

# New Technologies for Weather Information Communication

Benefiting Airspace Mobility, Capacity and Flight Safety



**Mike Jarrell**

**Weather Information Communications Project Element Manager**

**NASA Glenn Research Center**

**21000 Brookpark Road, MS 54-6**

**Cleveland, OH**

**(216) 433-8102**

**[Michael.A.Jarrell@nasa.gov](mailto:Michael.A.Jarrell@nasa.gov)**

# Weather Information Needs \*

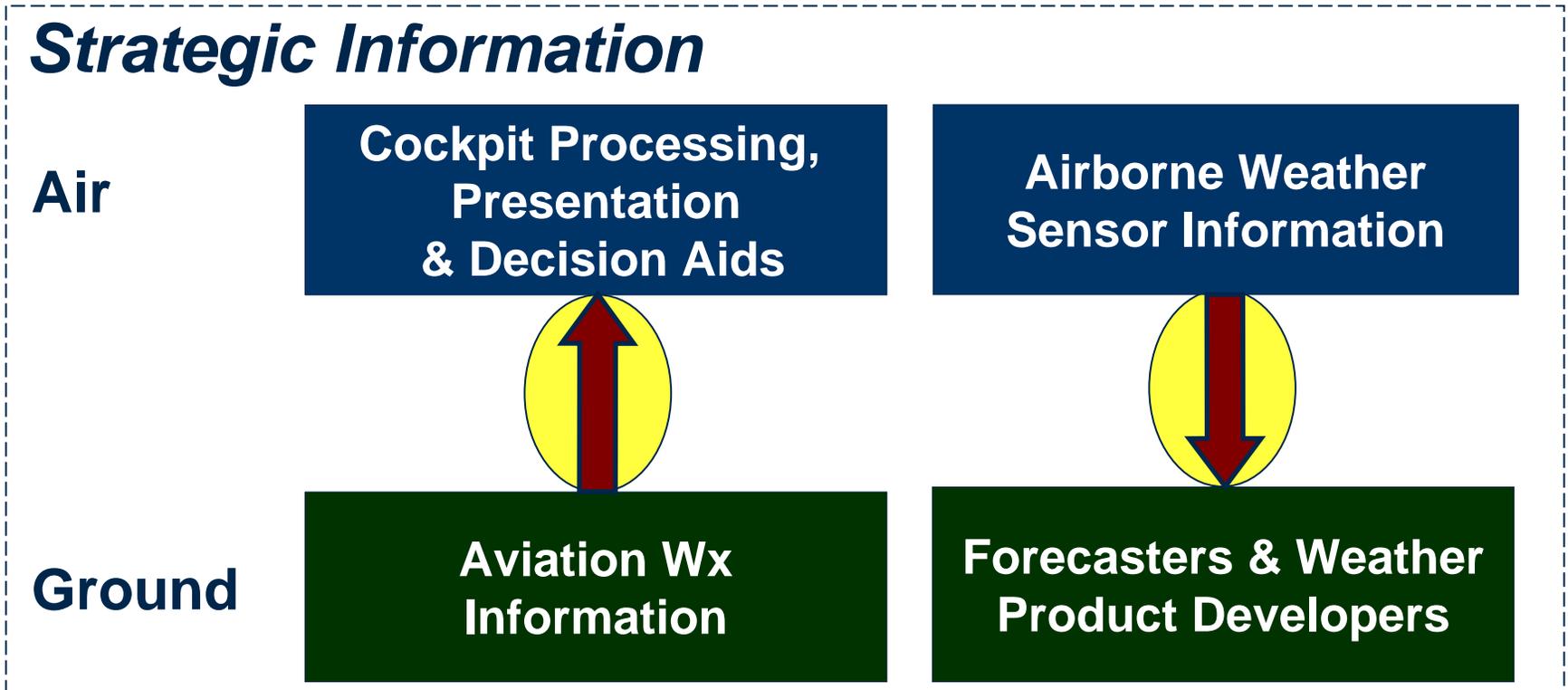
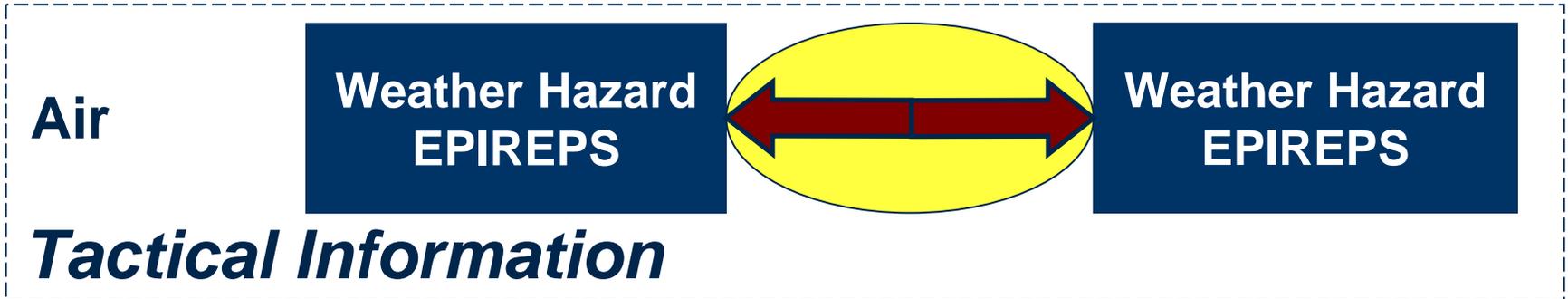
---

