FAA and NWS Weather Portfolio Programs

Federal Aviation Administration

September 18, 2018

- **What is NextGen?**
- **Weather in NextGen and the National Airspace System (NAS)**

Delivering NextGen Improvements

Legacy System		NextGen
Radar	→	Satellite
Inefficient Routes	→	Performance Based Navigation (fuel savings)
Voice Communications	→	Voice & Digital Communications
Disparate Information	→	Automated Decision Support Tools
Fragmented Weather Forecasting	→	Integrated Weather Information
Weather Restricted Visibility	→	Improved Access in Low Visibility
Forensic Safety Systems	→	Prognostic Safety Systems
Nationwide Focus	→	Focus on Congested Metroplexes

Aviation Data

Flight Planning   Push Back / Taxi / Takeoff   Domestic / Oceanic Cruise   Descent / Final Approach / Landing

Implementation   TFDM   PBN   TBFM   ASIAS   AIM   NWP

Transformational   ADS-B   CATM-T   SWIM   CSS-Wx   NVS   DataComm

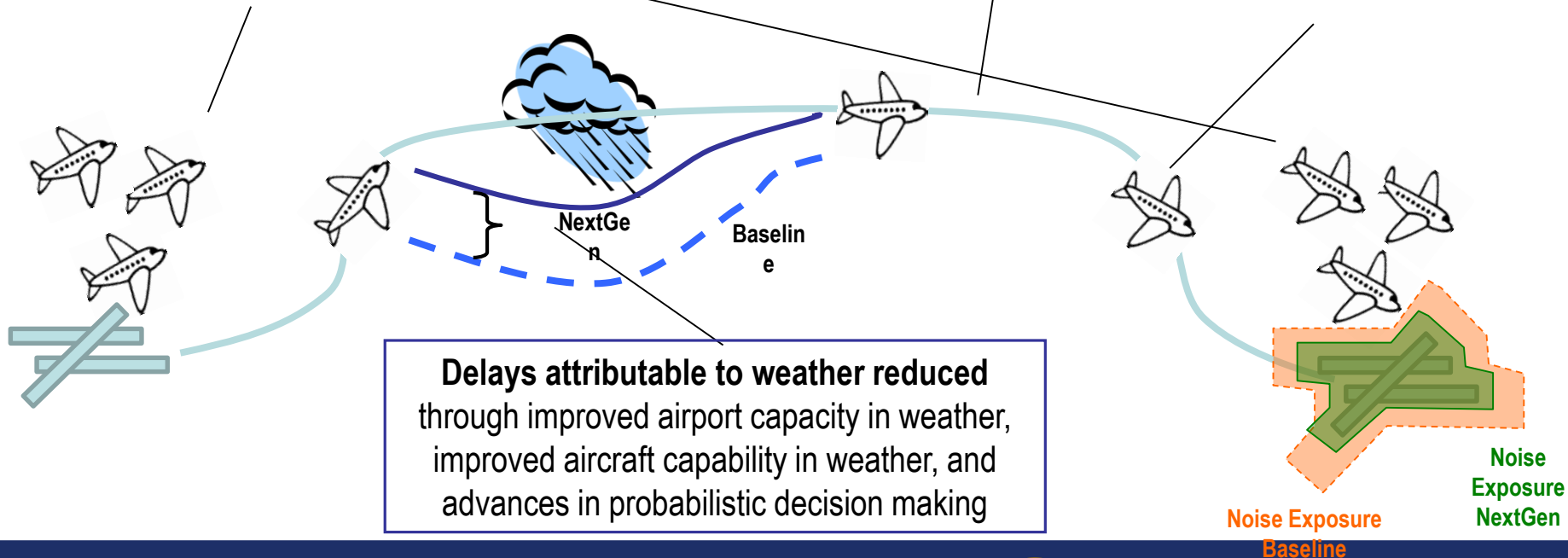**Foundational**   Terminal Automation Modernization and Replacement   En Route Automation Modernization   Terminal Automation Modernization and Replacement

Incremental and ongoing FAA modernization

NextGen Performance Benefits

Through High Density Operations, new runways, and other operational improvements, airport capacities increased, allowing **increased throughput** while maintaining reasonable Demand/Capacity ratios

Through Trajectory Based Operations, satellite navigation, data communications, and other operational improvements, **en route capacities increased**

Future individual aircraft (airframes, engines) and ATC exhibit:
Noise reduction
Reduction in fuel burn
Reduction in emissions

NextGen

Baseline

Delays attributable to weather reduced through improved airport capacity in weather, improved aircraft capability in weather, and advances in probabilistic decision making

