

U.S. En Route PBN Implementation

Presented to: ICAO SAIOSEACG/3

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Date: April 2024

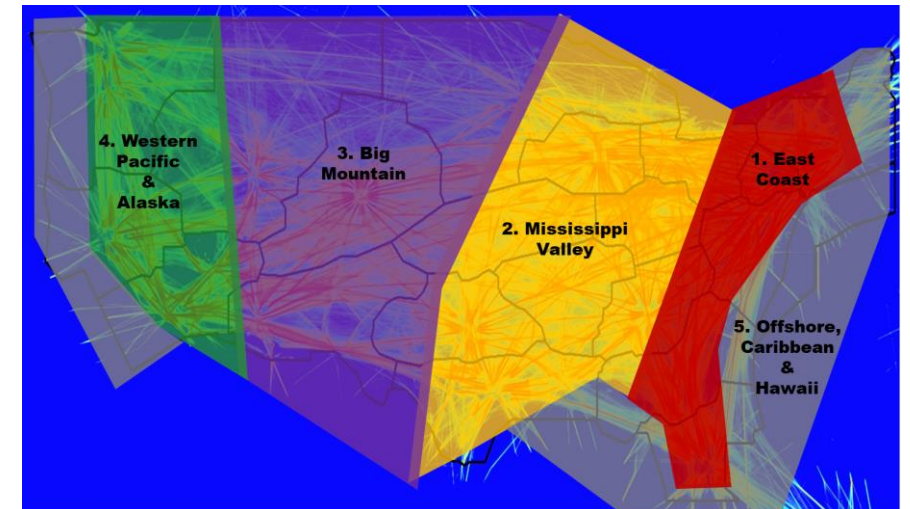
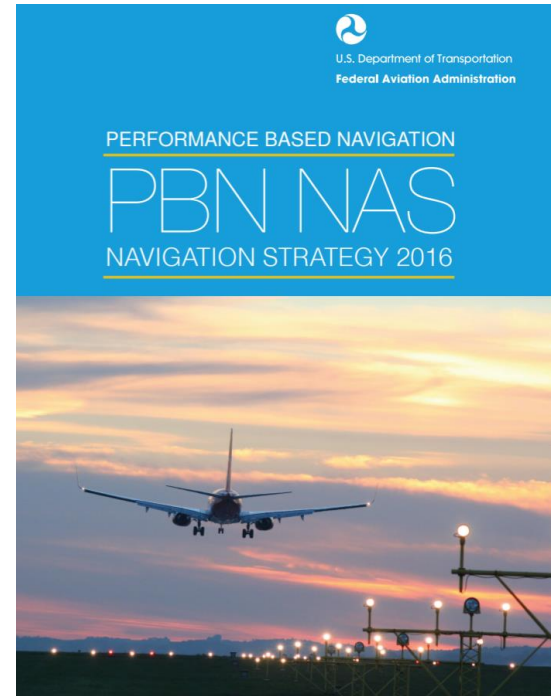


**Federal Aviation
Administration**



Background

- The 2016 PBN NAS Navigation Strategy described FAA's commitment to transition to PBN point-to-point navigation and replace conventional routes with PBN routes where structure is needed
- The Draft PBN Route Structure CONOPS outlined the methodology for the transition of the national high- and low-altitude route structure to a predominantly PBN environment
 - The first step identified was a high-altitude redesign of the highly congested route structure up and down the East Coast
 - This redesign was conducted jointly through the Florida Metroplex project (ZJX, ZMA, ZSU, and ZTL) and the Northeast Corridor Atlantic Coast Routes (NEC/ACR) project (ZDC, ZNY, ZBW)

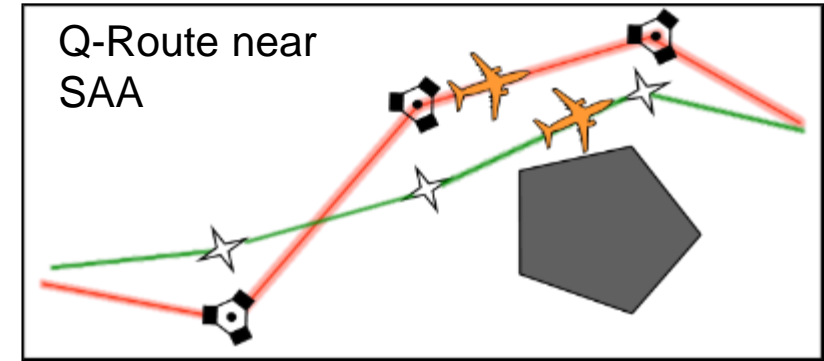
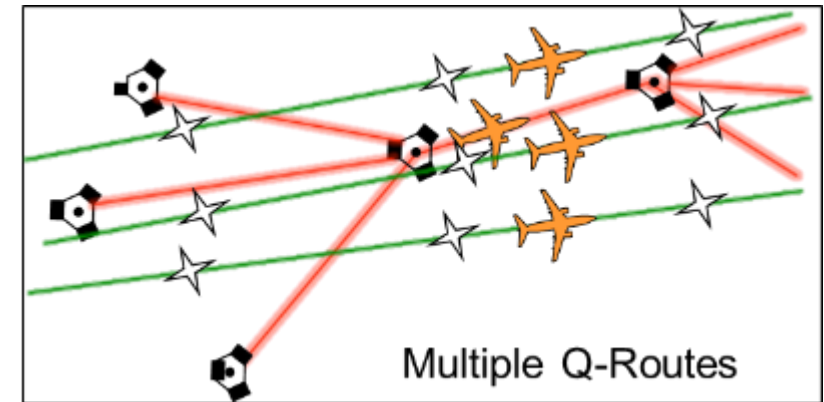
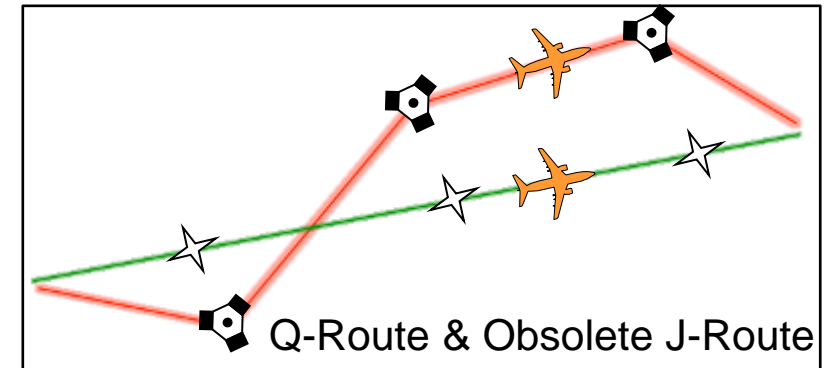


Benefits of a High-Altitude PBN Q-Route Network

- **Reduce mileage, time en route, fuel use, fuel loading requirements and emissions**
- **Simplify flight planning, coordination, controller phraseology, and the operating environment**
 - Provide seamless PBN flight path from SID to STAR
 - Reduce sector complexity by decreasing the number of intersecting flight paths
 - Reduce pilot-controller communications
 - Expand routing options during irregular operations (e.g., weather reroutes)
- **Eliminate underutilized conventional routes and support NAVAID divestment**
- **Reduce systems maintenance costs**
- **Harmonize with ICAO RNAV performance expectations**

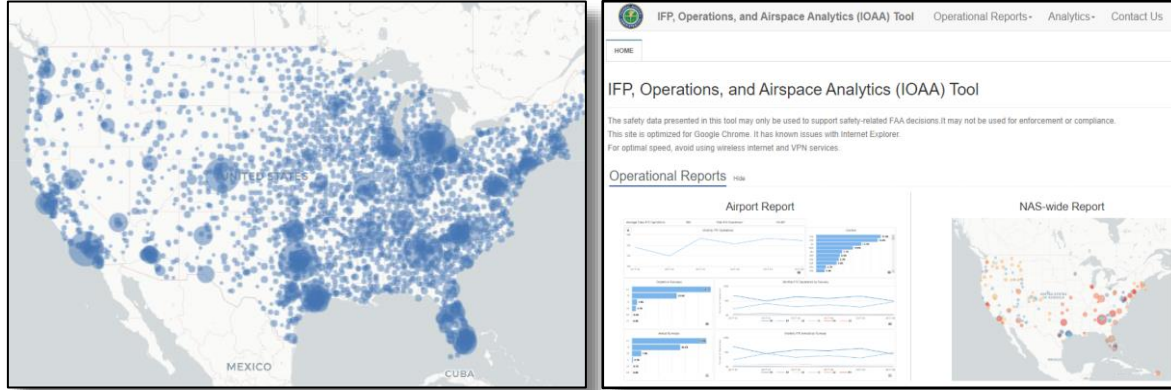
Q-Route Implementation Strategies

- **Focus on more direct routing leveraging satellite navigation**
- **Leverage multiple Q-routes for direct, segregated routing and more efficient use of airspace,**
- **Eliminate unnecessary merge points, reduce delays, and enable opportunities for unrestricted continuous descents (OPD)**
- **Leverage satellite navigation and “short-cuts” to avoid special activity airspace without reliance on ground-based NAVAIDS**



Airspace and PBN Design and Analysis Capabilities

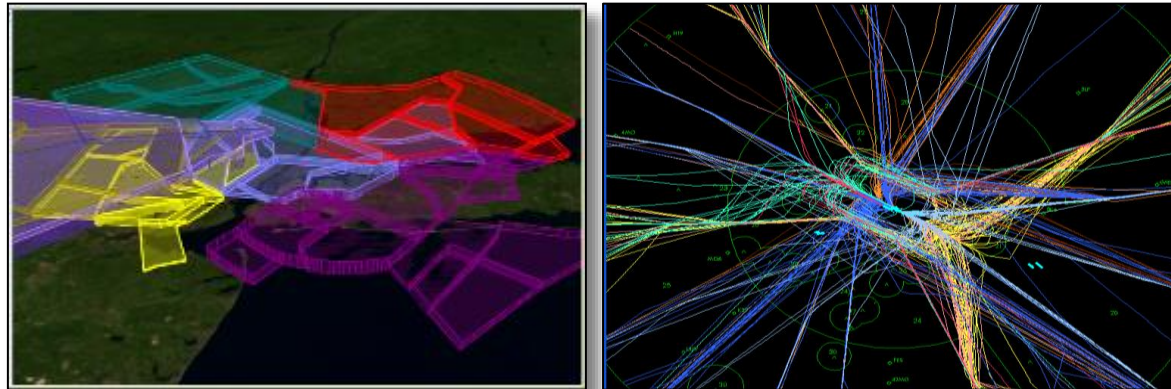
IFP, Operations, and Airspace Analytics (IOAA) Tool