- Aviation weather products are important to NAS **safety**: *Weather is directly related to 40 percent of all aviation accidents.*
- Aviation weather products are important to NAS **capacity and efficiency**: *65 percent of ATC system delays are caused by weather.*
- In addition to the aviation public, aviation weather products are required to support FAA **operations**: *Controllers need weather information to make operational decisions (e.g., runway selection, instituting a ground hold program).*

# Weather Information Communications Project Team

# WINCOMM

# Goals



# Goals to Reality as Validated by FY05 Laboratory Experiments and Flight Demonstrations

## *Tactical Information* Air



Aircraft networks and avionics have been modified to enable EPIREPS exchange via surveillance services without the aid of satellite or ground support.

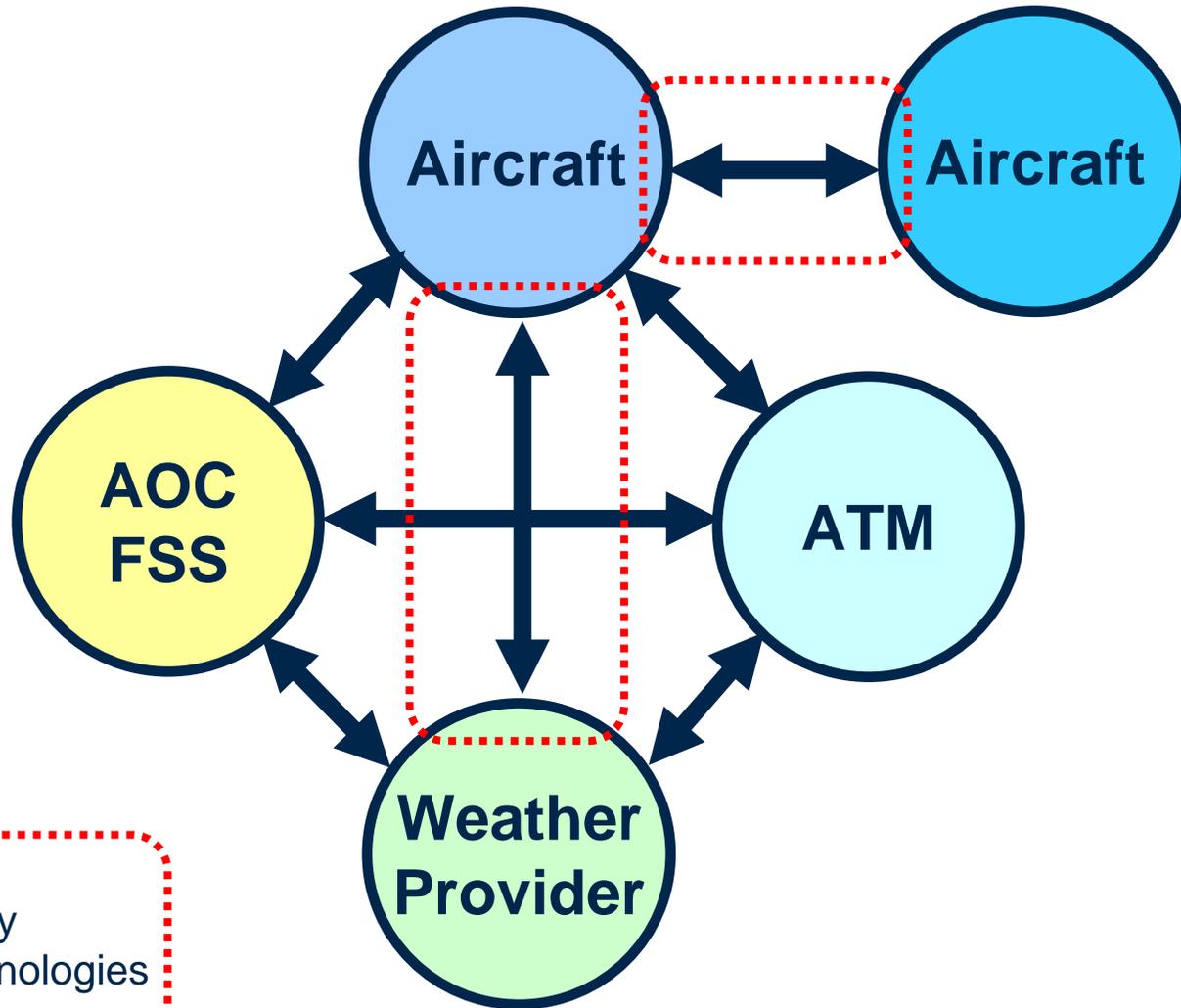
## *Strategic Information*



**First generation systems** (developed in FY00-FY02) weather-only links are commercially available today. **Second generation systems** (FY03-FY05) are modified aircraft networks and avionics to enable exchange of weather information between ground providers and pilots via multi-use surveillance, air traffic, and airline operation communications services without impacting normal traffic or the purpose of the communication link.