Noise Exposure Baseline

Noise Exposure NextGen

NextGen Weather System Benefits

Reduce FAA Operations Costs

$2.1B Cost Avoidance Over 25 Year Lifecycle Including $383M Ops Cost Savings

Eliminates Need for Legacy System Tech Refreshes

Payback After 6 Years

Modernize National Airspace System

Decommission Outdated Systems

Leveraging SWIM and FTI

Cloud Compatibility

Global Data Standardization

Improve Efficiency

Over $2.9B of User Benefits

Reduce Flight Delays

Enable Collaborative Decision-making

Improve Safety

Enhanced Weather Information
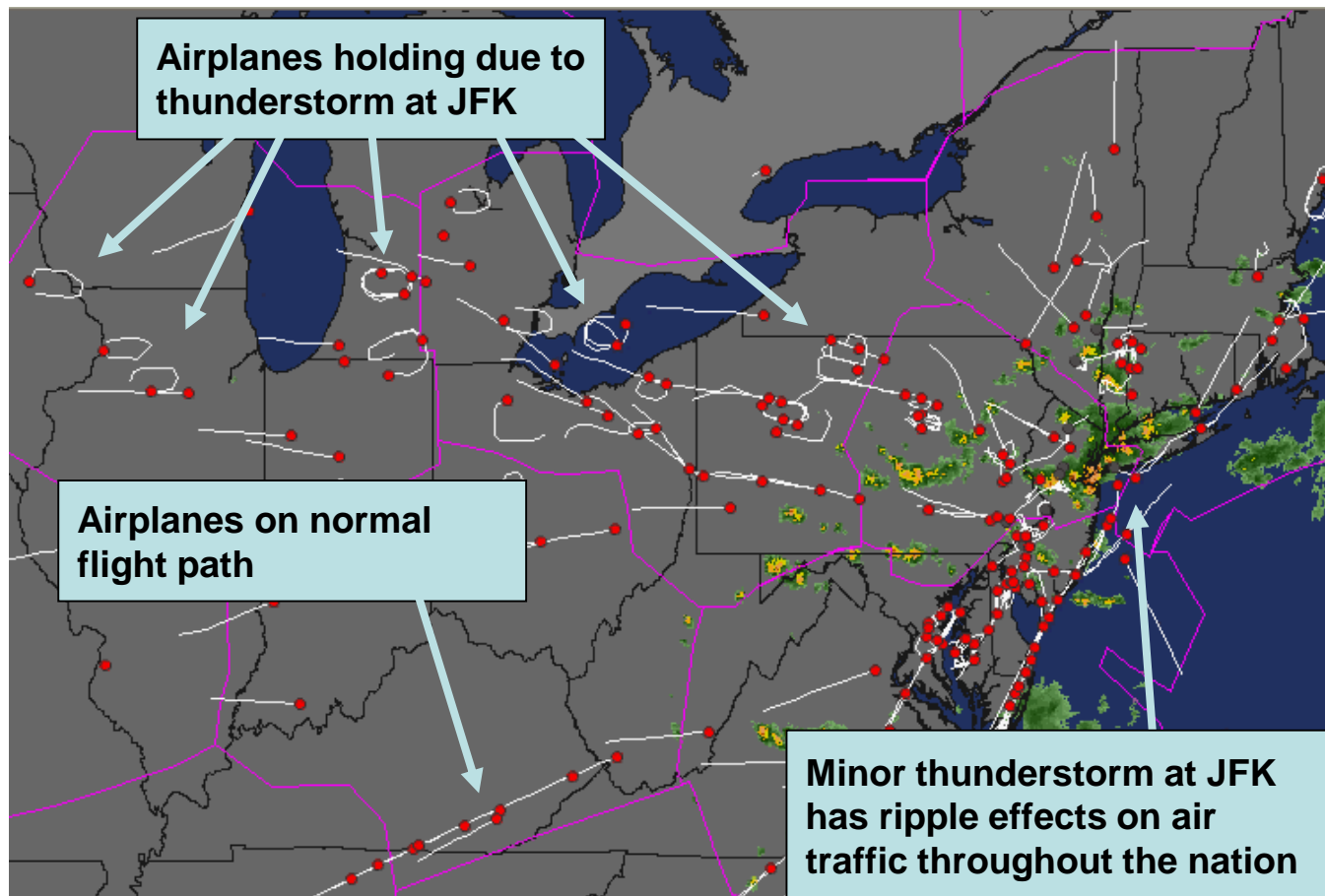
Greater Access

Common Situational Awareness

Air Traffic Delays

$41 billion annual loss to the U.S. economy*

- Airline operating costs
- Passenger value of time
- Delayed delivery of goods and services

70% Delays Due to Weather

$29 billion annual loss to the U.S. economy

Airplanes holding due to thunderstorm at JFK

Airplanes on normal flight path

Minor thunderstorm at JFK has ripple effects on air traffic throughout the nation

41% of weather delays potentially avoidable through improved integration, use and accuracy of weather information
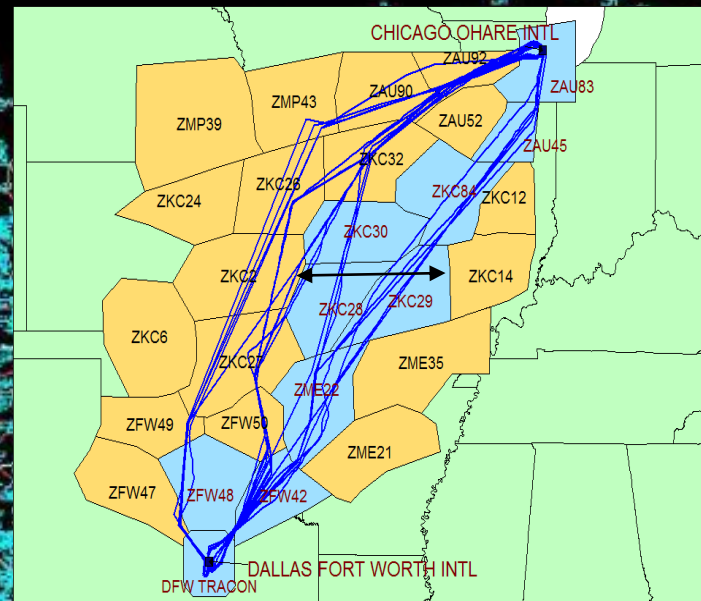***$19 billion annual potential recoup to U.S. economy***

