



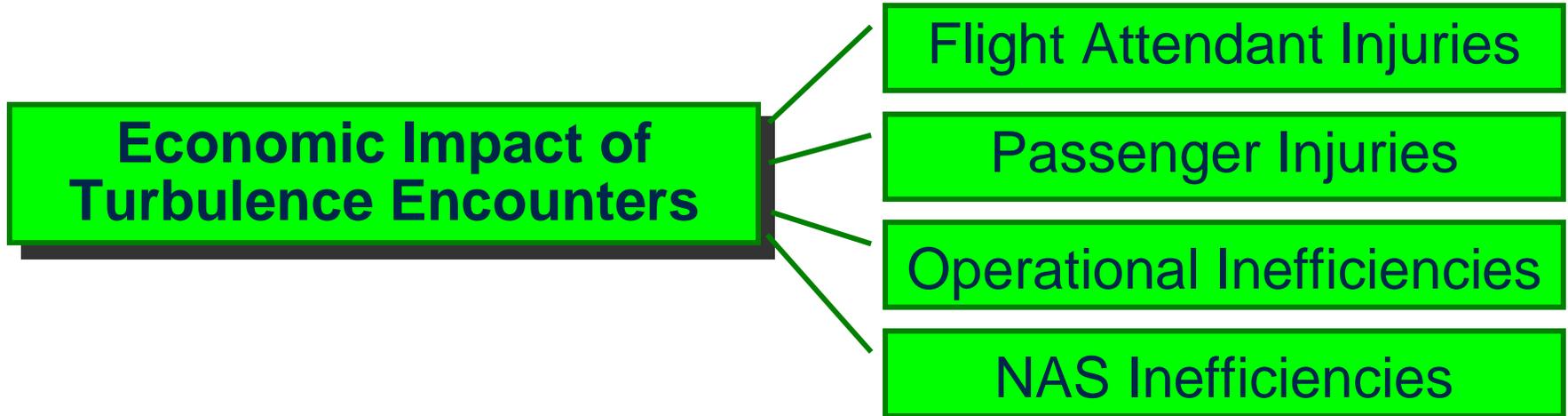
*An Integrated Turbulence Avoidance Decision-Aid
for Pilots, Dispatchers, & Controllers*

**2005 NASA ICNS Conference & Workshop
Fairfax, Virginia**

May 5, 2005

**Dr. Paul A. Robinson
President, AeroTech Research**

The Turbulence Impact



Estimated Costs > \$100M / year

The Turbulence Encounter Reporting Problem

***Current Turbulence Encounters
Are GROSSLY Under Reported.***

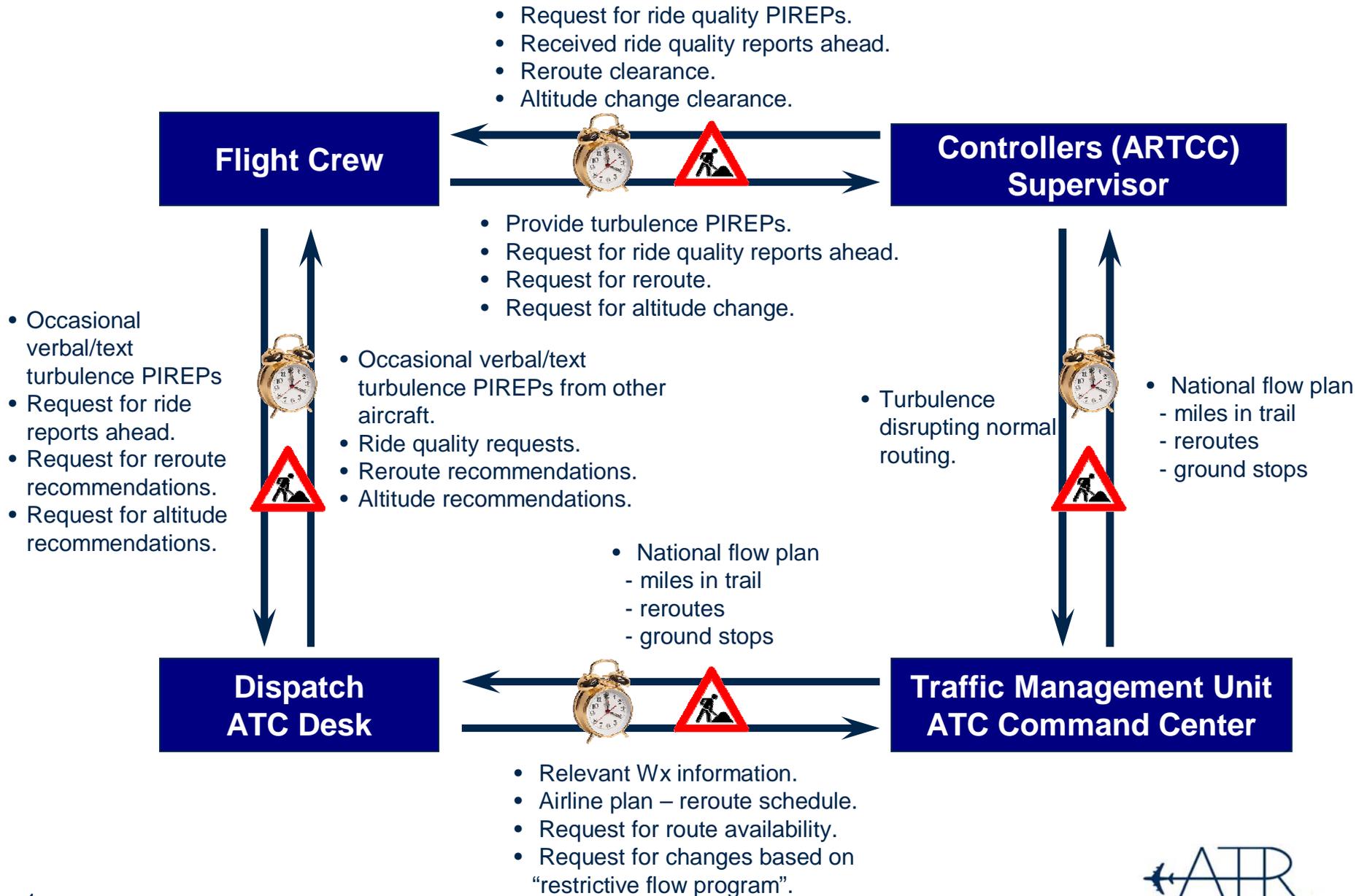
Those PIREPs that are made are:

