Air Traffic Control and Runway Separations

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Discussion of Flight Rules Used in Aviation

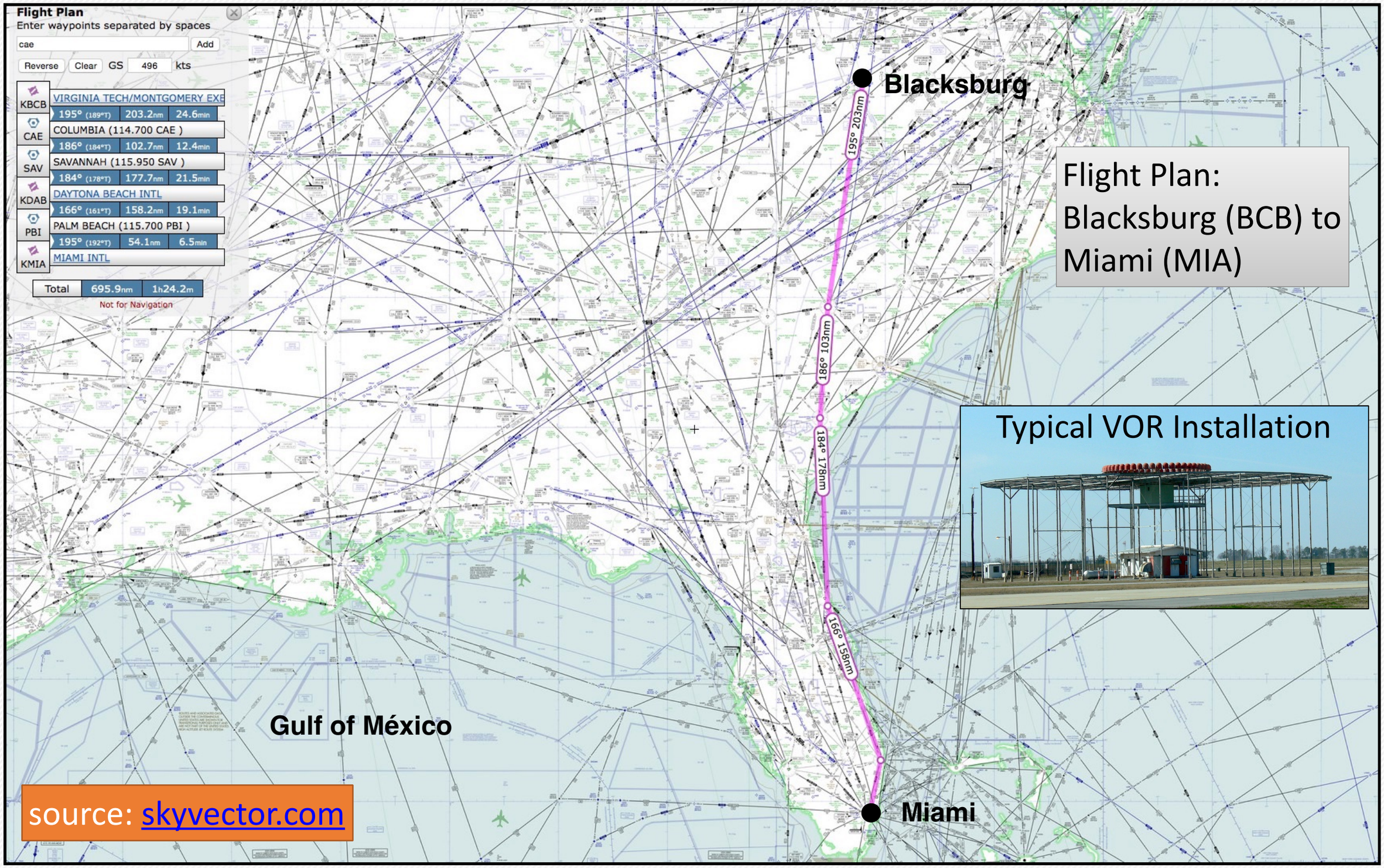
Flight Rules

- IFR - instrument flight rules (ATC controlled flights)
- VFR - visual flight rules (> 3 nm visibility and 1000 ft. from clouds)

Weather conditions

- VMC - visual meteorological conditions
- IMC - instrument meteorological conditions

An airliner could fly in VMC conditions (i.e., good weather) but is always subject to IFR flight rules.


Flight Plan
Enter waypoints separated by spaces
cae
Add
Reverse
Clear
GS 496 kts
KBCB VIRGINIA TECH/MONTGOMERY EXE
195° (189°T) 203.2nm 24.6min
CAE COLUMBIA (114.700 CAE)
186° (184°T) 102.7nm 12.4min
SAV SAVANNAH (115.950 SAV)
184° (178°T) 177.7nm 21.5min
KDAB DAYTONA BEACH INTL
166° (161°T) 158.2nm 19.1min
PBI PALM BEACH (115.700 PBI)
195° (192°T) 54.1nm 6.5min
KMIA MIAMI INTL
Total 695.9nm 1h24.2m
Not for Navigation
Blacksburg
195° 203nm
186° 103nm
184° 178nm
166° 158nm
Miami
Gulf of México
Flight Plan: Blacksburg (BCB) to Miami (MIA)
Typical VOR Installation
source: skyvector.com

The Role of Air Traffic Control

- Air traffic controllers maintain safe aircraft separations
- Use of verbal and datalink communications

Classification of ATC Services

There are three control components of ATC and one support component. These components interact all time among themselves via telephone or microwave data links.

Control Components:

- Air Traffic Control Systems Command Center (ATCSCC)
- Air Route Traffic Control Centers (ARTCC)
- Terminal Approach/Departure Control Facilities (TCA - TRACON)
- Airport Traffic Control Tower (ATCT)

Support Component (Information)

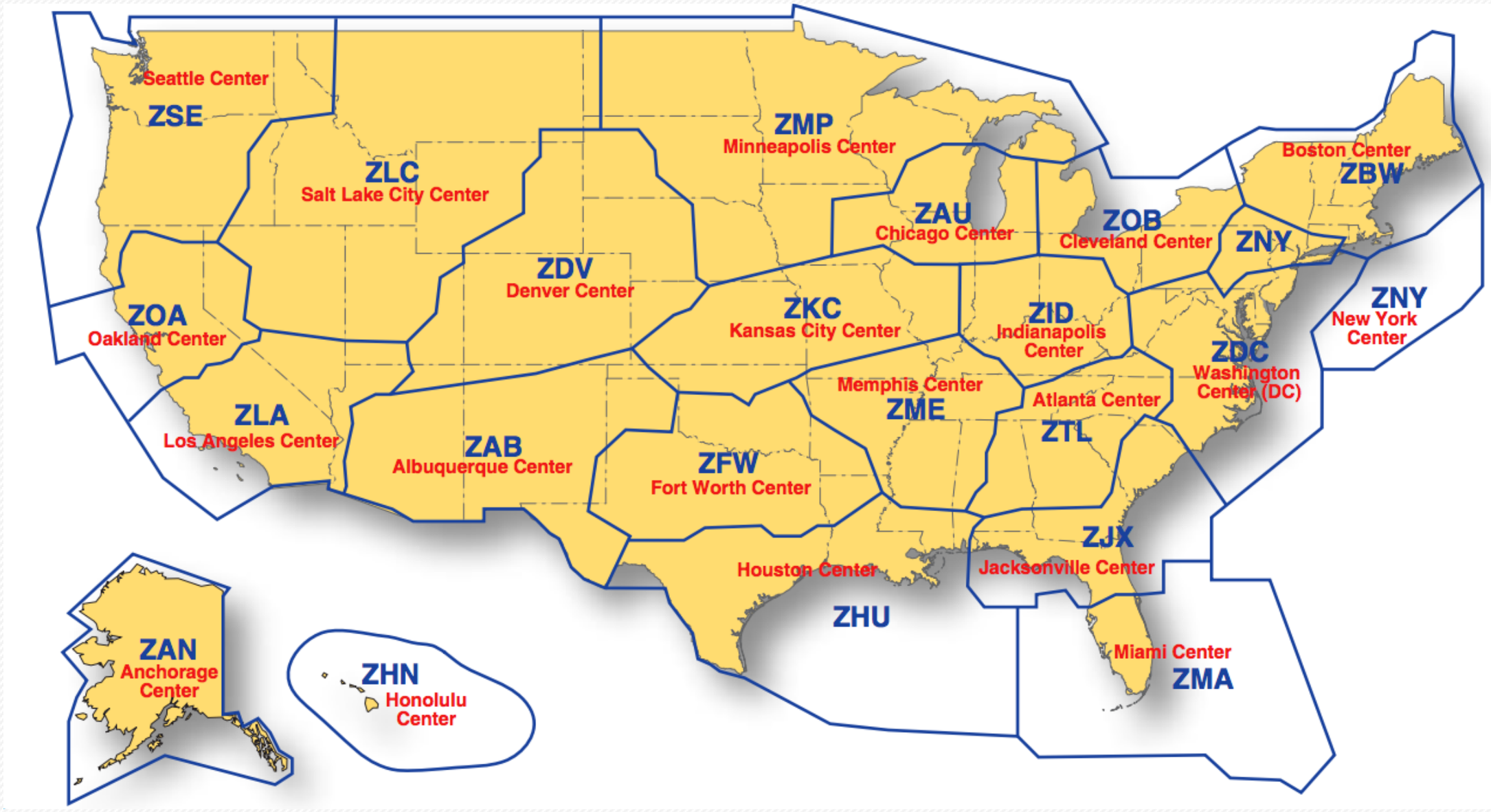
- Flight Service Stations (FSS)

US Air Route Traffic Control Centers (ARTCC)

- Twenty one ARTCC facilities in the U.S.
- 30-50 sectors (horizontal and vertical) in each ARTCC
- Control over 200-300 nm from radar sites (use of multiple radars to track targets at long distances) Today, surveillance is also done using ADS-B systems
- Use of long range radars for surveillance (12 seconds between scans or update rate)
- The size of the ARTCC varies according to traffic density over NAS (see next page)

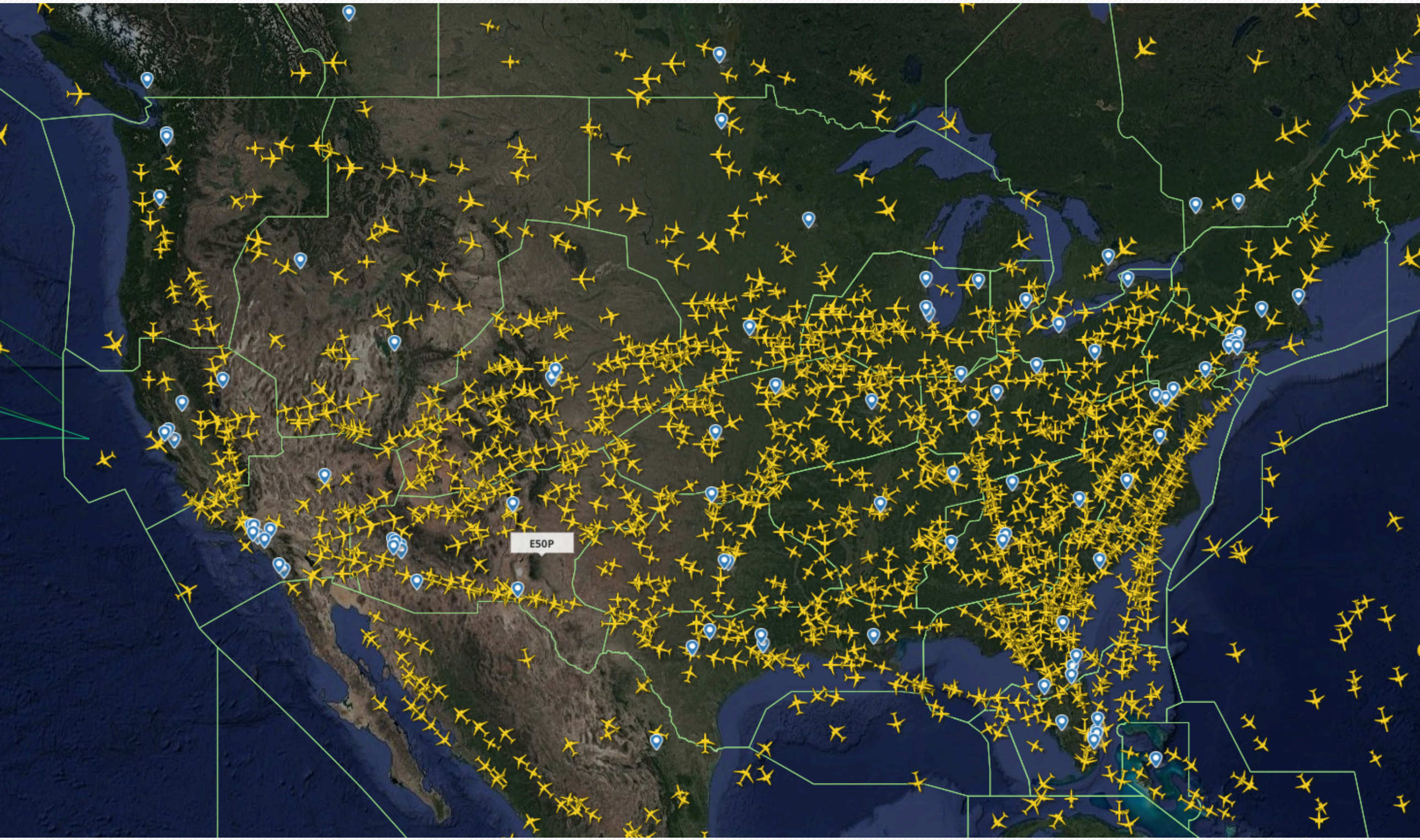
Enroute Control Centers in the US

- A well organized and hierarchical system
- Communications are typically carried via Voice channels (one channel per controller).