System Efficiency Through Direct Routing: Data Communications

Without data communications

With data communications
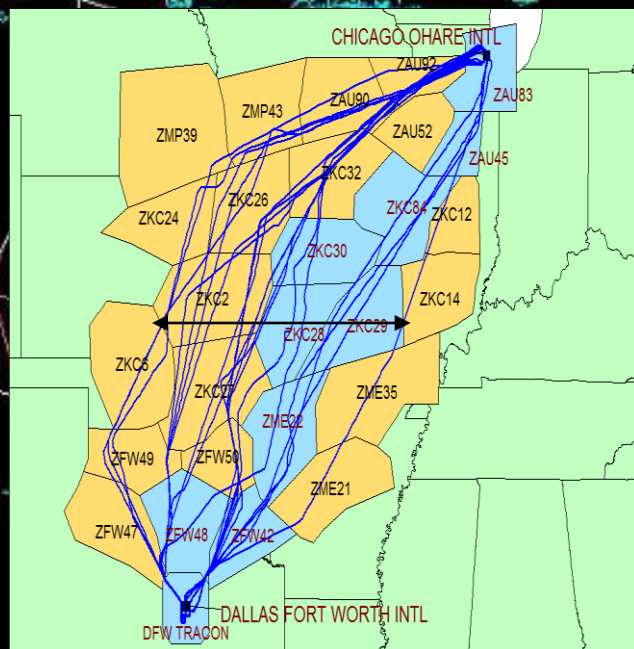
**More direct routes with Air Traffic Data Communications to aircraft**

	Ave Miles/flt	Ave min/flt
Good Day:	846	107
Bad Day with Data Link:	895	125
Bad Day:	922	135
Savings (Bad Day):	27	10

ADS-B Interval Management - Future

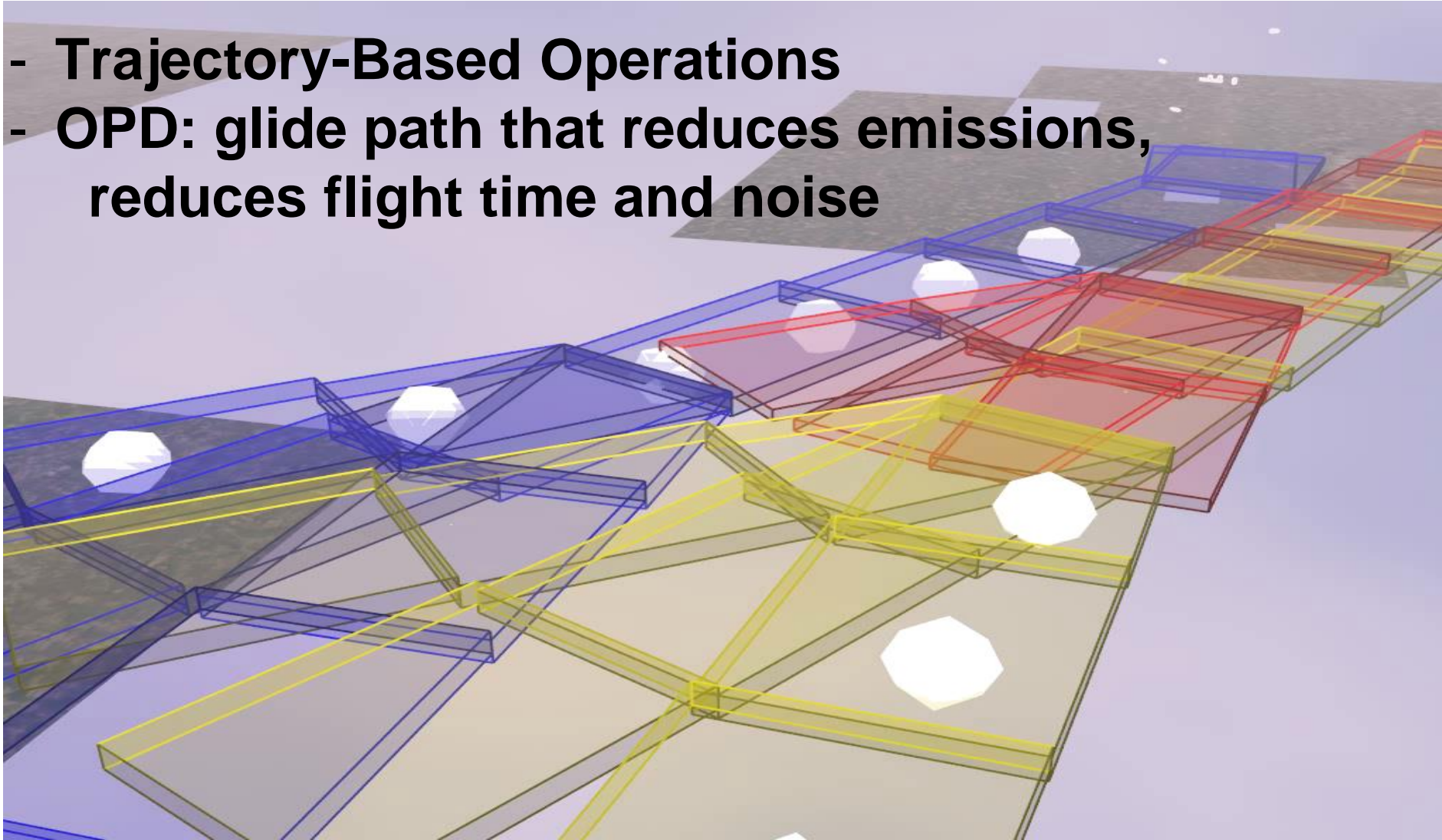**Have you heard of Adaptive Cruise Control in Cars?**