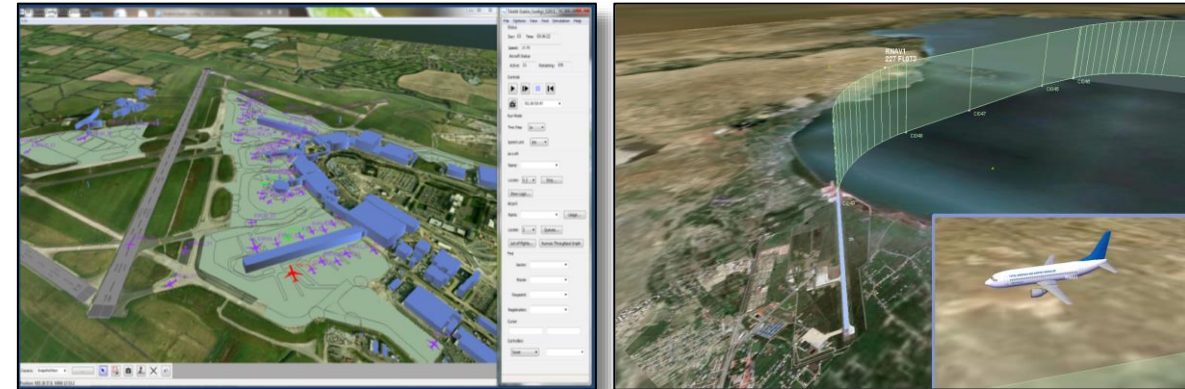
Human-in-the-Loop (HITL) Simulations



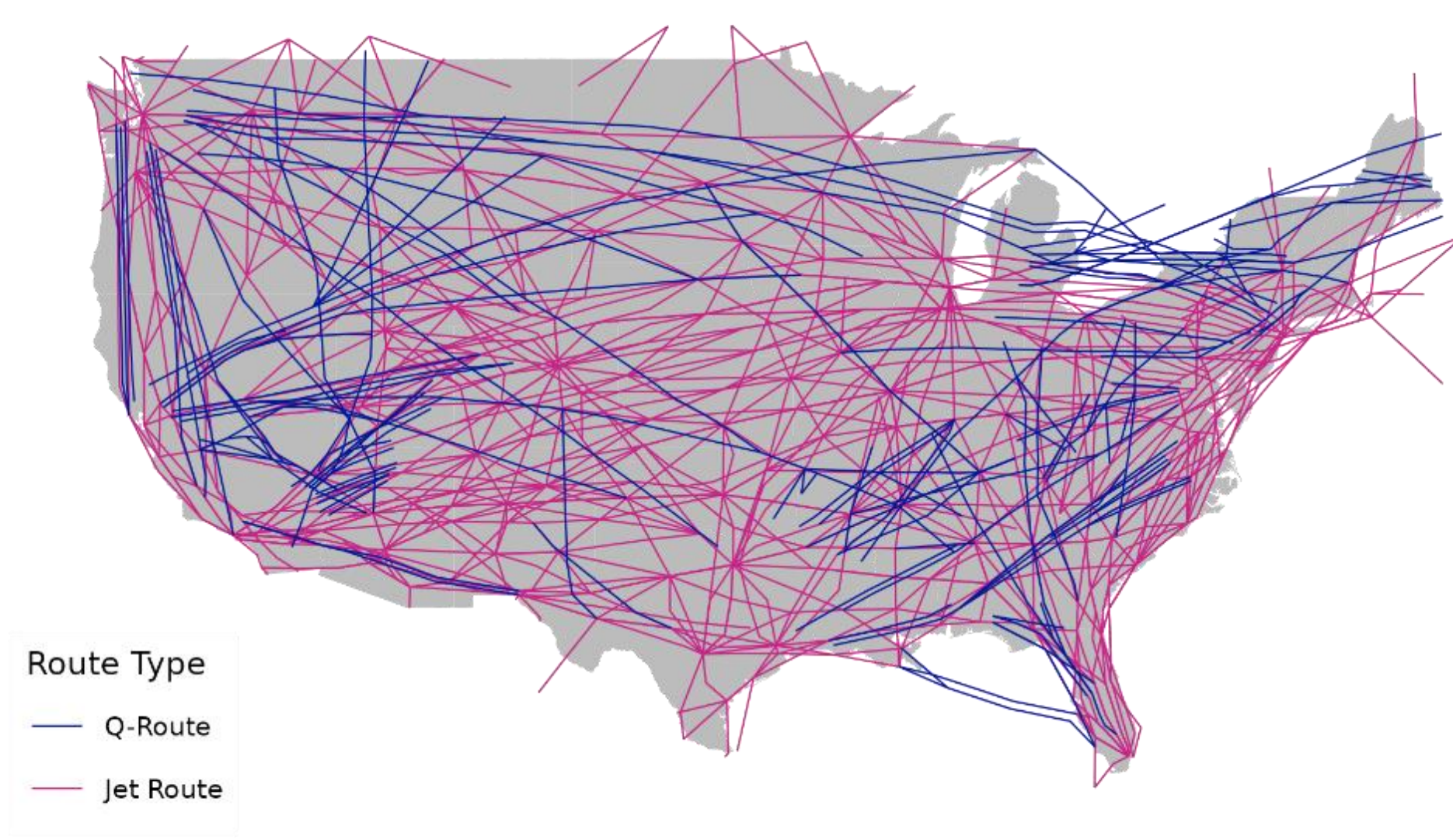
Airspace and Procedure Design and Visualization Capabilities