Source: FAA Instrument Procedures Handbook

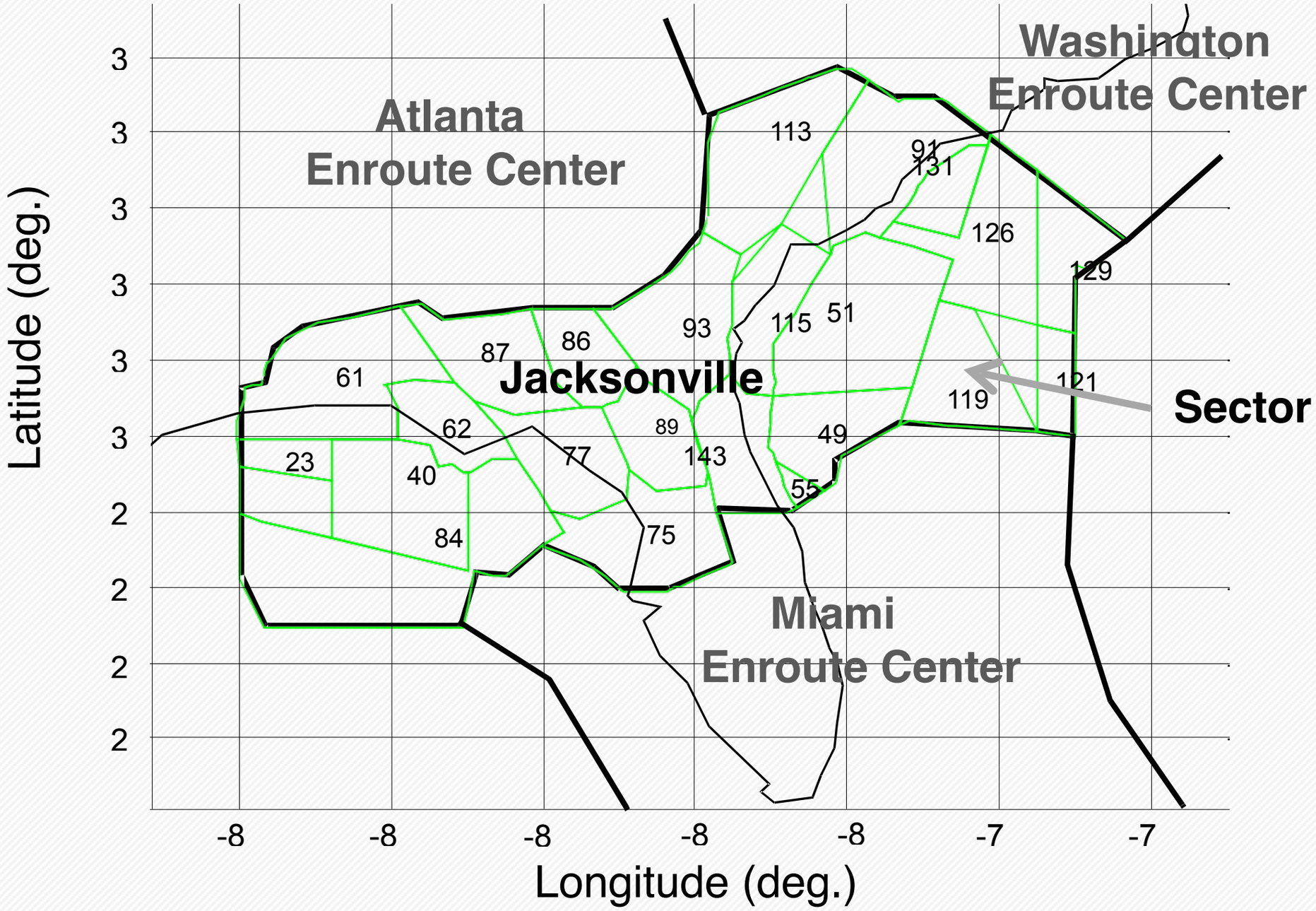
Enroute Control Centers (ARTCC) in the US



Source: Flightradar24

Airspace Sectorization to Control Flights inside ATRCC

- The ARTCC Center airspace is divided into **Sectors** to control flights
- Each sector is manned by 1-3 ATC controllers (depending on workload)



Standard Horizontal Separations (with Radar)

If radar surveillance and aircraft location is less or equal than 40 nm from radar antenna

- 3 nm minimum
- Assumes no wake vortex effect

If radar surveillance and aircraft location is more than 40 nm from radar antenna

- 5 nm minimum
- Assumes no wake vortex effect

Enroute Separations (Vertical)

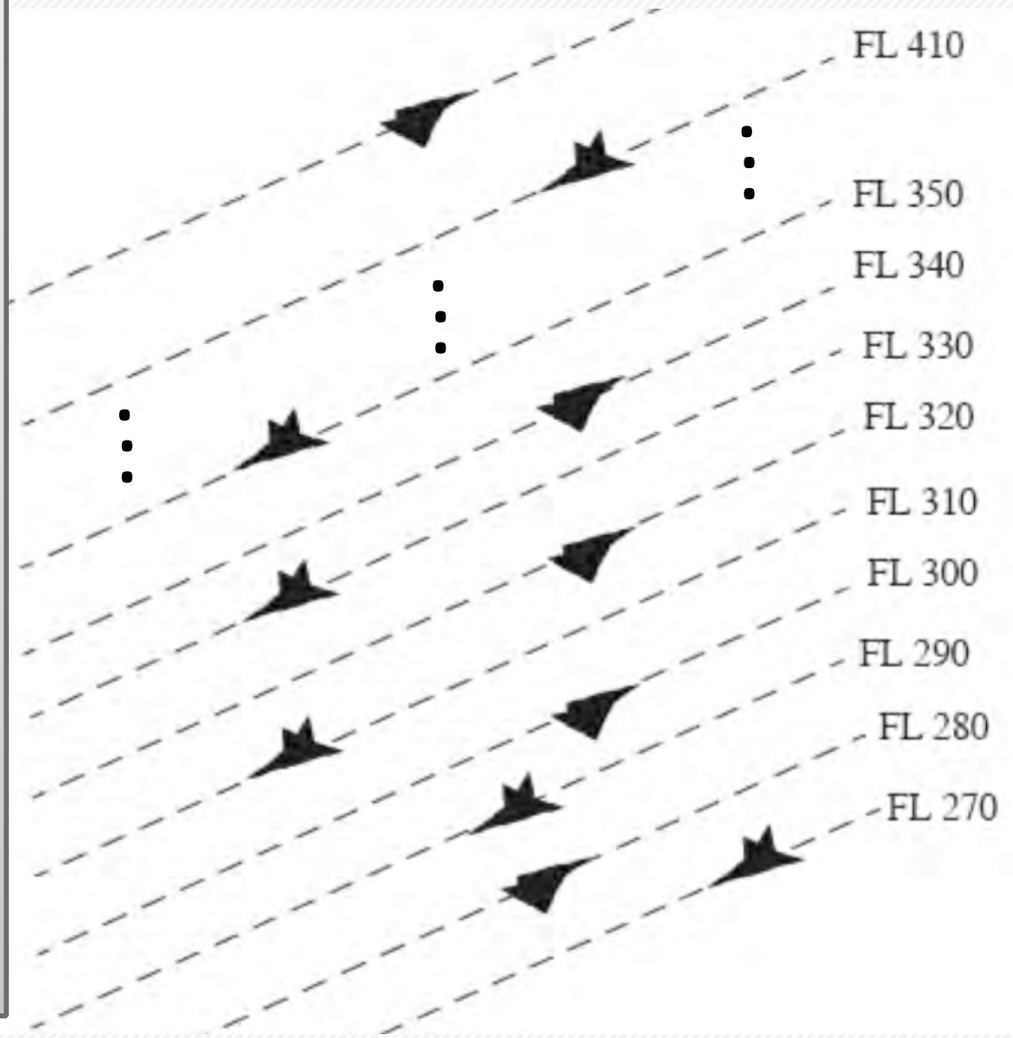
- In January 20, 2005 the FAA instituted Reduced Vertical Separation Minima (RVSM) in the domestic US airspace
- Canada and Mexico (and Gulf of Mexico) also implemented the same RVSM rules on the same day
- The new vertical separations allow six new flight levels to be selected every 1,000 between flight levels 290 and 410
- North Atlantic operations use RVSM since March 1997 and Pacific operations since February 2000
- Europe started RVSM operations in January 2002

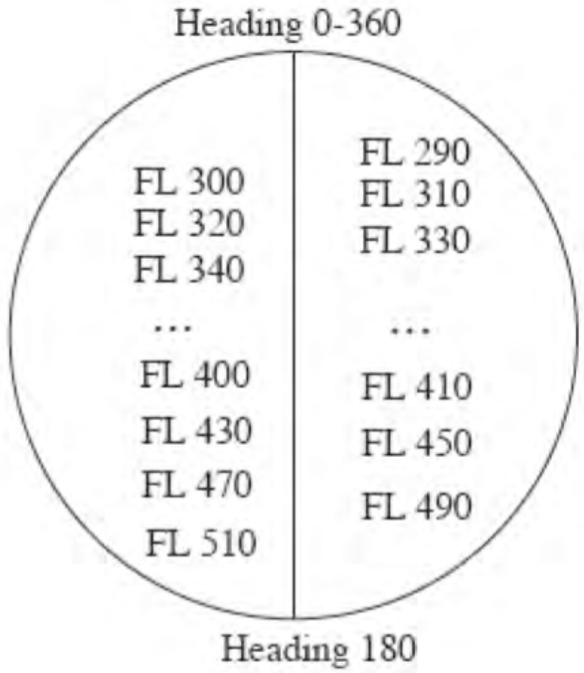
Vertical Separations in the NAS

- Below 41,000 feet (Flight level 410), flights are separated by 1,000 feet (one flight level)
- Above flight level 410, separations are 2,000 feet

Example:
Flight from
JFK (New York) to LAX (Los Angeles) flies generally a West heading (~270 degrees)

Possible flight levels to use are: 340 (34,000 feet), 360 (36,000 feet), 380 (38,000 feet) and 400 (40,000 feet)