ADS-B provides accurate position information that allows Time-Based Flow Management (TBFM) to adjust aircraft speed and trajectory for the Approach Control.
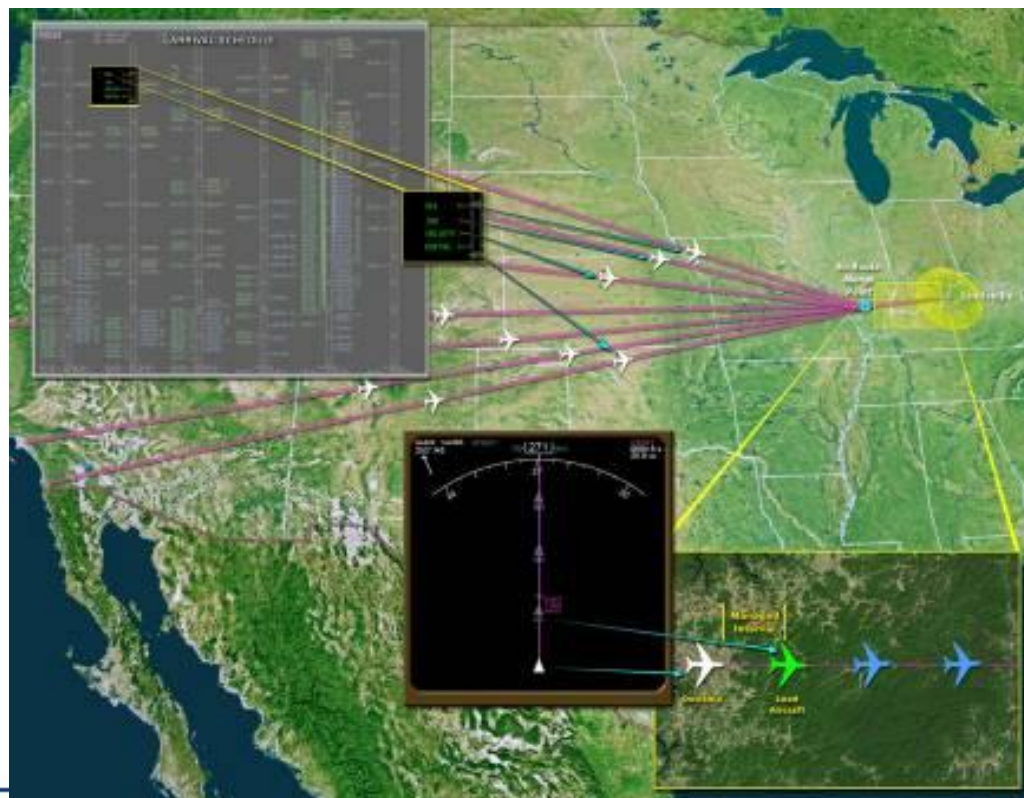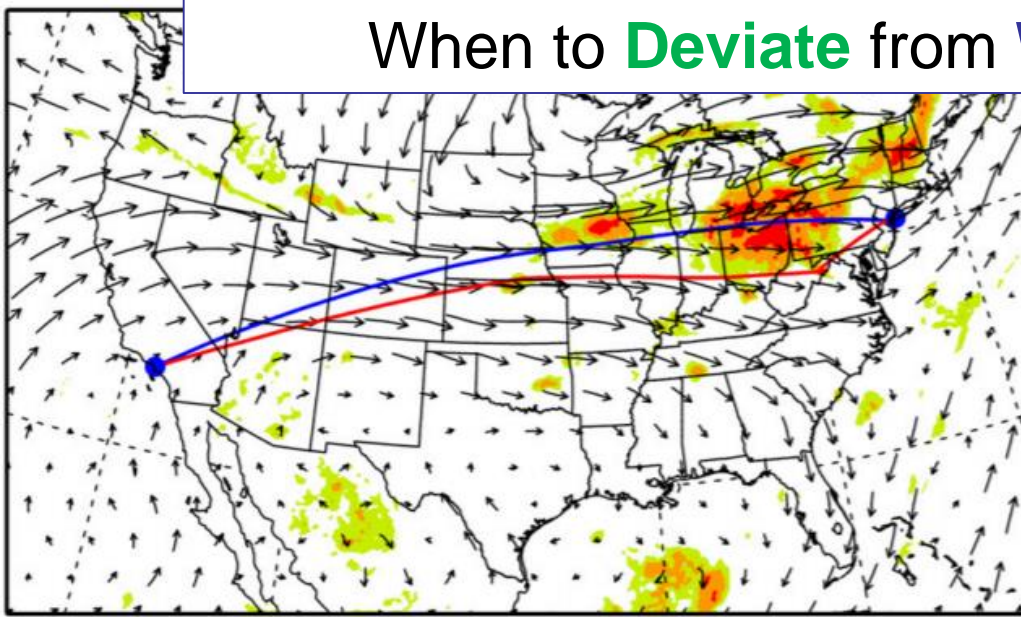
Next Generation Air Transportation System
Joint Planning and Development Office