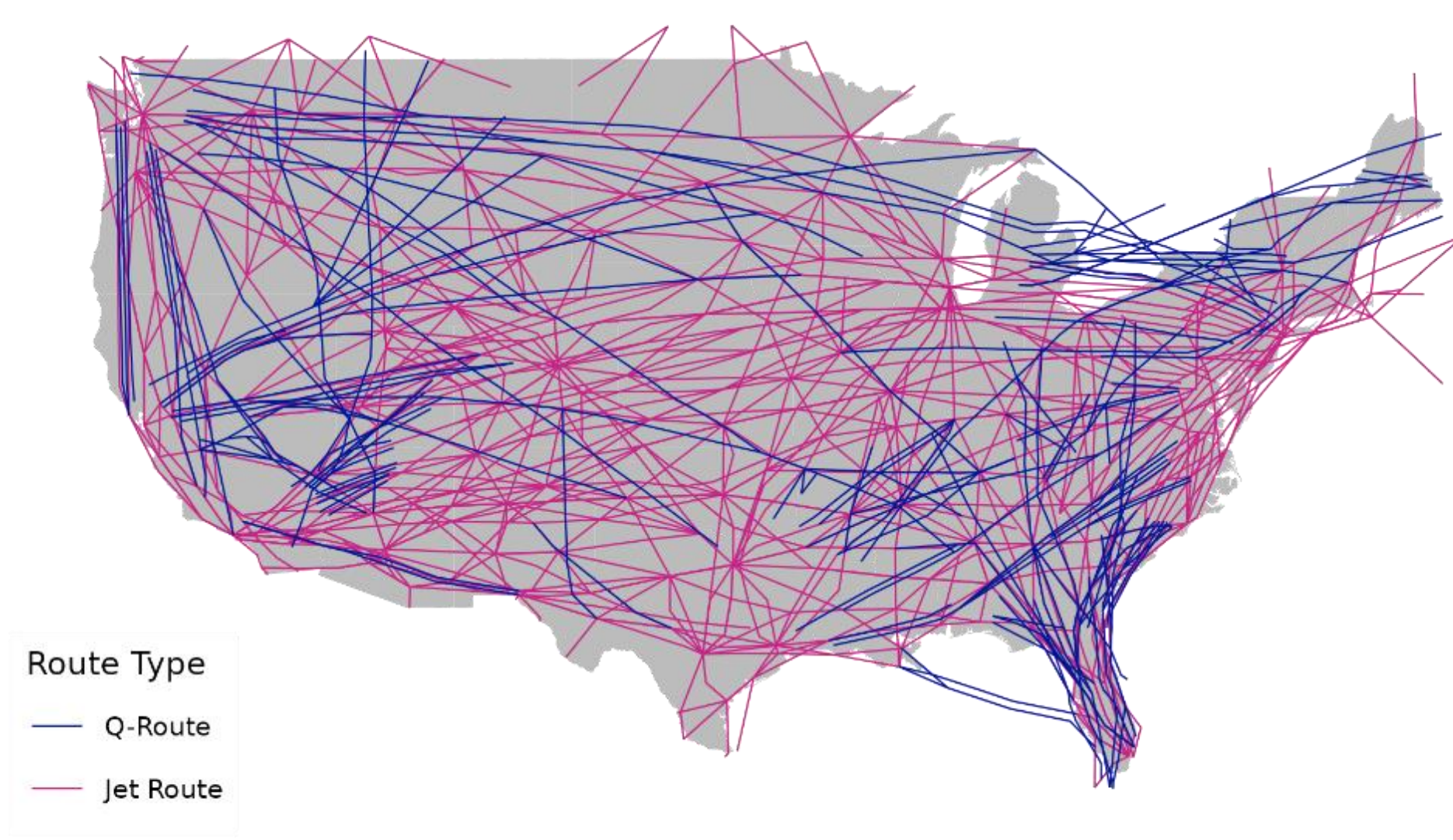
Fast-Time Simulations



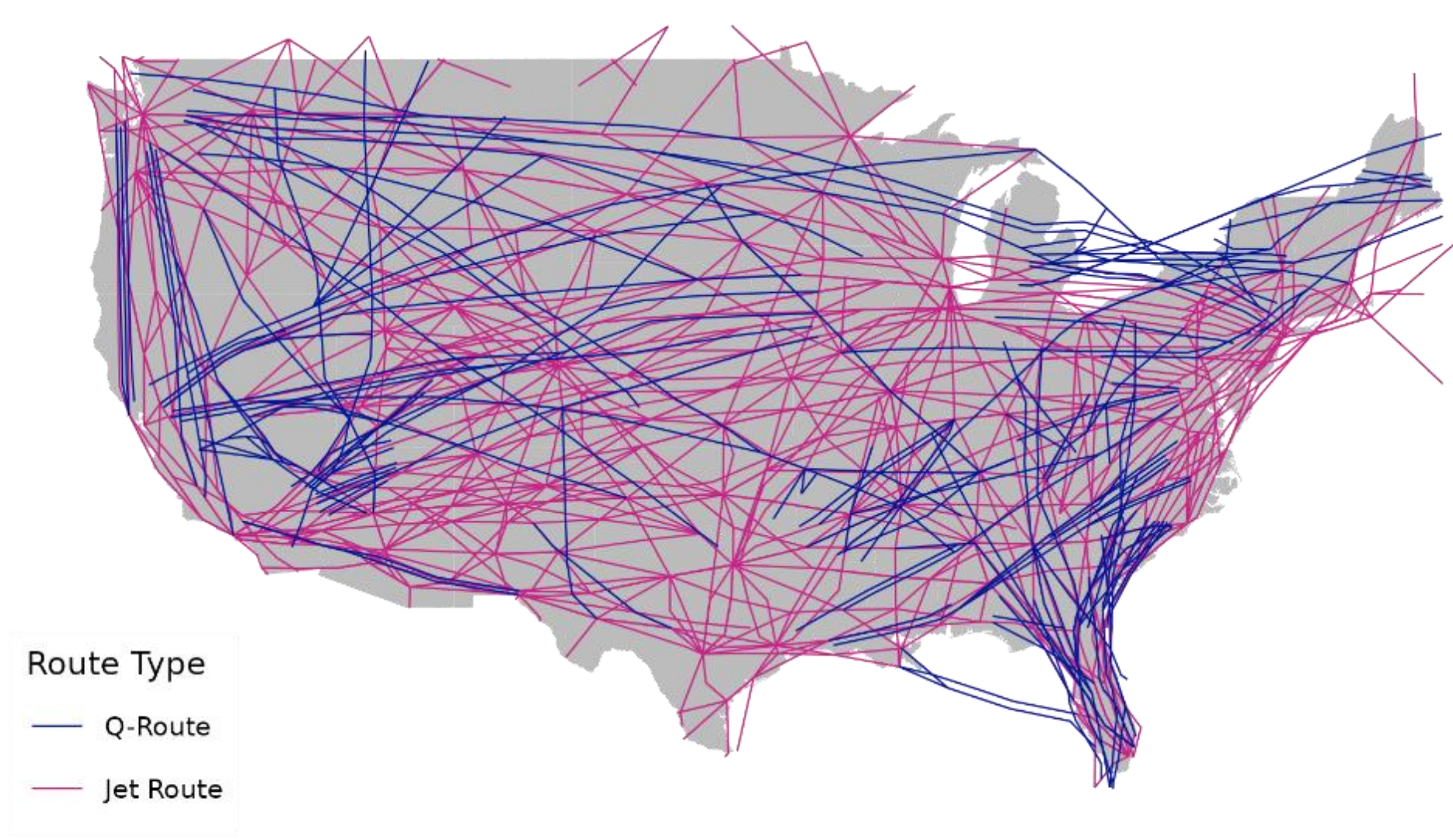
Q-Routes and Jet Routes: 2017



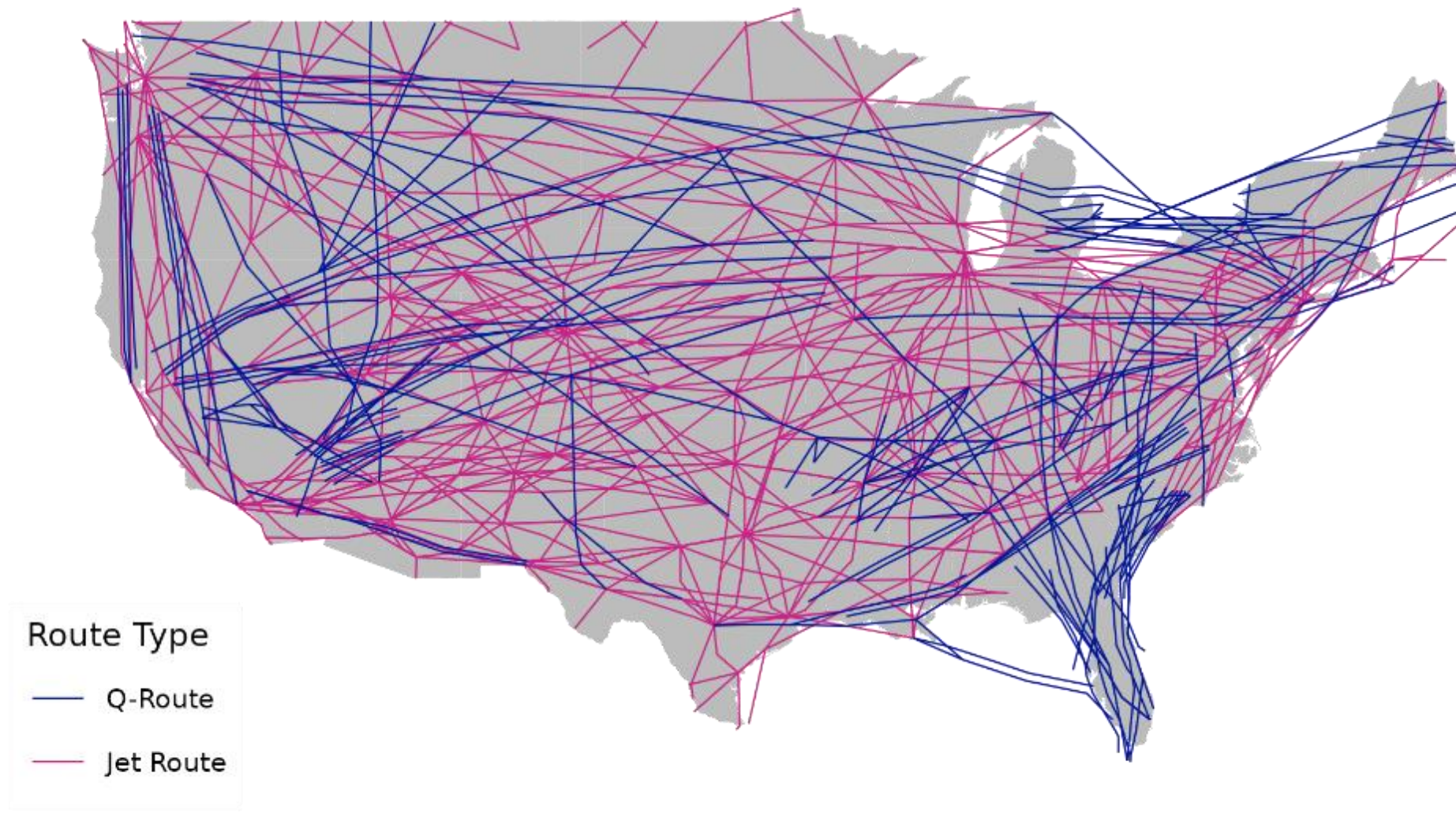
Q-Routes and Jet Routes: 2018



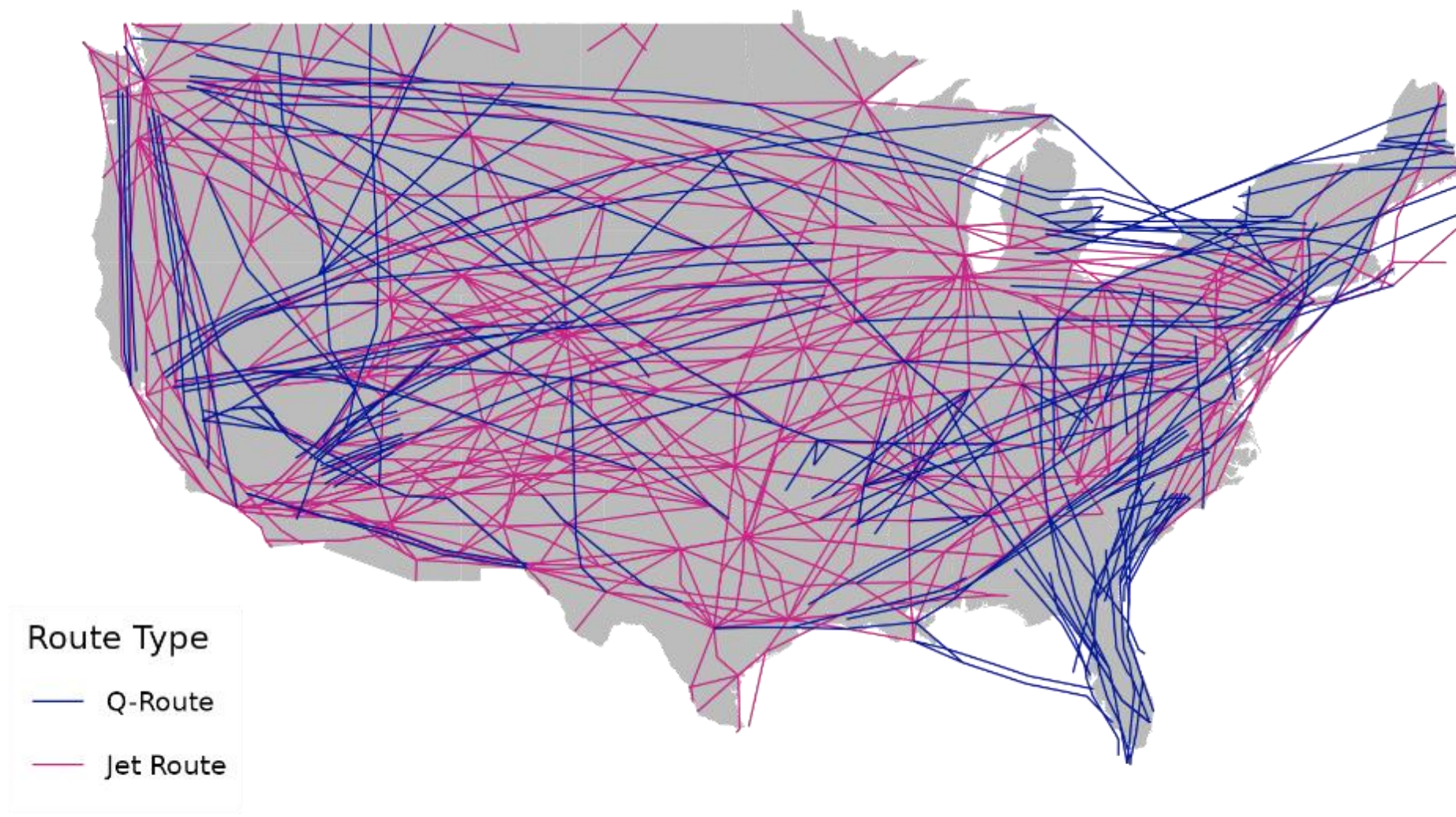
Q-Routes and Jet Routes: 2019



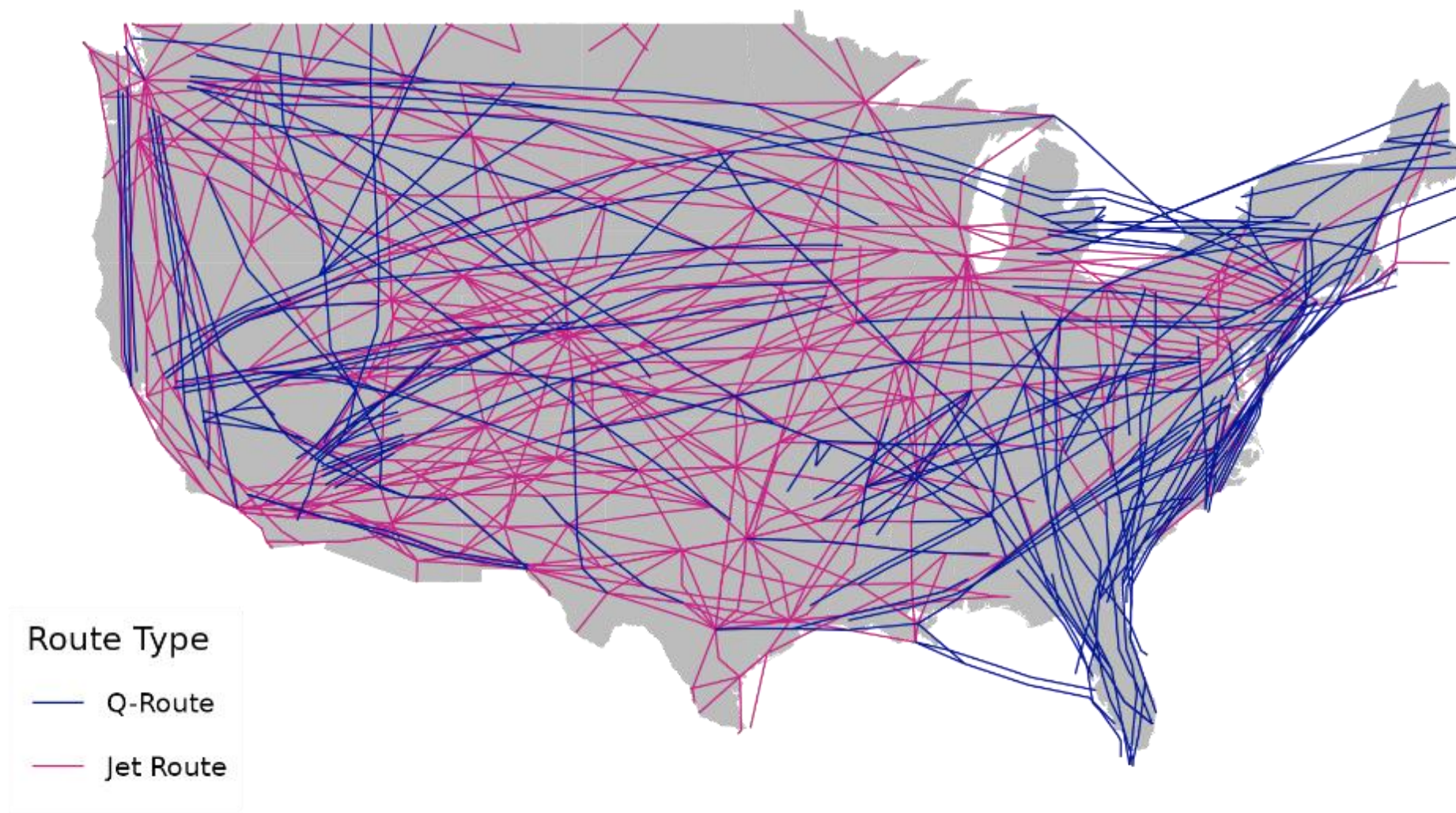
Q-Routes and Jet Routes: 2020



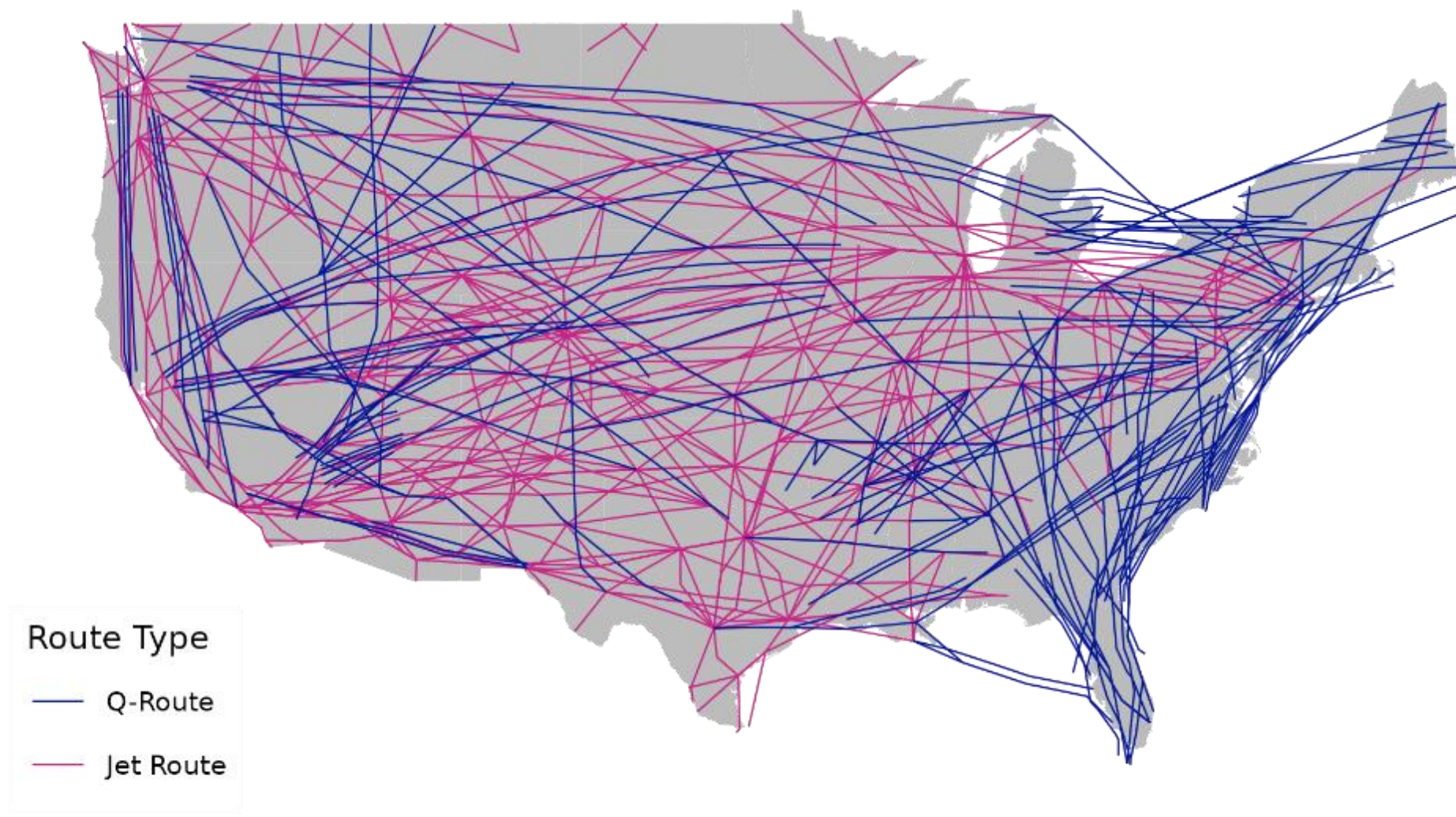
Q-Routes and Jet Routes: 2021



Q-Routes and Jet Routes: 2022

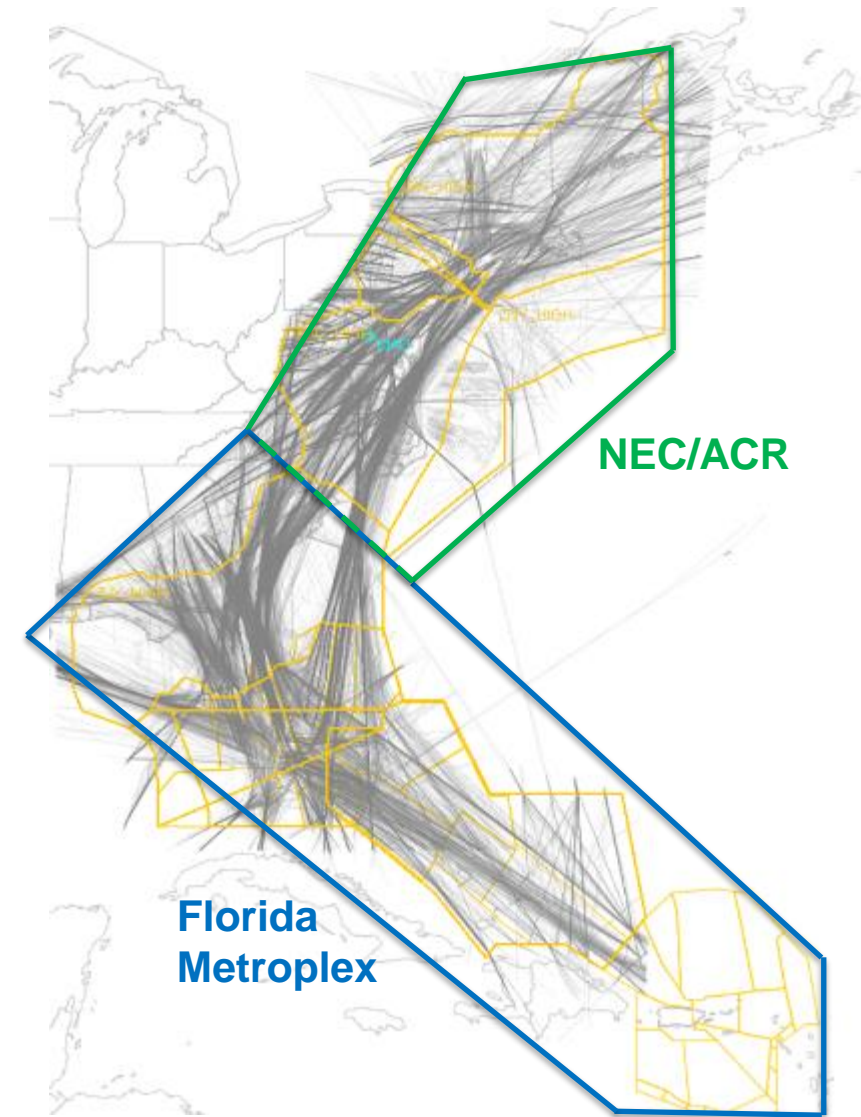


Q-Routes and Jet Routes: 2023



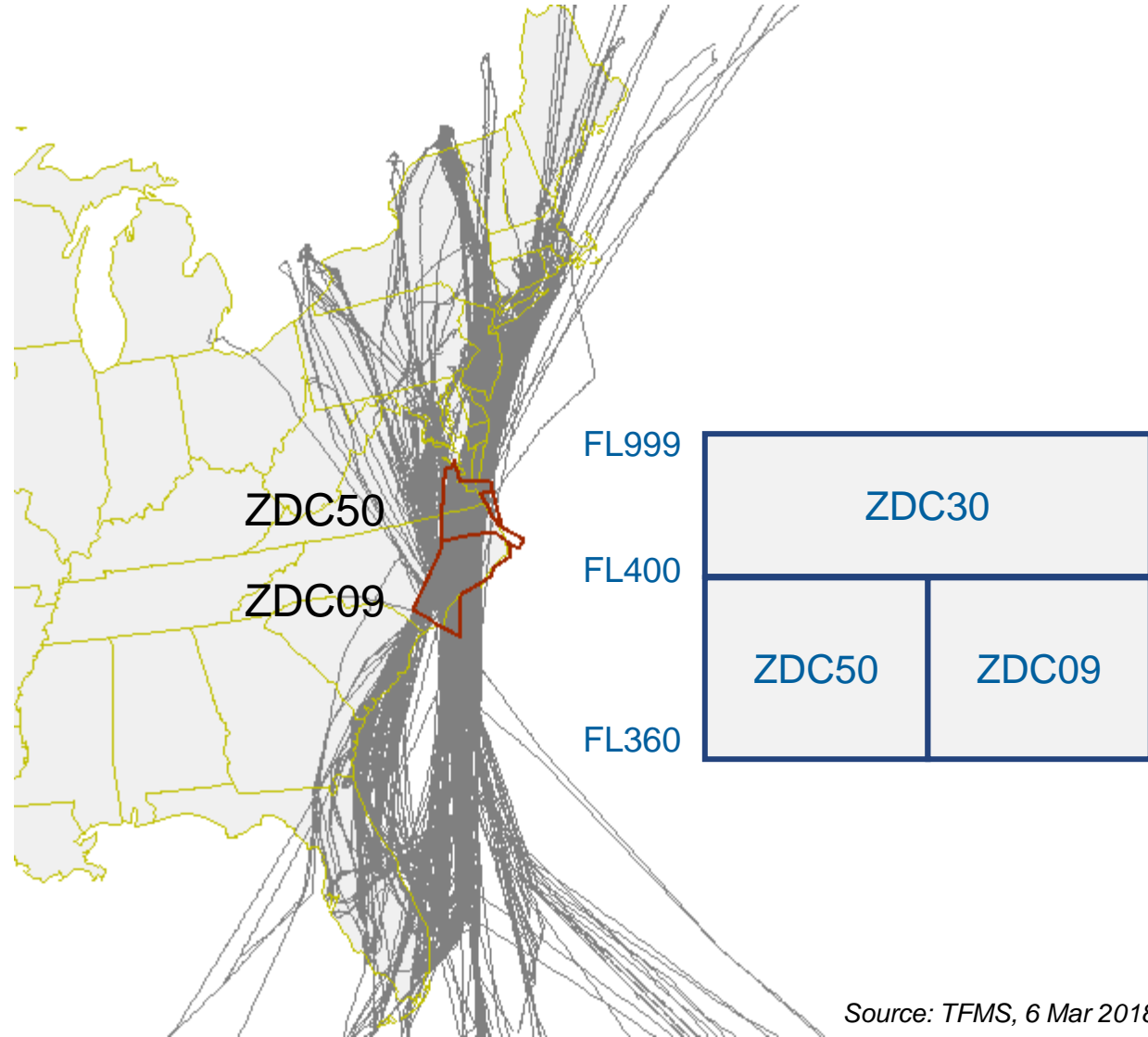
FL Metroplex & NEC/ACR Mission Statement / Expected Benefits

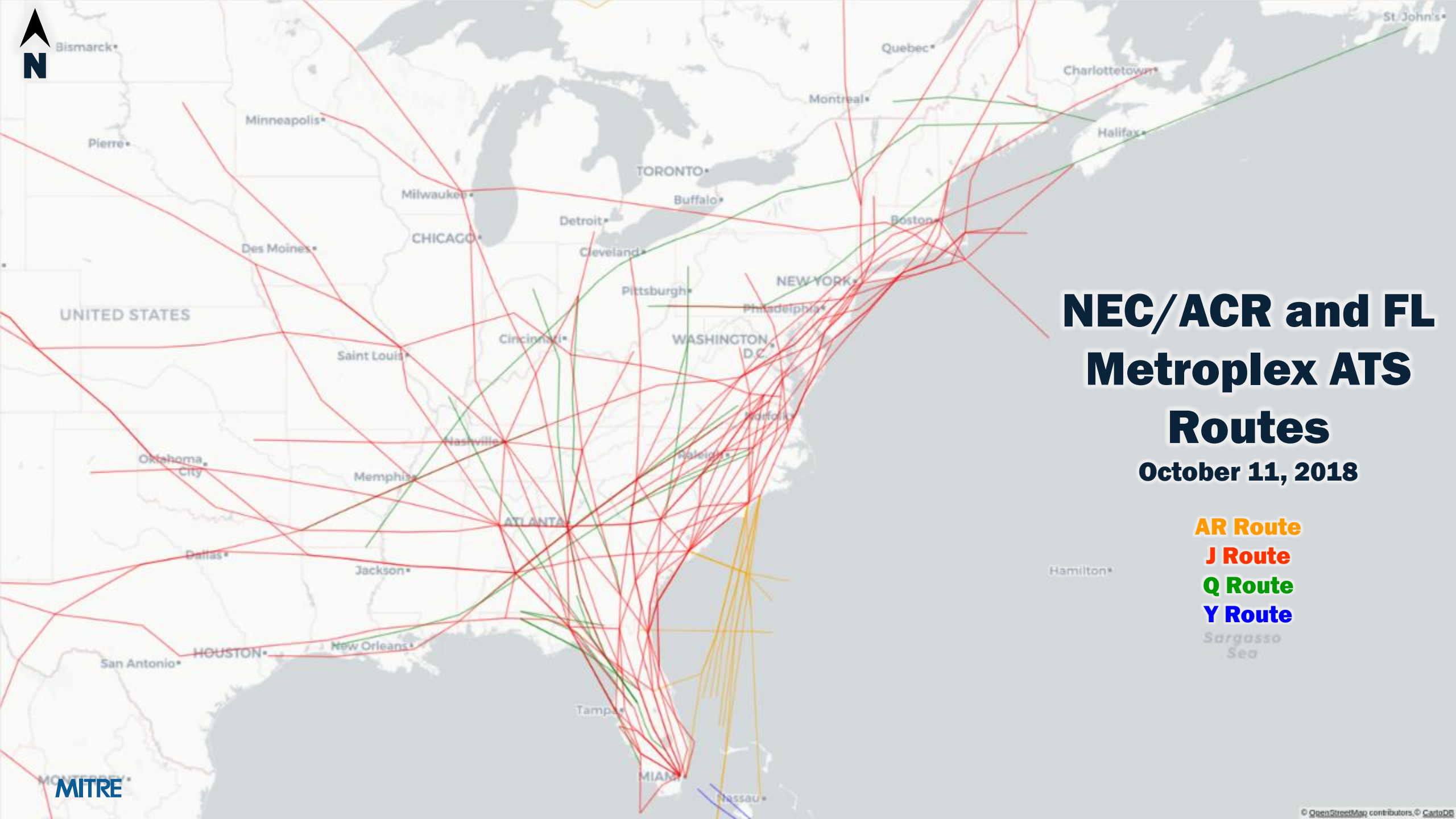
- **Develop North-South Q routes in heavily traveled and constricted airspace of 6 ARTCCs along the US Atlantic Coast**
- **Remove J-routes after implementation of new routes, supporting VOR Minimum Operating Network (MON) work**
- **Expected benefits:**
 - Enhanced sector throughput in high-demand airspace
 - Reduced propagation of delay caused by airspace constraints
 - Reduced controller and pilot task complexity
 - More optimal climbs, descents, and transitions by segregating traffic
 - Less restrictive TMIs
 - More optimally defined playbook routes, CDRs, and preferred IFR routes
 - Removal of J-routes, reducing procedure costs and supporting VOR MON goals by reducing the number of VORs requiring maintenance



New ZDC Ultra-High Sector

- **ZDC09 (Dixon) Pre-NEC/ACR:**
 - Bottleneck for East Coast Traffic
 - Congestion caused volume delays and reroutes in the Northeast Corridor
- **NEC / ACR change**
 - Moved MCO flow out of most-congested sector
 - Removed chokepoint near PXT
 - Reduced airspace complexity
- **New Ultra-High ZDC30 at FL400 implemented in May 2022 to alleviate excess volume**
 - Low-altitude sectors ZDC24, ZDC25, ZDC26, and ZDC 28 consolidated to free up resources

