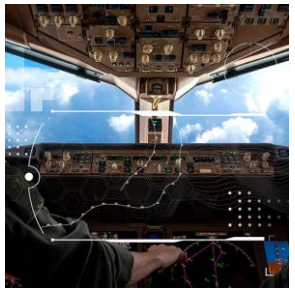
Collins Aerospace
An RTX Business

UNPRECEDENTED ALL-WEATHER OPERATIONS CAPABILITY

June 2024

OUR STRATEGIC INITIATIVES

Build safer, more connected systems and solutions



AUTONOMOUS OPERATIONS

System-controlled complex tasks, including the evolution to autonomous flight

CONNECTED BATTLESPACE

Intelligent, cross-domain connectivity & sensing in contested environments

CABIN EXPERIENCE

Optimization of all cabin design aspects to meet evolving operator and passenger expectations

CONNECTED ECOSYSTEMS

Digital enablement and transformation with end-to-end solutions and service

ELECTRIFIED AIRCRAFT

Electrical propulsion and aircraft systems for sustainable aviation

INTEGRATED SOLUTIONS

Platform & mission performance-enhancing solutions that cross traditional system boundaries

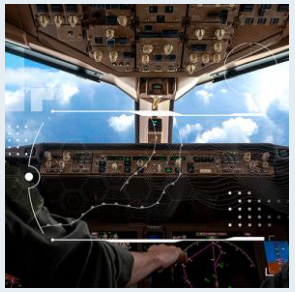
STRUCTURAL TECHNOLOGIES

Complex interior and exterior solutions leveraging advanced materials and additive manufacturing

Collins Aerospace
An RTX Business

OUR STRATEGIC INITIATIVES

Build safer, more connected systems and solutions



AUTONOMOUS OPERATIONS

System-controlled complex tasks, including the evolution to autonomous flight

CONNECTED BATTLESPACE

Intelligent, cross-domain connectivity & sensing in contested environments

CABIN EXPERIENCE

Optimization of all cabin design aspects to meet evolving operator and passenger expectations

CONNECTED ECOSYSTEMS

Digital enablement and transformation with end-to-end solutions and service

ELECTRIFIED AIRCRAFT

Electrical propulsion and aircraft systems for sustainable aviation

INTEGRATED SOLUTIONS

Platform & mission performance-enhancing solutions that cross traditional system boundaries

STRUCTURAL TECHNOLOGIES

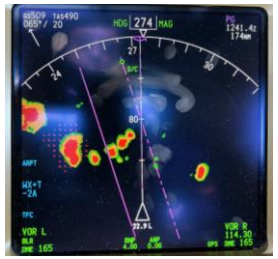
Complex interior and exterior solutions leveraging advanced materials and additive manufacturing


ALL-WEATHER OPERATIONS
Collins Aerospace
An RTX Business

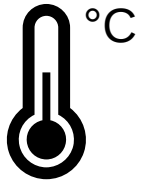
DEALING WITH ADVERSE WEATHER

PREDICT – DETECT – PROCEED THROUGH ADVERSE CONDITIONS

Predict:
What is ahead of me?



Detect:
What am I experiencing right now?

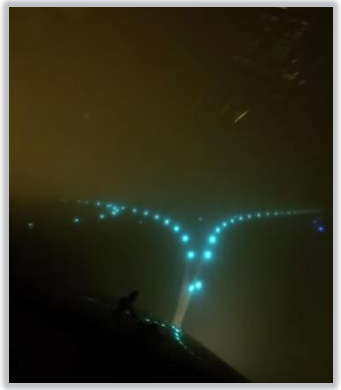


Proceed:
How do I safely continue my flight?

Collins Aerospace
An RTX Business

WEATHER THREATS

Build safer, more connected systems and solutions



REDUCED VISIBILITY

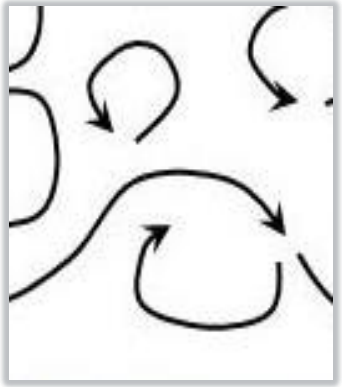
Limits take-off and landing, taxi

ICING

Contamination of surfaces, weight, aerodynamic impact

PRECIPITATION

Indicator of turbulence, lightning



TURBULENCE

Passenger and crew comfort and safety, structural integrity

LIGHTNING

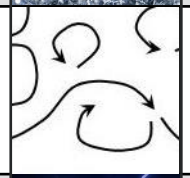
Airframe and systems damage

WINDSHEAR

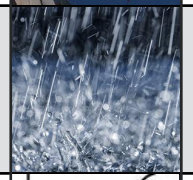
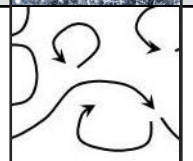
Aircraft performance and safety

Collins Aerospace
An RTX Business

ADVERSE WEATHER - THE BIG PICTURE

	Predict	Detect	Proceed
Visibility 			
Icing 			
Precip 			
Turbulence 			
Lightning 			
Windshear 			

ADVERSE WEATHER - THE BIG PICTURE

		Predict	Detect	Proceed
Visibility		Weather Forecast RVR, METAR	Look outside	ILS, GLS, LPV, CAVS HUD, EFVS, new sensors
Icing				
Precip				
Turbulence				
Lightning				
Windshear				

