2.0, IWP

Deliverables: Final version of standards for IOC

Exit Criteria: Accepted service standards

Agency Roles and Responsibilities: FAA will develop standards for use within the FAA. Standards will be made available for use within the larger NextGen Enterprise.

2.2.2 FAA Weather Product Data Format Standards

Reference: WBS 2.2.2

Description: The FAA is developing a weather data model and weather data formats for the weather data that will reside in FAA's portion of the Cube. These formats are being developed in conjunction with, and therefore will be common with, formats used by Eurocontrol. These formats will be based on Weather Information Models and Schemas being jointly developed by FAA and Eurocontrol. NOAA and DoD are also participating in developing the models and schemas.

Timeframes: January 2008 – September 2010

Inputs: Integrated Work Plan, IOC product list

Deliverables: Weather product data formats for IOC

Exit Criteria: Agreement of data formats

Agency Roles and Responsibilities: FAA will develop standards for use within the FAA.

2.2.3 NWS JMBL Gap Analysis

Reference: WBS 2.2.3

Description:
1) Analyze and document the changes needed in the Joint METOC Broker Language (JMBL) in order to support NWS requirements for weather data transfer and achieve compliance with applicable OGC standards.
2) Analyze and document changes needed in the JMBL business rules to meet NWS requirements.

Timeframes: December 2008 -- August 2009

Inputs:
1) *User's Guide for the Air Force Weather Weapon System Joint METOC Broker Language Version 3.x July 2007* (or later version)
2) JMBL schemas.

Deliverables:
1) Report documenting changes needed in JMBL to meet: (a) NWS requirements for data transfer; and (b) applicable OGC standards.
2) Report documenting changes needed in JMBL business rules to meet NWS requirements.

Exit criteria: Delivery and acceptance of the two reports identified above.

Agency Roles and Responsibilities: NOAA is lead agency for this task. DoD will assist NOAA personnel in learning JMBL and staying abreast of JMBL updates by providing JMBL user documentation, facilitating NOAA participation in relevant change control activities, and providing occasional consultations.

2.2.4 NWS IOC Services

Reference: WBS 2.2.4

Description: Develop and demonstrate reference implementation of the NOAA Cube. Determine detailed technical requirements for the operational Cube. Expand NWS National Digital Forecast Database (NDFD) to accommodate IOC aviation weather forecast elements. Develop techniques for merging multiple sources into SAS. Enable NDFD as a Cube service.

Timeframes: September 2009 -- December 2010

Inputs:
IOC product list
NextGen Network-Enabled Weather IT CONOPS

Deliverables:
4-D Weather Data Cube reference implementation (software, documentation)
Technical requirements specification for the operational Cube
Operational demonstration of the Cube
Report on operational demonstration

Exit criteria:
Acceptance of Cube reference implementation
Acceptance of the Cube technical requirements specification
Acceptance of IOC product adaptors
Acceptance of report on operational demonstration

Agency Roles and Responsibilities:
NOAA is lead agency. FAA and DoD will collaborate and consult on data transfer language issues. Operational demonstration will include FAA as the major customer. FAA will provide feedback for report on operational demonstration.

2.3 Software Development

The software development tasks encompass the design and development of Cube "central" software (as distinct from services and clients).

Discovery—the ability of would-be service consumers (clients) to find services meeting their needs—is central to a SOA. Discovery is supported by one or more registries, where services publish their resource identifiers and expose the interfaces by which they may be invoked. That information is persisted in an associated repository. The Cube will include a scalable number of Organization for the Advancement of Structured Information Standards (OASIS) ebXML-compliant registry/repositories.

Web coverage services will be developed to support the dissemination of large gridded data sets via OGC-compliant interfaces. OGC web feature services will support dissemination of non-gridded data. Service adapters will be developed to allow customers to request data using one data transfer language from data providers supporting a different language.

For a specific flight, the weather information needed to support decision making by the pilot and air traffic controllers may span thousands of miles and several hours. If gridded data to meet that need were retrieved by traditional means, the data set would be very large—too large for timely retrieval. The Cube will support complex retrieval processes, whereby only the data within a specified radius of a four dimensional flight path will be transferred.

2.3.1 & 2.3.2 Web Coverage Service (WCS) and Web Feature Service (WFS)

Reference: WBS 2.3.1 & 2.3.2

Description: The FAA is developing software that implements the WFS and WCS services in accordance with standards discussed above (WBS 2.2.1). The development effort will include WCS and WFS requirements documents and architecture and design documents, as well as functional test suites. Four versions of the software will be developed.

Timeframes: October 2008- May 2012

Inputs: FAA Weather Specific Services Design Standards

Deliverables: Final software for IOC that implements WCS and WFS services

Exit Criteria: Software that has been shown to meet requirements

Agency Roles and Responsibilities: FAA is developing software for use within FAA. Software will be made available to NOAA, other agencies, and interested external users (e.g., airlines).