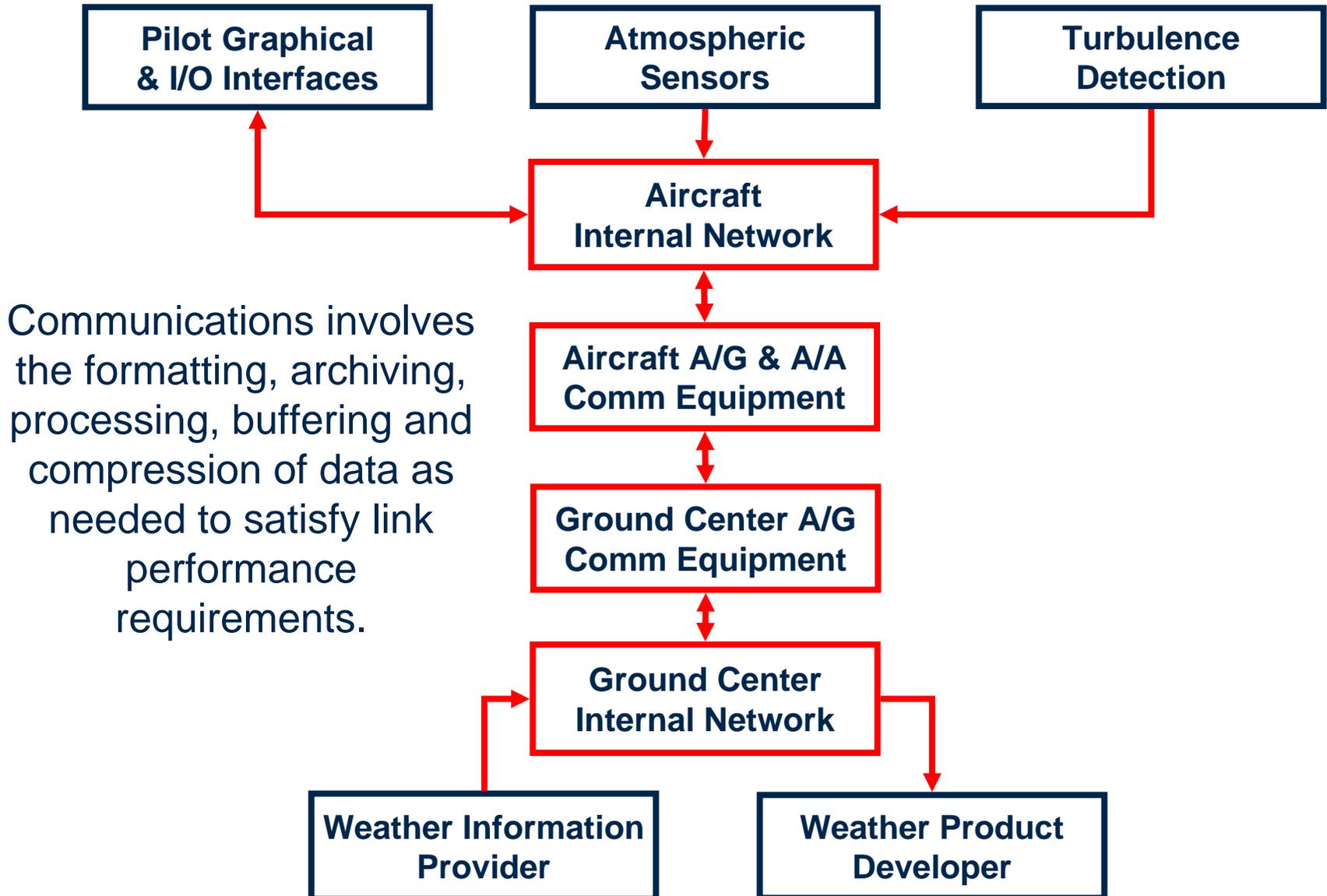
# Weather Information Exchange

---



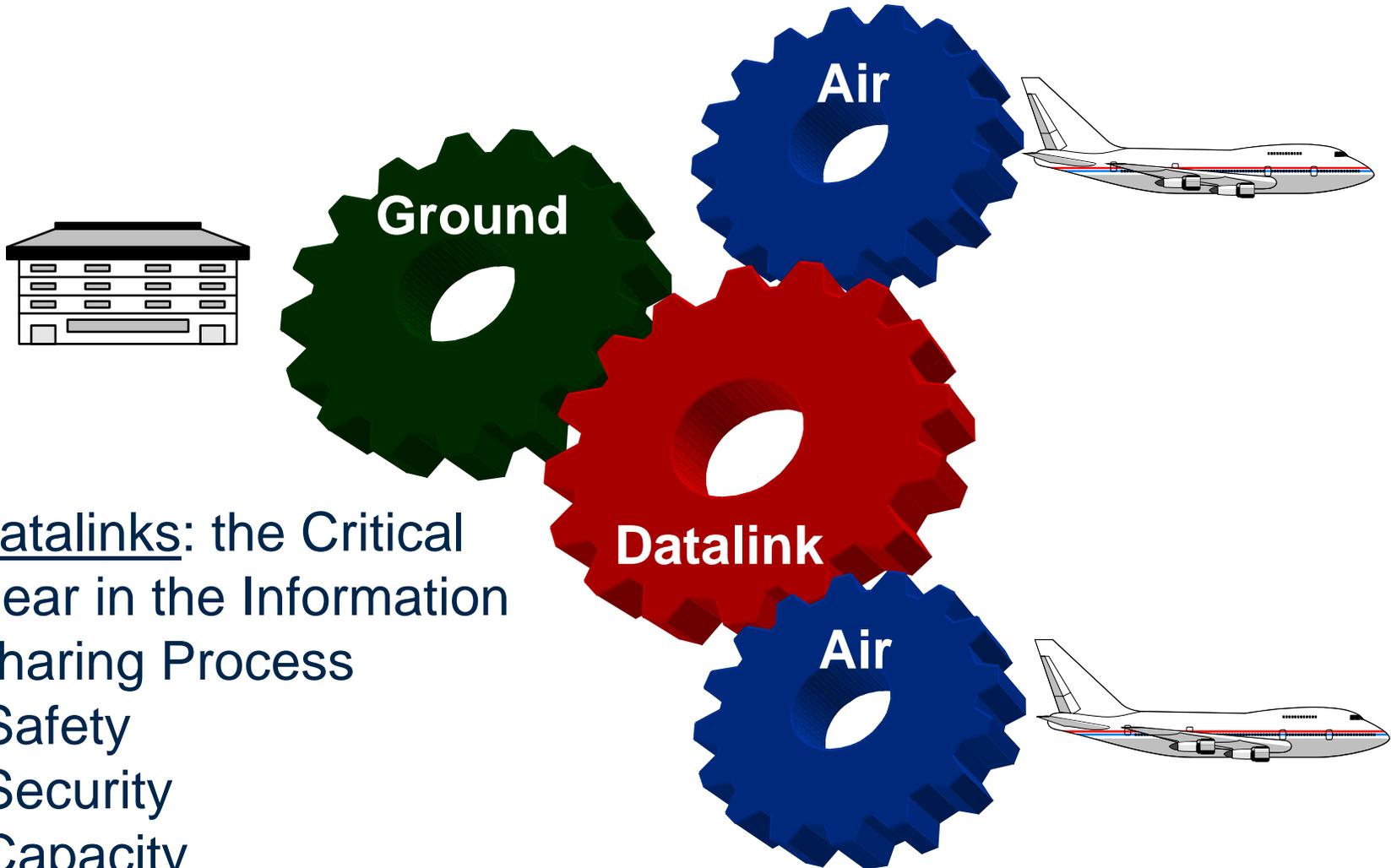
Enabled by  
WINCOMM Technologies

# Weather Information Communications



# Enabling Role of Datalinks

---

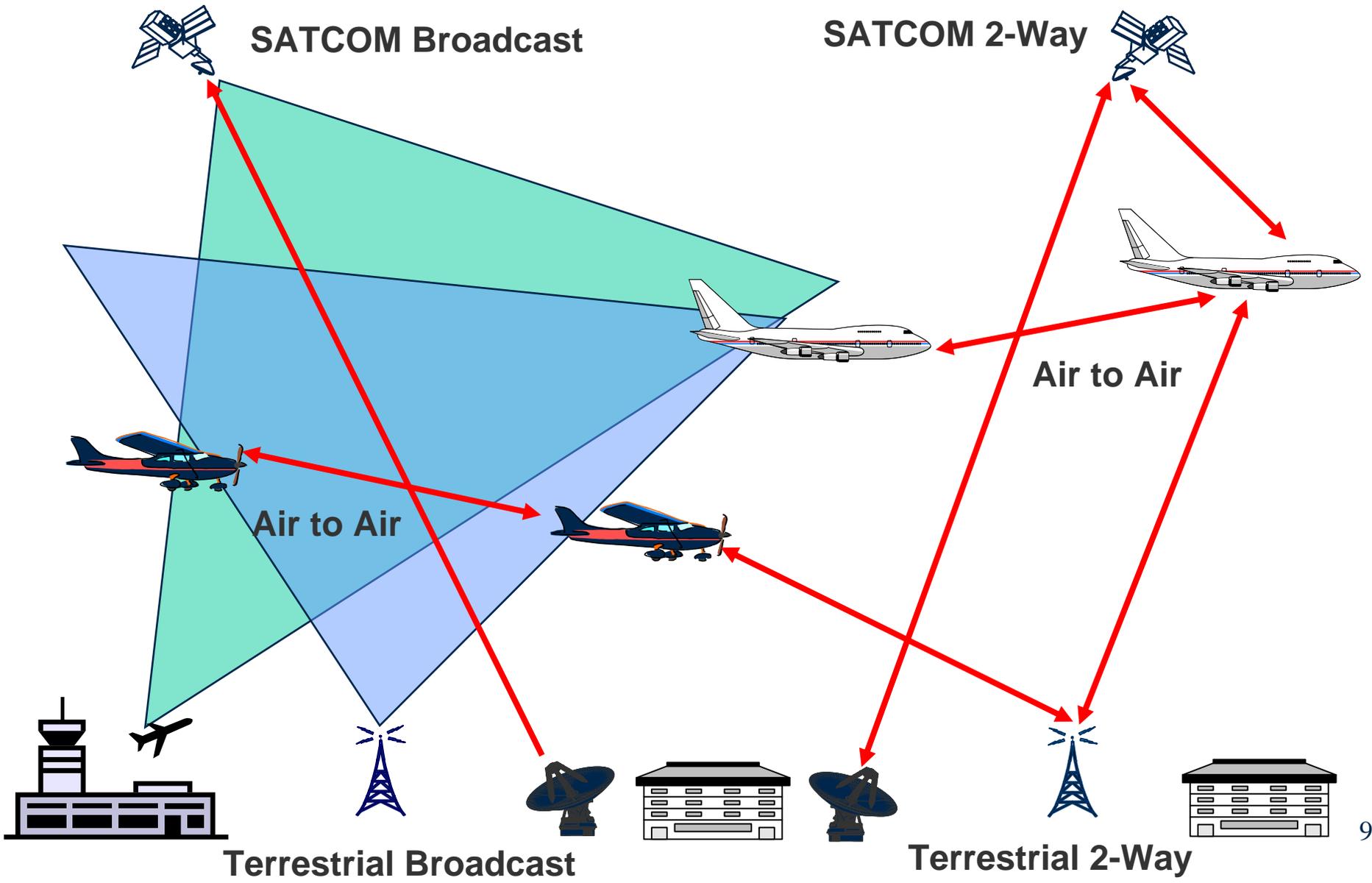


Datalinks: the Critical Gear in the Information Sharing Process

- Safety
- Security
- Capacity
- Efficiency

# Datalink Architectures

(weather information dissemination)



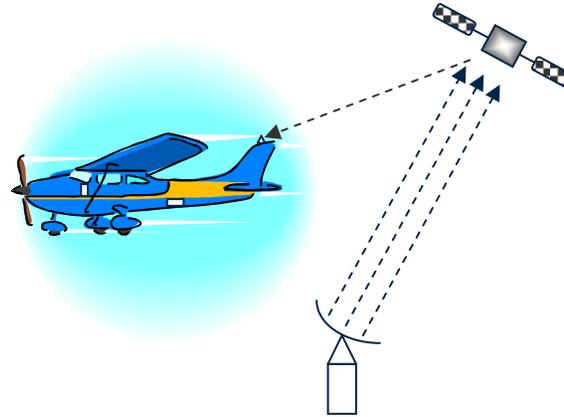
# GA En-Route Weather Dissemination

(FY00 – FY02 Successes)