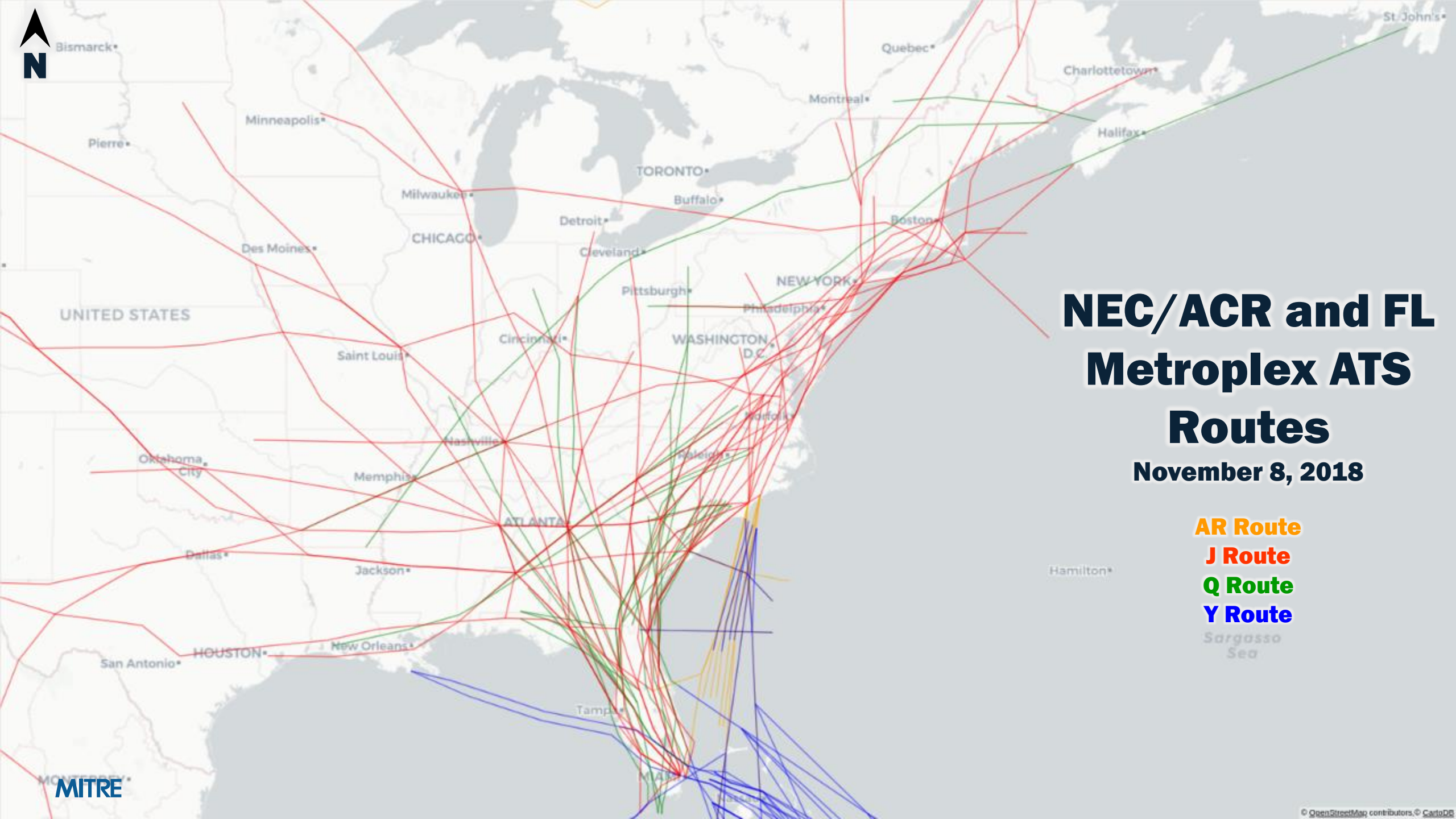




NEC/ACR and FL Metroplex ATS Routes

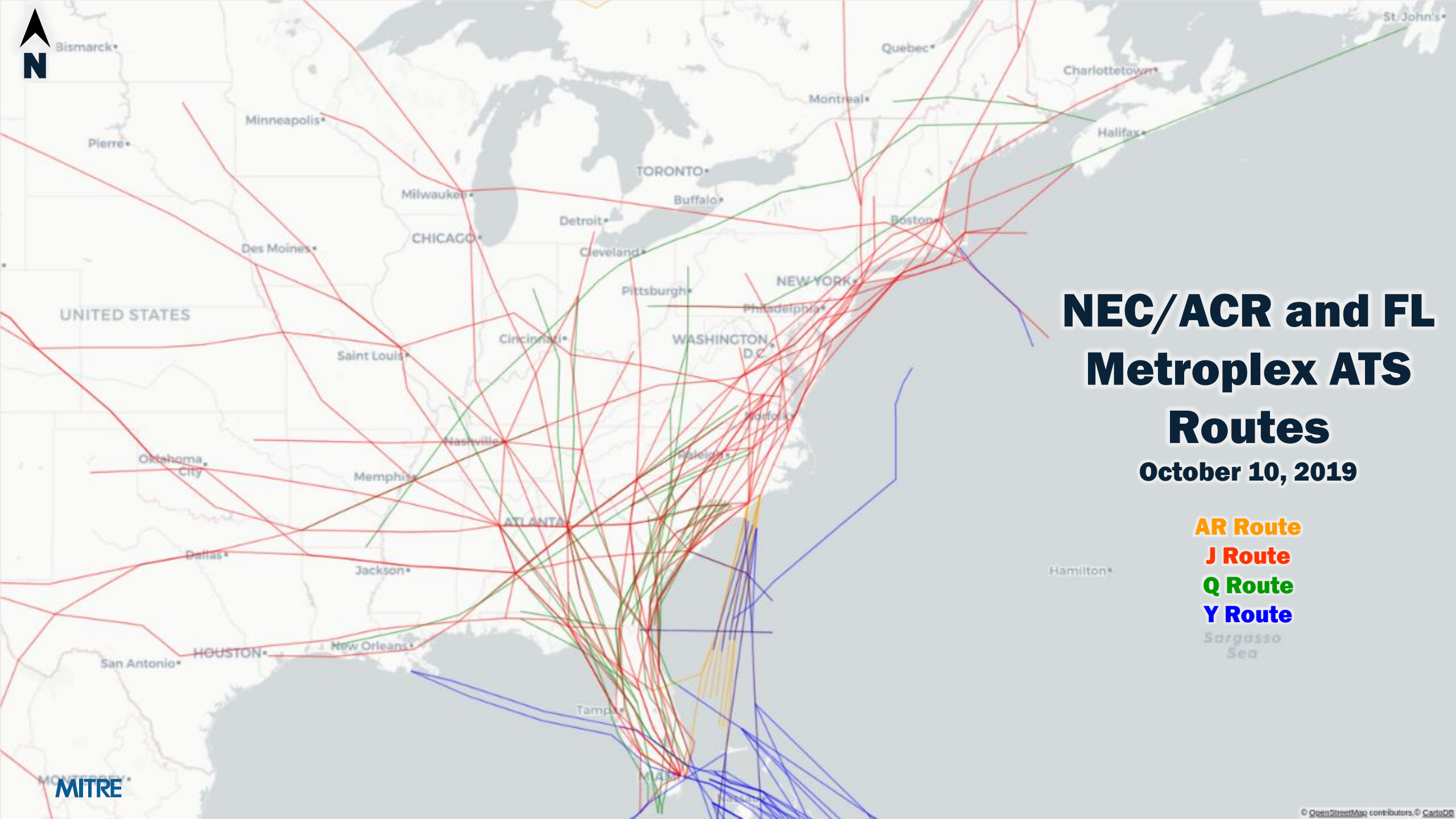
October 11, 2018

- AR Route
- J Route
- Q Route
- Y Route



NEC/ACR and FL Metroplex ATS Routes

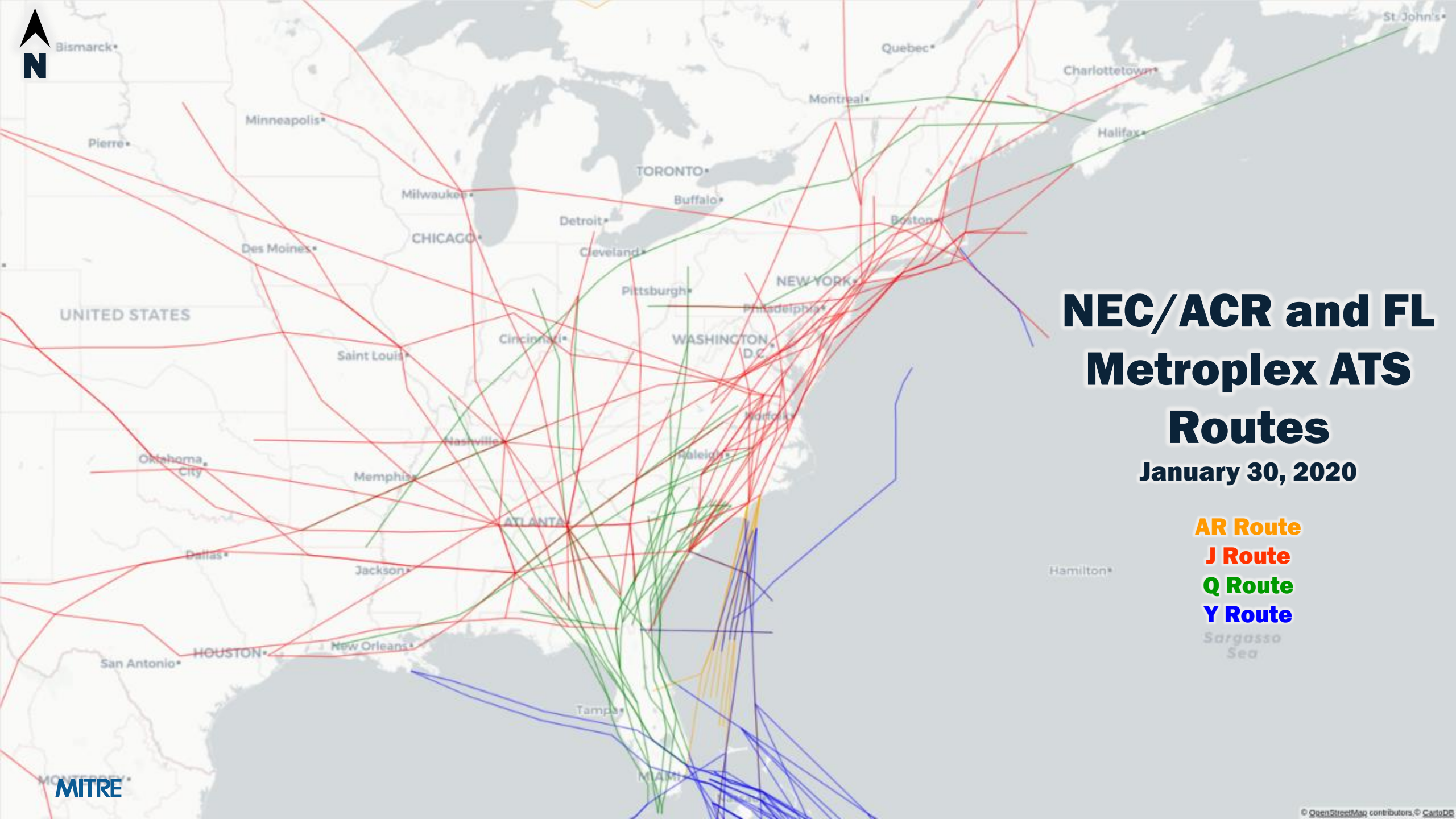
November 8, 2018



NEC/ACR and FL Metroplex ATS Routes

October 10, 2019

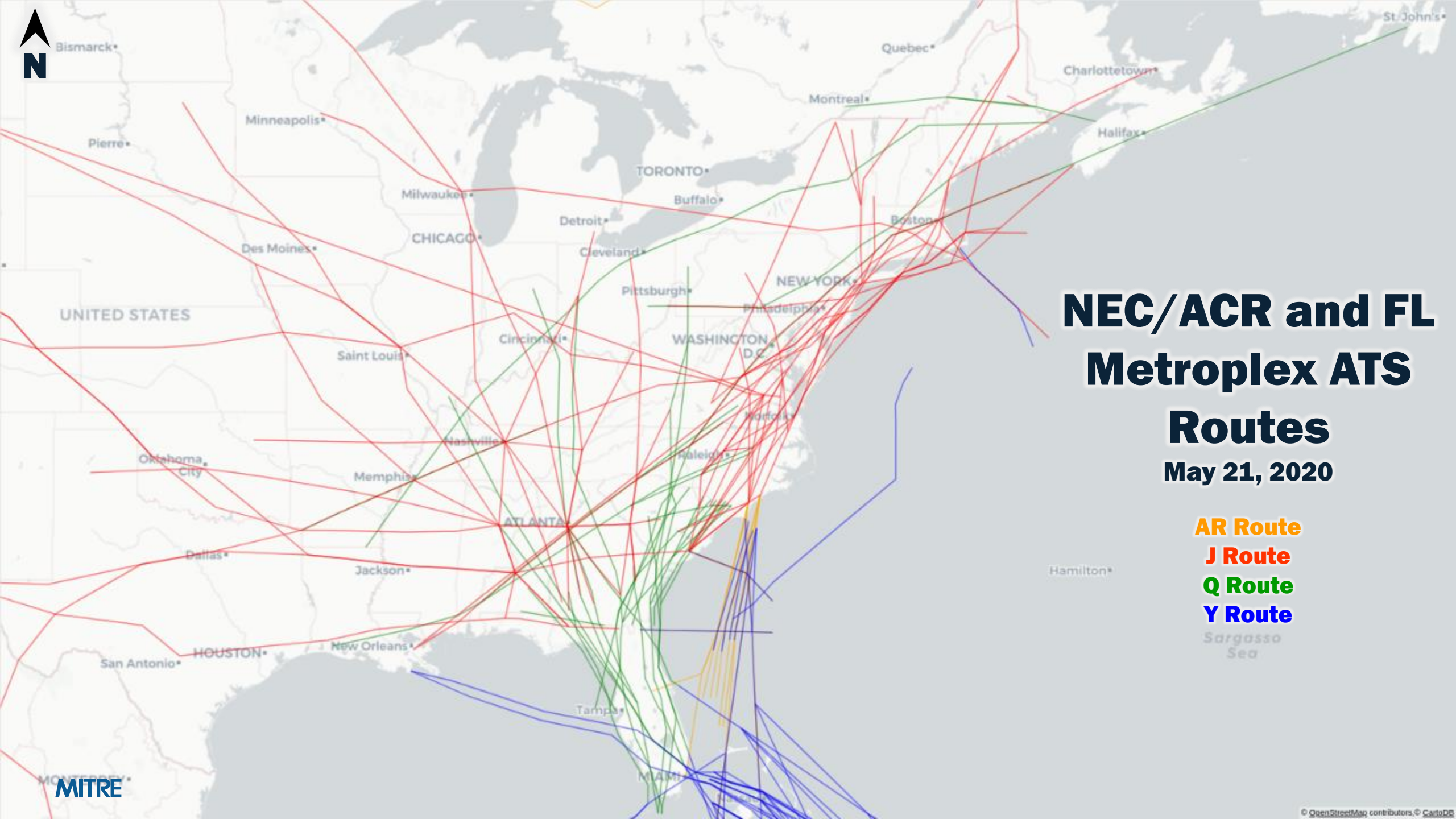
- AR Route
- J Route
- Q Route
- Y Route