2.3.3 Service Adapters

Reference: WBS 2.3.3

Description: FAA will develop Service Adapters for legacy FAA systems so that these systems, weather data providers and weather data users, can utilize the Cube without significant modifications to their systems.

Timeframes: October 2009 – March 2011

Inputs: Legacy systems data formats, FAA Weather Product Data Format Standards

Deliverables: Service adapters for FAA legacy systems

Exit Criteria: Service adapters that meet requirements

Agency Roles and Responsibilities: FAA will develop service adapters for FAA legacy systems

2.3.4 Registry/Repository

Reference: WBS 2.3.4

Description: At least one registry/repository is required as a point of control and governance within the Cube SOA deployment. A registry/repository stores and manages service information artifacts in a consistent manner supporting publishing, discovery, and consuming of weather information, and enforcement of Cube policies. For the Cube, the FAA plans to use a registry/repository that conforms to the OASIS ebXML registry/repository standard, allowing organizations to share and link information with other organizations in a secure manner. The ebXML registry/repository will support federated information management, allowing multiple registry/repositories to federate together and appear as a single, virtual registry/repository, while allowing individual organizations to retain local control over their own registry-repositories. FAA is acquiring the registry/repository from a commercial source.

Timeframes: January 2008 – December 2013

Inputs: 4-D Weather Data Cube IT ConOps, Four Dimensional Weather Functional Requirements for NextGen Air Traffic Management, NNEW/RWI Preliminary Portfolio Requirements

Deliverables: Registry/repository that conforms to the OASIS standard

Exit Criteria: Effective federation of registry/repository capabilities

Agency Roles and Responsibilities: FAA is procuring the registry/repository for FAA and NOAA in the development phase

2.3.4.1 Metadata Guidelines

Reference: WBS 2.3.4.1

Description: A standard set of metadata is essential to enable discovery and access to weather datasets and associated data access services. The International Organization for Standardization (ISO) 19115 data model, and accompanying ISO 19139 XML schema definition, has been selected for use in the Cube. Adopting this standard, however, is not sufficient to achieve true, large-scale interoperability due to the flexibility provided by the standard. In view of this, the FAA NNEW Program is developing Metadata Guidelines that provide further guidance on how metadata should be prepared. These Guidelines will be coordinated with NOAA and the JPDO in order to ensure adoption of a consistent set of guidelines for the Cube. Five versions will be developed.

Timeframes: October 2008 – August 2012

Inputs: Content Standard for Digital Geospatial Metadata (CSDGM), Vers. 2 (FGDC-STD-001-1998); ISO 19139 XML schema definition standard

Deliverables: Metadata guidelines

Exit Criteria: Metadata guidelines acceptable to NOAA and FAA

Agency Roles and Responsibilities: FAA is developing the metadata guidelines and coordinating its development with NOAA.

2.3.5 Ontology and Mediation

Reference: WBS 2.3.5

Description: A requirement of the Cube is to support net-centric interoperability across diverse domain models and terminologies, such as Climate and Forecast (C&F) terms, and Joint METOC Conceptual Data Model (JMCDM) and the associated METOC/JMBL terms. Ontology will provide semantically enhanced discovery of datasets. This feature will enable users to discover datasets registered in the Registry/Repository and the corresponding service endpoints, in a vocabulary-independent manner, i.e., no matter if data are stored using C&F or JMBL. Mediation will provide the capability for translating CF weather data terms into JMBL terms and vice versa so that a user will receive weather data in a manner his system can accommodate no matter the format used by the provider of the data.

Timeframes: February 2009 – September 2011

Inputs: IWP, Climate and Forecast terms, METOC/JMBL terms

Deliverables: Completed ontology and mediation capabilities

Exit Criteria: Ontology and mediation capabilities that meet requirements

Agency Roles and Responsibilities: FAA is developing the ontology and will make it available to other agencies. NOAA will provide mediation that translates C&F terms to JMBL and FAA will provide mediation that translates JMBL terms to C&F.

2.3.6 Complex Retrieval Processing Capability

Reference: WBS 2.3.6

Description: The retrieval of only the data required by a data consumer such as the weather along an aircraft's 4-D trajectory is a key requirement of NextGen Weather. Services must be developed and the standards must be adopted which are capable of providing this capability. This task develops the requirements for the Complex Retrieval Capability, then develops the prototype services and standards required to implement the capability.

Timeframes: Jun 2009 – Jul 2011

Inputs: NextGen ConOps, NextGen Weather ConOps, Integrated Work Plan, WFS & WCS standards (2.3.1/2.3.2), requirements from Integration Team.

Deliverables: Complex Retrieval Capability requirements, functional services and standards ready for transition to operations.

Exit Criteria: Complete software and standards approved by appropriate governing bodies.