Late

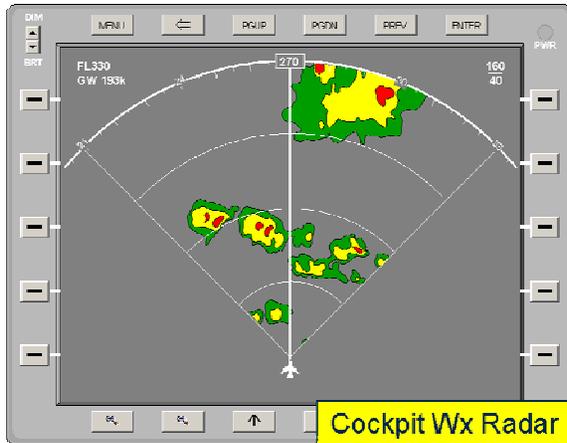
Subjective

**# Not distributed
throughout the system**

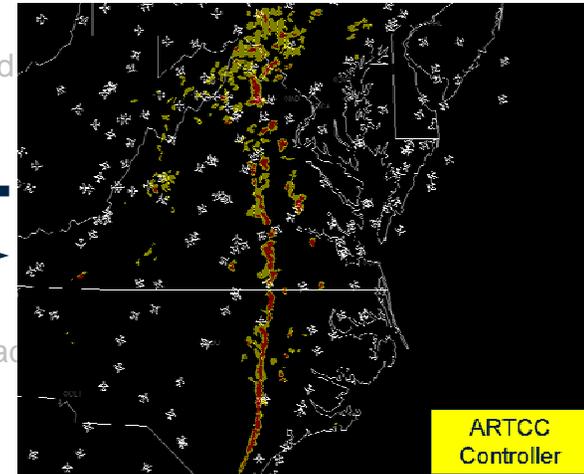
Turbulence Information Flow - Present



Turbulence Information Flow - Present



- Request for ride quality PIREPs.
- Received ride quality reports ahead.
- Reroute clearance.
- Altitude change clearance.



- Provide turbulence PIREPs.
- Request for ride quality reports ahead.
- Request for reroute.
- Request for altitude change.

- Occasional verbal/text turbulence PIREPs
- Request for ride reports ahead.
- Request for reroute recommendations.
- Request for altitude recommendations.



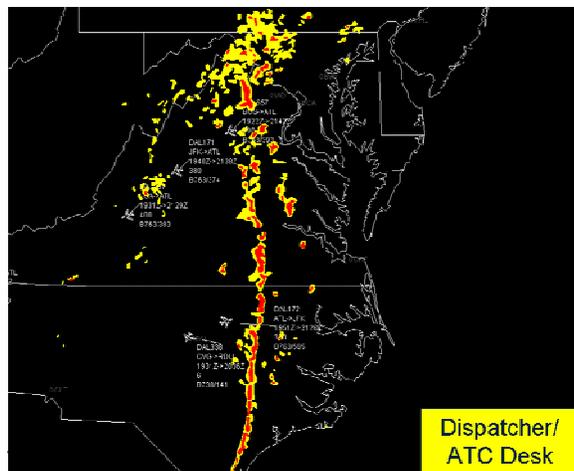
- Occasional verbal/text turbulence PIREPs from other aircraft.
- Ride quality requests.
- Reroute recommendations.
- Altitude recommendations.

- Turbulence disrupting normal routing.