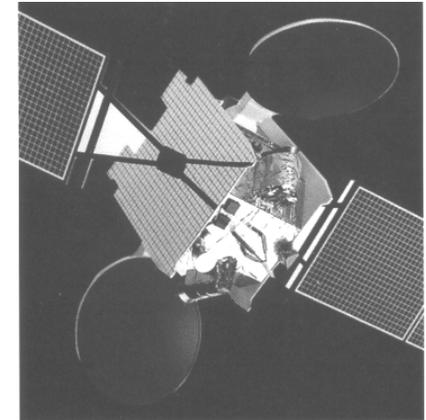
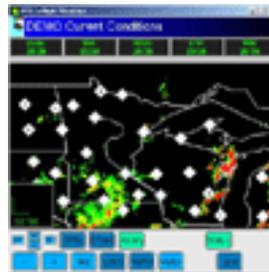


**Terrestrial Broadcast  
National FISDL**

via CRA  
Honeywell



**SATCOM Broadcast  
via SBIR**



**Satellite Digital Audio  
Radio Services  
(AfriStar)**

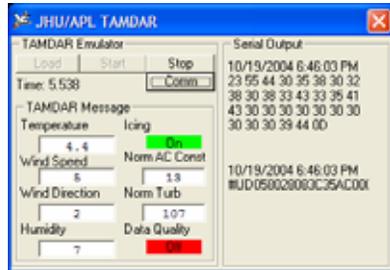
via CRA  
Rockwell Collins



**Catalyst for XM Radio and HeadsUp  
teamed with Baron  
XM WX Satellite Weather**



# GA UAT En-Route Weather Dissemination (FY03 – FY05 Final Configuration)



TAMDAR Data Emulator (JHU-APL)



Cockpit Display Unit



Modified UAT Avionics (Garmin)



NASA Learjet