Agency Roles and Responsibilities: NOAA will lead this effort with support from the FAA and DoD.

2.4 Security

Reference: WBS 2.4

Description: A robust IT Enterprise Security framework must be established to ensure data security and integrity for air traffic operations. In cooperation with the Net-Centric Operations Division, the Cube Team will develop appropriate SOA IT security standards, develop required security software and hardware, and achieve all necessary certifications for operation. The policy and regulatory issues involved with interagency security must also be resolved, while ensuring appropriate access to NextGen weather data by commercial and private users and providers.

2.4.1 FAA Security

Reference: WBS 2.4.1

Description: This effort consists of three components parts. The first is developing a Security Guidance Document that will detail aspects of security for the different layers of the NNEW architecture framework. Each layer, physical network layer, SOA and IT infrastructure layer, the NNEW/Weather domain layer, and the application layer, will be described in terms of what types of security protocols, standards, and tools should be used to ensure that the Cube is secure. In addition, the document will specify the administrative work that will have to be done in order to satisfy government security policies. This would include a high-level overview of Federal certification and accreditation policies.

The second part is development of a security plug-in for the SWIM (System Wide Information Management) service container security framework and the WCS and WFS data access services.

The third is obtaining certification and accreditation of the components forming the FAA's portion of the Cube.

Timeframes: October 2008 – August 2012

Inputs: Agency Security Standards

Deliverables: Security Guidance Document, security plug-in, and certification and Accreditation

Exit Criteria: Certification and Accreditation

Agency Roles and Responsibilities: FAA will carry out this work

2.4.2 NOAA Security

Description:
As part of WBS 2.2.4 NOAA will identify and document SOA-specific security requirements and implementation measures (e.g., authorization and authentication for customer and data provider access, data-set-specific security requirements for proprietary or otherwise sensitive data, measures to ensure service and network availability and data integrity, etc.). The NOAA CIO's office will identify and document agency-specific requirements for certification, accreditation, and other documentation. All measures (hardware and software) so identified will be put in place.

Reference: WBS 2.4.2

Timeframes: July 2009 - April 2013

Inputs:
DoC/NOAA Certification and Accreditation requirements
FAA, DoD security requirements for interconnection
Usage agreements for proprietary data

Deliverables:
Security plan
Certification and Accreditation package

Exit criteria: Completion of Certification and Accreditation

Agency Roles and Responsibilities:
NOAA will be the lead agency. DoD and FAA will have security requirements that NOAA must meet in order for DoD and FAA to allow interconnections with the NOAA Cube. And NOAA will have requirements that they must meet.

2.5 Latency and Performance Analysis

Reference: WBS 2.5 (2.5.1, 2.5.2, & 2.5.3)

Description: This work consists of a number of efforts involving latency and performance monitoring. One effort involves testing of the latency and performance of the registry repository. A White Paper will be written to document the results. Another effort will assess the high-level, total system performance of the WFS, the WCS, and the registry/repository through rigorous testing. This work will be documented in a Latency and Performance Monitoring Report. The third effort is development of, and incorporation into the WCS and WFS software, an operational monitoring infrastructure framework to enable monitoring of services and clients.

Timeframes: November 2008 – June 2011

Inputs: Architecture, security requirements, and performance requirements

Deliverables: Registry/Repository Performance Analysis White Paper, Latency and Performance Monitoring Report, capability to monitor services and clients

Exit Criteria: A system that can be effectively monitored and managed

Agency Roles and Responsibilities: FAA will conduct this work

2.6 Efficient XML Technology

Reference: WBS 2.6

Description: While XML has many benefits with regards to extensibility, transformation, self-description, and other key areas, it tends to have an impact on system performance due to increased data sizes over previous technologies. This work will investigate different solutions to this problem for the weather domain, and the relative advantages of each approach. The work will be summarized in a report.

Timeframes: November 2009 – March 2010

Inputs: Current state of WXXM and Efficient XML Interchange (EXI) Format 1.0

Deliverables: Efficient XML Technology Report

Exit Criteria: An acceptable report

Agency Roles and Responsibilities: FAA will perform testing, analysis results, develop the report, and make it available to other agencies.

2.7 Demonstrations

Reference: WBS 2.7

Description: Two types of demonstrations are planned, IT Demonstrations and NextGen Test Facility Demonstrations. IT Demonstrations are conducted periodically in order to demonstrate and test various components and capabilities that have been developed. NextGen Test Facility Demonstrations are supported in order to show improvements that can be made when weather data are integrated into traffic management operations.

Timeframes: September 2008 – November 2012

Inputs: Capabilities as developed prior to each demonstration

Deliverables: Demonstrations of Cube-type capabilities

Exit Criteria: Successful demonstrations

Agency Roles and Responsibilities: Going forward, these demonstrations will be jointly supported by NOAA and FAA.