PRECISION APPROACH

ILS AND GLS EXPERIENCE

1950
- First ILS and autopilot system

1977
- First to acquire, track and decode GPS satellite signal

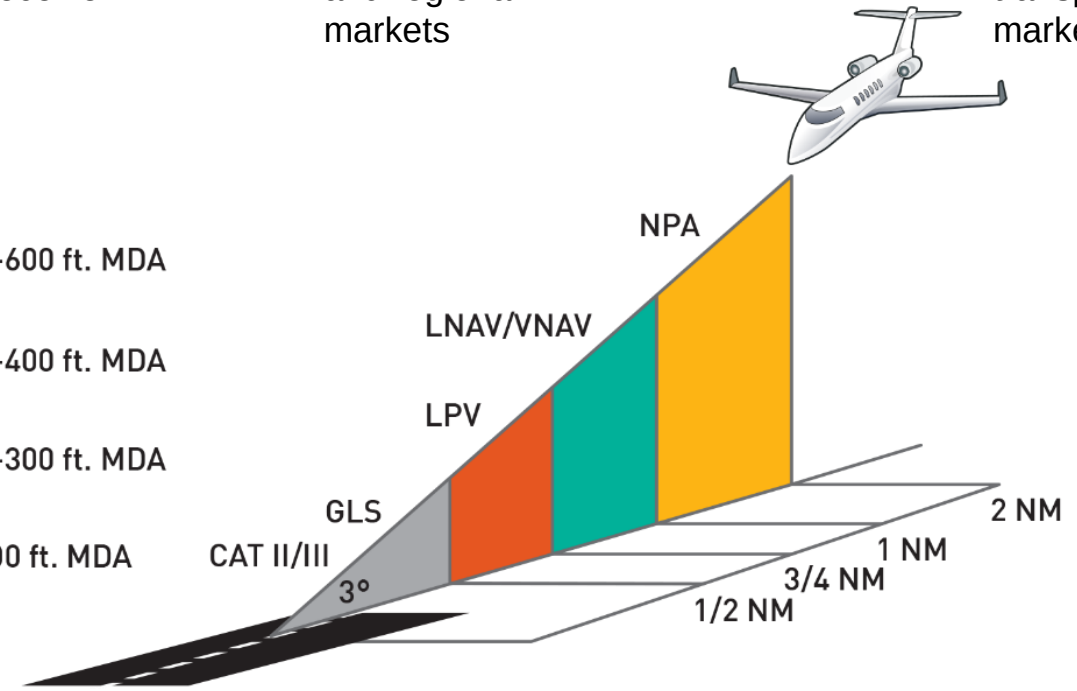
1995
- Certified first multi-mode receiver

2003
- Introduced LPV in business and regional markets

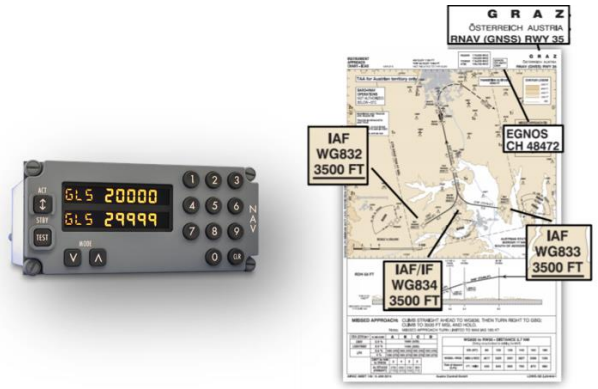
2005
- First GPS landing system

2010
- First LPV solution in air transport market

Future
- GBAS Cat II/III and LPV everywhere



SBAS/LPV CONSIDERATIONS



Approach Selection

- LPV Database
- LPV approach access & selection
- MMR or FMS hosted
- Dataloading and Validation

GNSS Receiver

- SBAS capable GPS TSO-C145/C146
- DO-229E
- Host LPV databases
- Output LPV approach path for Displays

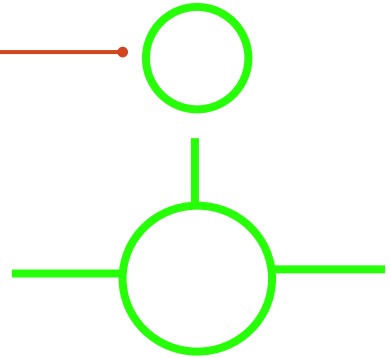
Monitoring & Guidance

- Integrated or Standalone Display annunciation
- Flight Control and Autopilot Systems
- LPV Lateral & Vertical Modes