Altitude Assignments in the National Airspace

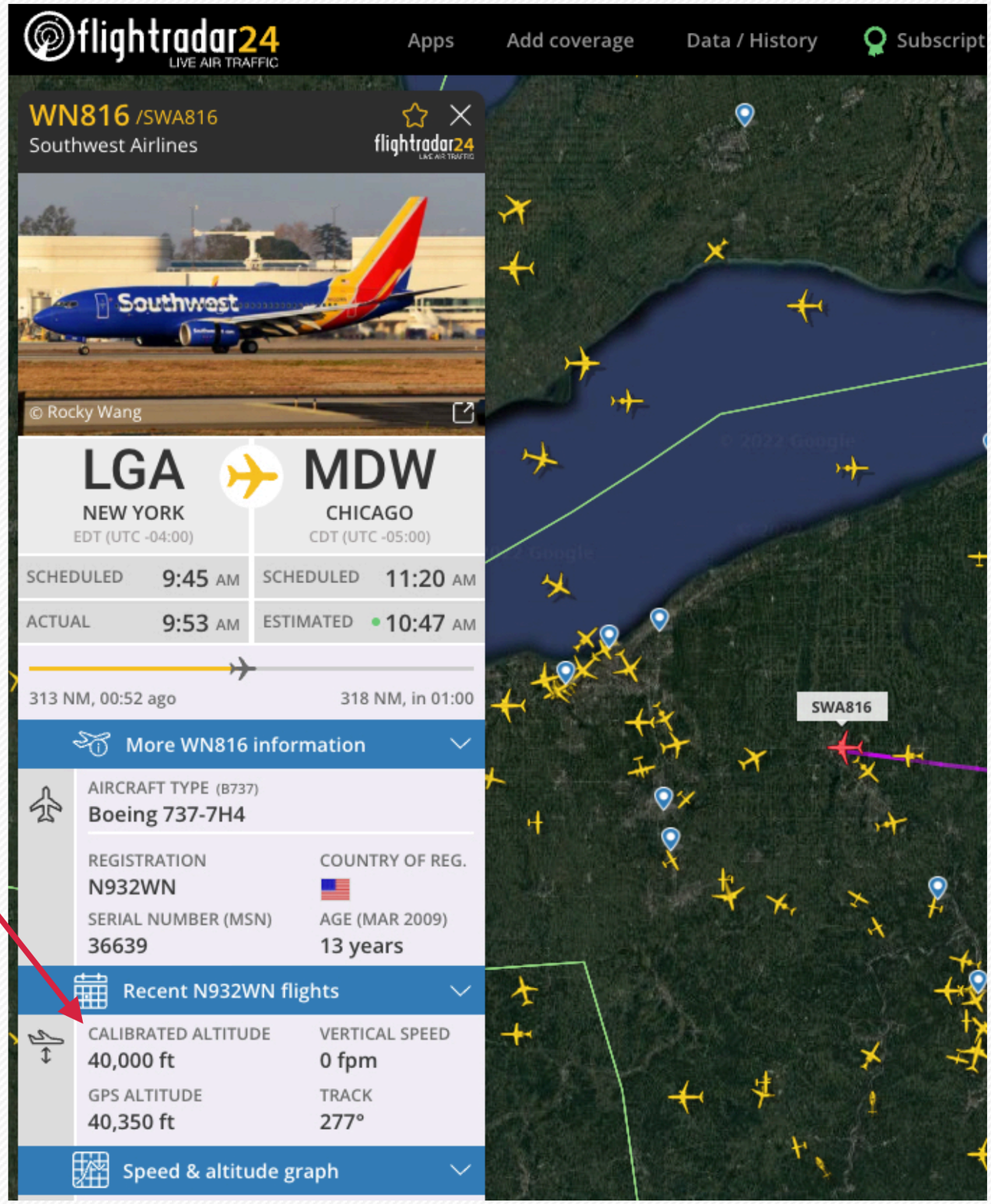
Altitude Assignment

Aircraft Operating	On course degrees magnetic	Assign	Examples
Below 3,000 feet above surface	Any course	Any altitude	
At and below FL 410	0 through 179	Odd cardinal altitude or flight levels at intervals of 2,000 feet	3,000, 5,000, FL 310, FL 330
	180 through 359	Even cardinal altitude or flight levels at intervals of 2,000 feet	4,000, 6,000, FL 320, FL 340
Above FL 410	0 through 179	Odd cardinal flight levels at intervals of 4,000 feet beginning with FL 450	FL 450, FL 490, FL 530
	180 through 359	Odd cardinal flight levels at intervals of 4,000 feet beginning with FL 430	FL 430, FL 470, FL 510
One way routes (except in composite systems)	Any course	Any cardinal altitude or flight level below FL 410 or any odd cardinal flight level above FL 410	FL 270, FL 280, FL 290, FL 300, FL 310, FL 410, FL 430, FL 450
Within an ALTRV	Any course	Any altitude or flight level	
In aerial refueling tracks and anchors	Any course	Altitude blocks as requested. Any altitude or flight level	050B080, FL 180B220, FL 280B310

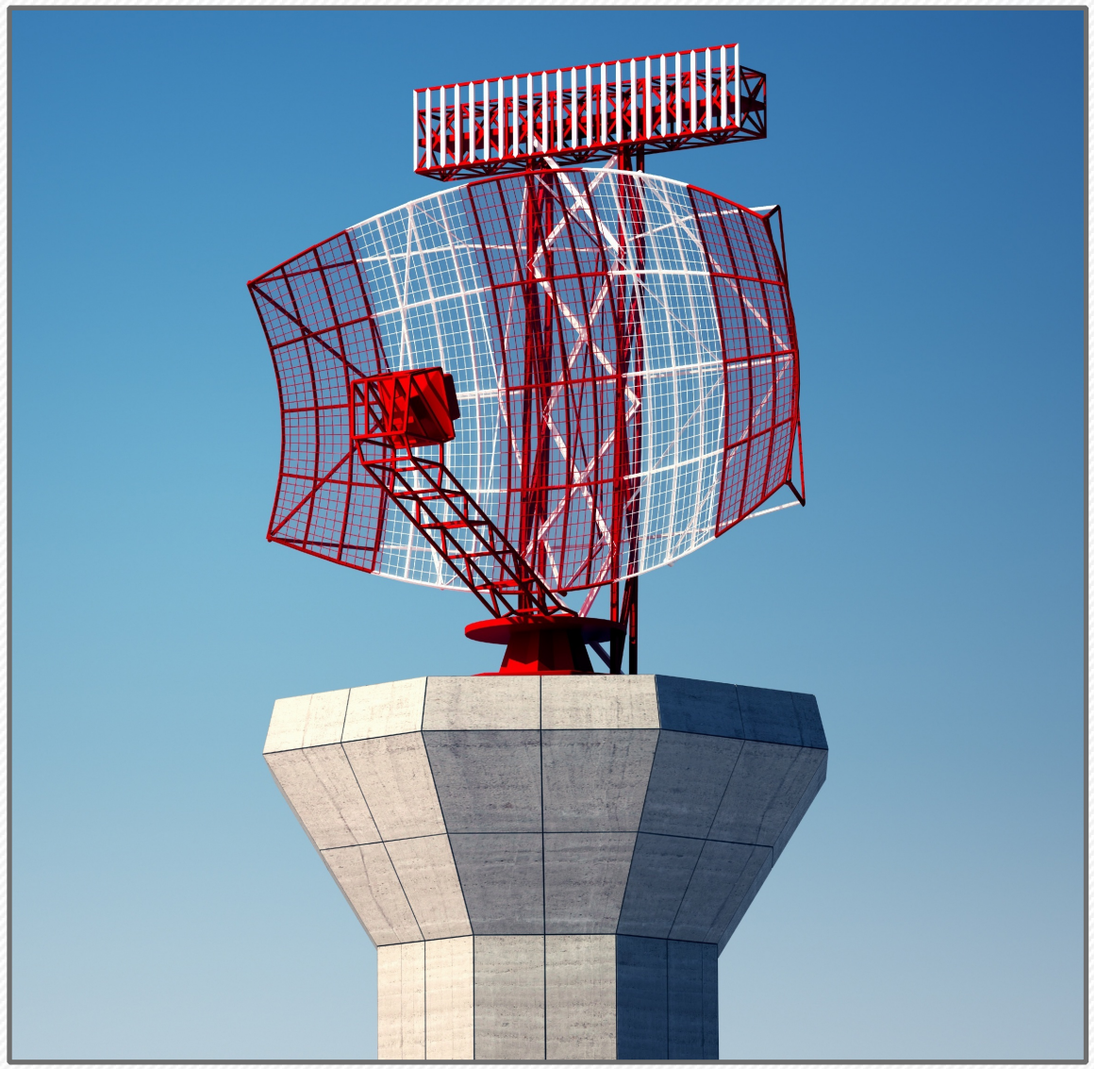
Source: Air Traffic Control Handbook (https://www.faa.gov/air_traffic/publications/atpubs/atc_html/chap4_section_5.html

Vertical Separations in the NAS

- Southwest Airlines Boeing 737-700 flying from New York LGA to Chicago Midway airport (MDW)
- Flying at FL400
- Mach 0.78



ATC Surveillance Technology



Radar (Still available)

ADS-B (mandatory since 2020)

ADS = Automatic Dependent Surveillance
GPS = Global Positioning System

Automatic Dependent Surveillance – Broadcast (ADS–B)

- Surveillance technology
- Aircraft determines its position via satellite navigation
- Ground stations improve the satellite position
- Started in January 2020, all aircraft operated in the National Airspace System are required to have ADS-B out capability
- Benefits:
  - Efficiency
  - Safety
  - Cockpit traffic information

Terminal Approach and Departure Control Facilities (TRACON)

- Control terminal traffic (both arrivals and departures)
- Typically 50-80 nm from the airport
- Some TRACON control more than one airport (SW California)
- TRACONs are divided into sectors to ease workload for controllers
- TRACONs meter traffic approaching an airport facility
- Heavy use of verbal advisories (vectors)

  AA52 turn right heading 120

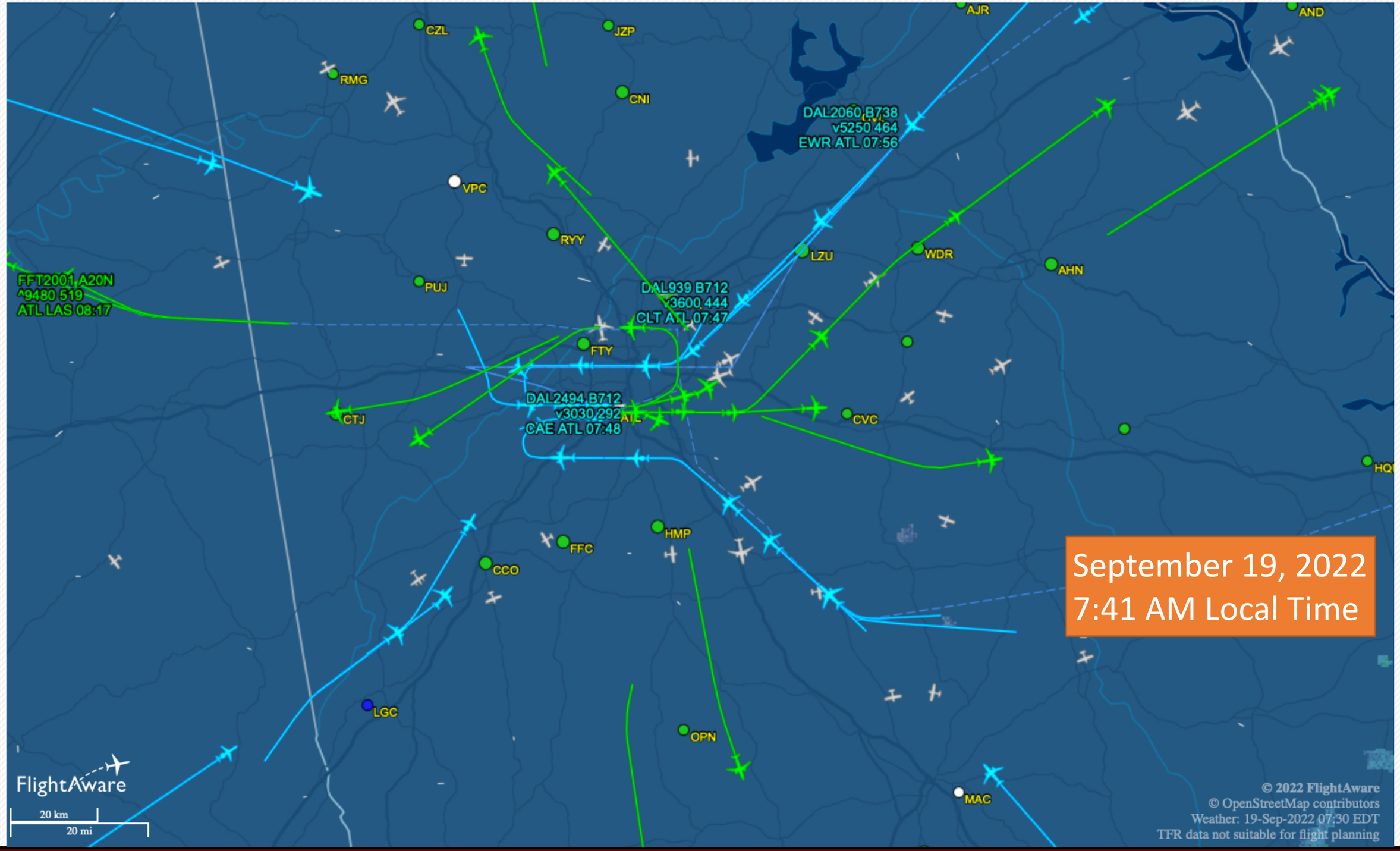
  UA53 descent and maintain 170 (17,000 ft.)

  Aeromexico reduce to 230 (IAS airspeed)

- Minimum separation inside TRACON is either 5 nm (>40 nm from radar antenna) or 3 nm (if < 40 nm from radar antenna) assuming no wake vortex effect is present