NASA Learjet



Ground-to-Air Link  
Weather Information



Modified UAT Ground Based Terminal (Sensis) & Router (MITRE)



Air-to-Ground Link  
Airborne Weather Reports



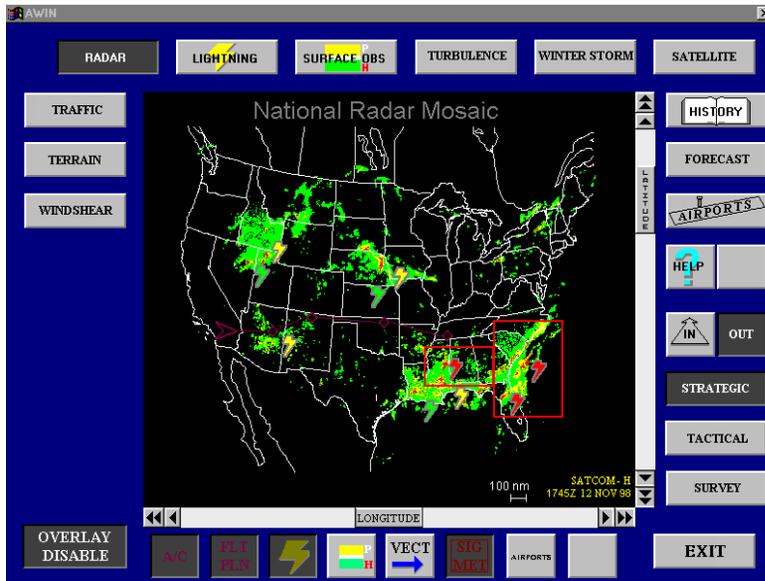
Weather Information

TAMDAR Data Collection

UAT ADS-B System utilized in cooperation with the FAA Safe Flight 21 office

# Transport En-Route Weather Dissemination (FY00 – FY02 Successes)

- CRAs with Boeing & Honeywell leveraged off-the-shelf communication equipment for rapid implementation
- In-Service Evaluations of Honeywell system by United Airlines