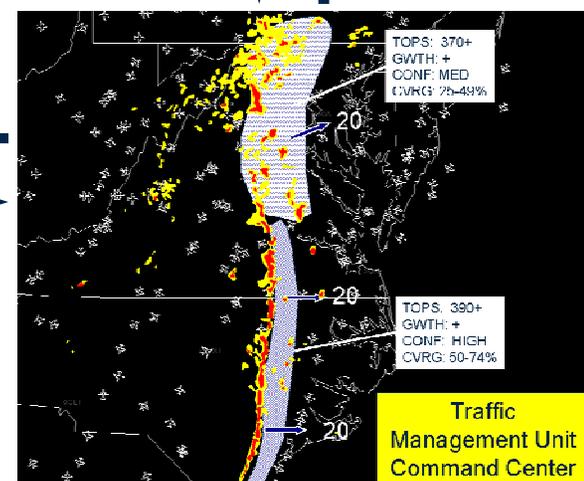


- National flow plan - miles in trail - reroutes - ground stops

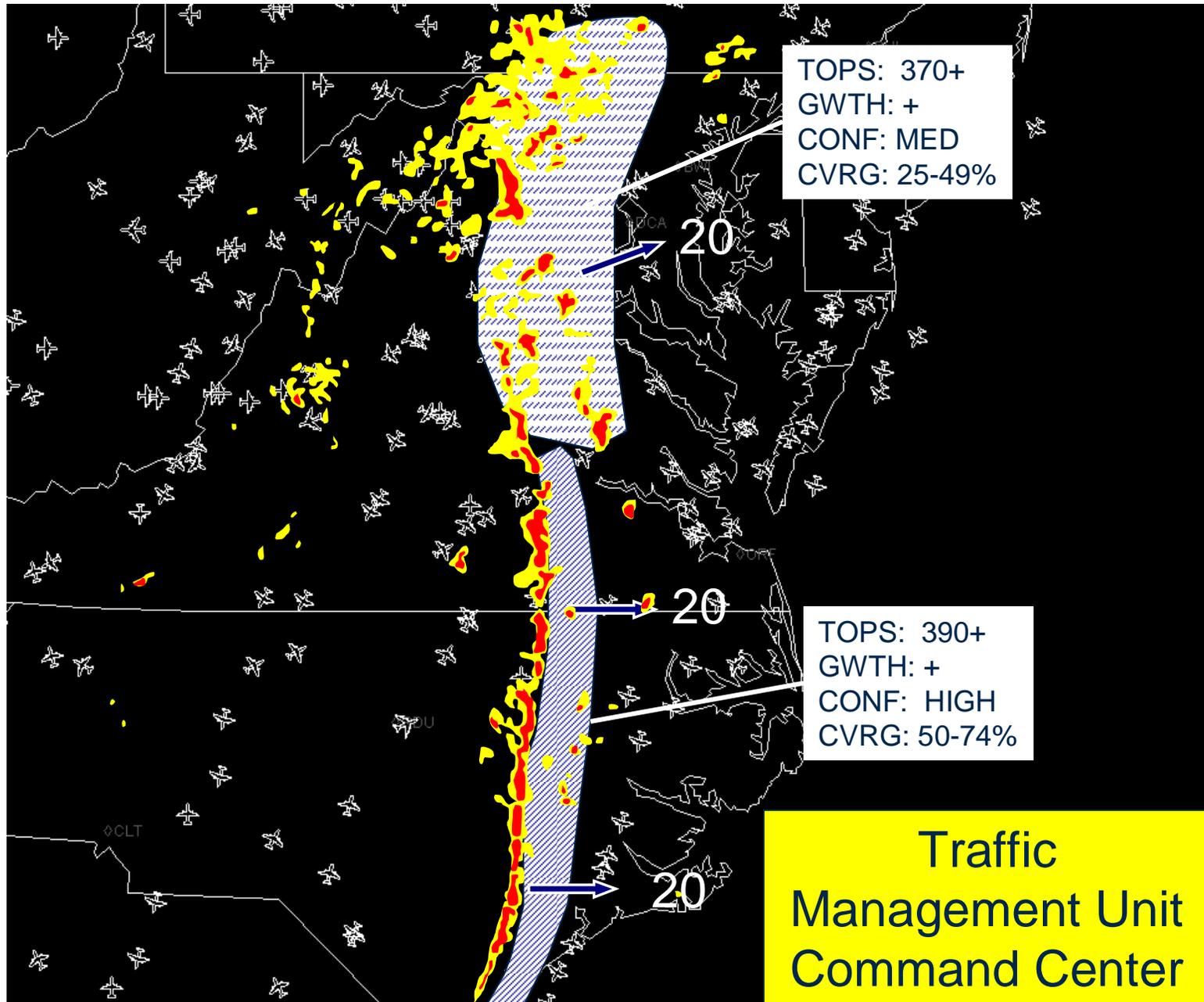
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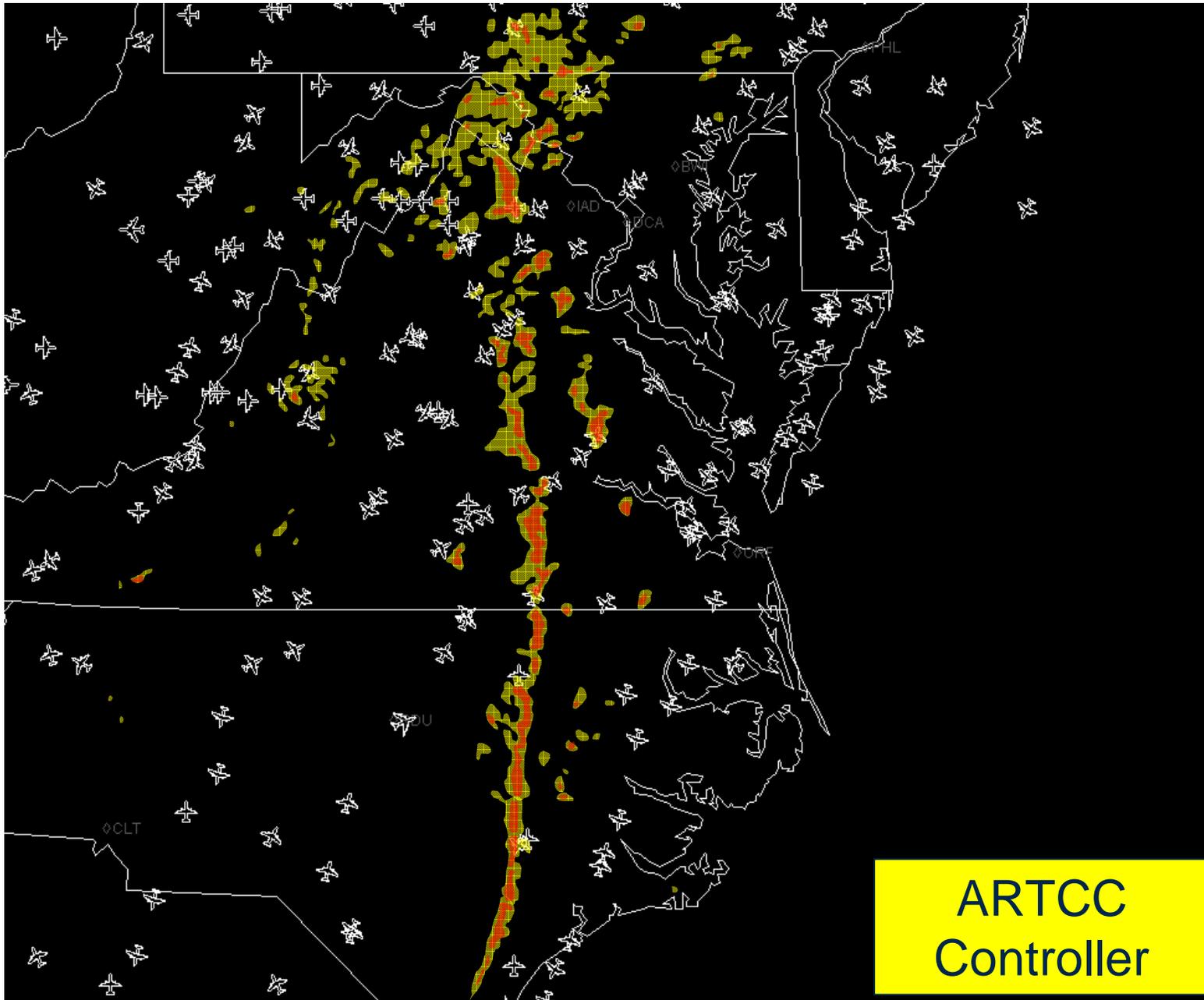
- Relevant Wx information.
- Airline plan – reroute schedule.
- Request for route availability.
- Request for changes based on “restrictive flow program”.