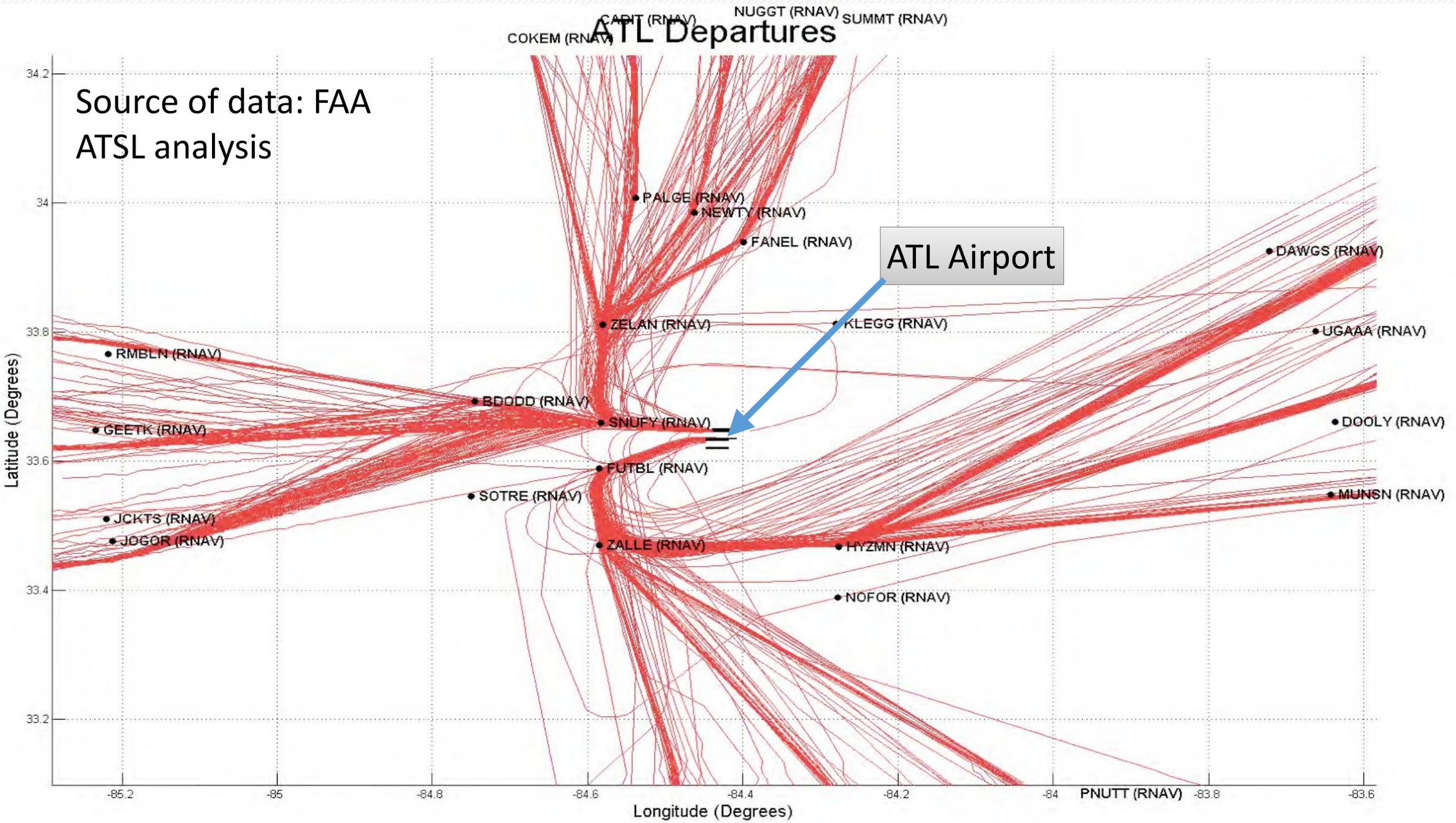
Example of TRACON Organization (Atlanta)

Terminal Approach and Departure Control Facility (Traffic inside Atlanta TRACON)

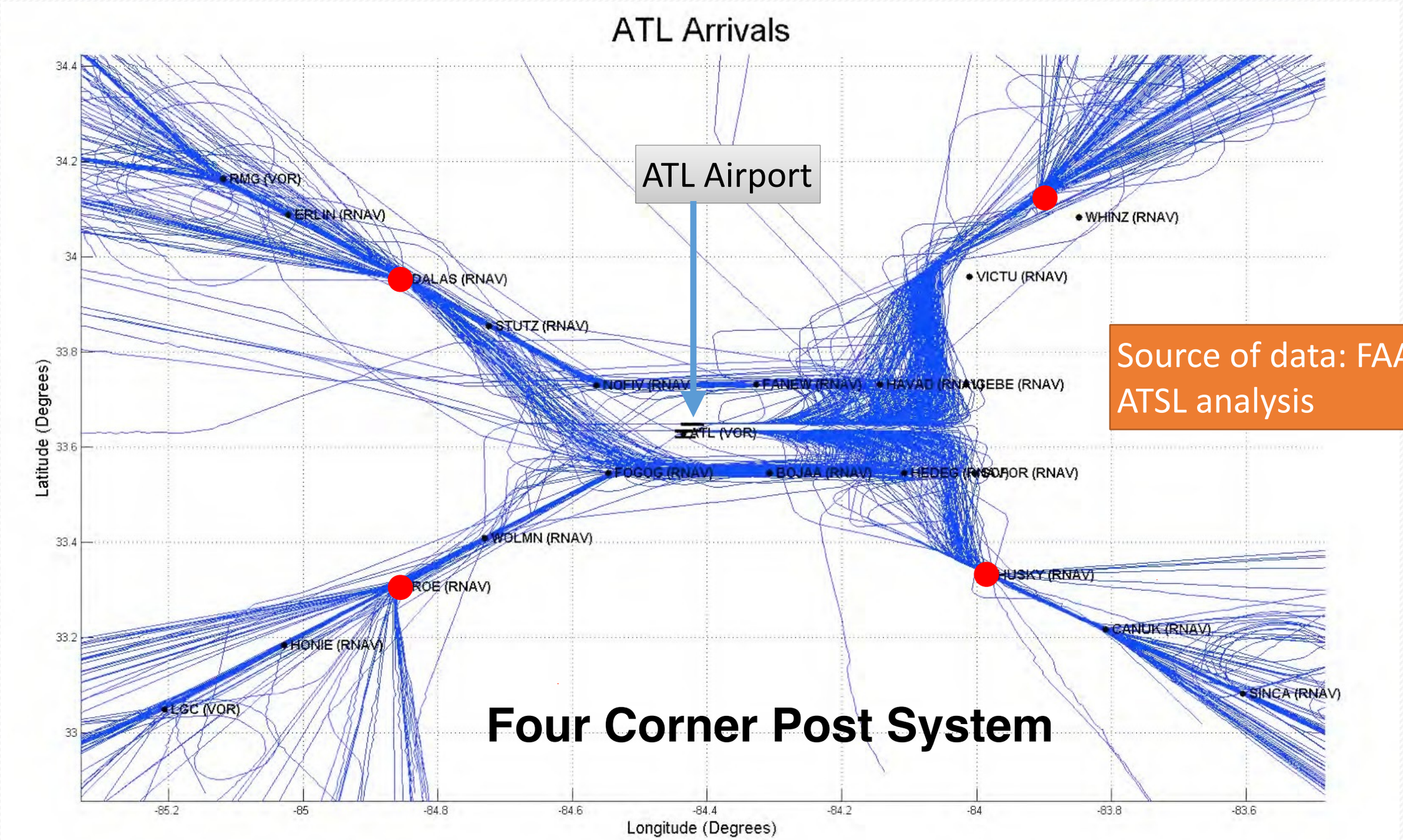


Terminal Area Operations in Atlanta (Departures)

Source of data: FAA
ATSL analysis



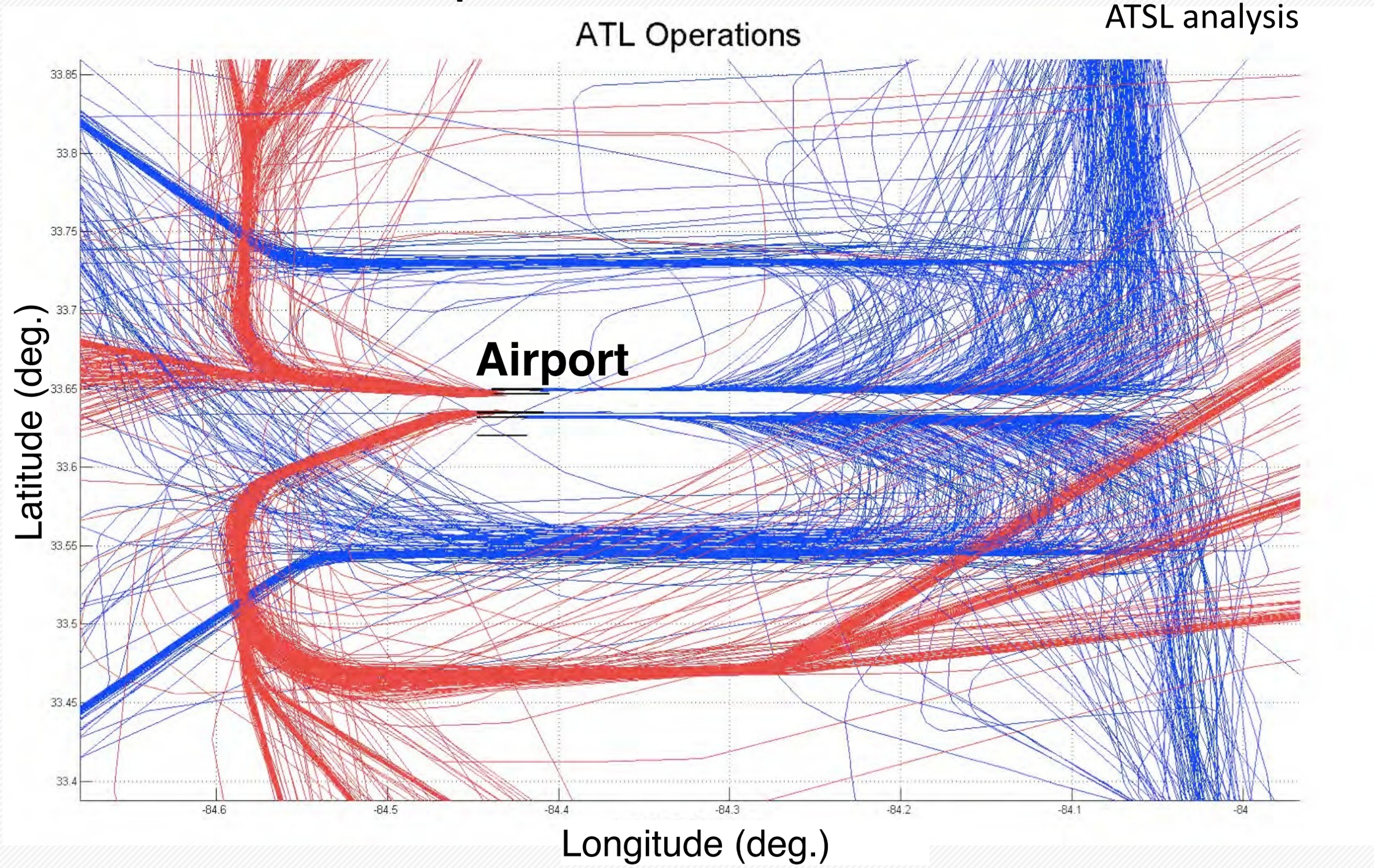
Terminal Area Operations in Atlanta (Arrivals)