- **Trajectory-Based Operations**
- **OPD: glide path that reduces emissions, reduces flight time and noise**
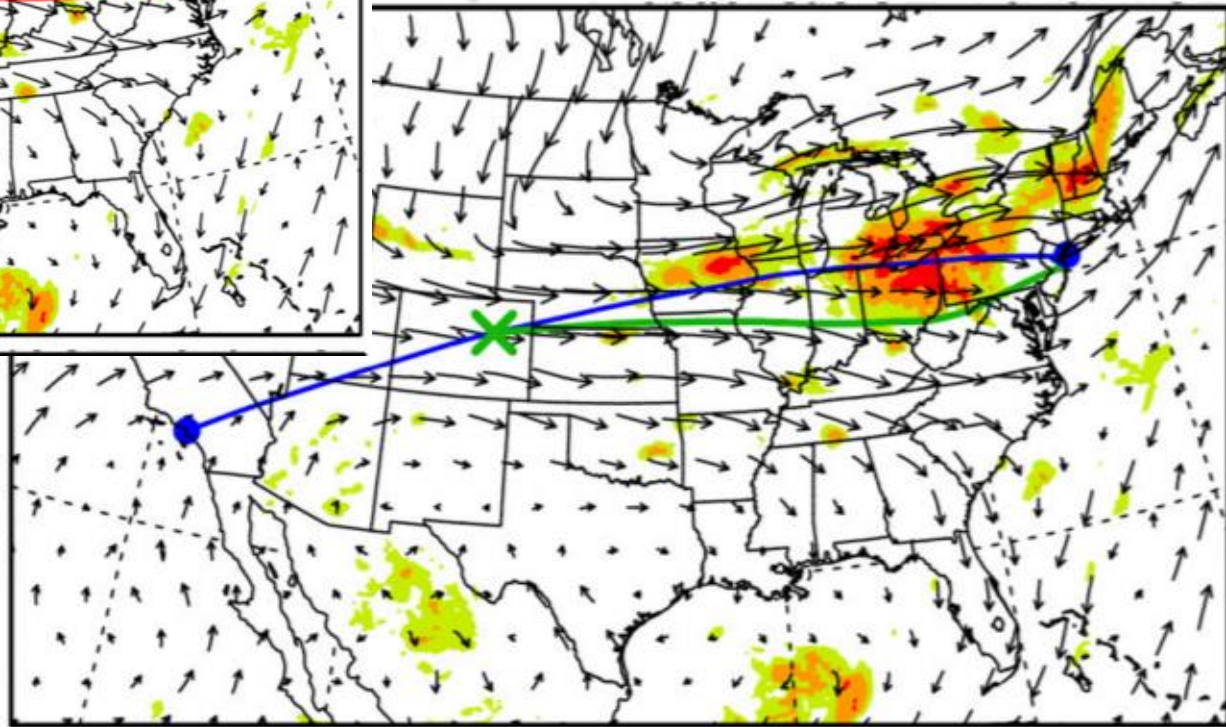
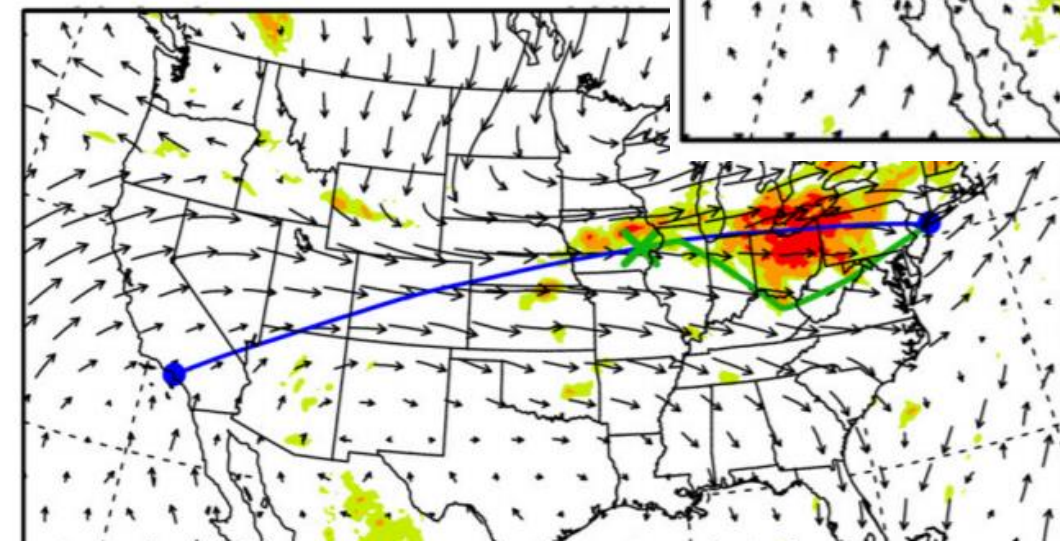# When to **Deviate** from **Wind Optimal Route**
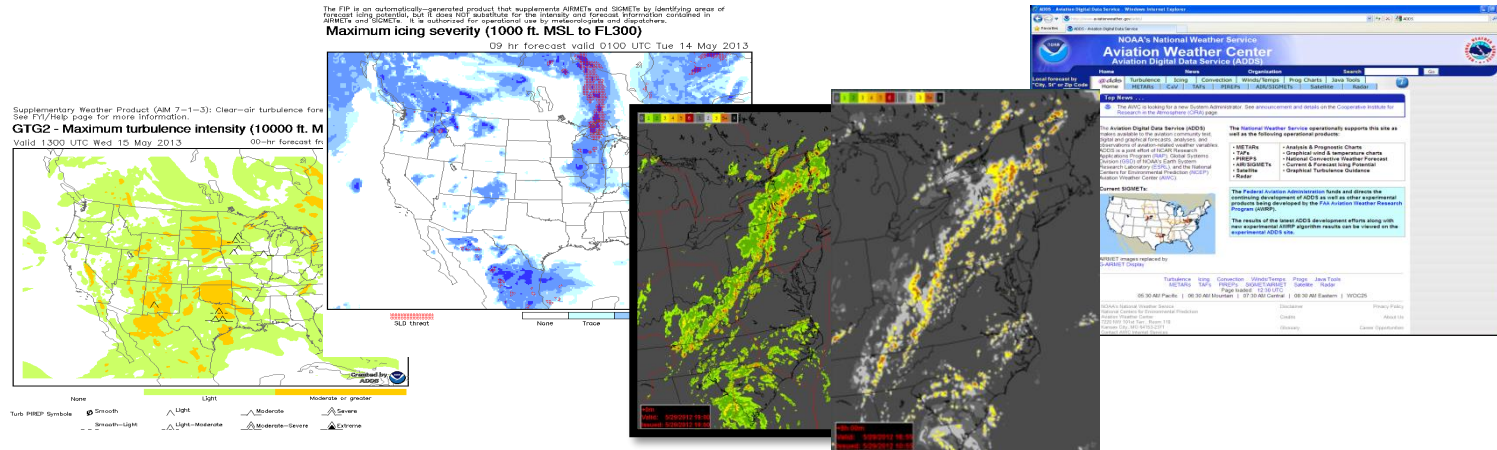