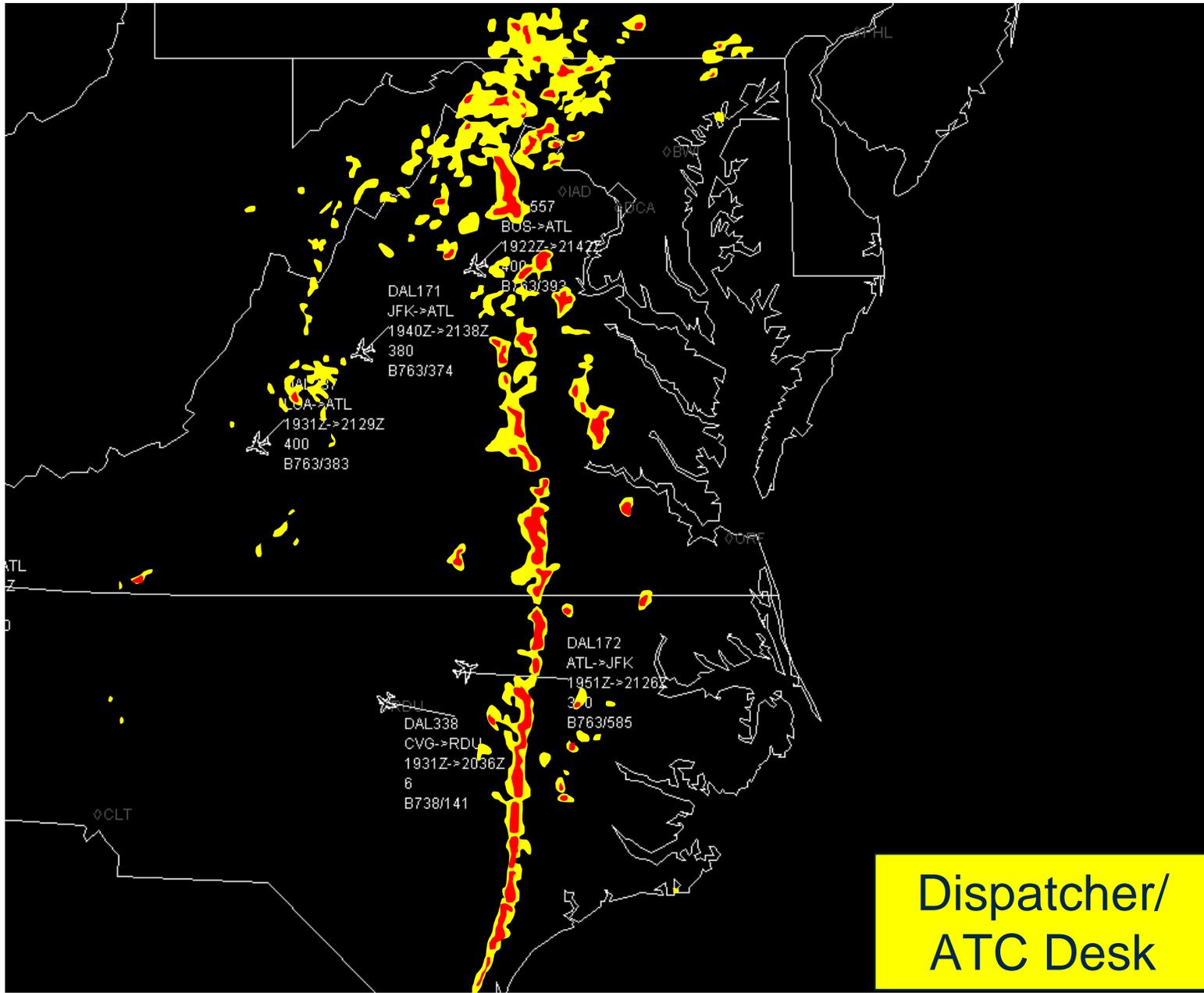
Traffic + NEXRAD + CCFP



Traffic + NEXRAD

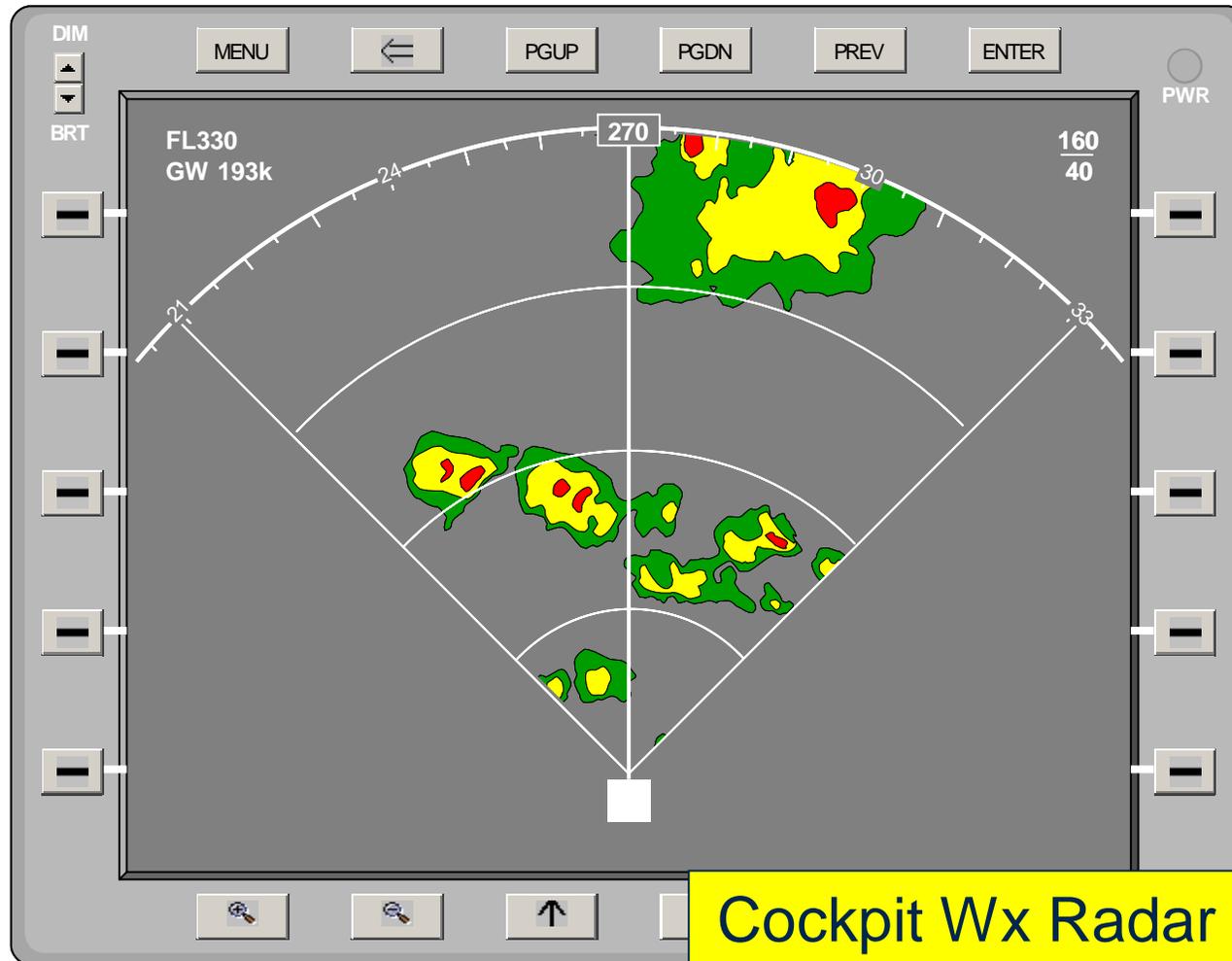


Traffic + NEXRAD

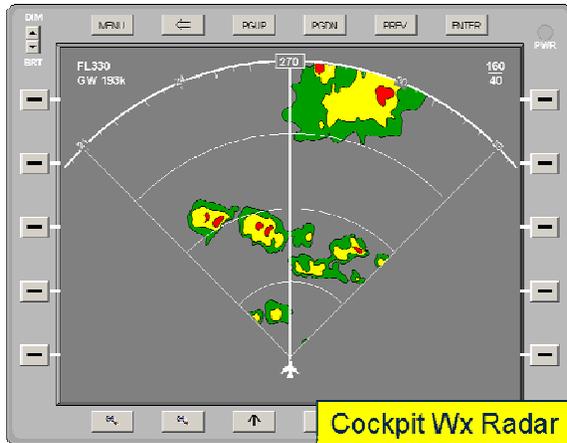


Wx Radar Cockpit Display

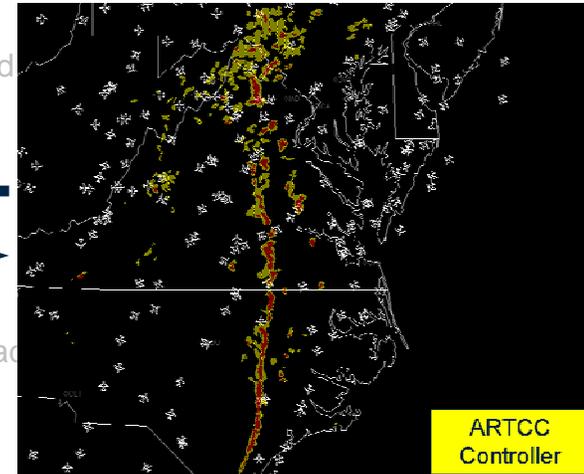
Sector PPI Display Concept