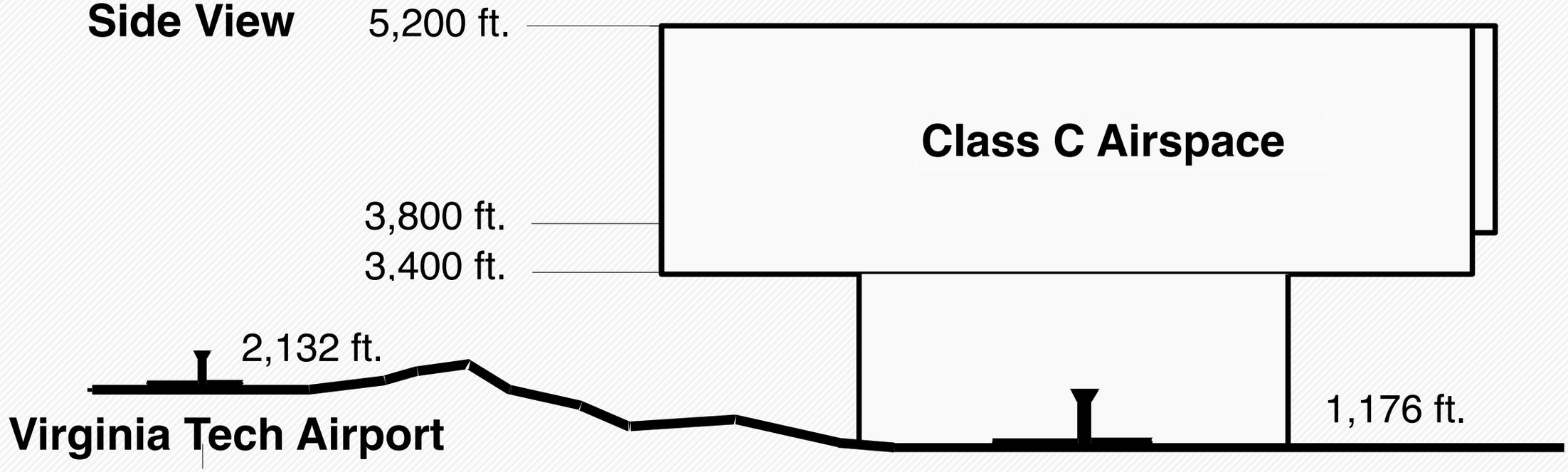
Atlanta Arrival and Departure Patterns

Departures **Arrivals**

Source of data: FAA ATSL analysis



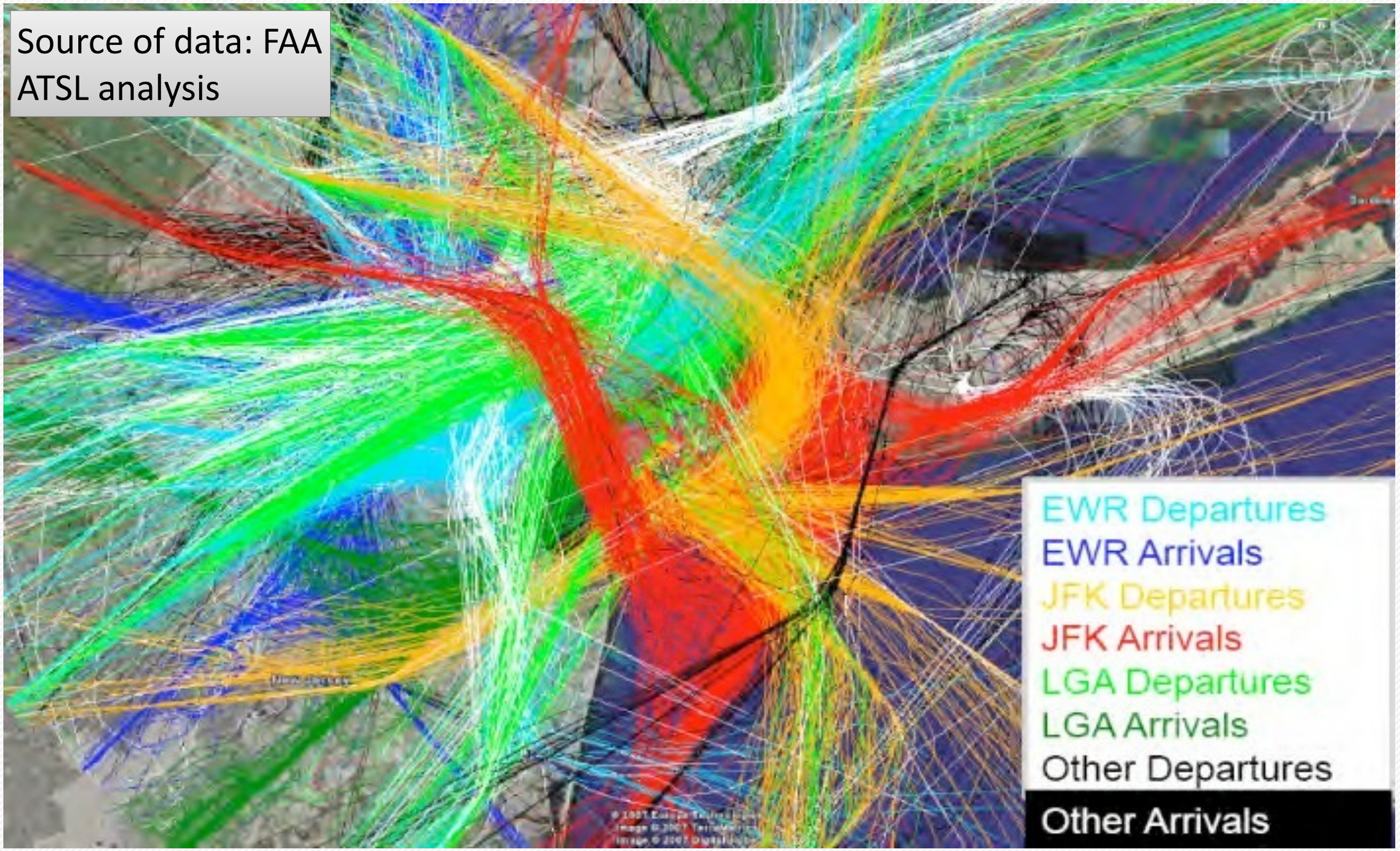
A Small TRACON - Roanoke, Virginia



Notes:

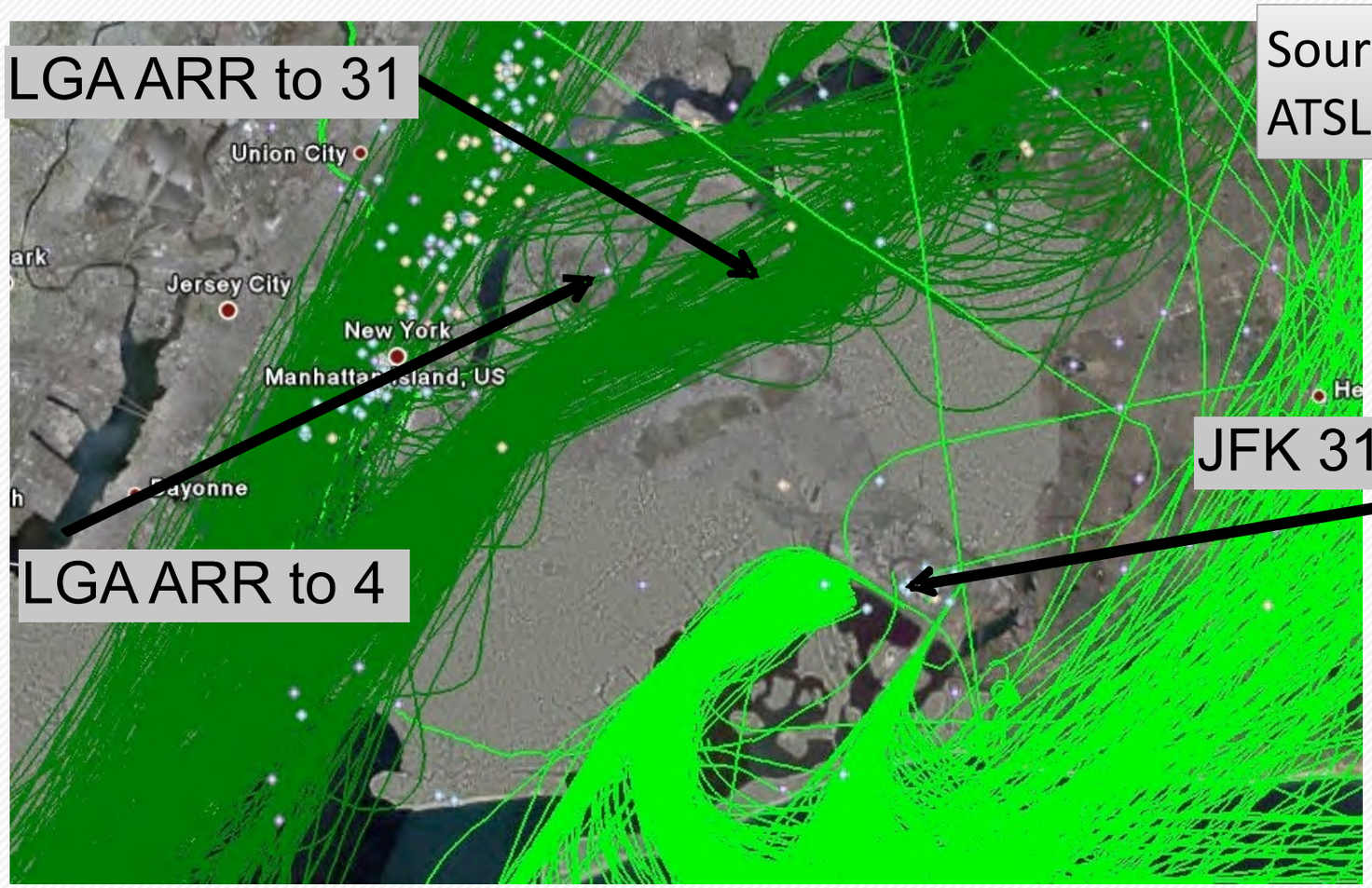
- The volume of airspace controlled by ROA Approach Control looks like an inverted wedding cake
- Typical of many TRACONs in the U.S.
- The complexity of the TRACON increases as traffic increases

Terminal Area Operations in New York City



One Day of Traffic into five New York Area Airports

Terminal Operations in New York



- Approaches to La Guardia Airport (LGA) (dark green color lines) are executed in close proximity with departures from JFK Airport (light green color lines)

- Operations at LGA, JFK and EWR require substantial coordination

Air Traffic Control Tower

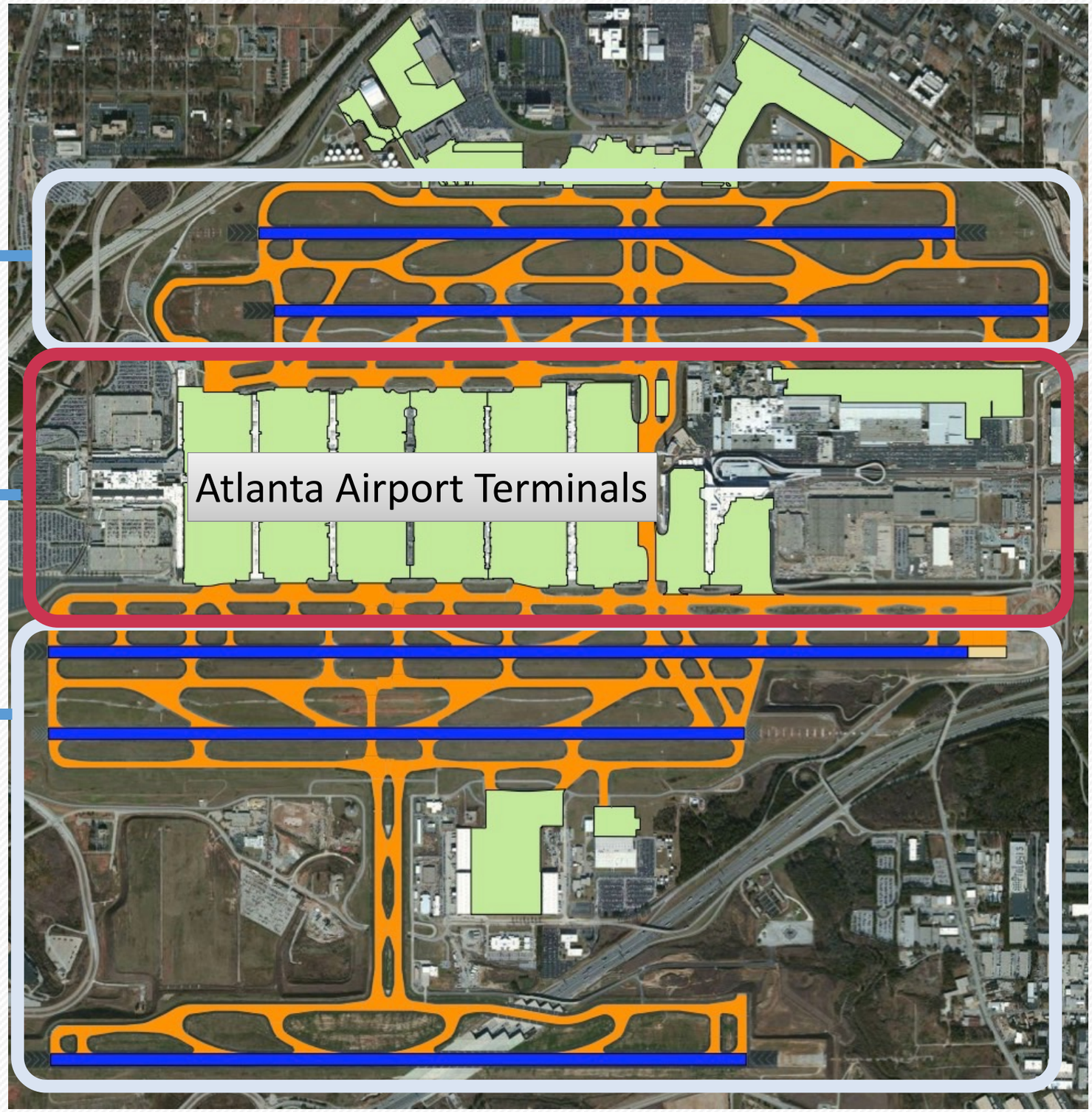
- Controls aircraft traffic (both arrivals and departures) at the airport (includes ramps near gates, taxiways, runways, and airspace up to 5 nm from airport)
- Three ATC controller posts
  - Local controller (runways and landing areas)
  - Ground control (taxiways and aprons)
  - Clearance delivery (provides information on flight plans)
- Some ATCT divide workload into East-West operations
- Use of short and precise language
  - AA52 taxi to RWY 36 via alpha-3
  - UA53 clear for takeoff, wind 040 at 12
  - Aeromexico clear to land RWY 36

Atlanta International Airport (ATC Tower Responsibilities)

Area under control of
Local Controller

Area under control of
Ground Controller

Area under control of
Local Controller



Issues in Separating Aircraft Near Runways

Airspace criteria are intrinsically used for runway separations:

- Minimum radar separations (driven by the ability to differentiate targets in a radar display)
- Wake vortex separations - driven by the hazard created by flying behind the wake of a lead aircraft

Runway occupancy time (ROT)

- Can also be an important factor in separations on final approach
- If ROT is small (i.e., due to high speed runway exits), the airspace separations may need to be increased to avoid simultaneous occupancy of the runway

Typical Minimum Values of Aircraft Separations in the United States under IMC Conditions (with Radar)

Minimum Separation Matrix (mn)	Arrivals - Arrivals				
Trailing Aircraft (Header Columns - in Orange)					
Lead (Column 1)	Small	Large	B757	Heavy	Superheavy
Small	3	3	3	3	3
Large	4	3	3	3	3
B757	5	4	3	3	3
Heavy	6	5	4	4	4
Superheavy	8	8	8	8	8

Highlighted values are minimum radar separations

Minimum radar separations are 2.5 nm if ROT <= 50 seconds

Consolidated Wake Turbulence Recategorization Classification (CWT)

- FAA Introduced a **consolidated wake re-categorization in 2019**
- Consult FAA Order JO 7110.126A

U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION
Air Traffic Organization Policy

ORDER JO 7110.126A

Effective Date:
September 28, 2019

SUBJ: Consolidated Wake Turbulence (CWT) Separation Standards

1. Purpose of This Order. This order provides procedural guidance to FAA Order JO 7110.65, Air Traffic Control, related to the use of Consolidated Wake Turbulence procedures and separation minima.