2.8 Procure-Deploy Hardware and Software

Description: The Procure Hardware and Software activities include agency specific acquisition procedures ranging from acquisition plan development to contract award to delivery and installation of systems.

2.8.1 Procure-Deploy FAA HW-SW

Reference: WBS 2.8.1

Description: This effort consists of the work needed to procure hardware to host the software being developed and to deploy the hardware and software to the field. This includes any specifications and procurement documentation needed.

Timeframes: September 2010 – October 2012

Inputs: Final Investment Decision; Performance requirements and FAA Detailed Architecture

Deliverables: Fielded FAA hardware and software to provide the FAA's portion of the Cube

Exit Criteria: Successfully deployed hardware and software

Agency Roles and Responsibilities: FAA will procure and deploy its hardware and software

2.8.2 Procure-Deploy NOAA Hardware and Software

Reference: WBS 2.8.2

Description: NOAA is planning to award a contract for a Lead Systems Integrator to 'productionize' the Cube systems and software. Acquisition plan development begins in FY10, with contract award in Q2 FY11. Production and deployment of NOAA systems will be complete by the end of FY12.

Timeframes: October 2009 – July 2012

Inputs: Program Management Plan, NOAA Developmental systems and software

Deliverables: Acquisition Plan, production systems and software

Exit Criteria: final IOC systems installed and operational, ready for OT&E

Agency Roles and Responsibilities: NOAA responsible for delivering and deploying its own systems. Close coordination with partner agencies required to ensure compatibility.

2.9 Operational Test and Evaluation (OT&E)

Reference: WBS 2.9

Description: The OT&E activity represents the agency specific test and evaluation processes required to implement an operational system. OT&E will ensure the Cube meets the minimum standards specified in the system requirements.

Timeframes: "Planning" Nov 2010 – Nov 2012
"Execution, Certification, & Accreditation" Nov 2010 – Sep 2013

Deliverables: This task will produce an OT&E Plan and execute that plan to ensure system performance. Following OT&E, a final report listing discrepancies and remediation actions will be prepared.

Exit Criteria: Authority to operate. System meets interoperability, cost and manpower estimates, command and control supportability, applicable security and information assurance requirements.

Agencies Roles and Responsibilities: Both the NWS and FAA will work together to determine a contractor who will develop the OT&E plan that will be approved and implemented by both offices.

3.0 Cube Content

3.1 Element R&D

Reference: WBS 3.1

Description: This section focuses on research and development needed to ensure individual observational and forecast elements are ready for transition to the Cube by IOC. Specific algorithms in development by NWS and the FAA's Aviation Weather Research Program (AWRP) are considered for potential. Products will be compared against the Four Dimensional Weather Functional Requirements for NextGen Air Traffic Management and the FAA Performance Requirements.

For this section, threshold requirements should be considered as the minimum acceptable, those labeled objective are optional, but work should proceed toward meeting those requirements.

3.1.1 Develop IOC Icing Content

Reference: WBS 3.1.1

Description: Icing issues consist of a ground deicing component and an in-flight icing component. For IOC, the threshold capability will be analyses and forecasts of in-flight icing.

Timeframes: November 2008 – September 2010

Inputs:

- [Threshold] Current regulatory icing information comes from Airman's Meteorological Advisories (AIRMETs), specifically the AIRMET Zulu product, issued for widespread moderate icing and freezing levels; and Significant Meteorological Advisories (SIGMETs), issued for severe icing. It is anticipated these products will still be required by FAA as primary for flight-related decision making at IOC and thus must be considered as a threshold input for the Cube.
- [Threshold] The state-of-the-science automated icing algorithms at this time produce a Current Icing Product (CIP) (analysis) and a Forecast Icing Product (FIP). These algorithms produce icing probability and severity with hourly updates, but FAA has certified them for use only as supplementary products, which means they can only be used in conjunction with a primary product (AIRMET/SIGMET).
- [Threshold] Graphical AIRMETs (G-AIRMET). This product is in development, and FAA has requested it be included as threshold information for the Cube.
- [Objective] World Area Forecast System (WAFC) global maximum and average icing grids. The World Area Forecast System (WAFS) has commitments to produce global digital (gridded) products. As a member of the WAFS, the U.S. participates in preparation and dissemination of these products. The algorithms underlying these

products differ from those used in CONUS products, so issues surrounding these differences must be addressed in the IOC time frame.

Exit Criteria: Gridded icing product emerges as the standard for the Cube.

Agency Roles and Responsibilities: FAA continues to fund in-flight icing research to refine the CIP and FIP algorithms. In addition, FAA Flight Standards completes safety analysis of the algorithms to permit advancement from supplementary to primary status and develops pilot training and testing standards for use of the new information. NWS transitions the algorithms to run in an operational environment (e.g. the supercomputing environment OR at Aviation Weather Center (AWC)).