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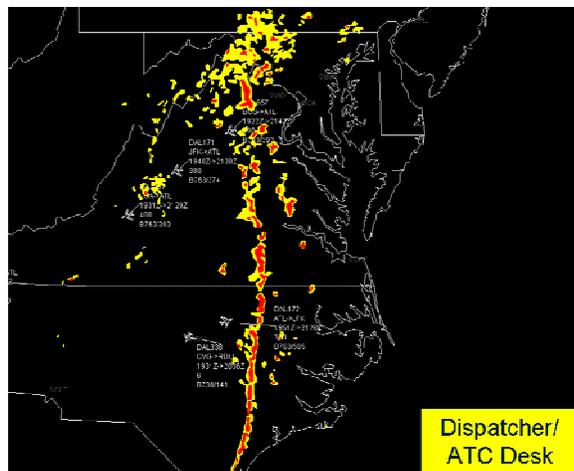
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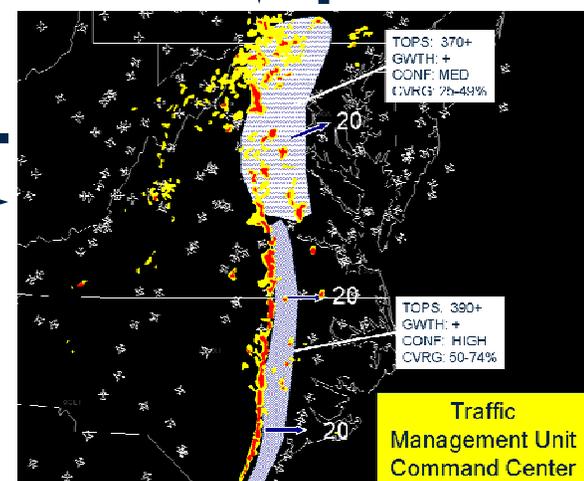


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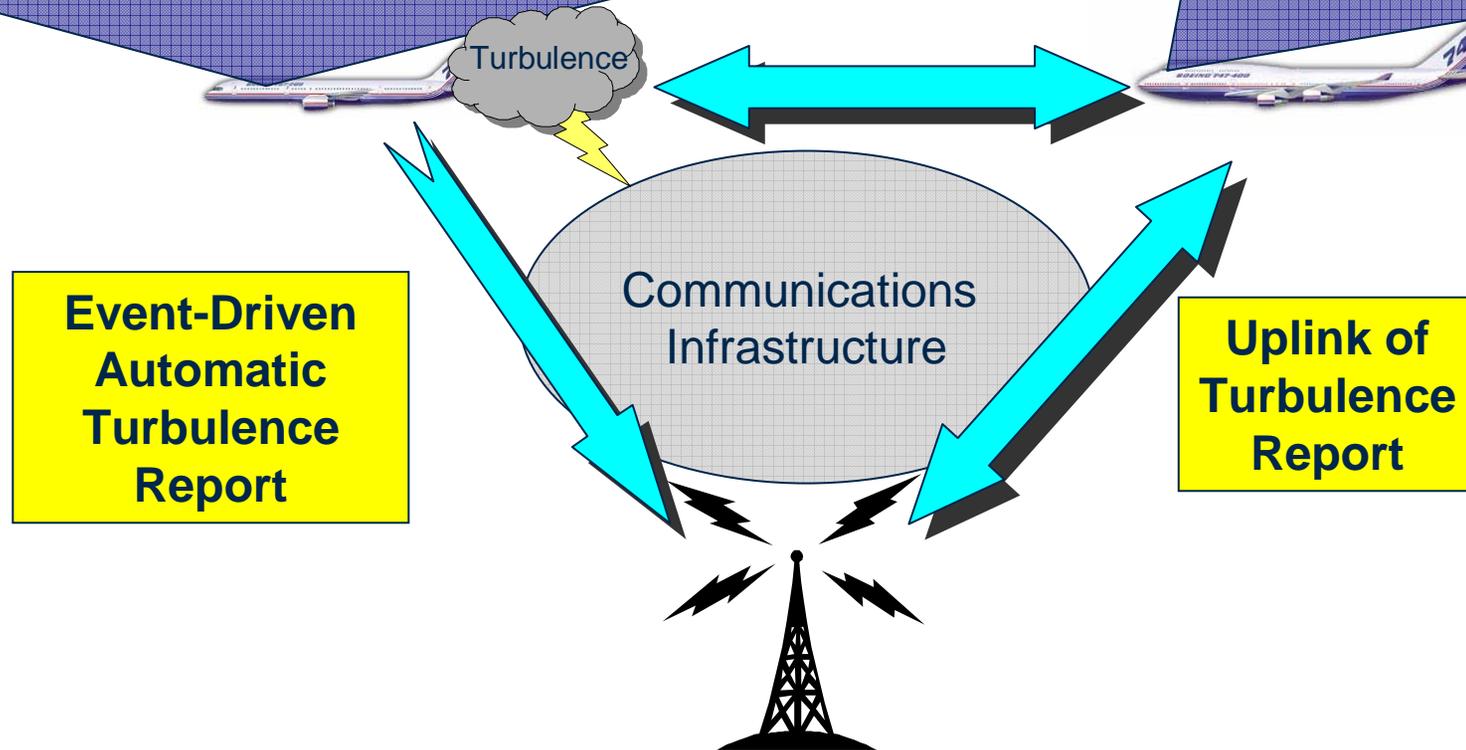
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TAPS Architecture