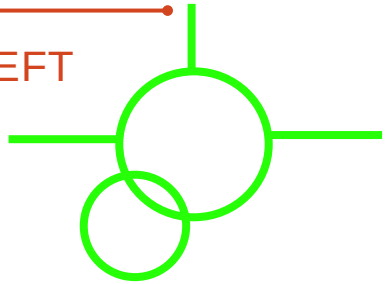
Aircraft Enablement

HEAD-UP GUIDANCE SYSTEM

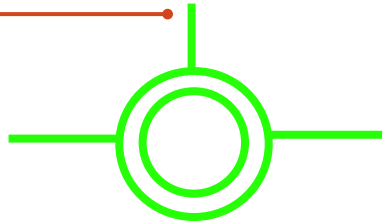
CLIMB



DESCEND AND FLY LEFT



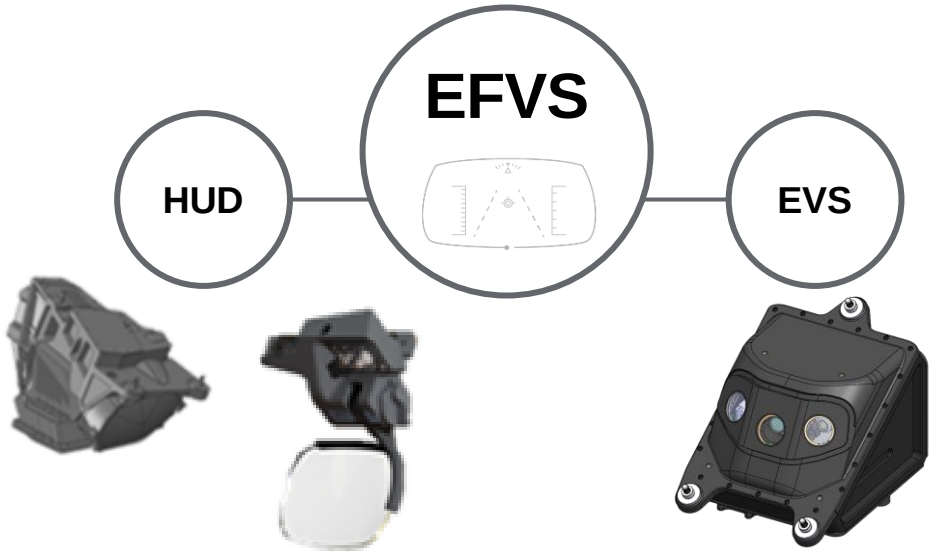
PERFECT



Collins Aerospace
An RTX Business

WHAT IS EFVS?

Enhanced Flight Vision System

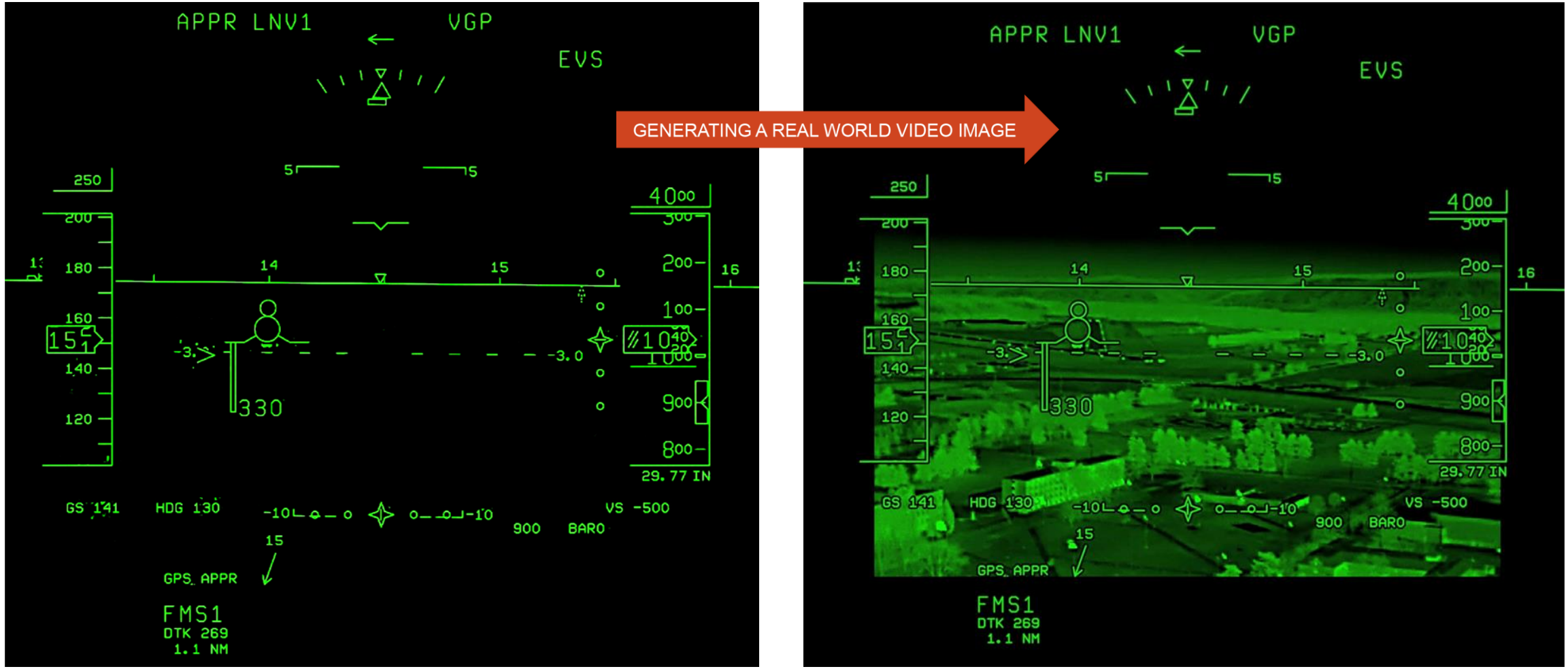


Head-Up Display that conformally displays the enhanced the image

Airborne, real-time imaging sensor that “sees” better than the human-eye

EFVS EVOLVING THE SOLUTION

VISUAL EQUIVALENT VIEW VIA SENSORS – EXCEEDING HUMAN VISION



EFVS BENEFITS

Flight Phase	EFVS Benefit
Flight Planning	Allows flight dispatch
EFVS Take-off	Allows take-off and departure
Approach	Allows start of approach (Approach ban relief)
EFVS Landing	Allows descent below Decision Height (DH) or Minimum Descent Altitude (MDA/DA)