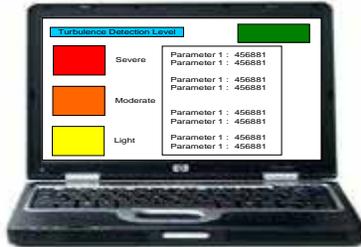
Boeing



Honeywell

# Transport Weather Information Dissemination (FY03 – FY05 Final Configuration)

Turbulence Emulator



Cockpit Display



Modified VDLM3 Avionics (Rockwell Collins)



NASA Learjet



NASA Learjet

**Air-to-Air Link (1090ES)**

**Turbulence Information  
(Honeywell/Sensis)**

**Ground-to-Air Link**

- Weather Information
- Broadcast

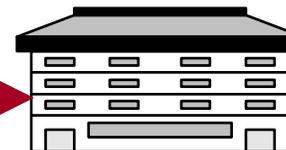


**VDLM3 Ground Terminal  
Modified to use Internet Protocol (IP)**



**Air-to-Ground Link**

- Turbulence Reports
- Pilot-requested Value-added Weather Products



FAA Technical Center

**Weather Information**

**Turbulence Data Collection**

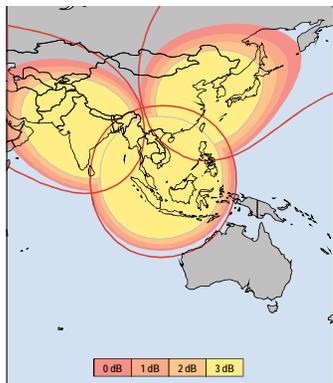
**VDLM3 Data Link utilized in cooperation  
with the FAA NEXCOMM office**

# International/Oceanic Dissemination

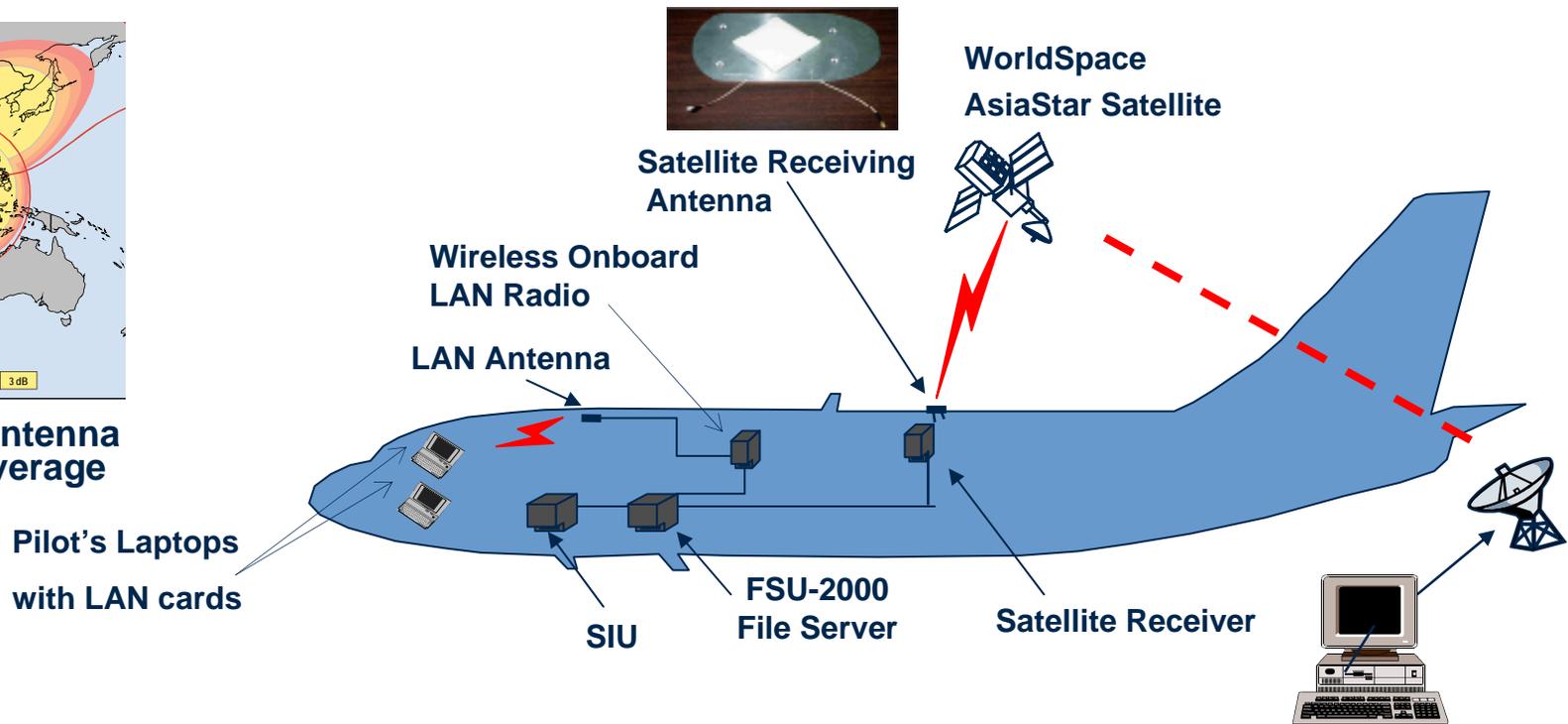
(FY00 – FY02 Successes)