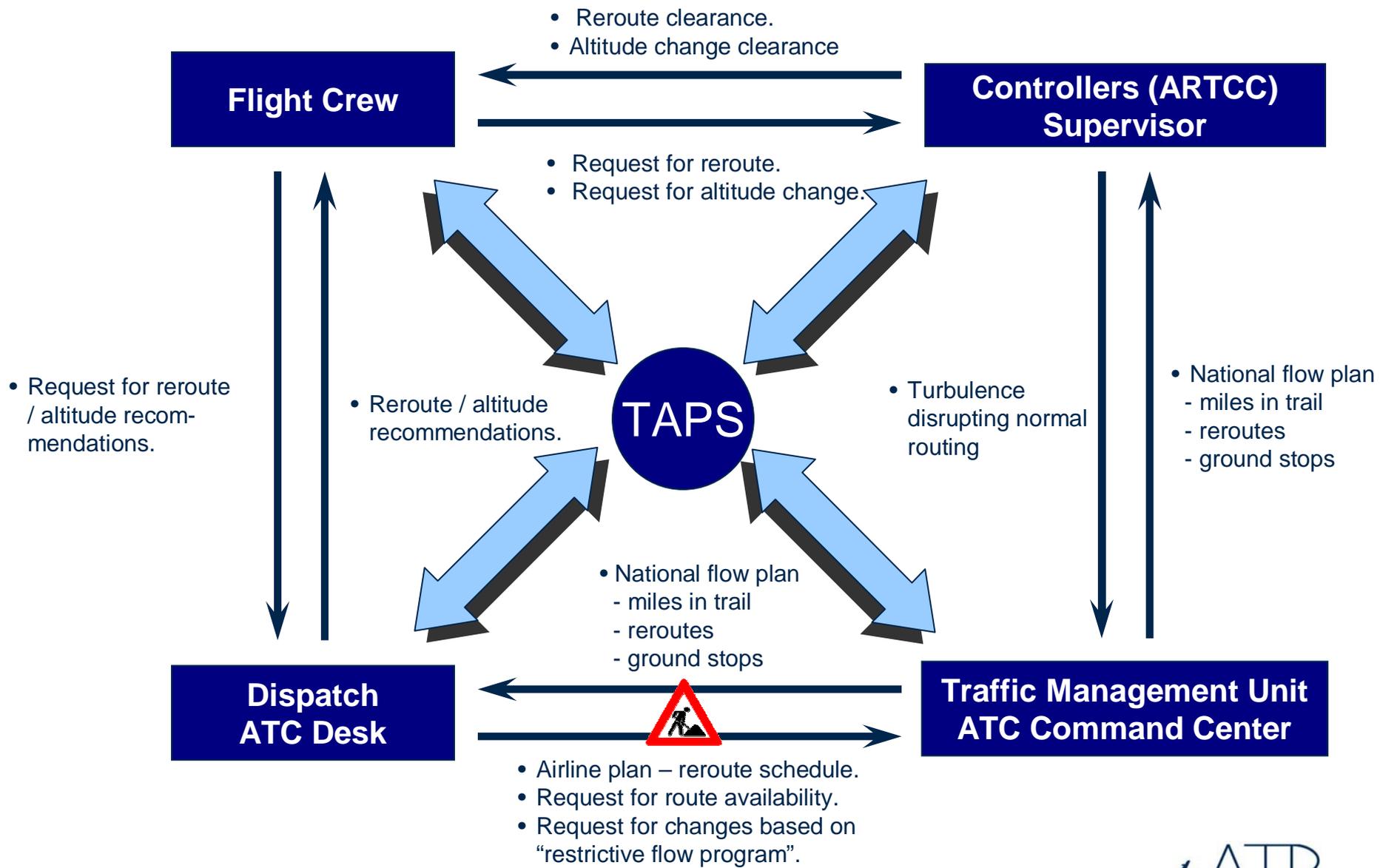
TAPS Software on Aircraft

Cockpit Display

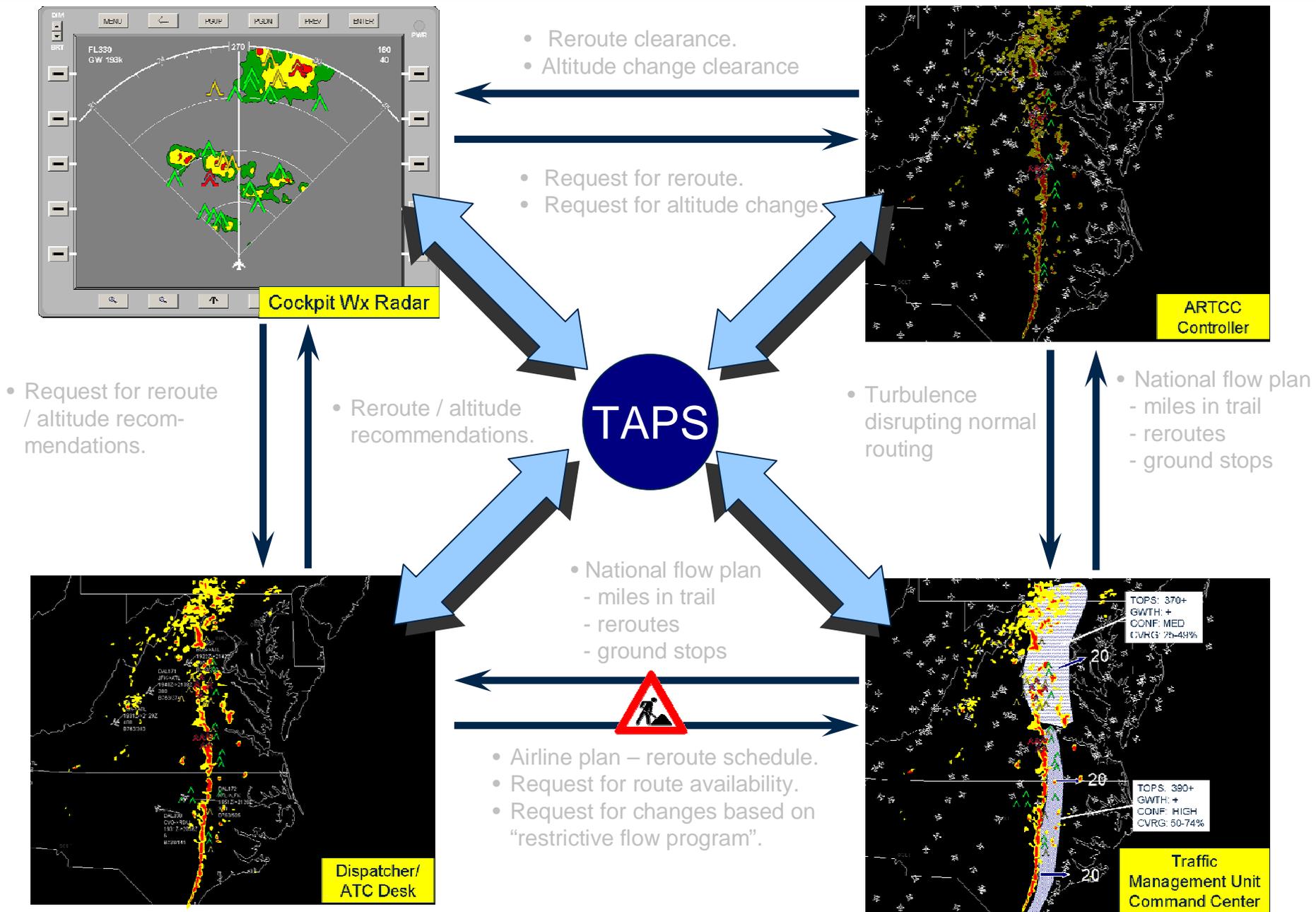


Groundstation Network
Flight Following & Flight Planning

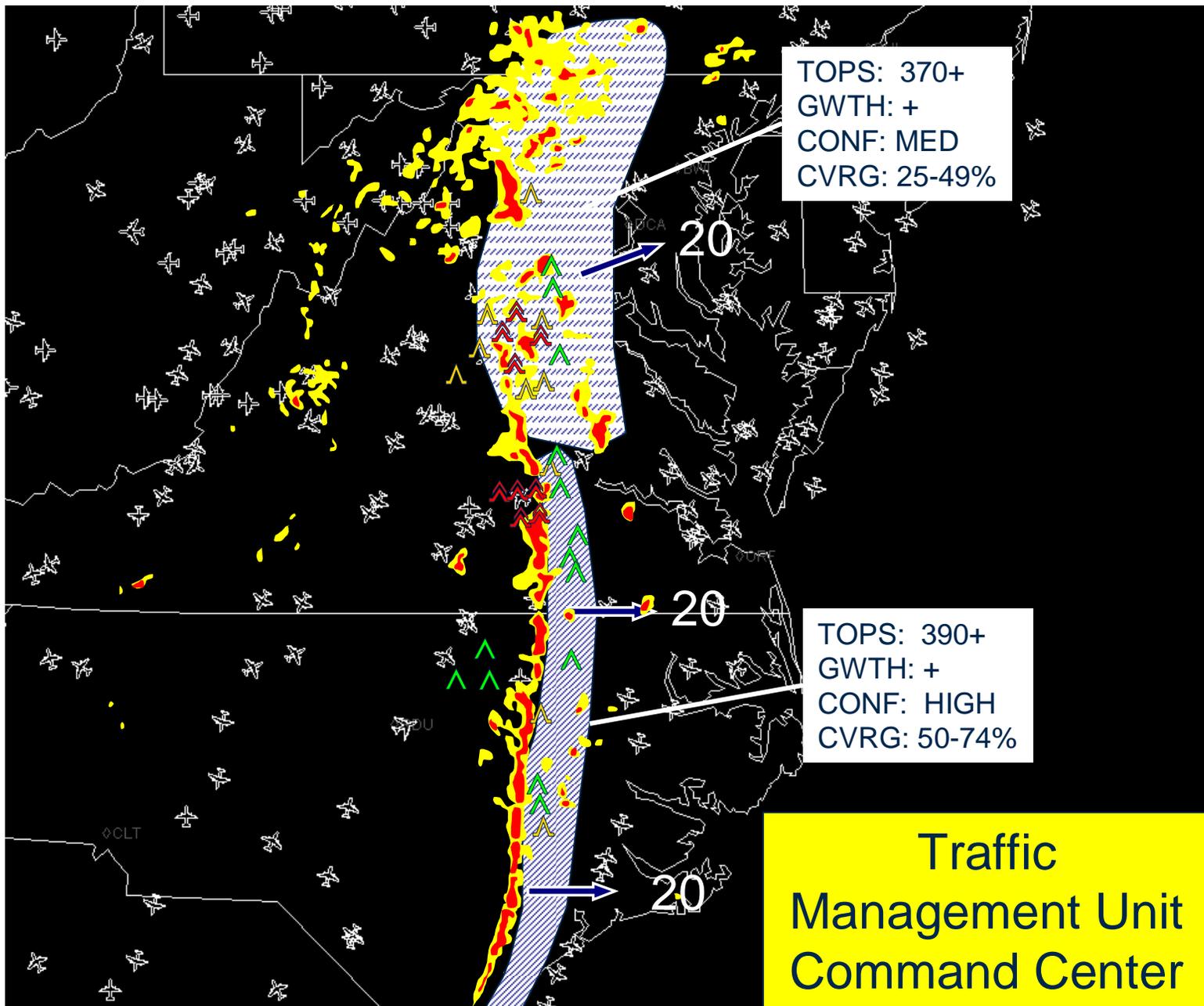