3.1.2 Develop IOC Turbulence Content

Reference: WBS 3.1.2

Description: Turbulence can span the vertical from the surface to high levels, in cloud or in clear air. Near the surface, turbulence is normally referred to as "low-level wind shear." This content specifically does not include wake vortex.

Timeframes: November 2008 – September 2010

Inputs:

- [Threshold] Current regulatory turbulence information comes from AIRMETs, specifically the AIRMET Tango product, issued for widespread moderate turbulence or sustained winds of 30 knots or more at the surface; and SIGMETs, issued for severe or extreme turbulence. It is anticipated these products will still be required by FAA as primary for flight-related decision making at IOC and thus must be considered as a threshold input for the Cube.
- [Threshold] The state-of-the-science automated turbulence algorithms at this time produce Graphical Turbulence Guidance (GTG) analysis and forecasts (updated every three hours). The algorithms output turbulence severity and potential (not probability) above 10,000 feet for clear air turbulence and are still in development to expand the vertical extent and include other turbulence regimes, such as mountain wave and convective. FAA has not certified these products for use by other than meteorologists and dispatchers. As such they are not for use by the main operator population for use in flight-related decisions.
- [Threshold] Graphical AIRMETs (G-AIRMET). This product is in development, and FAA has requested it be included as threshold information for the Cube.
- [Objective] WAFC global maximum and average, clear air and in-cloud turbulence grids. The WAFS has commitments to produce global digital (gridded) products. As a member of the WAFS, the U.S. participates in preparation and dissemination of these products. The algorithms underlying these products differ from those used in CONUS products, so issues surrounding these differences must be addressed in the near-IOC timeframe.

Exit Criteria: Gridded turbulence product emerges as the standard for the Cube.

Agency Roles and Responsibilities: FAA continues to fund turbulence research to refine and expand the GTG algorithm. In addition, FAA Flight Standards completes safety analysis of the algorithms to permit use for flight related decisions (at minimum) and as a primary, stand-alone turbulence product (optimal) and develops pilot training and testing standards for use of the new information NWS transitions the algorithms to run in an operational environment.

3.1.3 Develop IOC Convective Content

Reference: WBS 3.1.3

Description: Convection is the weather element most disruptive to air traffic. The term convection encompasses thunderstorms in various configurations (cell, area, line) and related phenomena, such as tornadoes, hail, and strong surface winds. Because icing and turbulence are expected in and near thunderstorms, convection is forecast as a construction of the related and implicit phenomena. There are numerous sources of current and forecast thunderstorm information, from radar depictions to many automated and human-generated forecasts.

Timeframes: September 2009 – April 2011

Inputs:

- [Threshold] Current regulatory convection information comes from Convective SIGMETs, issued for severe surface weather (surface winds greater than or equal to 50 knots, hail greater than or equal to ¾ inches in diameter, and tornadoes), embedded thunderstorms, lines of thunderstorms, or strong thunderstorms affecting a widespread area. It is anticipated the Convective SIGMET will still be required by FAA as primary for flight-related decision making at IOC and thus must be considered as a threshold input for the Cube.
- [Threshold] Collaborative Convective Forecast Product (CCFP). The CCFP is the currently used product arising from collaborative decision making (CDM) by forecasters, operators, and air traffic managers. Because CDM results in agreement on use of airspace, CCFP is included at this time, though it may be supplanted in the future.
- [Threshold] Corridor Integrated Weather System (CIWS) 0-2 hour nowcasts of convection. FAA has requested CIWS be included in the Cube at IOC. CIWS is still in development and has recently expanded to national coverage.
- [Threshold] A 2-6 hour planning forecast, formerly known as Consolidated Storm Prediction for Aviation (CoSPA)
- [Objective] WAFC global thunderstorm grids for tops and extent. The WAFS has commitments to produce global digital (gridded) products. As a member of the WAFS, the U.S. participates in preparation and dissemination of these products. The algorithms underlying these products differ from those used in CONUS products, so issues surrounding these differences must be addressed in the near-IOC timeframe.

- [Objective] Gridded Localized Aviation Model Output Statistics (MOS) Program (LAMP) probabilistic thunderstorm forecasts.

Exit Criteria: Gridded thunderstorm product for aviation application emerges as the standard for the Cube.

Agency Roles and Responsibilities: FAA continues to fund convection research to refine and expand the CIWS and to produce longer-range thunderstorm forecasts. In addition, FAA Flight Standards completes safety analysis of the algorithms to permit use for flight-related decisions (at minimum) and as a primary, stand-alone convection product (optimal) and develops pilot training and testing standards for use of the new information. NWS or FAA transitions the algorithms to run in an operational environment. NWS continues to fund development of probabilistic forecast capability in LAMP.