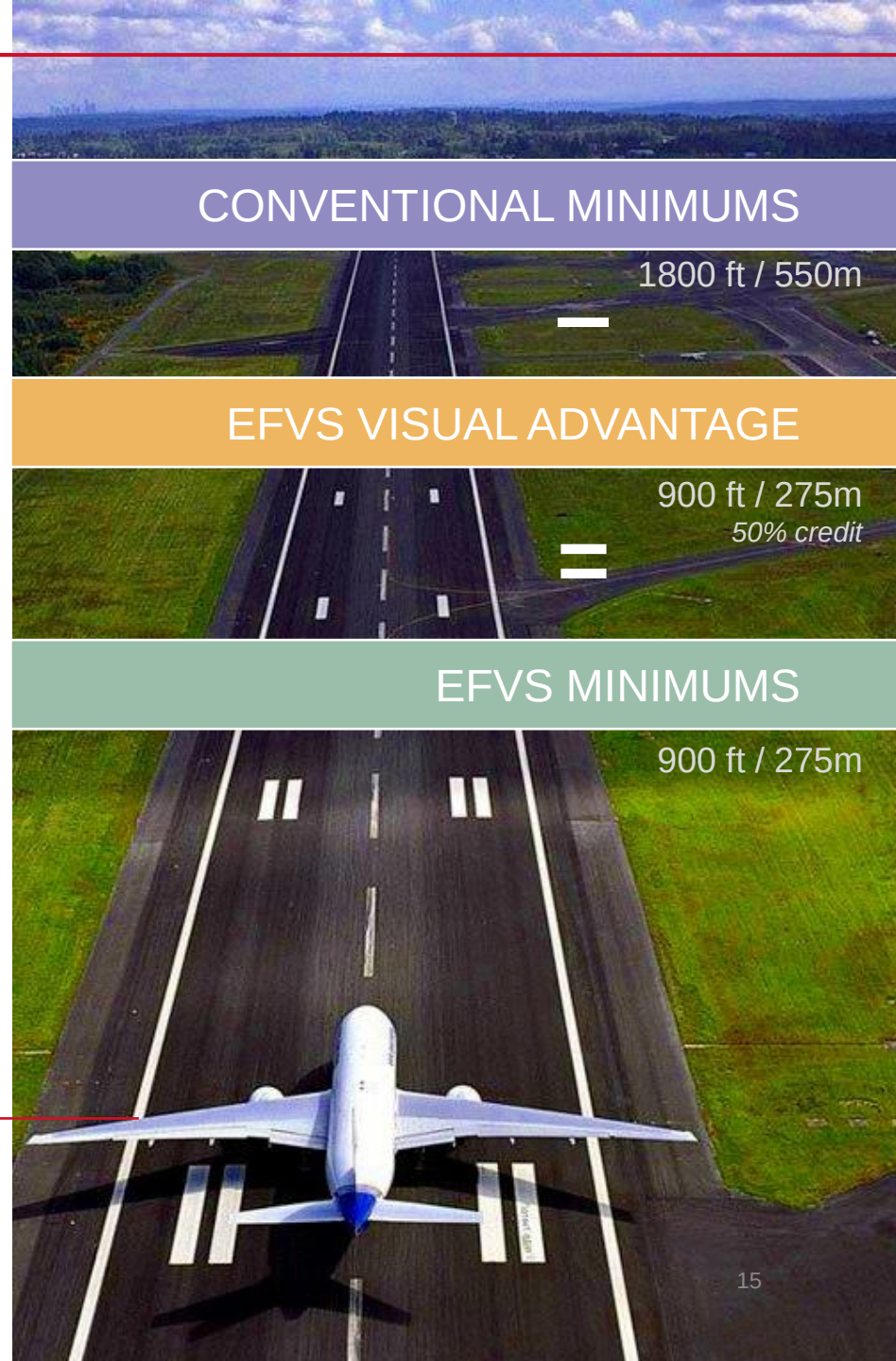
EFVS provides benefits across many flight phases

2000 — Situation Awareness

2010 — Approach Ops (to 100 ft HAT)

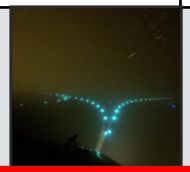
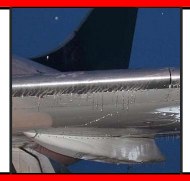
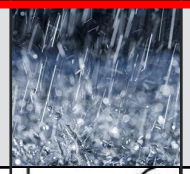
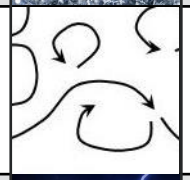
2020 — Landing Ops (1000 RVR); Air Carrier, Charter, Commuter