NEC/ACR and FL Metroplex ATS Routes

January 30, 2020

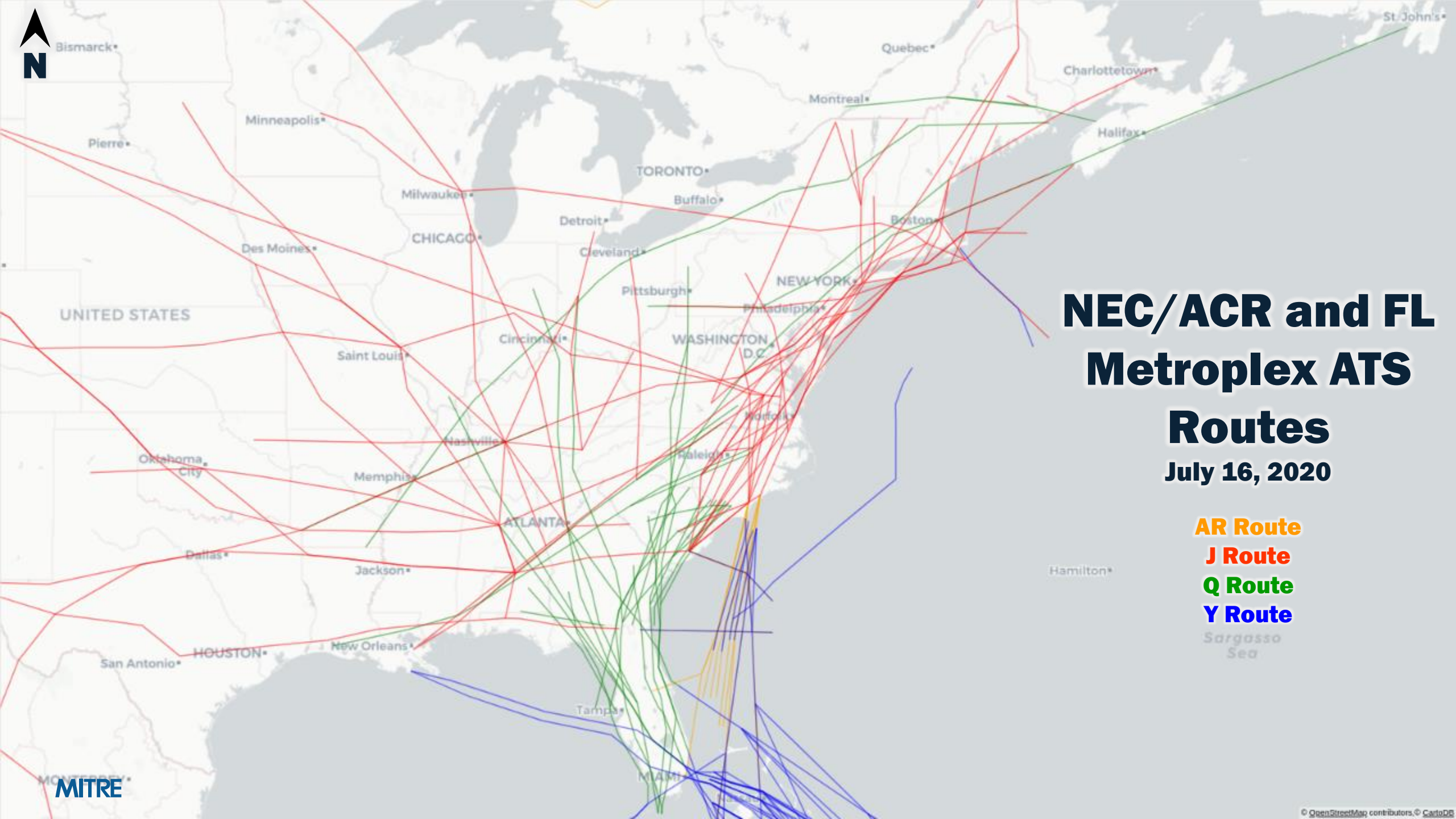
- AR Route
- J Route
- Q Route
- Y Route



NEC/ACR and FL Metroplex ATS Routes

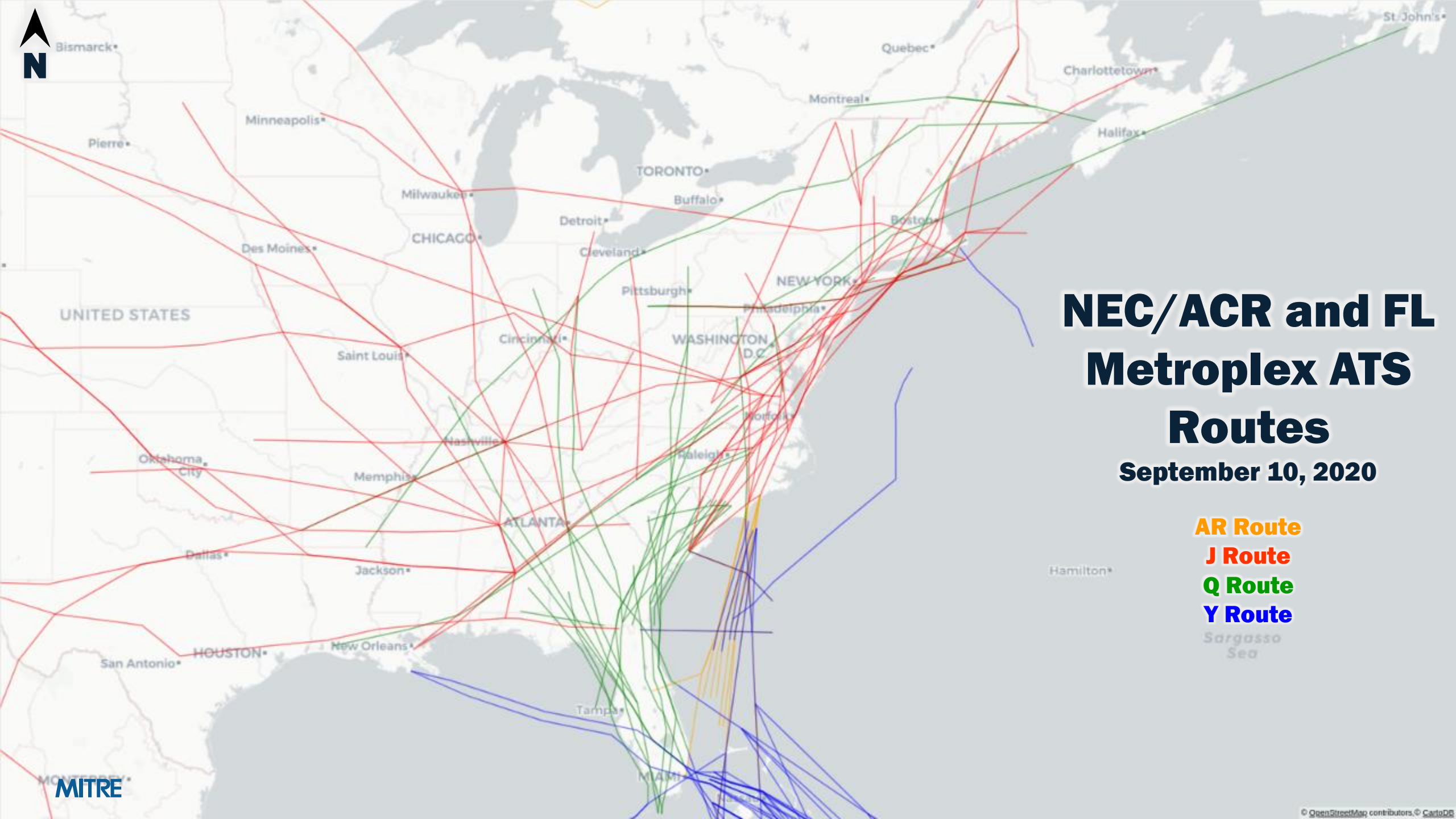
May 21, 2020

- AR Route
- J Route
- Q Route
- Y Route



**NEC/ACR and FL
Metroplex ATS
Routes**
July 16, 2020

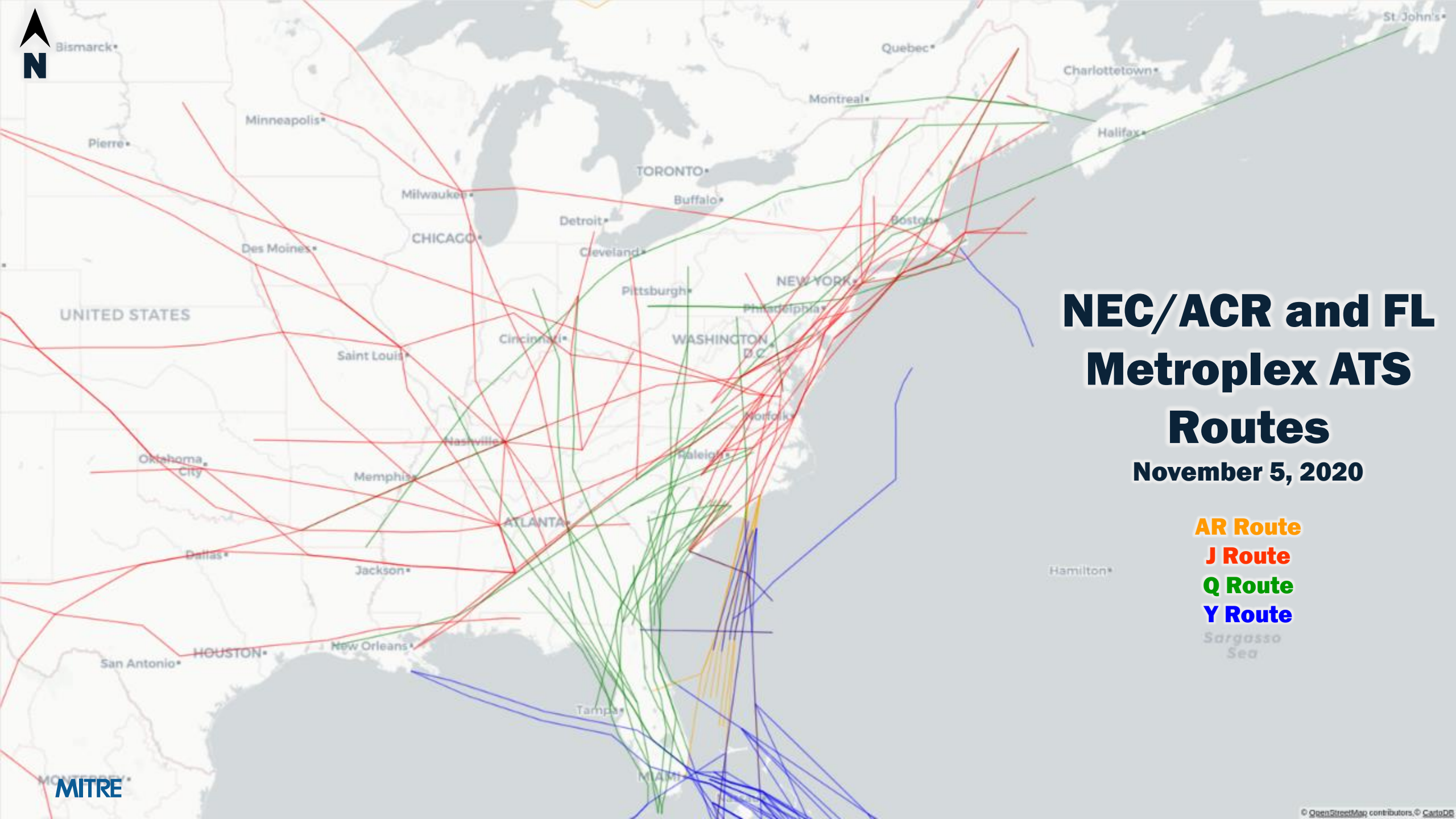
- AR Route
- J Route
- Q Route
- Y Route