Turbulence Information Flow - Future



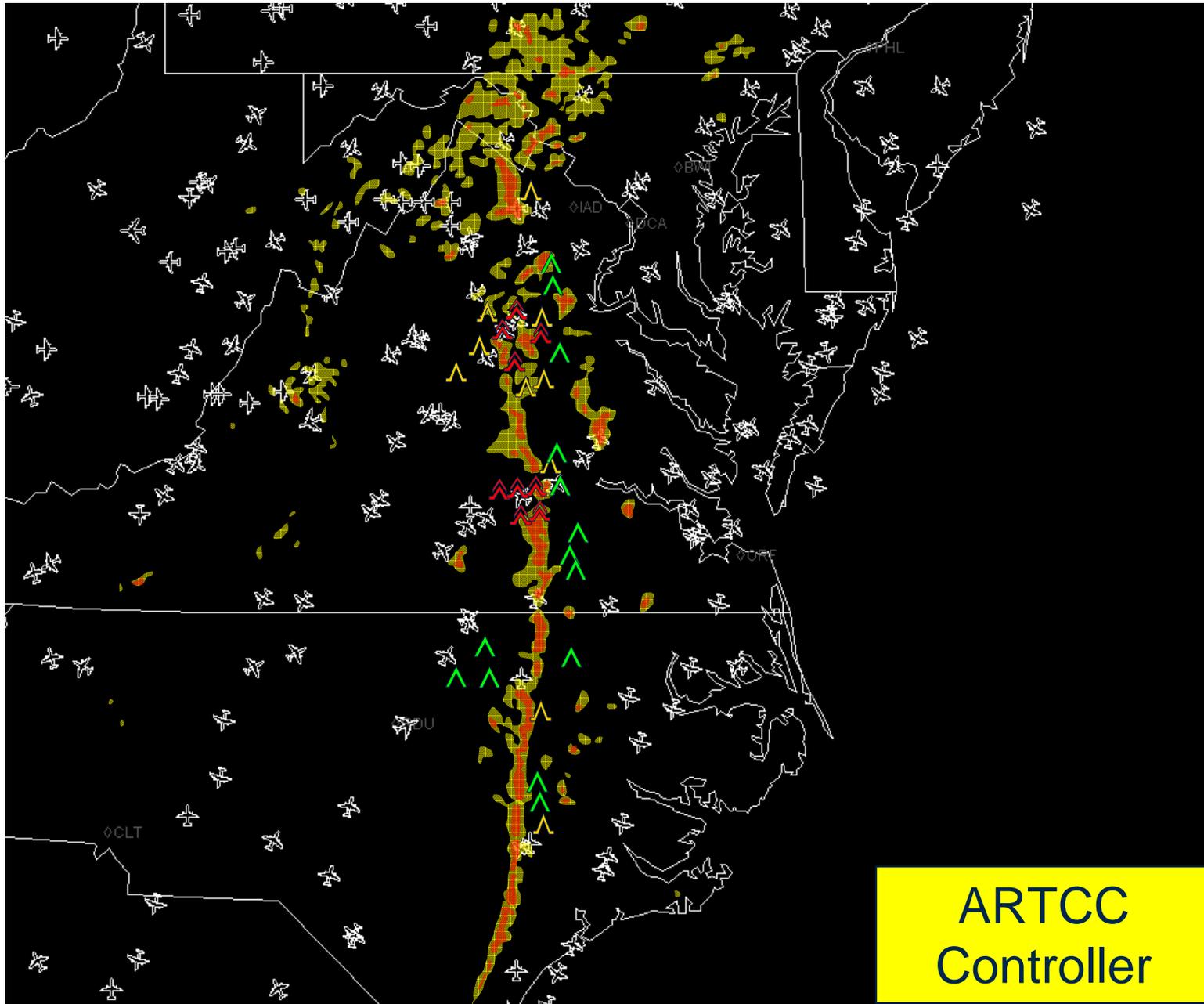
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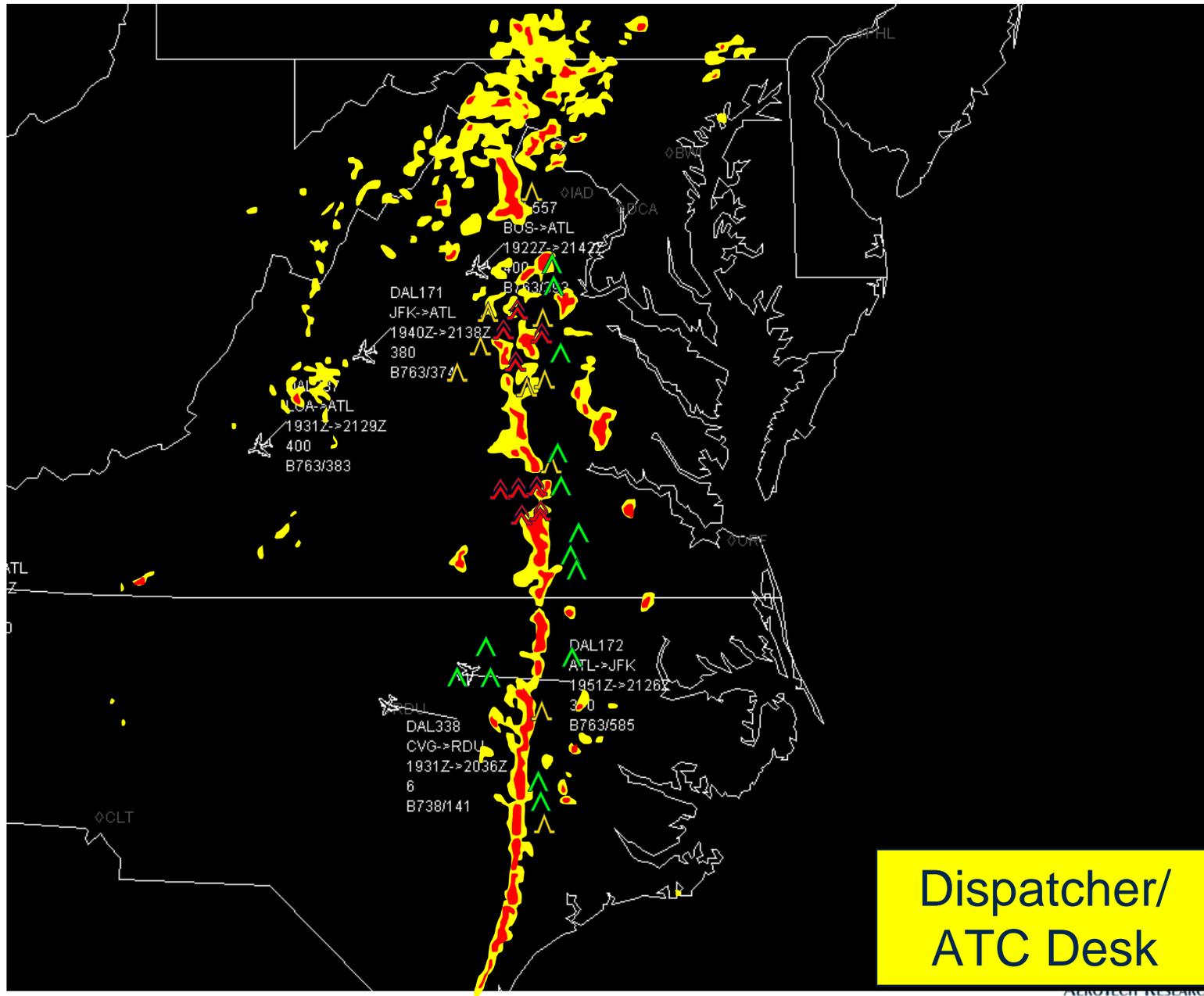
TRAFFIC + NEXRAD + CCFP + TAPS