2030 — Takeoff Ops; Landing Ops (<1000 RVR) *Future*



Collins Aerospace
An RTX Business

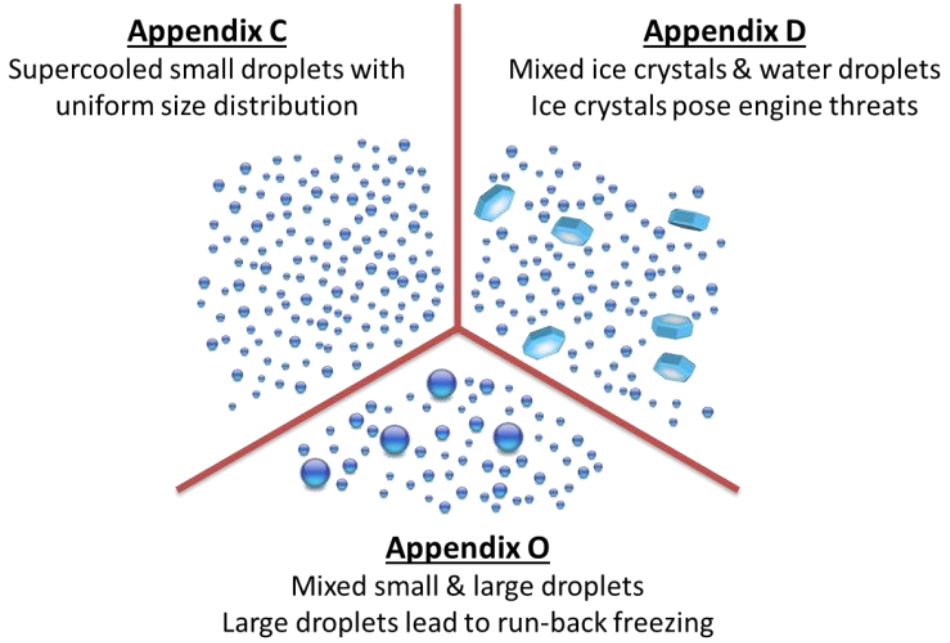
ADVERSE WEATHER - THE BIG PICTURE

		Predict	Detect	Proceed
Visibility		Weather Forecast RVR, METAR	Look outside	ILS, GLS, LPV, CAVS HUD, EFVS, new sensors
Icing		Weather Forecast PIREPs	Pilots monitoring Ice detectors	De-ice, anti-ice
Precip				
Turbulence				
Lightning				
Windshear				

ICE DETECTION

NEW ICING REQUIREMENT

- Aircraft icing regulations updated in 2014/2015
- Past: only small supercooled water drops (Appendix C)
- Added two new types of icing
  - Supercooled water with some large drops (Appendix O)
    - Dangerous because larger drops impact/freeze on areas not covered by standard ice protection
    - Exit conditions if aircraft not certified for Appendix O conditions
  - Ice crystals (Appendix D in FAA terms, P in EASA terms)
    - Dangerous because they can clog openings like Pitot tubes and even engine cores
    - Aircraft must be able to sustain all Appendix D/P icing

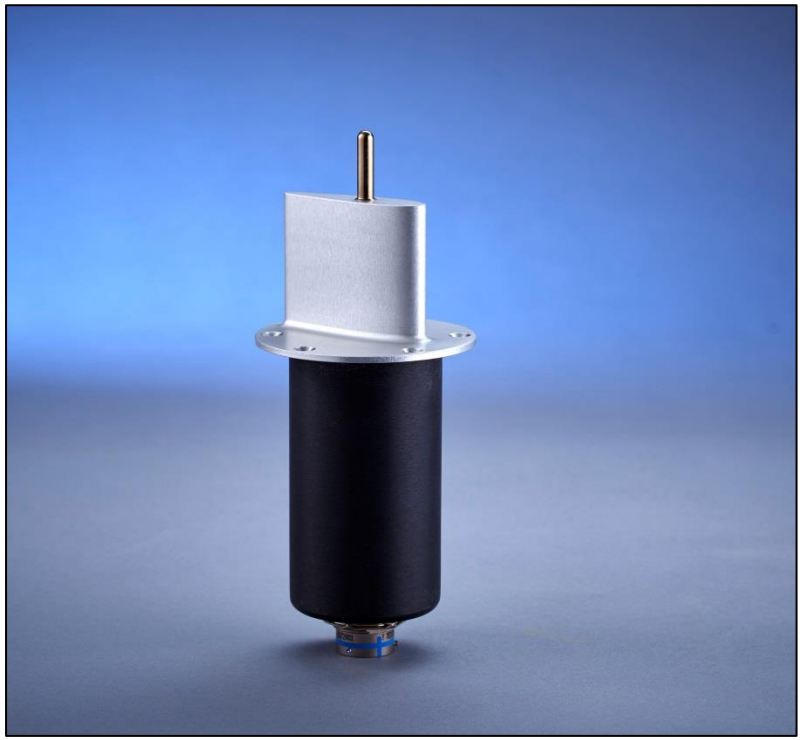


Collins Aerospace
An RTX Business

ICE DETECTION

TODAY'S TECHNOLOGY: MAGNETOSTRICTIVE ICE DETECTOR

- Proven technology on over 100 different aircraft types
- Certified primary on multiple platforms
- Detects all supercooled liquid icing
- Cannot differentiate between Appendix C and O
  - App C = small uniform droplet distribution
  - App O = some large droplets
- Designed to be insensitive to Appendix D/P (ice crystals)
  - Primarily used for activation of ice protection and ice crystals just bounce off the wing
- Accretion-based technology



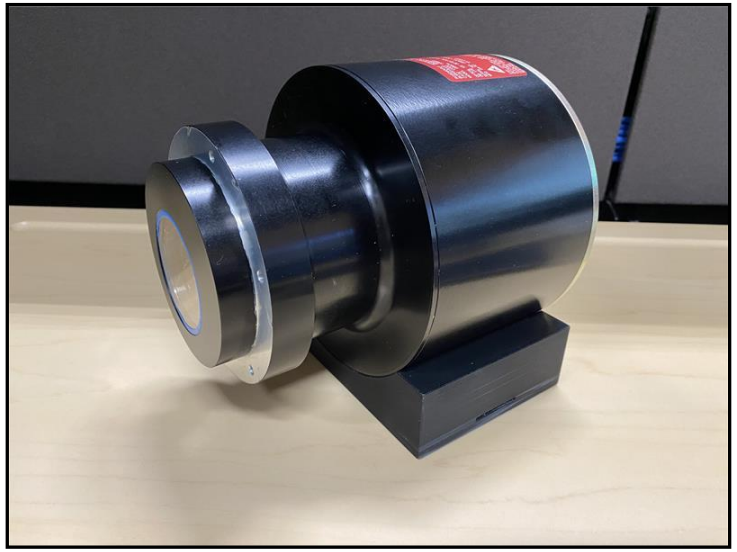
Collins Aerospace
An RTX Business

ICE DETECTION

NEPTUNE OPTICAL ICE DETECTOR

Key Features

- Detection of App C, O, D/P
- Differentiation of App C, O, D/P
- Flush Mount
- Laser-based system sees out approximately 30” from side of aircraft
  - Avoids local flow effects
- Large sample volume
  - Faster response