NEC/ACR and FL Metroplex ATS Routes

September 10, 2020

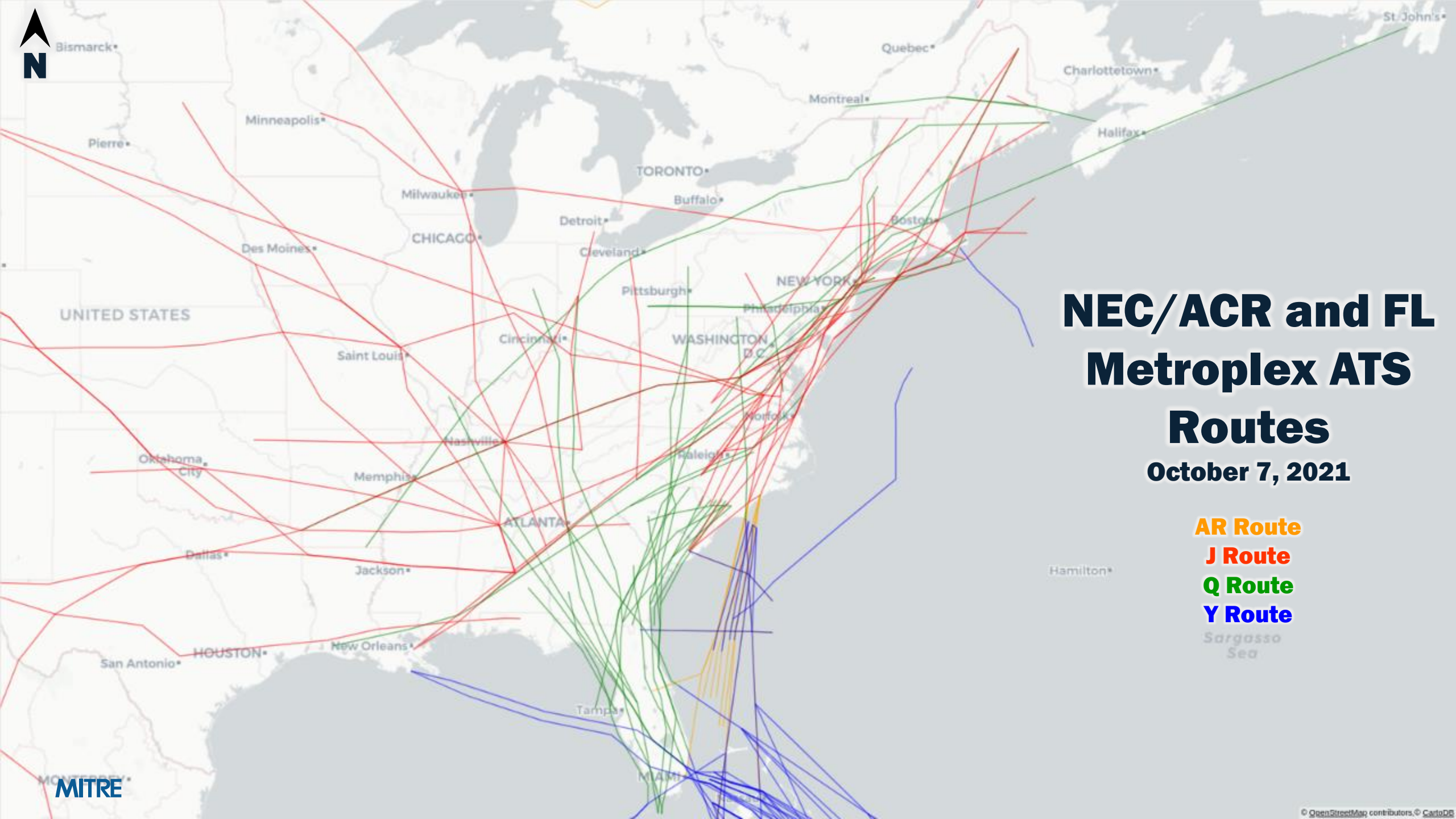
- AR Route
- J Route
- Q Route
- Y Route



NEC/ACR and FL Metropolitan ATS Routes

November 5, 2020

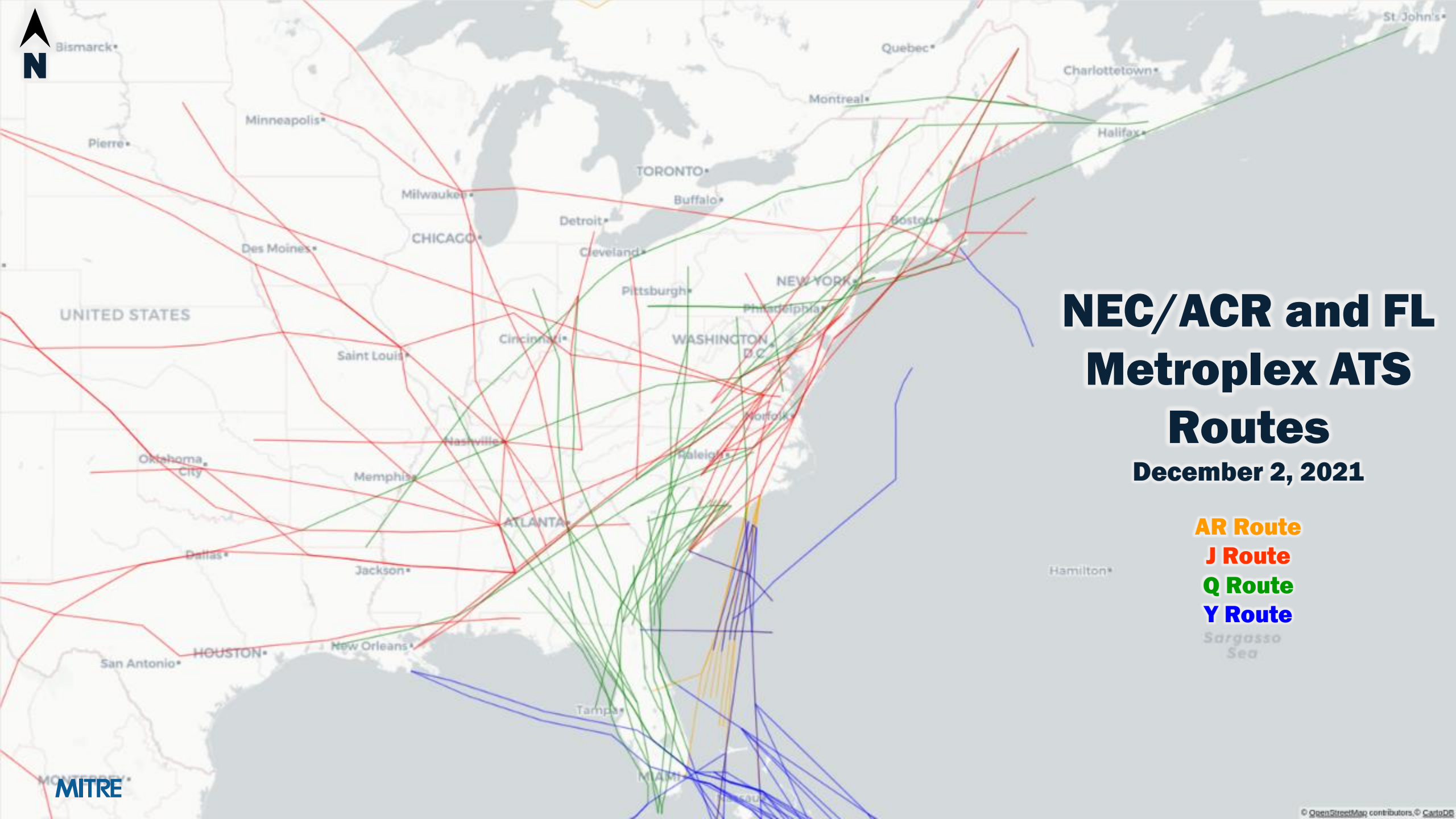
- AR Route
- J Route
- Q Route
- Y Route



NEC/ACR and FL Metroplex ATS Routes

October 7, 2021

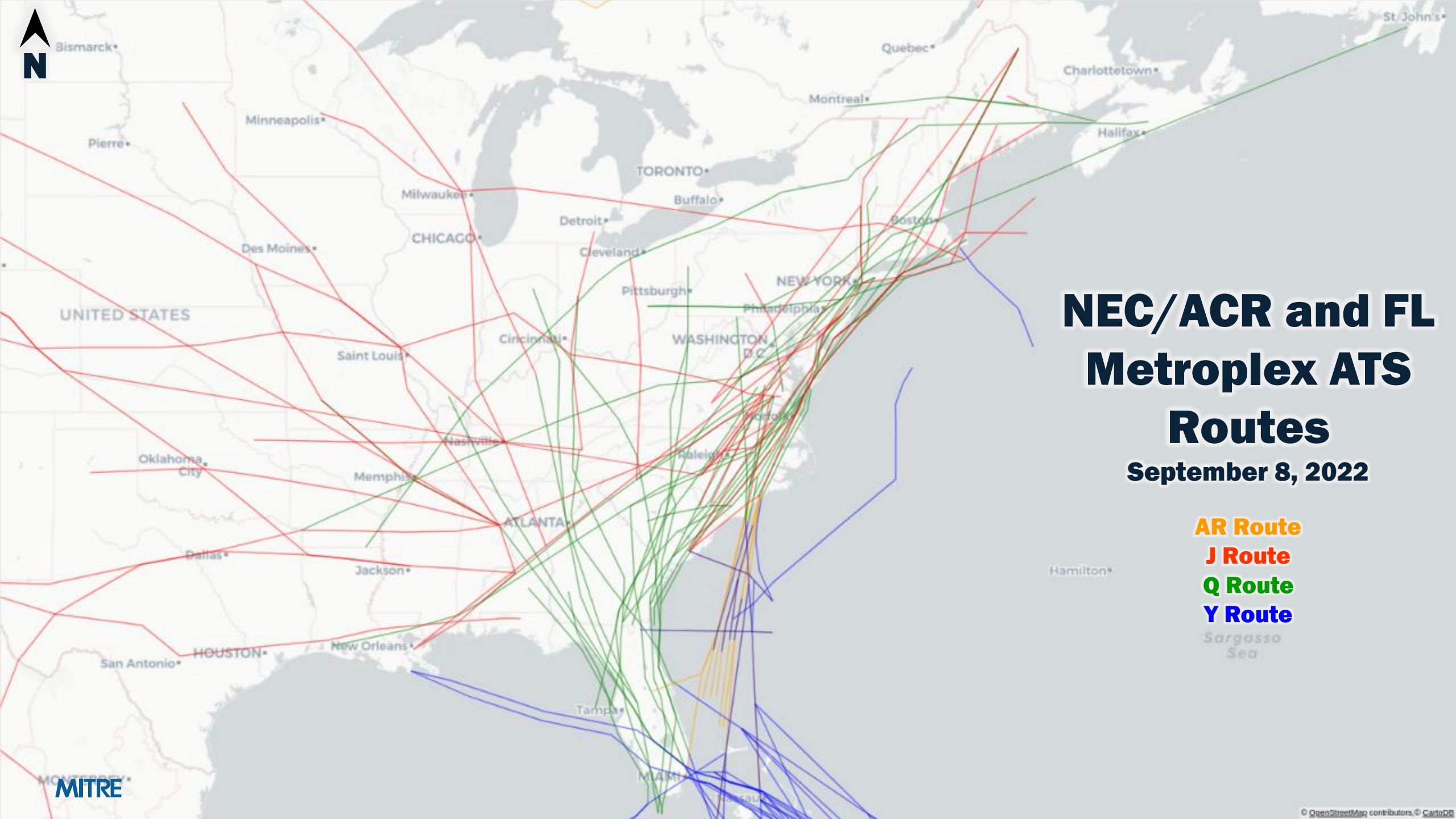
AR Route
J Route
Q Route
Y Route



NEC/ACR and FL Metroplex ATS Routes

December 2, 2021

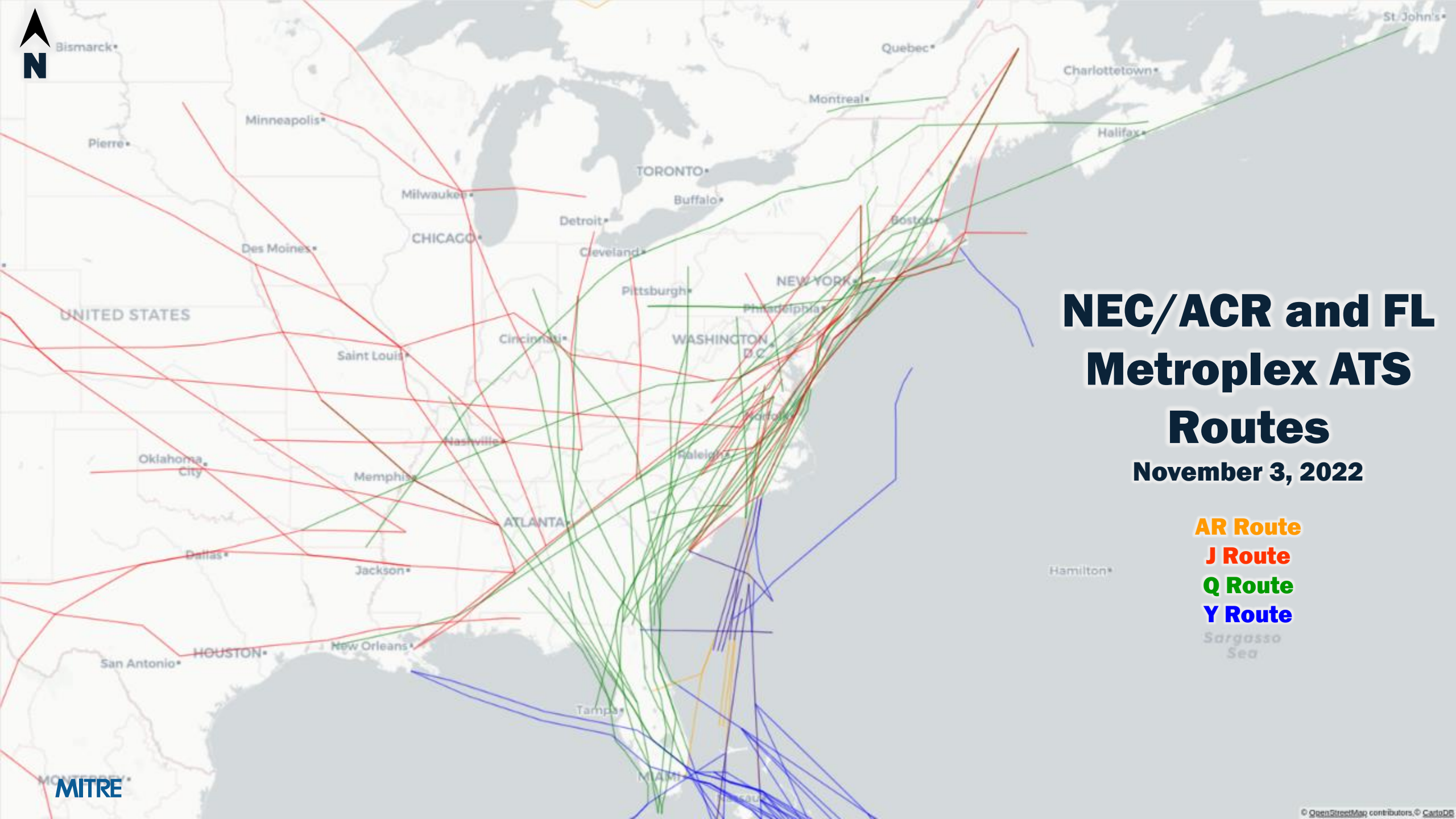
- AR Route
- J Route
- Q Route
- Y Route