3.1.4 Develop IOC Ceiling and Visibility (C&V) Content

Reference: WBS 3.1.4

Description: Ceiling and visibility are among the most difficult elements to forecast due to strong terrain and microclimate influences resulting in fine-scale variations. The outlook for development of a fully developed and vetted gridded C&V product by IOC is poor at this point.

Timeframes: November 2008 – March 2011

Inputs:
- [Threshold] Current regulatory C&V information comes from AIRMETs, specifically AIRMET Sierra, issued ceilings less than 1000 feet and/or visibility less than 3 miles affecting 50 percent of the area. It is anticipated the AIRMET will still be required by FAA as primary for flight-related decision making at IOC and thus must be considered as a threshold input for the Cube.
- [Threshold] Additional C&V information is contained in the Terminal Aerodrome Forecast (TAF), which is expected to continue as a regulatory product through IOC.
- [Threshold] The AWRP is developing the National Ceiling and Visibility (NCV) product to address C&V between reporting stations. FAA has requested NCV be included in the Cube as a Threshold product, but there is concern the product may not be ready for routine operational use at IOC.
- [Threshold] Graphical AIRMETs (G-AIRMET). This product is in development, and FAA has requested it be included as threshold information for the Cube.
- [Objective] Gridded and point LAMP probabilistic C&V forecasts are in development.

Exit Criteria: One primary, gridded ceiling and visibility product for aviation application emerges as the standard for the Cube.

Agency Roles and Responsibilities: FAA continues to fund C&V research to advance the NCV Analysis product from experimental to operational and to develop a forecast extension. In addition, FAA Flight Standards completes safety analysis of the algorithms to permit use for flight related decisions (at minimum) and as a primary, stand-alone C&V product (optimal) and develops pilot training and testing standards for use of the new information. NWS or FAA transitions the algorithms to run in an operational environment. NWS continues to fund development of probabilistic forecast capability in LAMP.

3.1.5 Develop IOC Observation Content

Reference: WBS 3.1.5

Description: Observations from a multitude of ground-based, airborne, and satellite sensors must meet common data standards and be net-enabled and included in the Cube in an architecture that permits fast retrieval.

Timeframes: November 2008 – March 2011

Inputs:
[Threshold] Ground-based direct measurement: ASOS
[Threshold] Ground-based remote sensing: NEXRAD Level III, TDWR Level II, lightning (proprietary)
[Threshold] Airborne direct sensing: rawinsonde, aircraft-sensor measurements of temperature, winds, moisture (some possibly proprietary), Pilot Reports (PIREPs) (subjective)
[Threshold] Space-based remote sensing: GOES-R, NPOESS

Exit Criteria: Required data net-enabled and in the Cube following common data standards and exchange protocols

Agency Roles and Responsibilities: NWS, FAA, and DoD agree on standards and architecture that will permit data to exist in virtual Cube. NWS, FAA, and DoD reach agreement with international partners on data standards.

3.1.6 Develop Enhanced Numerical Modeling Enabling Capabilities

Reference: WBS 3.1.6

Description: Enhanced and improved numerical modeling capabilities are enablers critical to meeting many of the resolution and update frequency requirements for NextGen weather forecasts. Though many of the significant requirements and improvements are expected beyond IOC, it will be important to support any existing and needed initiatives the modeling community has planned between now and 2013. It is also important to support the modeling community R&D plans for those requirements already in place beyond IOC.

Timeframes: July 2008 – March 2012

Inputs: Four Dimensional Weather Functional Requirements for NextGen Air Traffic Management, FAA Performance Requirements, WBS 1.8 (IOC Content Definition), WBS 3.1.1 – 3.1.5

Deliverables: All systems that produce analysis and forecast products of aviation specific weather impact variables will transition to, or be capable of transitioning to, output run from the latest applicable model sources available through IOC. There is a commitment to work with the modeling community to provide them with updated NextGen requirements and ensure R&D to meet these requirements is fully supported. This R&D will be needed to meet both tactical (at least hourly updating with latest observations) and strategic (updated less frequently) requirements.

Exit Criteria: Approval of forecast process prototype that includes the most recent initiatives and updates from the modeling community. Approval of an R&D support plan that addresses future requirements.

Agency Roles and Responsibilities: NOAA will lead this effort but significant input and coordination is required from the FAA, the DoD, and the research community.

3.2 Contents Tool Production

Reference: WBS 3.2

Description: The aviation specific weather parameters identified for inclusion in the Cube will be generated by various observation dissemination and forecast generation processes

Timeframes: February 2010 – Nov 2012

Inputs: EI Team IOC Definition List, developmental or existing weather products, tools, and techniques

Deliverables: A full suite of content generation tools will be available for content generation of the threshold observation and forecast parameters. These tools will include legacy systems (such as NWS TAF generation systems) and the development of new systems such as MADIS for observations or new forecast processes detailed in section 3.4

Exit Criteria: All threshold parameters, as identified in the EI Team IOC Definition, are available in the Cube at IOC

3.3 Element Transition to Operations

Reference: WBS 3.3

Description: The aviation-specific weather parameters, including icing, turbulence, convection, ceiling/visibility, and observed surface weather must be transitioned, and/or certified for operational use in the Cube.