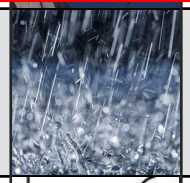
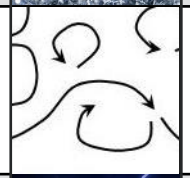


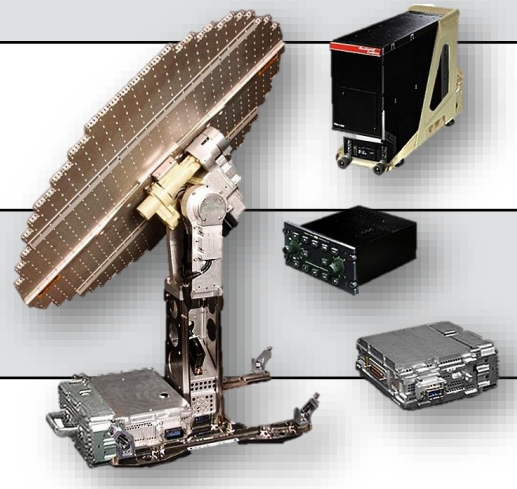
Technology Status

- Prototype icing wind tunnel test successfully completed
- TRL 6 achieved for detection and differentiation of all 3 types of icing
  - Proven through icing flight test
- Collins is progressing towards product development and certification

Collins Aerospace
An RTX Business

ADVERSE WEATHER - THE BIG PICTURE

		Predict	Detect	Proceed
Visibility		Weather Forecast RVR, METAR	Look outside	ILS, GLS, LPV, CAVS HUD, EFVS, new sensors
Icing		Weather Forecast PIREPs	Ice detectors	De-ice, anti-ice
Precip				
Turbulence				
Lightning				
Windshear				



Collins Aerospace
An RTX Business

WEATHER RADAR

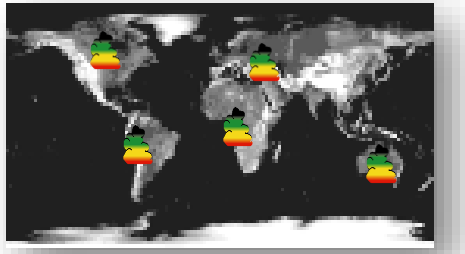
Functionality Evolution

Traditional Weather Radar

Traditional Weather Radar
Tri-Color & Solid State
Doppler Turb Detection Introduced

Forward Looking Windshear
Take-Off and Landing Safety

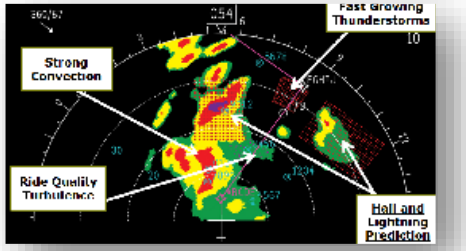
MultiScan™



MultiScan™
Fully Automatic Operation
Superior Ground Clutter Suppression

Geographic Wx Correlation
Quiet Dark Cockpit

MultiScan ThreatTrack™



MultiScan ThreatTrack™
Track-While-Scan
Hazard/Threat Tracking and Analysis
Evolving Algorithm (Oceanic)

Collins Aerospace
An RTX Business

MULTISCAN™

Key Technology Base

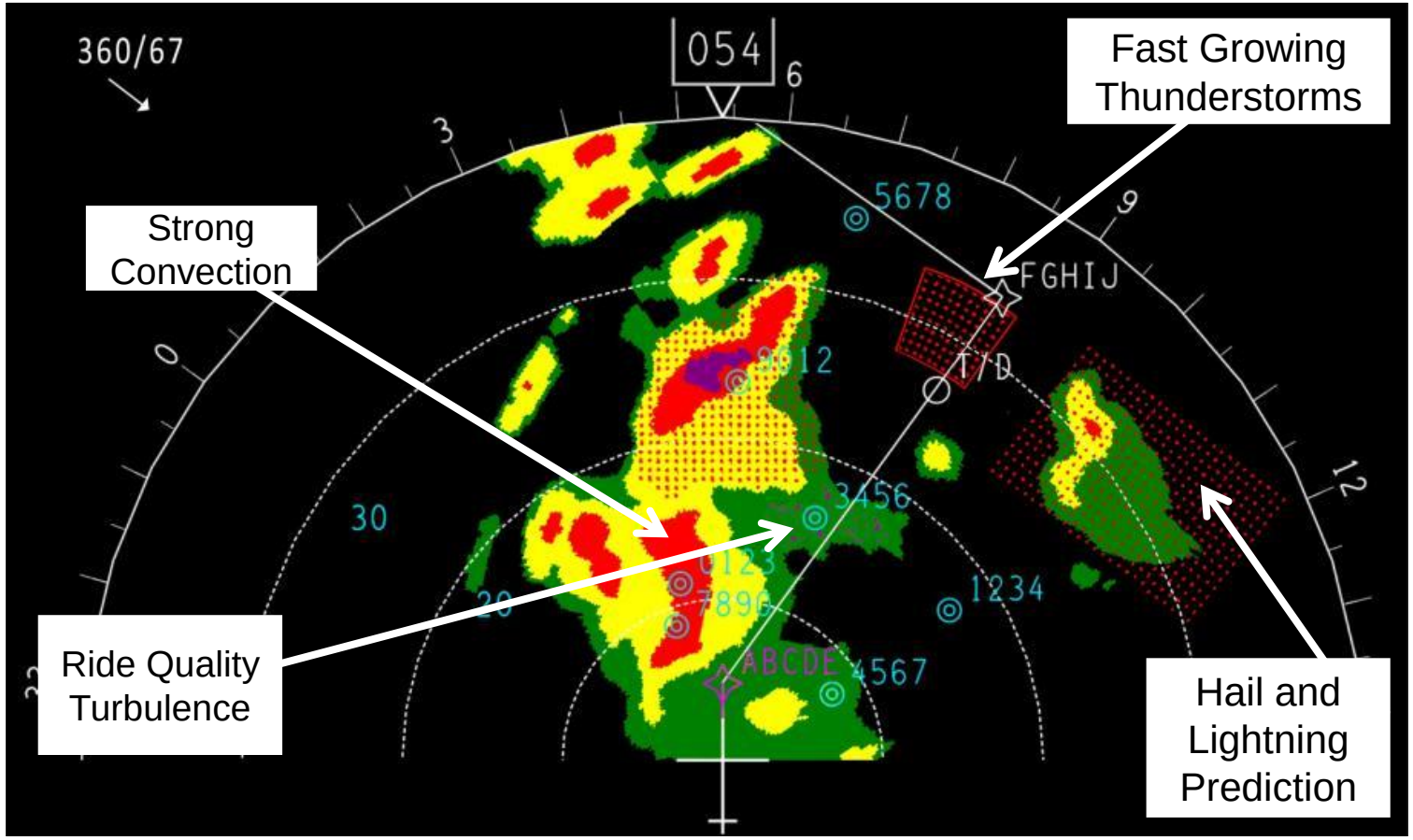
- Predictive Windshear
- Live Ground Clutter Suppression
- Automatic Temp Based Gain
- True Zero™ Auto Alignment
- SmartScan™
- Overflight Protection™
- Geographic Weather Correlation
- Certified Turbulence