2. Audience. This order applies to all Air Traffic Organization (ATO) personnel authorized to use this order and anyone involved in the implementation and monitoring of Consolidated Wake Turbulence separation standards.

3. Where Can I Find This Order? This change is available on the FAA Website at http://faa.gov/air_traffic/publications and https://employees.faa.gov/tools_resources/orders_notices/.

4. What This Order Cancels. FAA Order JO 7110.126, Consolidated Wake Turbulence Radar

Consolidated Wake Turbulence (CWT) Re-categorization Classification

Category	Description
A	A388
B	Pairwise Upper Heavy aircraft
C	Pairwise Lower Heavy aircraft
D	Non-Pairwise Heavy aircraft
E	B757 aircraft
F	Upper Large aircraft excluding B757 aircraft
G	Lower Large aircraft
H	Upper Small aircraft with a maximum takeoff weight of more than 15,400 pounds up to 41,000 pounds
I	Lower Small aircraft with a maximum takeoff weight of 15,400 pounds or less

Source: FAA Order JO 7110.126A

Consolidated Wake Vortex Recategorization Classification

Aircraft Types Categorized

A Super	B Upper Heavy	C Lower Heavy	D Non-Pairwise Heavy		E B757	F Upper Large		G Lower Large		H Upper Small	I Lower Small
A388	A332	A306	A124	DC85	B752	A318	C130	AT43	E170	ASTR	BE10
	A333	A30B	A339	DC86	B753	A319	C30J	AT72	E45X	B190	BE20
	A343	A310	A342	DC87		A320	CVLT	CL60	E75L	BE40	BE58
	A345	B762	A3ST	E3CF		A321	DC93	CRJ1	E75S	B350	BE99
	A346	B763	A400	E3TF		B712	DC95	CRJ2	F16	C560	C208
	A359	B764	A50	E6		B721	DH8D	CRJ7	F18H	C56X	C210
	B742	C17	AN22	E767		B722	E190	CRJ9	F18S	C680	C25A
	B744	DC10	B1	IL62		B732	GL5T	CRJX	F900	C750	C25B
	B748	K35R	B2	IL76		B733	GLEX	DC91	FA7X	CL30	C402
	B772	MD11	B52	IL86		B734	GLF5	DH8A	GLF2	E120	C441
	B773		B703	IL96		B735	GLF6	DH8B	GLF3	F2TH	C525
	B77L		B741	K35E		B736	MD82	DH8C	GLF4	FA50	C550
	B77W		B743	KE3		B737	MD83	E135	SB20	GALX	P180
	B788		B74D	L101		B738	MD87	E145	SF34	H25B	PAY2
	B789		B74R	MYA4		B739	MD88			LJ31	PA31
	C5		B74S	R135			MD90			LJ35	PC12
	C5M		B78X	T144						LJ45	SR22
			BLCF	T160						LJ55	SW3
			BSCA	TU95						LJ60	
			C135	VMT						SH36	
			C141							SW4	

Source: FAA Order JO 7110.126A

Consolidated Wake Vortex Separations - **Directly Behind**

WAKE TURBULENCE APPLICATION

Source: FAA Order JO 7110.126A

g. Separate aircraft by the minima specified in TBL 5–5–1 in accordance with the following:

1. When operating within 2,500 feet and less than 1,000 feet below the flight path of the leading aircraft over the surface of the earth of a Category A, B, C, or D aircraft.

2. When operating within 2,500 feet and less than 500 feet below the flight path of the leading aircraft over the surface of the earth of a Category E aircraft.

3. When departing parallel runways separated by less than 2,500 feet, the 2,500 feet requirement in subparagraph 2 is not required when a Category I aircraft departs the parallel runway behind a Category E aircraft. Issue a wake turbulence cautionary advisory and instructions that will establish lateral separation in accordance with subparagraph 2. Do not issue instructions that will allow the Category I aircraft to pass behind the Category E aircraft.

Wake Turbulence Separation for Directly Behind

		Follower								
		A	B	C	D	E	F	G	H	I
Leader	A		4.5 NM	6 NM	6 NM	7 NM	7 NM	7 NM	7 NM	8 NM
	B		3 NM	4 NM	4 NM	5 NM	5 NM	5 NM	5 NM	5 NM
	C					3.5 NM	3.5 NM	3.5 NM	5 NM	5 NM
	D		3 NM	4 NM	4 NM	5 NM	5 NM	5 NM	5 NM	5 NM
	E									4 NM
	F									
	G									
	H									
	I									

Empty Cells: Apply Minimum Radar Separation
3 nm default
2.5 nm for runways that meet a 50 second Runway Occupancy Time criteria

Visual Meteorological Conditions (VMC) Separations

- Under visual meteorological conditions, pilots are expected to be responsible for separations
- Data collected at airfields in the United States indicates that VMC separations are 10% below those observed under IMC conditions
- Therefore:
  - Runways have more capacity under VMC conditions for the same fleet mix
  - Higher runway utilization is possible under VMC conditions
  - Runway occupancy times and VMC airspace separations are closer in magnitude

Air Traffic Control (ATC) Departure-Departure In-Trail Separations

Typical In-trail Separations (**in seconds**) for Departing Aircraft on the same Runway

Lead Aircraft	Trailing Aircraft				
	Superheavy	Heavy	B757	Large	Small
Superheavy	120	180	180	180	180
Heavy	120	120	120	120	120
B757	60	60	60	120	120
Large	60	60	60	60	60
Small	60	60	60	60	60

Source: FAA JO 7110.65Z

Runway Separations

Runway Separation Guidance

- Runway separations are established based on safety principles
- Runway separations affect airport capacity
  - Example: parallel runways separated by large distances can allow simultaneous operations
- FAA AC 150/5300-13B has discussion on runway separations in Section 3.9

3.9 **Parallel Runway Separation.**

This section provides an overview of the basic separation criteria between parallel runways. The FAA continues to refine parallel runway separation standards for various operational scenarios as part of modernization efforts for the NAS, including the Next Generation Air Transportation System (NextGen). FAA Order 7110.65, *Air Traffic Control*, establishes FAA policy addressing operational procedures for parallel runways, including information on relevant dependencies with aircraft avionics and NAS automation equipment. While referencing FAA Order 7110.65 is normally

Runway Separations at Airports Depend on Airport Surveillance Technology

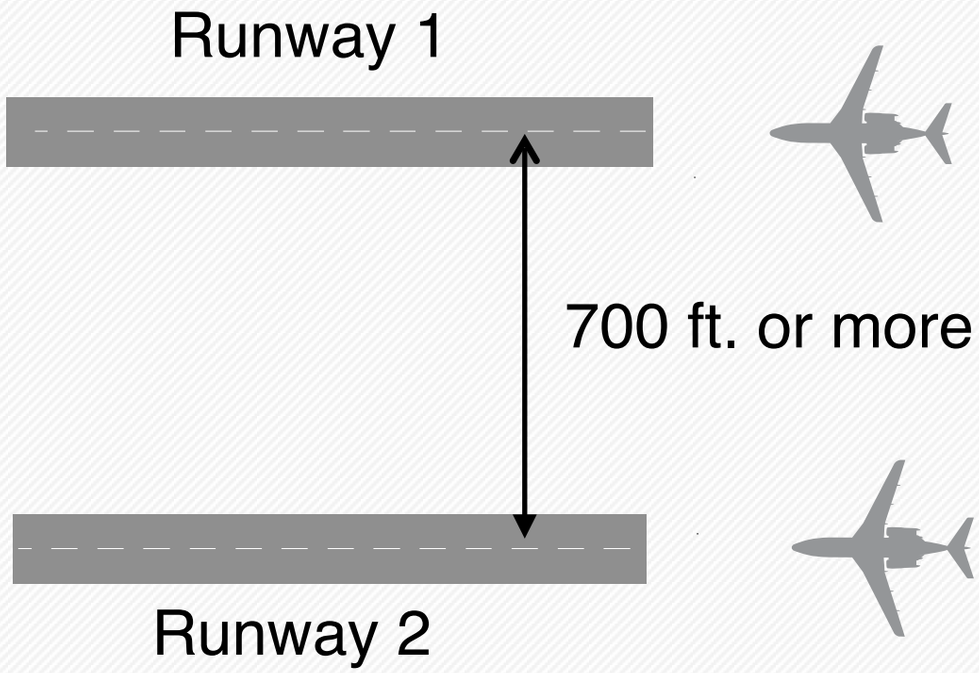
The same technology used to establish the position of aircraft in the airspace is used to perform surveillance activities near airports

- Radar technology has weaknesses to determine aircraft position
- The farthest from the antenna, the larger the uncertainty to determine accurate positions
- ADS-B provides faster updates on aircraft position
  - Improves accuracy to determine the real aircraft position
  - ADS-B position updates are 0.5 to 1 second

Independent Operations under VFR Conditions

- Independent simultaneous arrivals can be conducted with at least 700ft between runway centerlines if:
- VFR conditions (visibility > 3 nm)

- No wake vortex effect is present



Independent arrival streams

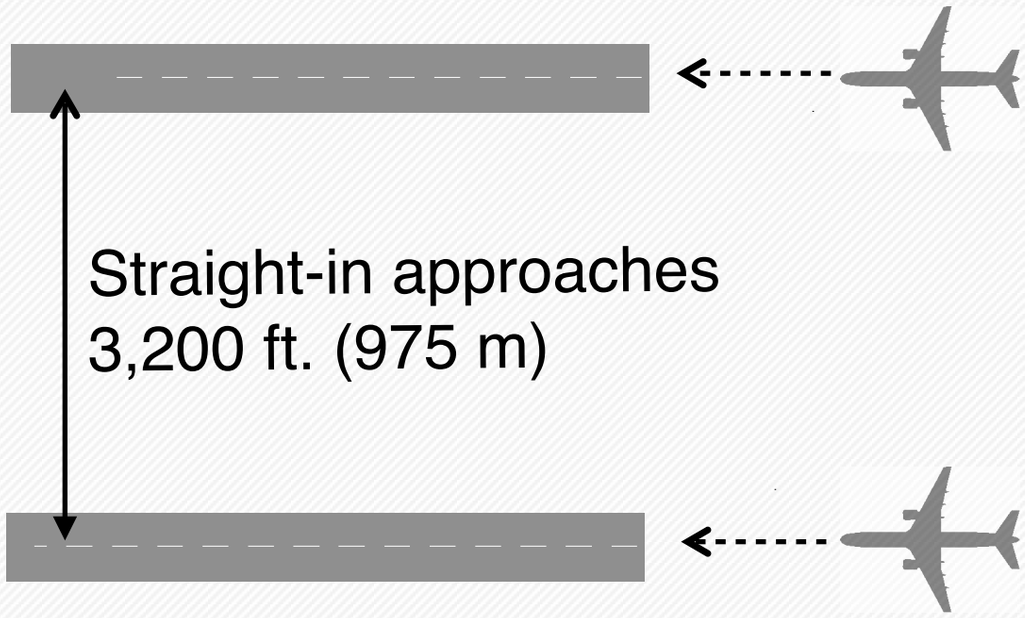
No wake vortex effect

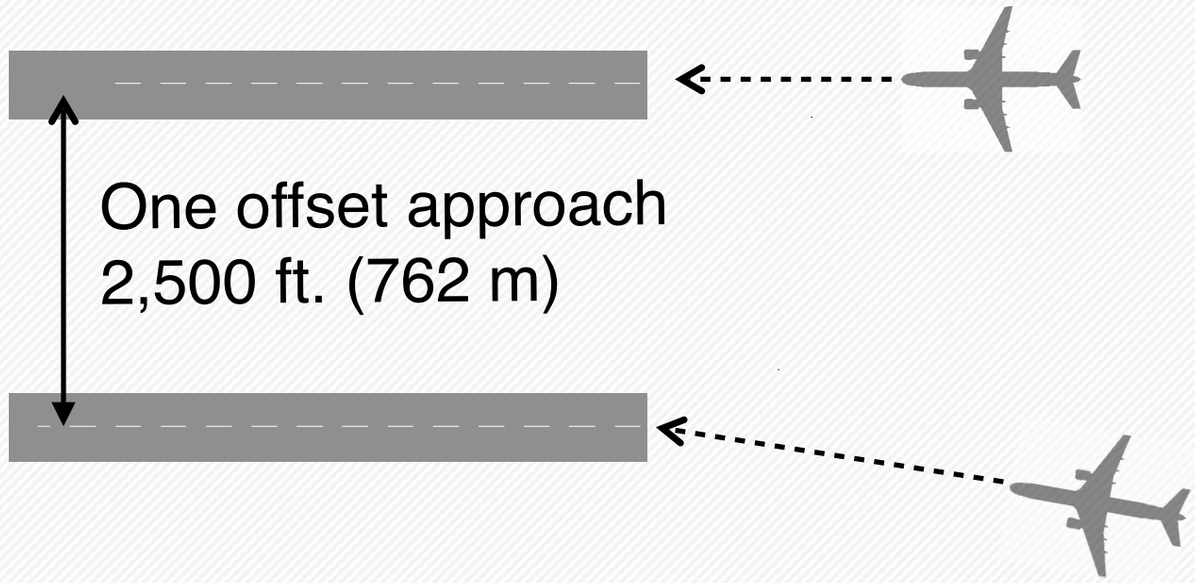
(seldom the case)