16 Extra Minutes

6 Extra Minutes

18 Extra Minutes

Aviation Weather Research Program (AWRP)

- **Applied research to minimize impact of weather on NAS by:**
    - Meeting specific NextGen Operational Improvements in NextGen Implementation Plans
    - Mitigating weather related safety and/or efficiency issues with a line of sight to operations
    - Evolving weather information required today in legacy capabilities to meet emerging NextGen needs often in collaboration with the National Weather Service (NWS)

AWRP – FY20 Portfolio

Core Wx Program	Provide Improved Thunderstorm Information to increase NAS efficiency, capacity, and safety (CW)
	Improve Capacity of NAS and Reduce Accidents Related to Turbulence (TRB)
	CONUS Ceiling and Visibility (C&V) Research
	Develop Alaska Ceiling and Visibility (C&V) Analysis for (CVA-AK)
	Perform Quality Assessment (QA) to verify and validate relevant weather nowcast and forecast capabilities
	Provide aviation weather demonstration, evaluation (AWDE) services to assess aviation weather research concepts to improve the delivery of capabilities
	Reduce Accidents and Fatalities Related to In-Flight Icing (IFI) Encounters
	Develop and Improve Aviation Weather Numerical Modeling Capabilities to improve safety and capacity of the NAS via Model Development and Enhancement (MDE)
	Integrate high resolution 4D weather radar analysis in support of safety and capacity in the NAS Advanced Weather Radar Techniques (AWRT)
	Improve weather capabilities to support safe and efficient Unmanned Aircraft System (UAS) operations in the NAS
AVS Wx	Mitigating the Ice Crystal Weather Threat to Aircraft Turbine Engines (HIWC)
	Terminal Area Icing Weather Information for NextGen (TAIWIN)
	Safety Driven Weather Requirements for Wake Mitigation

Aviation Weather
# NextGen Operational Improvements

- **Operational Improvements**
    - Include Convectively Induced Turbulence (CIT) in Graphical Turbulence Guidance (GTG)
    - Implement 0-2 hour winter weather forecast in NWP
    - Icing product for Alaska
    - Translation of 2-8 hour convective forecast into NAS constraints
    - Tailored weather information geographically, temporally, and by weather
    - C&V Analysis available NAS-wide
    - Provide liquid water equivalent rates for all frozen precipitation types
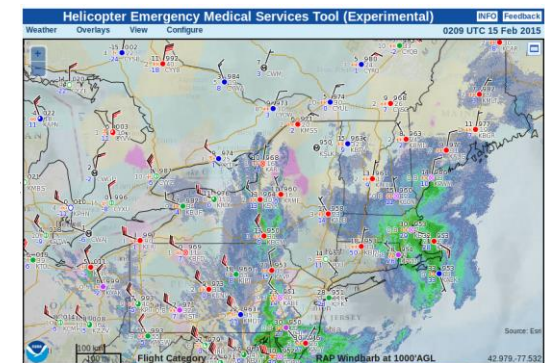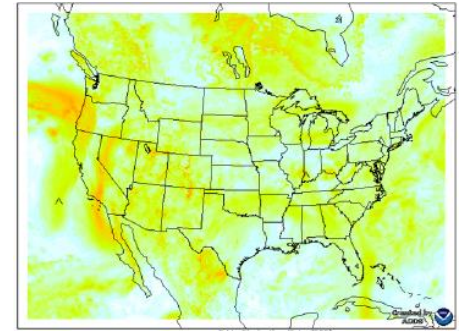
Aviation Weather
NextGen Operational Improvements

- **Operational Improvements**
  - Additional weather constraint translations
    - Terminal winds
    - Precipitation
  - Relate Forecast Icing Potential (FIP) values to icing intensities
  - Develop model of icing conditions for real-time ops
  - Translation of 2-8 hour convective forecast into NAS constraints
  - Add uncertainty attributes to C&V grids
  - Develop 2-8 hour winter weather forecast
  - Translation of C&V forecast into NAS constraints
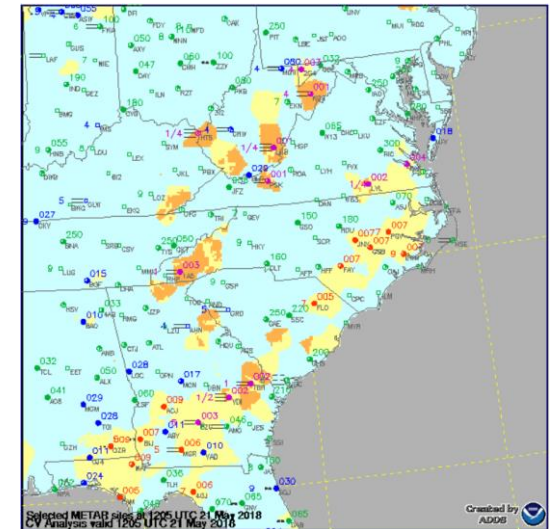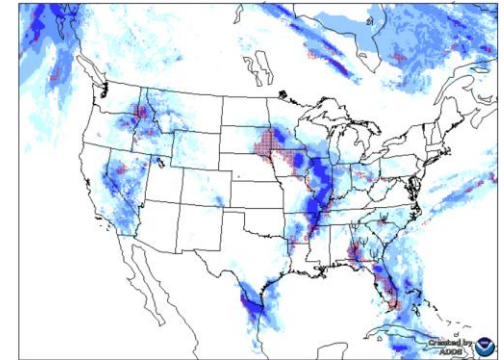
# Weather Technology in the Cockpit (WTIC)