Quiet Dark Cockpit

THREATTRACK™

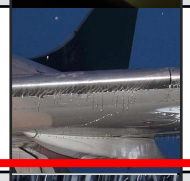
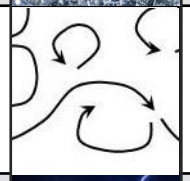
ThreatTrack™ Features

- Track While Scan Thunderstorm Assessment
- Core Threat Analysis
- Lightning and Hail Prediction
- Predictive Overflight
- Enhanced Turbulence Detection
- Flight Path Correlation



Fully Automatic Weather Radar

ADVERSE WEATHER - THE BIG PICTURE

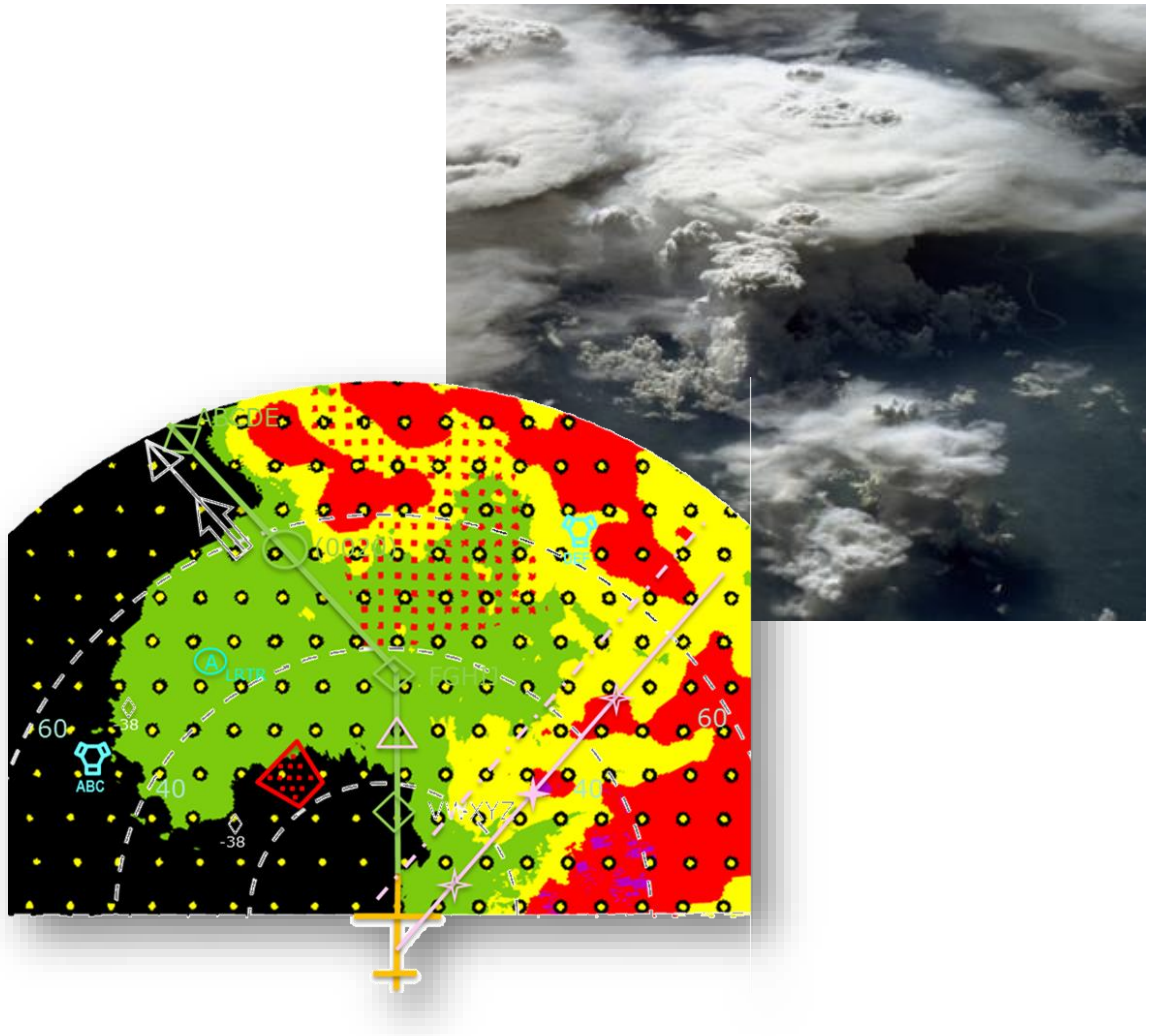
		Predict	Detect	Proceed
Visibility		Weather Forecast RVR, METAR	Look outside	ILS, GLS, LPV, CAVS HUD, EFVS, new sensors
Icing		Weather Forecast PIREPs	Ice detectors	De-ice, anti-ice
Precip		Weather Forecast Radar	Rain detectors Look outside	Windshield wipers Braking system
Turbulence			Feel it Tablets	Flight Controls Seat belts
Lightning			Definitely feel it	
Windshear			Reactive windshear	