CRA with Rockwell Collins

- Proved S-DARS for weather product delivery over AsiaStar

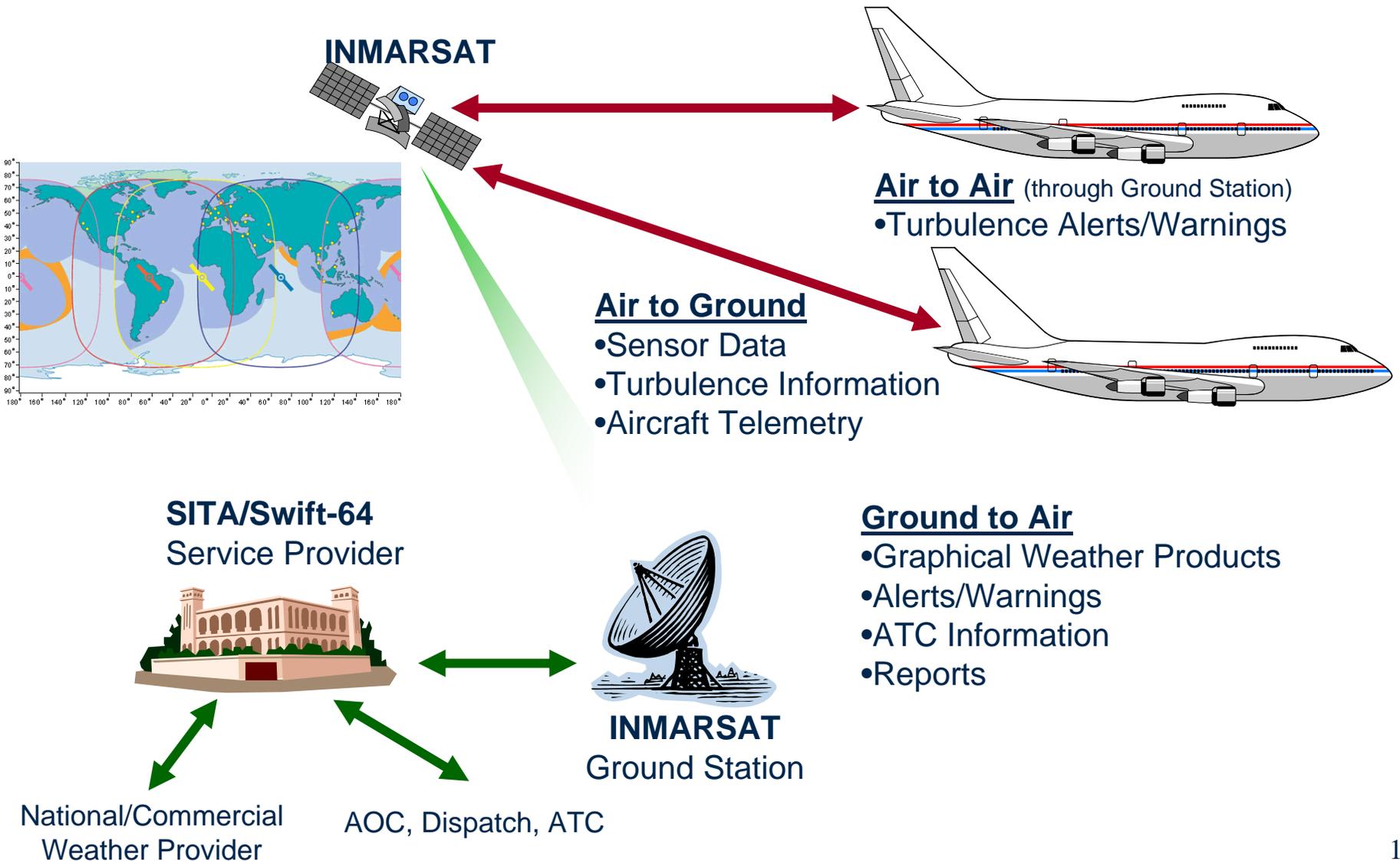


AsiaStar Antenna Beam Coverage

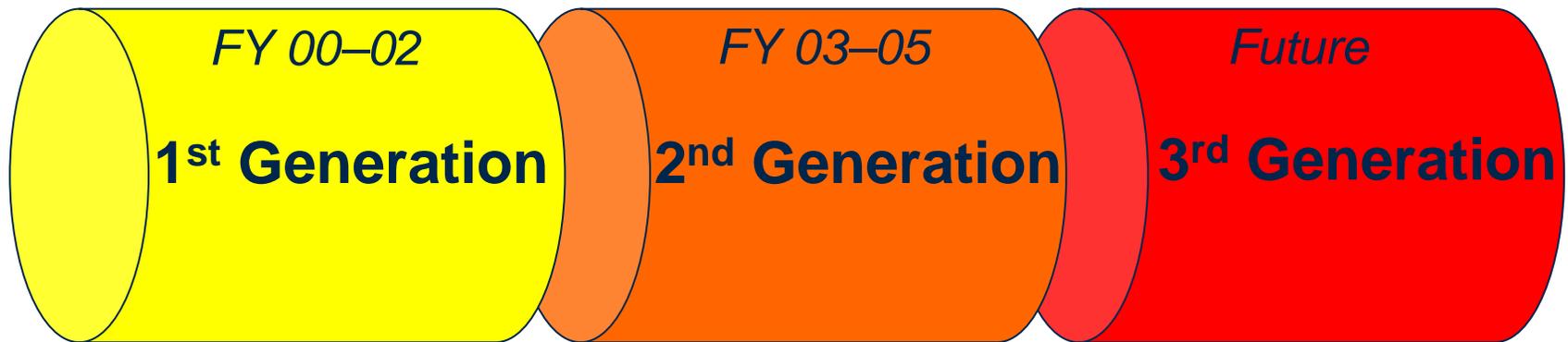


# International/Oceanic Dissemination

(FY03 – FY05 Final Configuration)



# Aviation Data Link Development



- G–A Broadcast
- Private Networks
- Weather (Wx) Only
- Limited Capacity
- High Relative Cost
- GA

- 
- FISDL (Terrestrial)
  - WSI (Satcom)
  - XM (Satcom DARS)

- G–A, A–G, A–A
- Private Networks
- Multi-Aviation Use
- Additional Capacity
- Increased Value
- GA & Com Transport
- EPIREPS
- A/C Wx Sensors
- Dynamic Requests

- 
- UAT & VDLM3 (Terrestrial)
  - Swift 64 (Satcom)
  - 1090ES (Air-Air)

- Full Mesh Networking
- Public Infrastructure
- Information Pipeline
- Broadband
- Low Relative Cost
- All Aircraft
- Crosslinks
- Data Processing
- Routing

- 
- Aviation Cellular
  - High-Value Satcom



Close Formation Flight before Execution of Maximum Separation Maneuver of ~100 nm  
[Lear Jet 23 as seen from the Lear Jet 25]

### Air to Air & Air to Ground

- Weather Hazard Encounters
    - ✓ Turbulence, Icing
  - Atmospheric Conditions
    - ✓ TAMDAR Sensor
- 
- 

### On-Board Routing & Display

- Own-Ship & From Other Aircraft
    - ✓ Weather Hazard Encounters
    - ✓ Atmospheric Conditions
  - From the Ground
    - ✓ Weather Products
- 
- 



Avionics Test Configuration on Lear Jet 25 and Display of Weather Information, Atmospheric Data & Traffic