Timeframes: September 2010 – July 2013

Inputs: EI Team IOC Definition List, developmental or existing weather products, tools, and techniques

Deliverables: FAA and NWS will transition existing aviation-specific weather algorithms to operations in the Cube. The path to operations for new and/or experimental algorithms will be agency specific. For example, gridded forecast products from advancements in the NWS forecast process will go through internal NWS certification, while transition of AWRP elements from the FAA will be certified through the NextGen Weather Evaluation Capability (NWEC). It is important to distinguish that transitioning elements to the Cube at IOC is not the same process that will used to fuse, merge, authorize, etc., the aviation weather parameter algorithms within the Cube and designate them as components of the SAS for Air Traffic Management (ATM).

Exit Criteria: All threshold parameters, as identified in the EI Team IOC Definition, are available in the Cube at IOC

3.4 Forecast Process

Reference: WBS 3.4

Description: The NextGen Weather Paradigm will drive changes to the way aviation weather parameters are forecast. This forecast process is expected to be some combination of model-generated output and algorithms, such as those from the FAA's Aviation Weather Research Program, along with the development and evaluation of tools which allow a Meteorologist in the/over the Loop (MITL/MOTL) to add value to provide additional input to forecasting algorithms as required. In the process of MITL/MOTL input to the forecasting algorithms, a meteorologist will provide additional input to forecasting algorithms using robust, user-friendly, man-machine interface software tools. This allows meteorologists to provide additional insight to the forecasting algorithms found in today's Numerical Weather Prediction (NWP) models, especially for terminal and route forecasts. It also provides confidence to the various users of weather information that the forecaster's best intelligence has been incorporated.

Timeframes: October 2008 – December 2010

Inputs: IWP, Four-Dimensional Weather Functional Requirements for NextGen Air Traffic Management, FAA Performance Requirements, algorithms from FAA's AWRP

Deliverables: As the IOC aviation weather impact variables are identified and requirement sets are finalized, forecast processes to meet these requirement suites will be fully supported. This set will likely include (but will not be limited to) existing AWRP algorithms for turbulence (Graphical Turbulence Guidance, GTG), icing (Current Icing Product, CIP/Forecast Icing Product, FIP), and ceiling/visibility (National Ceiling/Visibility, NCV); or for convection products such as the Corridor Integrated Weather System and the 2-6 hour planning forecast previously known as CoSPA. Also needed is the development of techniques for MITL/MOTL interactions with these AWRP algorithms and for convective products. Other initiatives from NOAA, NASA, and other government and non-governmental organizations may also surface and should be considered, as appropriate.

Exit criteria: Limited set of new forecast products produced by NWS forecasters to deliver required aviation weather impact parameters to the Cube for IOC

Agency Roles and Responsibilities: NWS will work with its research partners and with output from the FAA's AWRP

3.4.1 Framework Development

Reference: WBS 3.4.1

Description: Prototype and evaluate the forecast processes for the generation of NextGen 4-D weather datasets.

Timeframes: January 2009 – December 2010

Inputs: IWP, Four-Dimensional Weather Functional Requirements for NextGen Air Traffic Management, FAA Performance Requirements, algorithms from FAA's AWRP

Deliverables: The NWS has allocated a variety of tasks to either internal NWS research entities (NWS' Meteorological Development Laboratory (MDL)) or other NWS research partners to evaluate the current state of the aviation forecast process and then assess where and how forecasters will add value in the NextGen paradigm. These include:

- A feasibility study of adding ceiling and visibility to the NWS National Digital Forecast Database (NDFD)
- Evaluation report on the role of the forecaster in the NextGen era.

A prototype/ test bed of 4-D Weather Forecast Process will be in place which allows evaluation of both the model-generated techniques and algorithms with their MITL/MOTL processes. A process will also be in place to compare/measure the quality of the MITL/MOTL data with the fully automated forecasting systems without forecasters, though a comprehensive Quality Assurance/Quality Check (QA/QC) cannot be accomplished in this time period. A goal of this QA/QC process will be to provide feedback to the automated forecast system developers to enhance automated forecast system performance in areas where MITL/MOTL interactions add value on a regular basis.

Exit criteria: Approval of a defined forecast process for each aviation weather impact variable.

Agency Roles and Responsibilities: NOAA will lead this effort but the forecast process validation team will include members from the FAA, the DOD, and the research community including participation from the private/commercial sector.