Research Requirement

- Develop, verify, and validate requirements recommendations to incorporate into Minimum Weather Service (MinWxSvc) standards and guidance documents
    - Minimum cockpit meteorological (MET) information
    - Minimum performance standards/characteristics of the MET information
    - Minimum information rendering standards
    - Enhanced MET training

Outputs/Outcomes

- Enhance safety by identifying and resolving risks before they become accidents
- Incorporate MinWxSvc recommendations into standards and other guidance documents
- Resolve operational (current and NextGen) inefficiencies associated with adverse weather
- Enhance pilot MET-training to enable effective and consistent adverse weather decision-making

Future Plans

- Provide locations of convection and cloud top information to cockpits to reduce information gap in oceanic regions
- Develop rendering recommendations to reduce General Aviation pilot "change blindness" issue
- Incorporate into pilot training skills-based training on the latency of cockpit weather information
- Use crowd sourcing to enhance the MET information available to pilots
- Incorporate a tactical turbulence notification to enhance crew and passenger management and safety
- Produce guidance on content & format of mobile applications that support pilot adverse weather decision making
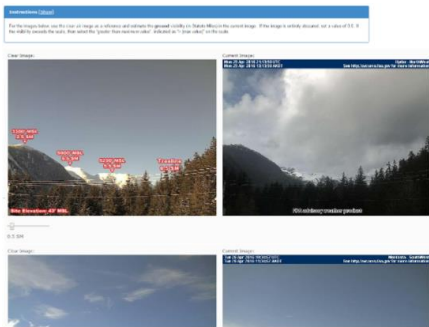
Weather Sensors & Radars

System	Qty	Surface Weather Observing System
AWOS-C	230	Automated Weather Observing System
ASOS	884	Automated Surface Observing System
SWS	226	Surface Weather System
SAWS	139	Stand Alone Weather System
DASI	130	Digital Altimeter Setting Indicator

➢ **1,100 Airports**
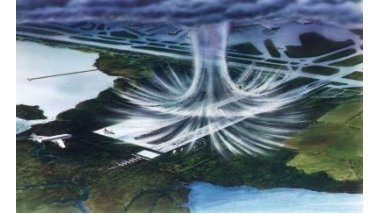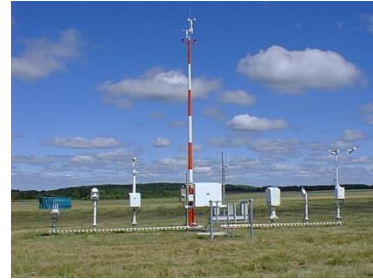
System	Qty	Wind Shear Detection System
TDWR	45	Terminal Doppler Weather Radar
WSP	34	Windshear Subsystem Processor
LLWAS	59	Low-Level Windshear Alert System

➢ **138 Airports**

System	Qty	En-Route Weather Radar
NEXRAD	12	Next Generation Weather Radar

➢ **12 FAA OWNED NEXRADs**
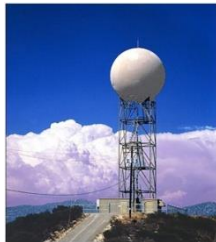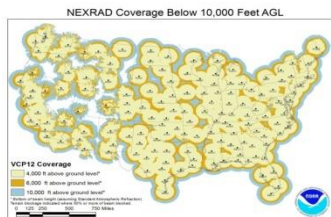
System	Qty	Juneau Airport System
JAWS	1	Juneau Airport Weather System

➢ **Only at Juneau International Airport**
  ➢ **Juneau Airport Wind System**
    ➢ **Detects terrain induced turbulence**

ASWON Tech Refresh Program
## (Aviation Surface Weather Observation Network)

- **System Description**
  - Provide accurate surface weather conditions to pilots, air traffic controllers, other aviation users, and the national weather data network

- **Program Description**
  - Replace obsolescent weather sensors, processor, and software
  - Legacy AWOS and AWSS are recently tech refreshed to AWOS-C
  - WEF (F-420) & C&G DASI system sites being replaced by Surface Weather System (SWS)
 - O&M cost savings by reducing the number of surface weather system types in the NAS

- **Future Plans**
  - Next Tech Refresh Program expected to start the business case in FY20
  - Replace SAWS and Stand-alone DASI with SWS
  - Goal: 2 primary surface weather observing systems → AWOS-C and ASOS
  - Only one backup system → SWS
  - Increase hardware commonality among systems
  - Reduce operating cost
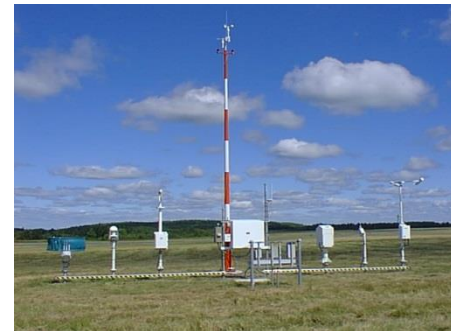
Wind, Temperature/Dew Point, Pressure, Cloud Height, Humidity, Rain Gauge, Present Weather/Visibility