### Ground to Air

- Aviation Weather Products
  - ✓ Textual
  - ✓ Graphical



Lear Jet 25 over Ohio During Air-Air Testing



Ground Station Location  
(Airport Operations Tower)

Cleveland Hopkins International Airport – Ground Station



### Air to Air & Air to Ground

- Turbulence Encounters

---

---

### Air to Ground

- Turbulence Encounters
- Pilot Weather Information Requests



Avionics Test Equipment and Experiment Test Stations on the Lear Jet 25

---

---

### Ground to Air

- Aviation Weather Products
  - ✓ Textual
  - ✓ Graphical



Close Formation Flight before Execution of Maximum Separation Maneuver of ~100 nm  
[Lear Jet 25 as seen from the Lear Jet 23]



Lear Jet 23 over Ohio During Air-Air Testing



VDL M3 Flight Path



Lear Jet 25 in the FAA Tech Ctr Hangar

# Aviation Safety and Security Program – FY05

## Technical Accomplishment – Commercial Transport Weather Dissemination Technologies



NASA Lear Jet 23  
(Air/Air Testing over Ohio)



Ground Station Equipment at the FAA William J. Hughes Technical Center, Atlantic City, NJ  
(During VDLM3 Flight Testing)



NASA Lear Jet 25  
(Air/Air Testing over Ohio)



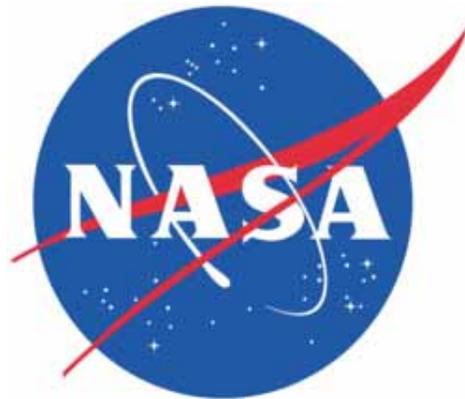
Integration of Equipment on the NASA Lear Jet 25 and Flight Checkout



NASA GRC-Based Flight Crew  
(Outside GRC Hangar)



# New Technologies for Weather Information Communication



Benefiting Airspace Mobility, Capacity and Flight Safety

[End of Presentation]