Increase to 1,200 ft. if aircraft belongs to Design Groups (ADG) V and VI

Simultaneous Instrument Approaches to Parallel Runways

- **Airports below 2,000 feet**
- Straight-in approaches with 3,200 feet (975 meters) parallel separation between runways
- Offset approach to one runway with parallel runways 2,500 feet (762 meters)
- Radar or ADS-B surveillance is available





Source: FAA AC 150/5300-13B 3.9.3.1

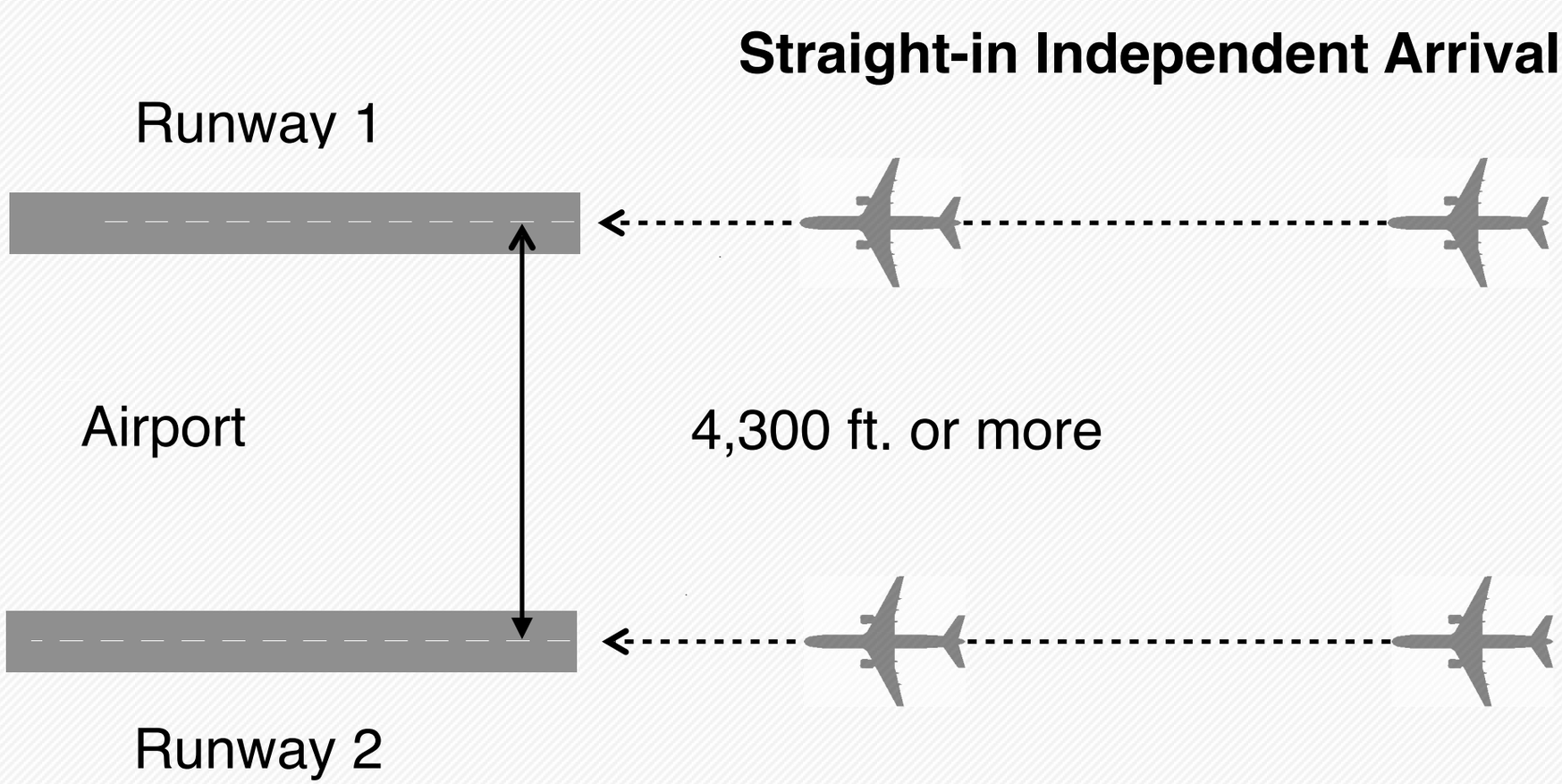
Simultaneous Instrument Approach Procedures

IFR operational conditions

4,300 ft. (1,311 meters) between runway centerlines

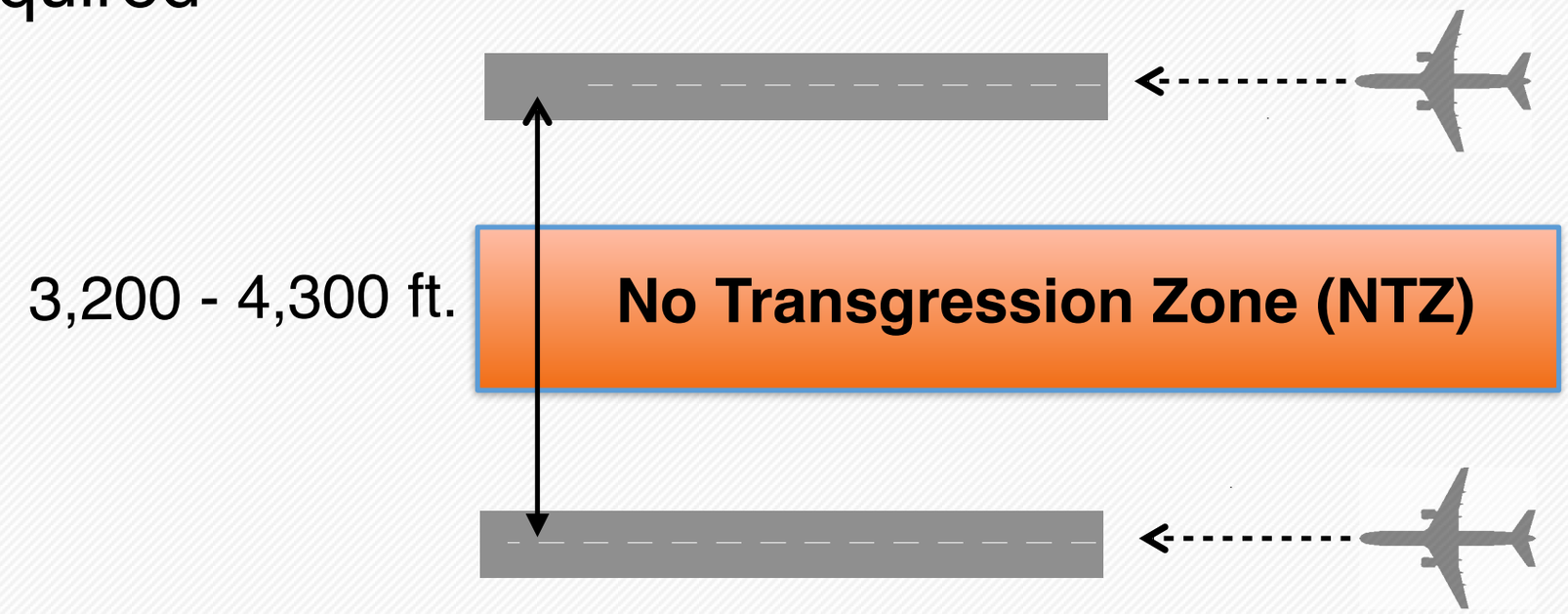
Airports located 2,000 ft or more above sea level

Radar or ADS-B surveillance is available



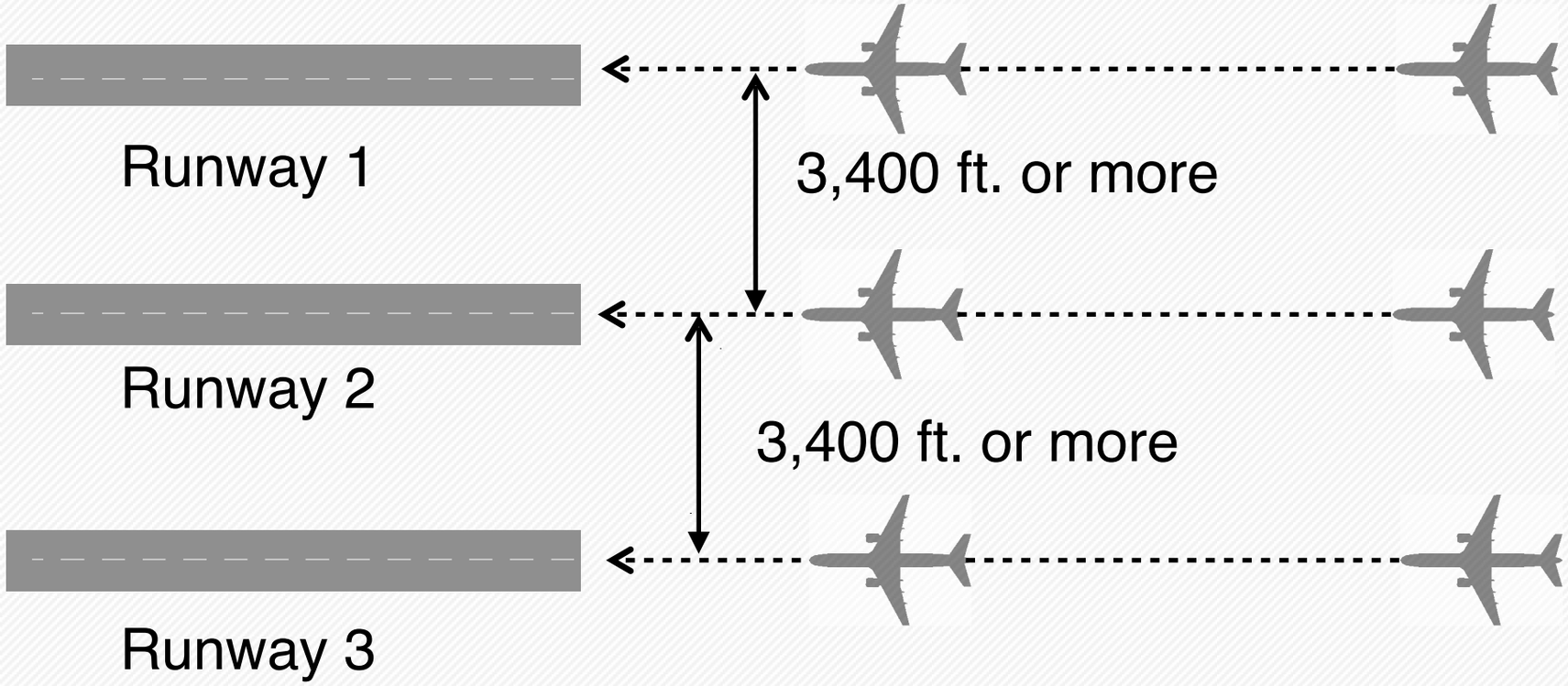
Legacy Runway Separations (PRM - Precision Runway Monitor)

- **Procedure developed two decades ago before ADS-B surveillance**
- Straight-in approaches with 3,200 feet (975 meters) parallel separation between runways
- No transgression zone and fast scan radar (1 second scan) required