NextGen Weather Architecture
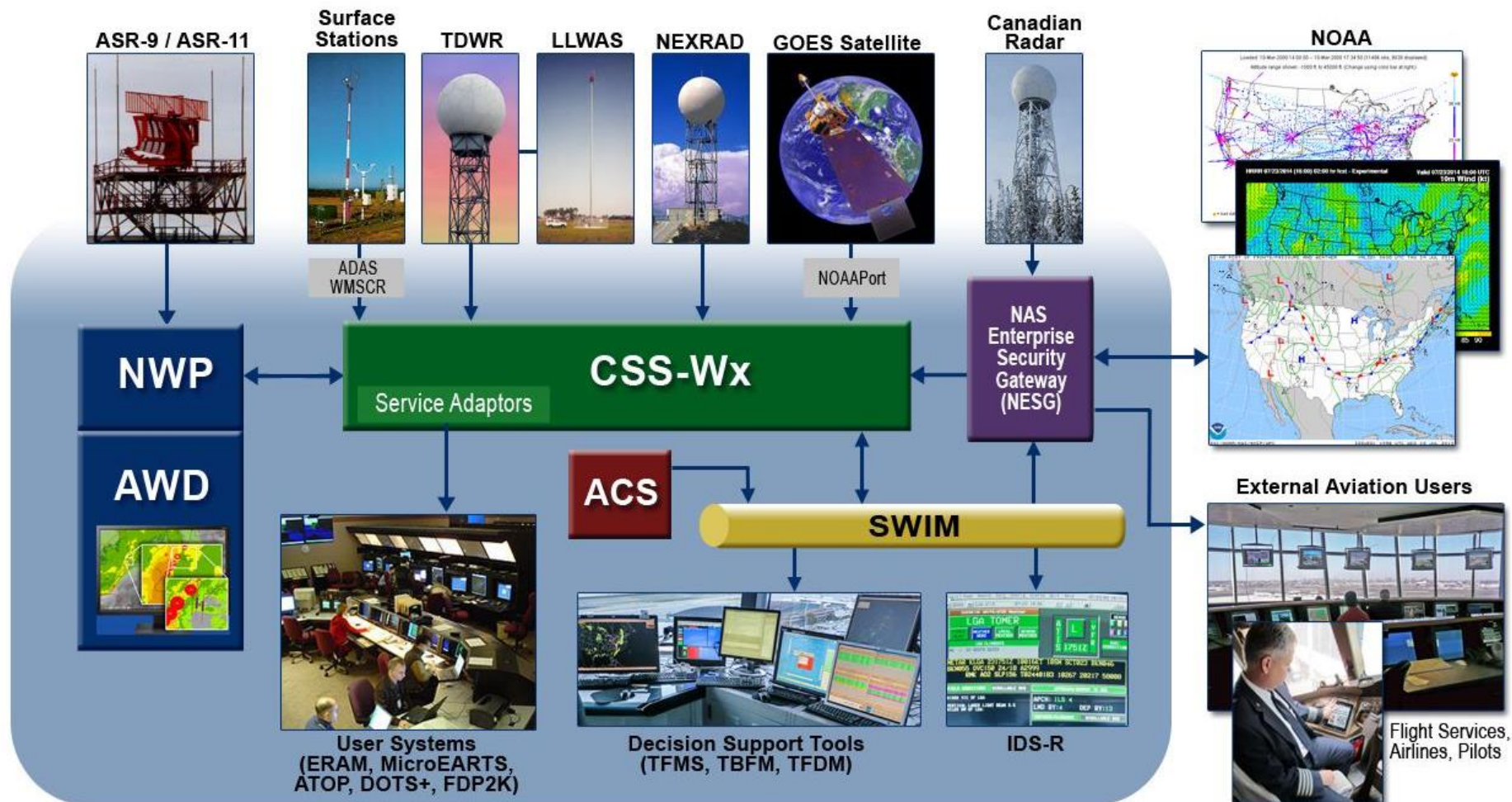
Common Support Services - Weather (CSS-Wx) Program

- **System Description**
  - Provides a single source for FAA weather and weather-related constraint information
  - Establishes an enterprise level common support services using System Wide Information Management (SWIM)
  - Focuses on weather information management, publishing to support users, and providing new interface standards and formats
  - Provides for extraction of weather information by user-specified criteria
- **Program Description**
  - Improves weather information management and user access; provide new interface standards and formats
  - Reduces FAA cost by enabling decommissioning of legacy weather dissemination systems (e.g., WARP WINS, FBWTG, CDDS)
  - Makes weather products available from NOAA, NWP and other data sources for integration to air traffic systems
  - Provides weather products via a set of common Web Services for weather, using international data access and data format standards

NextGen Weather Processor (NWP) Program

- **System Description**
  - New system subsumes legacy processing functions and generates advanced aviation specific weather information for users (i.e., controllers, traffic flow managers, Flight Operations Centers, pilots and Airport Operations Centers):
    - 0 to 8 hour aviation weather products using NOAA models
    - Real-time weather information
    - Convective Weather Avoidance Fields
    - Wind Shear alerts
  - Translates weather information into weather avoidance areas for integration into decision support tools (e.g., TFMS, TBFM)
  - Provides Aviation Weather Display (AWD) of NextGen weather information for AT users

- **Program Description**
  - Increases NAS efficiency and safety by improving weather product generation, translation, and display for aviation weather users
  - Reduces FAA costs by enabling decommissioning of legacy weather processor systems (e.g., WARP, ITWS, CIWS)

QUESTIONS