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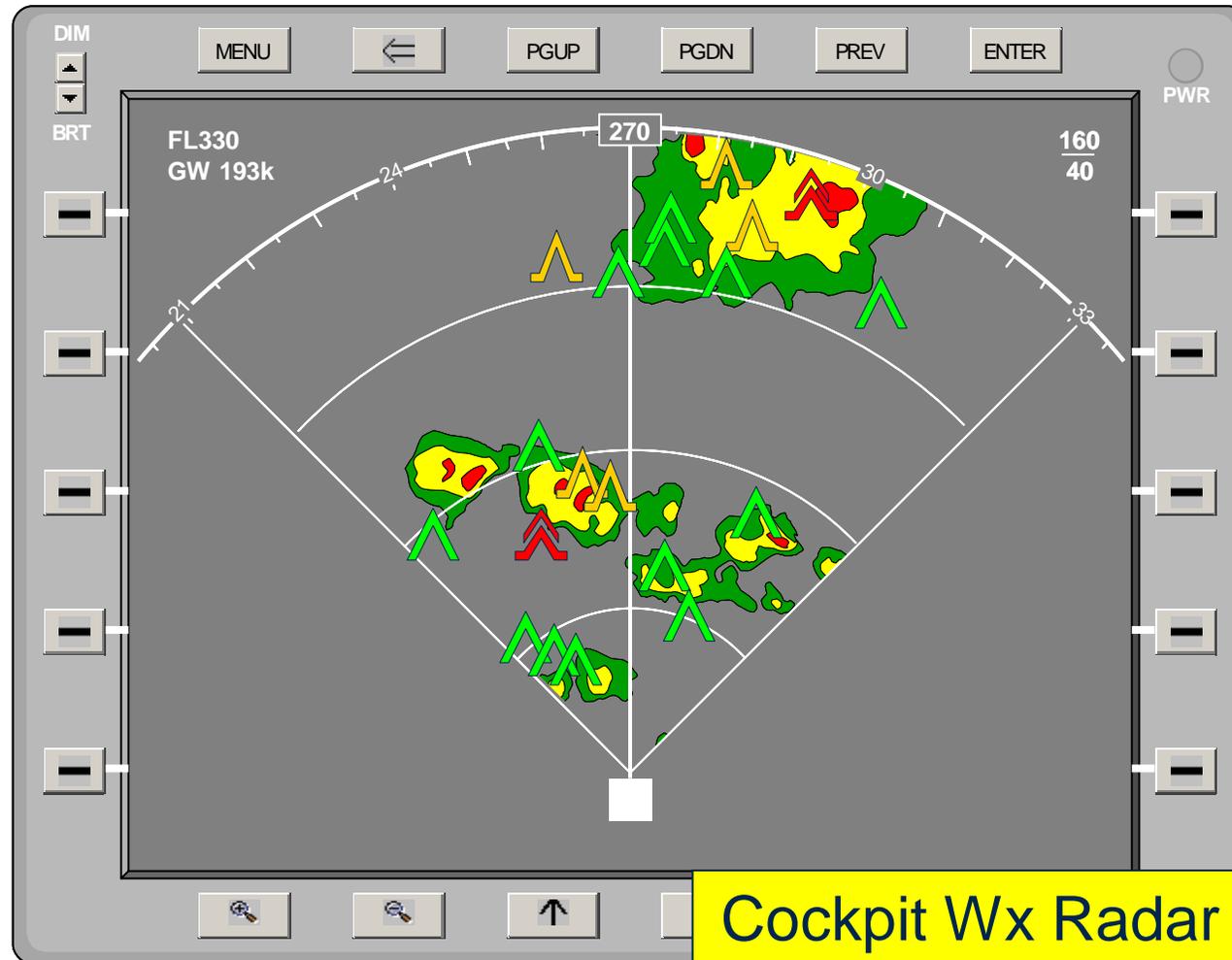


NEXRAD + TRAFFIC + TAPS



TAPS + Wx Radar Cockpit Display

Sector PPI Display Concept



Summary

- The dissemination and graphical presentation of real-time objective reports of turbulence encounters can greatly simplify operations.
- TAPS is a realizable solution – already implemented on 70+ Delta Air Lines' aircraft.
- Potential gains:
 - ✦ Safety
 - ✦ Airspace capacity