3.4.2 MITL/MOTL Tool Development

Reference: WBS 3.4.2

Description: Prototype and evaluate specific forecast processes for which allows meteorologists to adjust or enhance gridded NWP data

Timeframes: October 2008 – January 2010

Inputs: IWP, Four-Dimensional Weather Functional Requirements for NextGen Air Traffic Management, FAA Performance Requirements, algorithms from FAA's AWRP

Deliverables: NWS has tasked MDL and its research partners to continue with testing and evaluation of two specific MITL/MOTL processes:

- Interactive Calibration in Four Dimensions (IC4D) – IC4D allows NWS forecasters to modify and adjust 4-D gridded output from AWRP algorithms. IC4D test-bed has been in place in AK for the last 2 years and is newly expanded to the NWS Pacific Region. An IC4D test-bed is also planned for the NWS Aviation Weather Center in 2009
- AutoNowcaster (ANC) – ANC is a program to assist NWS forecasters in identifying convective initiation fields which add value to short-term (often automated) thunderstorm forecasts. ANC has been tested at the NWS Forecast Office in Ft. Worth, TX for the past few years and is planned for expansion to FL in 2009. It is also desired to incorporate ANC into live NextGen demonstrations as soon as possible.

NWS has tasked MDL and its research partners to continue expanding, testing, and evaluating both IC4D and ANC in the coming years with some limited application of these processes in place before IOC.

Exit criteria: Limited operational use of both IC4D and ANC output to generate forecasted aviation-impact variables at IOC, specifically icing and turbulence from IC4D and convective-initiation parameters from ANC

Agency Roles and Responsibilities: NOAA will lead this effort with continued support from MDL and its research partners. FAA will support through the AWRP and will help QA/QC

3.5 Verification

Reference: WBS-3.5

Description: A NWS forecast evaluation process will be established to provide metrics on aviation weather impact variable forecast skill in terms of both accuracy and quality. Capabilities for independent verification assessments and automated verification approaches will be used to determine where, when, and how forecasters add value in the forecast process using various product generation applications. Verification tools for local prototyping will be developed.

Verification and assessment techniques will be applied to evaluate aviation-weather-impact variables generated interactively from numerical and statistical guidance and made available in the Cube as deterministic and probabilistic forecasts. A Network-enabled Verification Service (NEVS) will provide capabilities for verification and performance management of all NOAA-generated, aviation-impact variables and products in the Cube.

High spatial and temporal resolution analyses of data from the Analysis of Record shall be provided as the basis for verification of gridded Aviation impact variables in the Cube including icing, ceiling height, obstruction to visibility, turbulence, and convection.

Timeframes: March 2009 – October 2012.

Deliverables: NEVS infrastructure interface to the Cube, reports on NWS Forecast Evaluation Process for IOC, verification analysis tools for applications used to generate the weather impact forecast variables in the Cube at IOC, aviation analyses of record, and verification metric reports for all forecast variables in the Cube at IOC. A demonstration of NEVS operations capabilities will be completed by October 2012.

Exit criteria: Operational NEVS capabilities required for verification of IOC weather elements in the Cube. Verification skill assessment of IOC gridded aviation-impact variables.

Agency Roles and Responsibilities: NOAA's Office of Oceanic and Atmospheric Research Global Systems Division will develop the NEVS and establish the forecast evaluation process. NOAA's NWS MDL will provide routine verification reports for generated products. NOAA's NWS Environmental Modeling Center will provide analyses of aviation-impact variables for gridded verification.

4.0 Single Authoritative Source

Reference: WBS 4

Description: The capability to have a rudimentary SAS of aviation weather information for use by Air Traffic Managers and systems is desired for IOC. Though the SAS available at IOC will not meet all functional or performance requirements of the SAS, the capability to designate selected products as members of the SAS, apply appropriate metadata and standards, and allow access to all required users is fundamental to future development. The SAS concept and architecture is a primary consideration of both the interagency and agency Cube architectures.

4.1 Single Authoritative Source Concept

Reference: WBS 4.1

Description: This task will develop the foundational documents for the IOC SAS capability. A SAS white paper, Concept of Operations, and an initial set of business rules will be delivered. The SAS requirements and architecture will be derived from these documents which will allow the techniques and tools required to manage the SAS to be developed.

Timeframes: Jan 2009 – May 2010

Deliverables: SAS White Paper, IOC SAS ConOps, requirements, and architecture

Exit criteria: Completed requirements and architecture for the IOC SAS

Agency Roles and Responsibilities: NOAA will be the lead agency for this effort but the documents will be developed under the auspices of the JPDO with input from FAA, DoD, and Industry participants.

5.0 Initial Operational Capability

Reference: WBS 5

Description: Initial Operational Capability of the Cube will be delivered, having completed all required OT&E and C&A processes. The IOC capability may be regional in coverage, with a limited number of users. Appropriate IT infrastructure will be in place to provide weather information from the Cube to NAS users.