Collins Aerospace
An RTX Business

HAIC

High Altitude Ice Crystallization

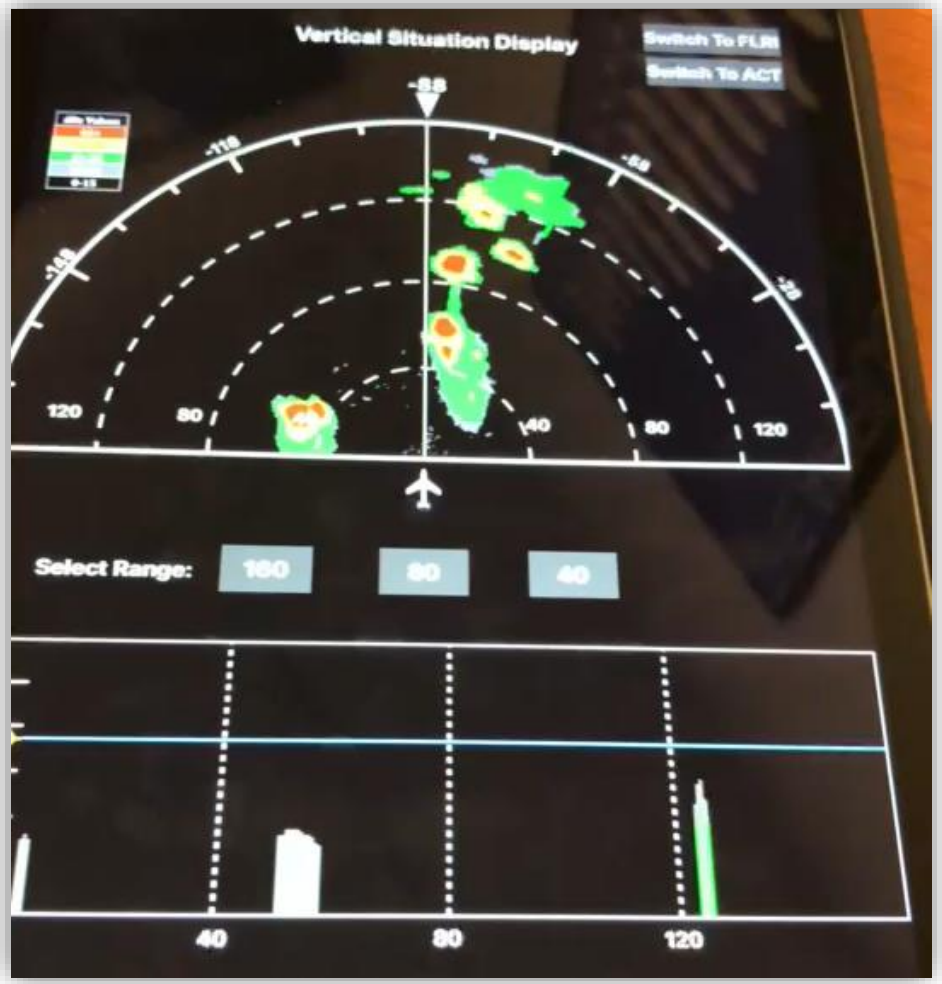
- Airlines regularly experience HAIC
- SOP varies depending on severity, flying through with Anti-Ice to leaving area as fast as possible
- HMI preferences vary
- Too many alerts would leave pilots with nowhere to go



CONNECTED WEATHER

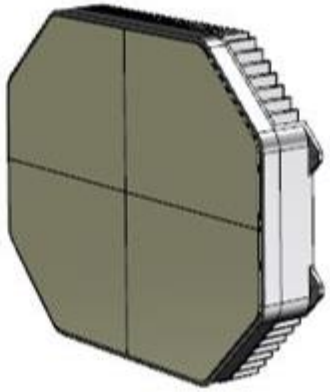
Internal and External Connections

- Weather on tablet complements weather on ND
- Beneficial during descent planning, emergency situations & when recalculating alternates
- Value in combining WXR returns with existing apps
- Weather data can be downlinked in real time
- OEM engagement increasing



Collins Aerospace
An RTX Business

RADAR – THINGS ARE CHANGING…



Boundaries between established avionics product lines are fading

Collins Aerospace
An RTX Business

SUMMARY

UNPRECEDENTED ALL-WEATHER OPERATIONS CAPABILITIES

- Tremendous improvements have been made
  - Precision approaches virtually anywhere
  - HUD and EVFS
- Dividing lines between traditional sensor types are fading
- Weather avoidance in future aircraft will be more automated
- Some weather will remain off-limits for aviation

Collins Aerospace
An RTX Business

Martin Pauly

Avionics Strategy – COM, NAV, SURV

www.linkedin.com/in/martin-pauly-06838696

martin.pauly@collins.com

Collins Aerospace
An RTX Business