NEC/ACR and FL Metroplex ATS Routes

September 8, 2022

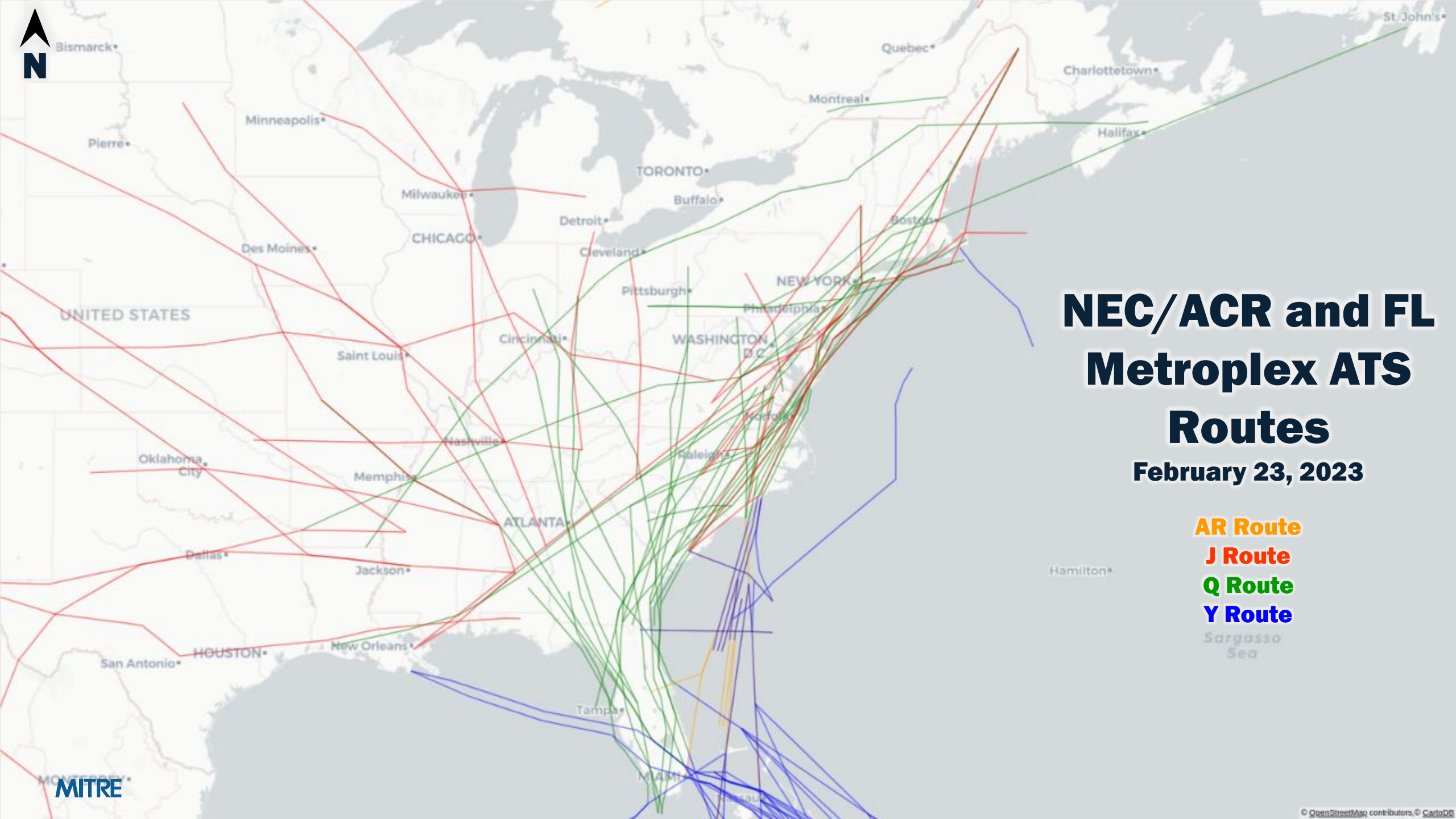
- AR Route
- J Route
- Q Route
- Y Route



NEC/ACR and FL Metroplex ATS Routes

November 3, 2022

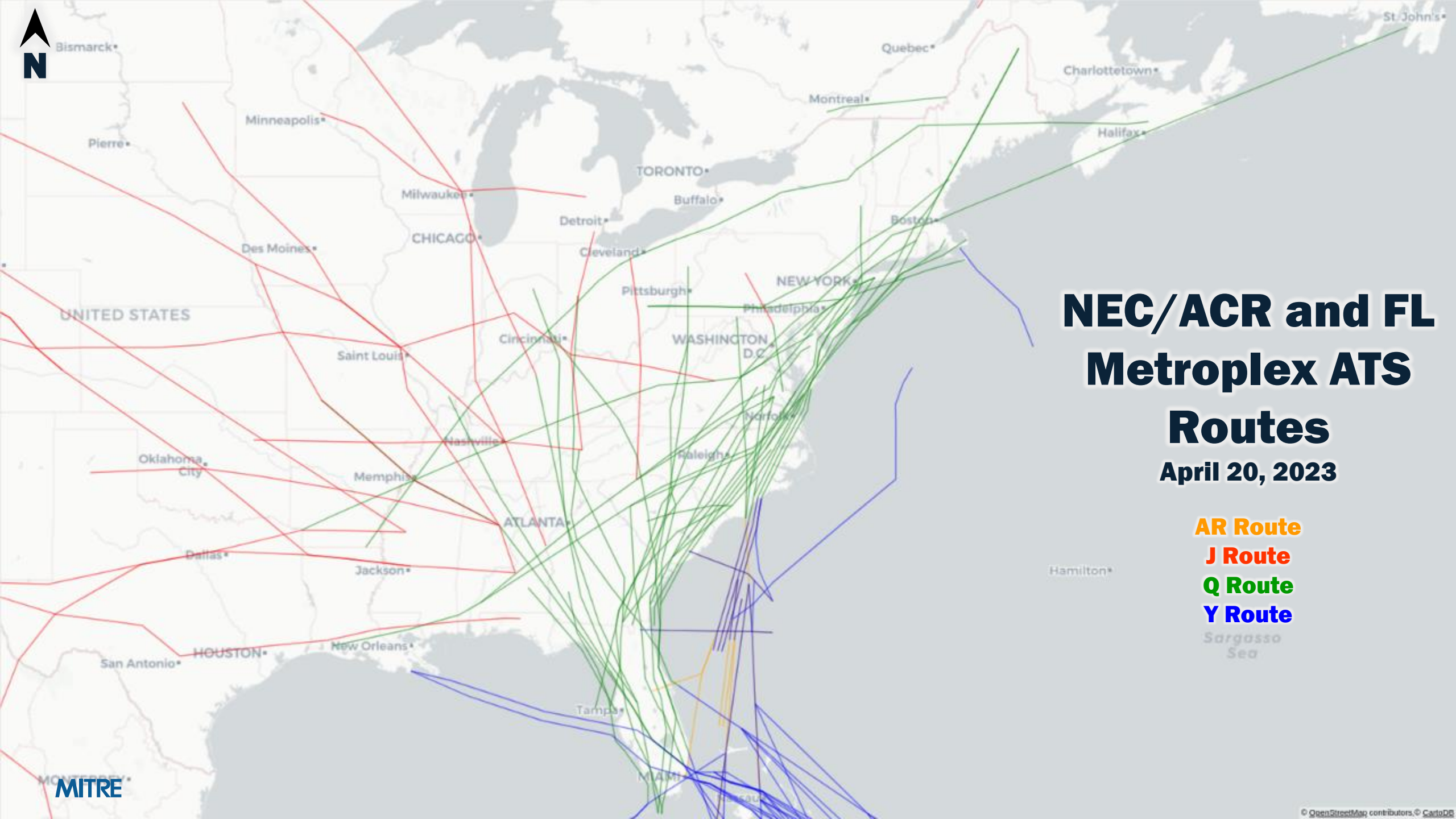
- AR Route
- J Route
- Q Route
- Y Route



NEC/ACR and FL Metroplex ATS Routes

February 23, 2023

- AR Route
- J Route
- Q Route
- Y Route



NEC/ACR and FL Metroplex ATS Routes

April 20, 2023

- AR Route
- J Route
- Q Route
- Y Route

Successful East Coast Transition to a PBN NAS

- East Coast City Pair Route
Use example:

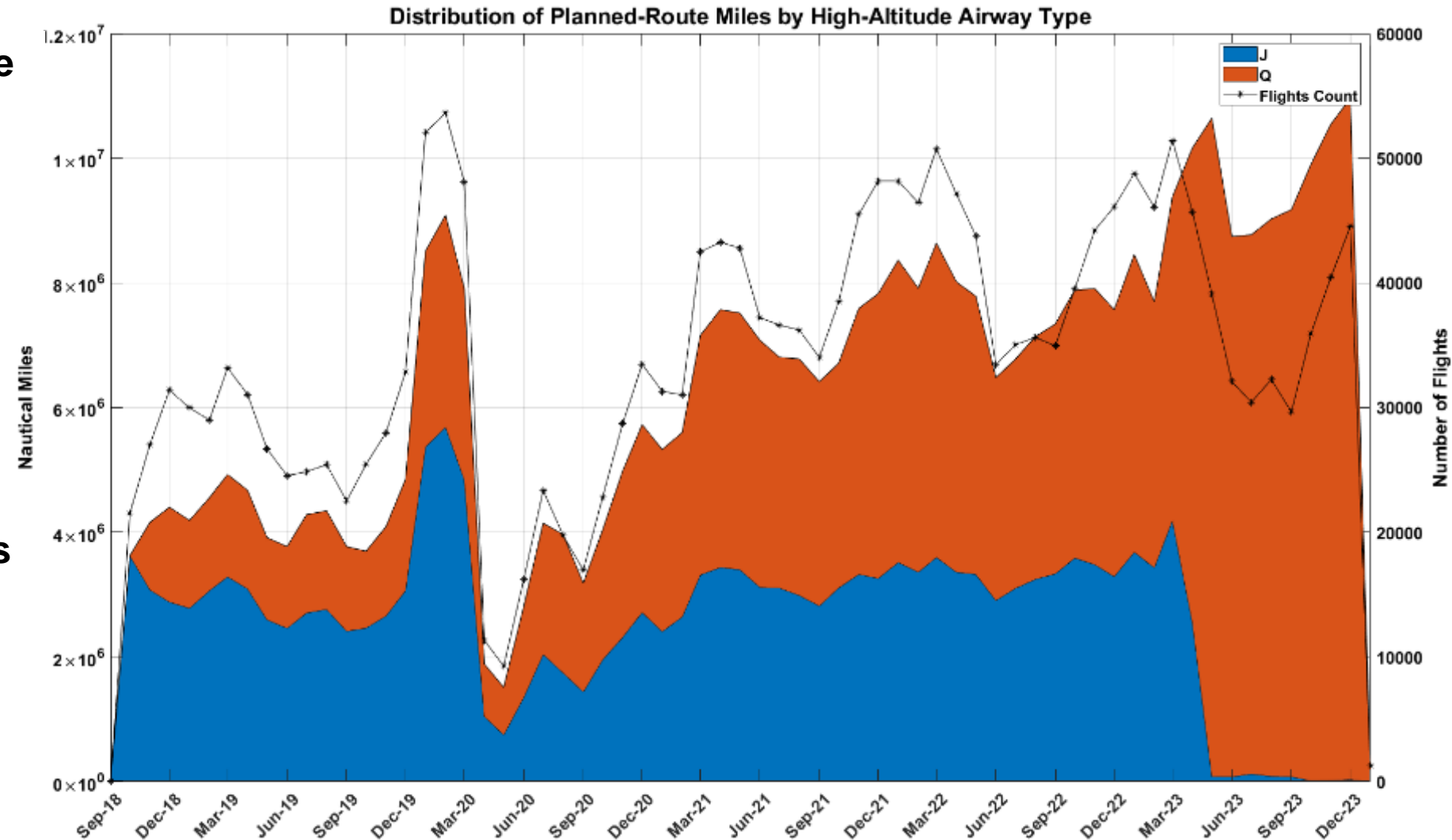
Jan 2019: Q 34% J 66%

Mar 2023: Q 75% J 25%

June 2023: Q 99% J 1%

Dec 2024: Q 100% J 0%

- 436 En Route High- and Low-Altitude PBN Airways
NAS-wide



Challenges

- **Long Implementation Timelines over Multiple Chart Cycles Increased Complexity**
- **Early Florida implementation required ZJX to transition traffic between the Jet Routes and Q-Routes; ‘*Route stitching plan*’**
- **Florida Metroplex implemented Q-Routes in November 2018, but corresponding Jet Routes were not removed until January 2020, causing some confusion and chart clutter**
- **Preferred routings were amended multiple times (multiple FL Metroplex implementations and multiple NEC/ACR implementations)**
- **East Coast demand patterns have shifted substantially since implementation began in 2018, and new challenges are emerging**

Questions?