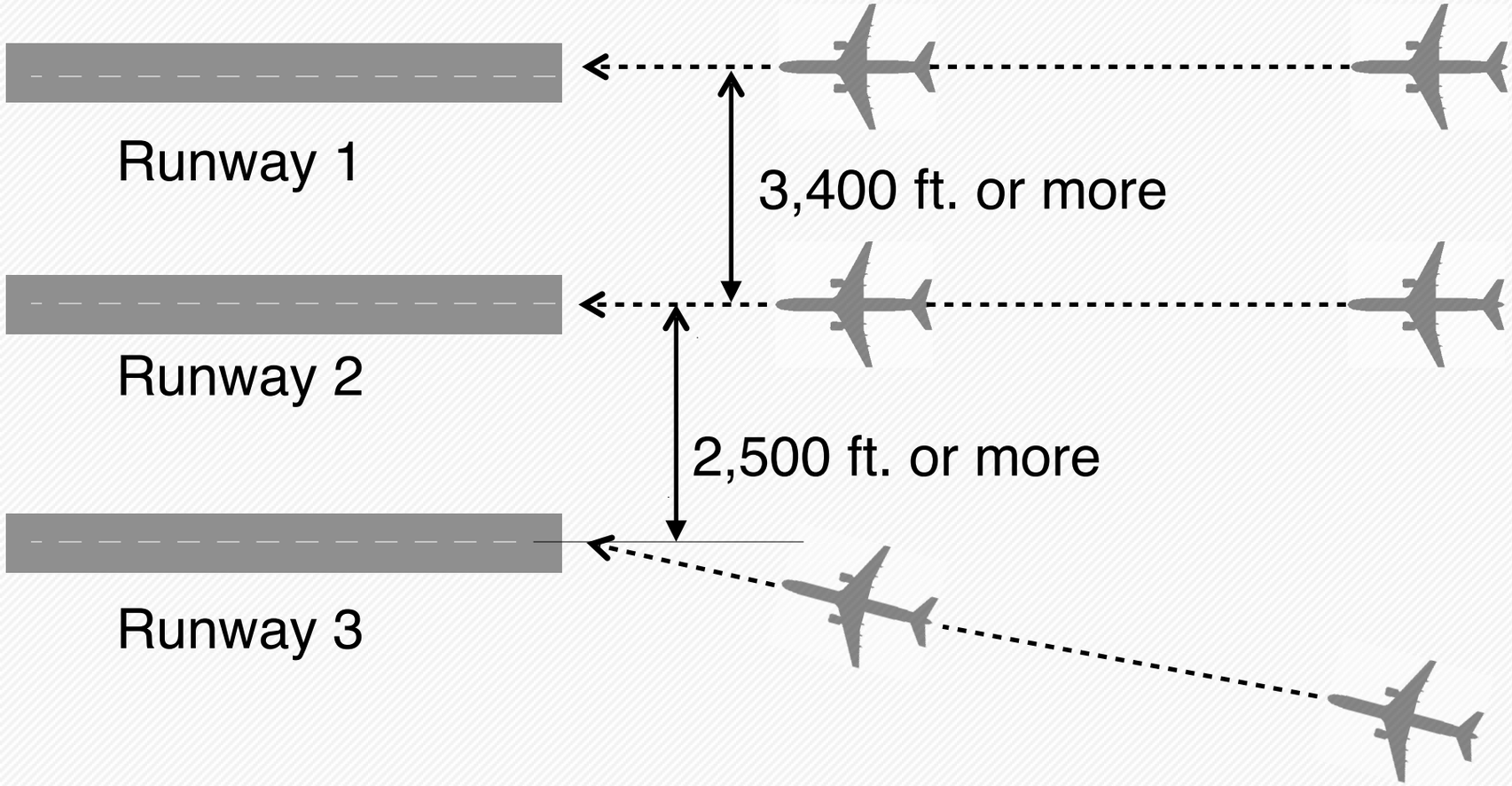
Simultaneous Instrument Approaches: Three Parallel Runways

- Airports **below 2,000 feet** above mean sea level
- 3,400 feet (1,036 meters) for straight-in approaches



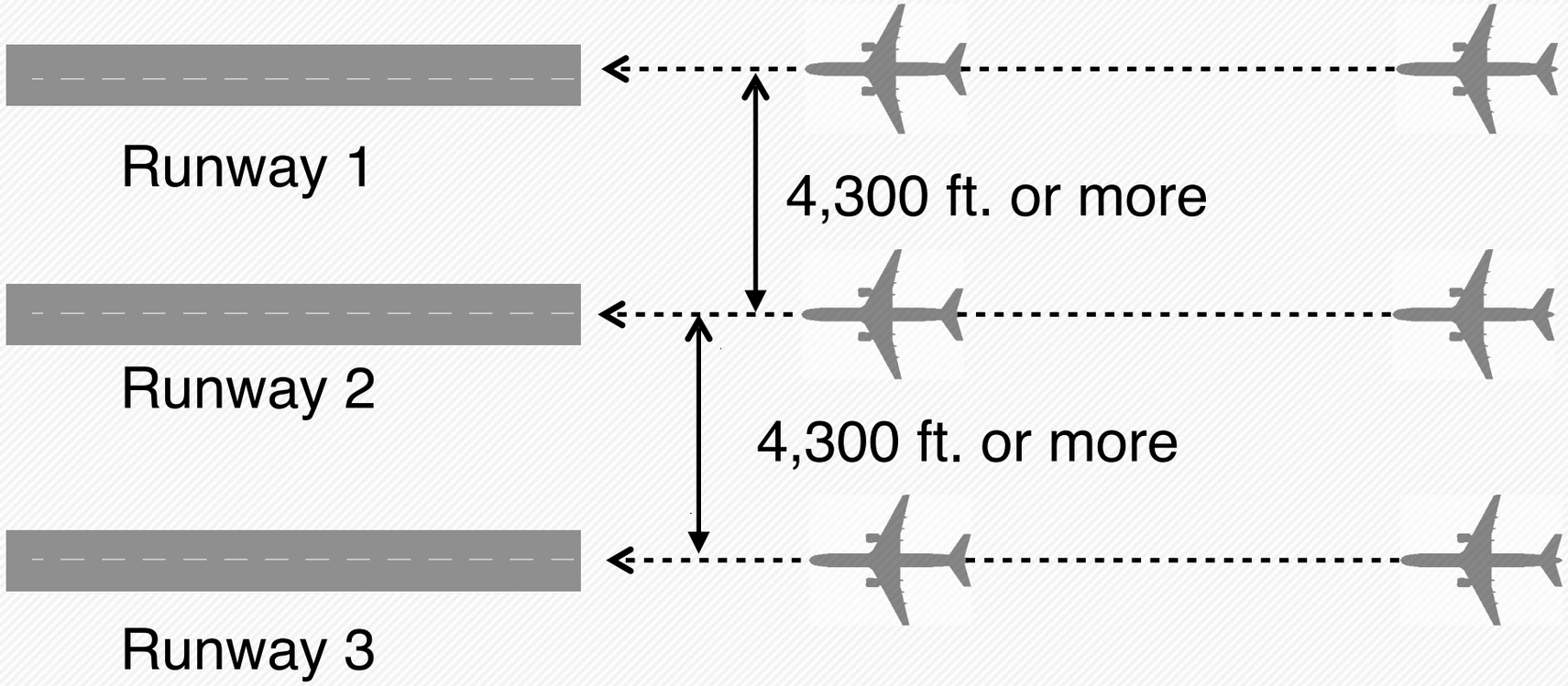
Simultaneous Instrument Approaches: Three Parallel Runways

- Airports **below 2,000 feet** above mean sea level
- 2,500 feet (762 meters) for one offset approach to an outboard runway



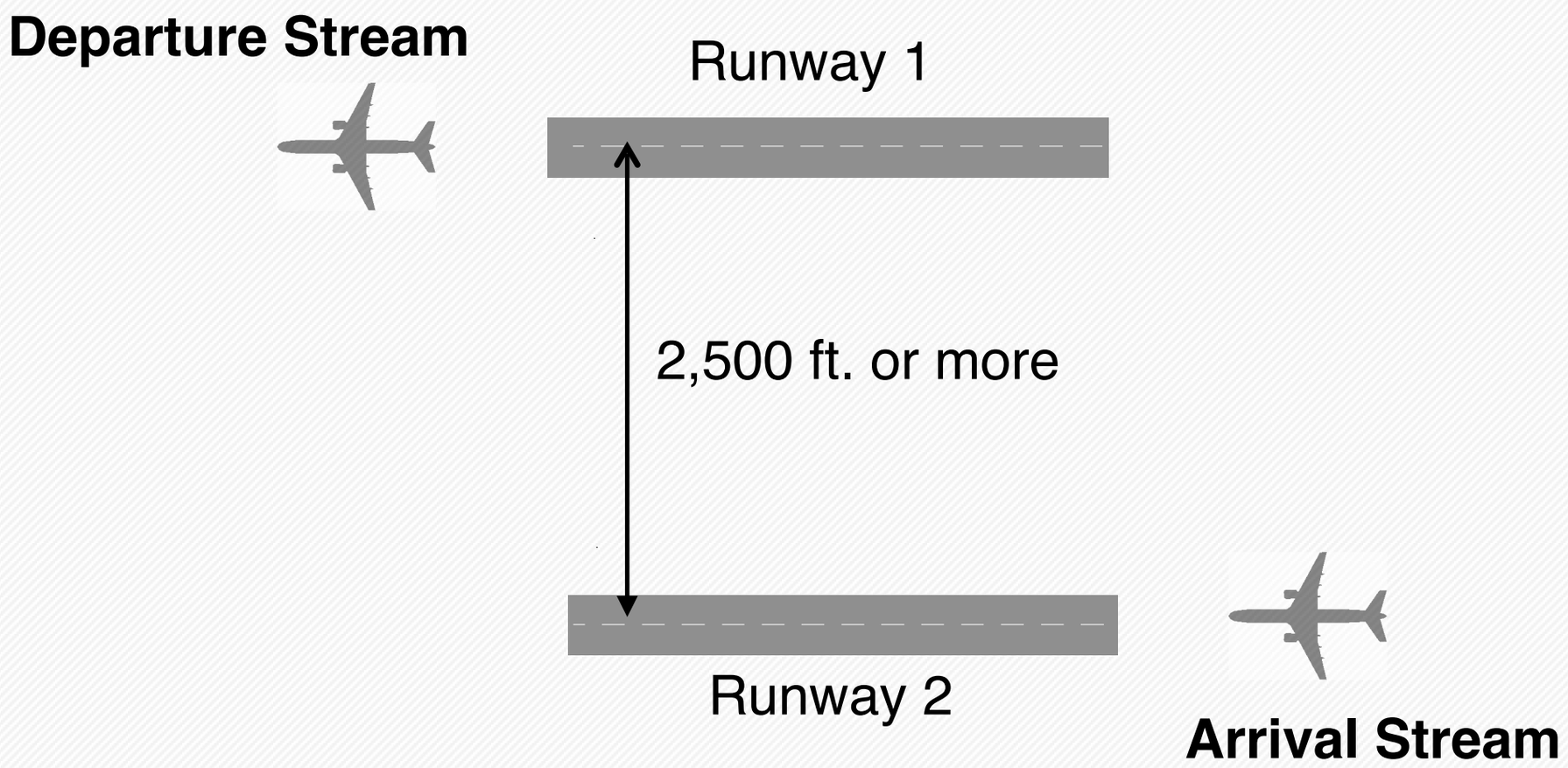
Simultaneous Instrument Approaches: Three Parallel Runways

- Airports **at or above 2,000 feet** above mean sea level
- 4,300 feet (1,311 meters) for straight-in approaches
- Old guidance was 5,000 feet between runway centerlines



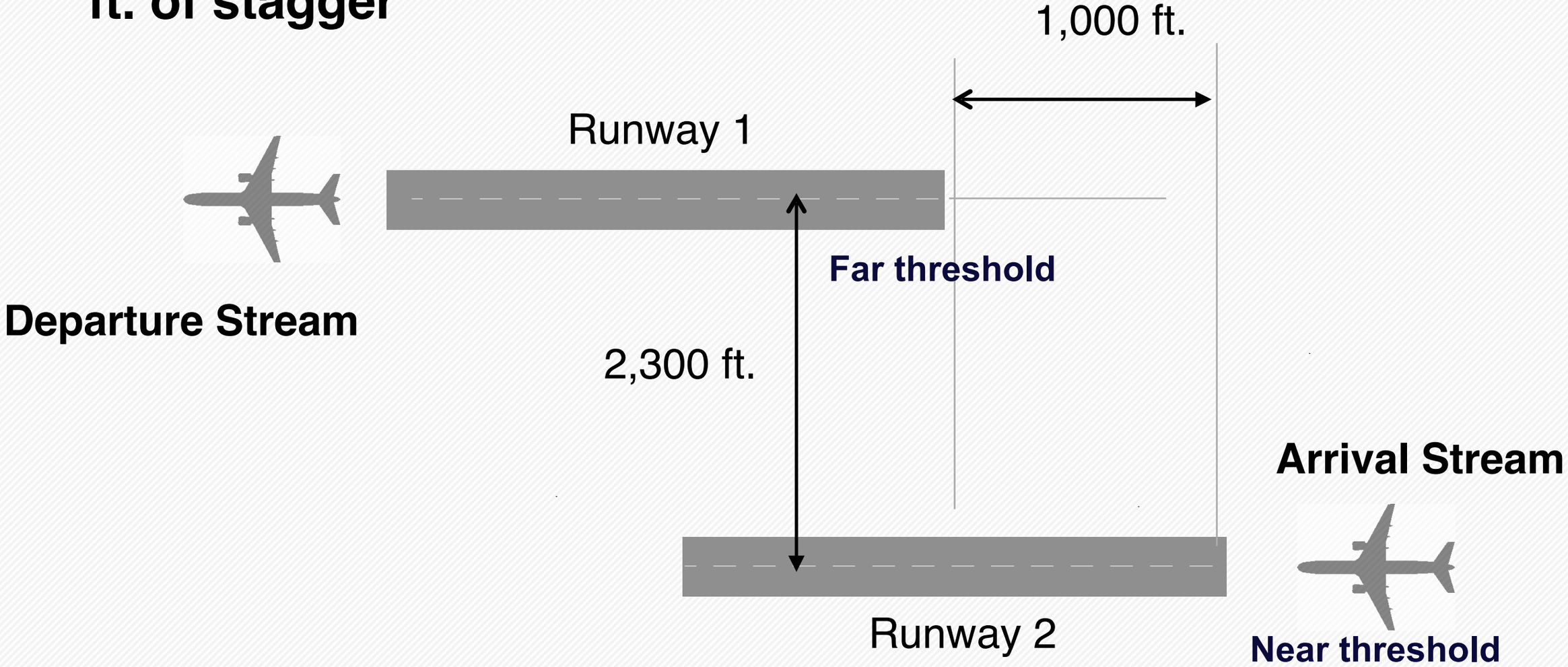
Independent Departures and Arrivals in IFR Conditions (Radar and ADS-B Surveillance)

Simultaneous departures and arrivals can be conducted if two parallel runways are located 2,500 ft. or more



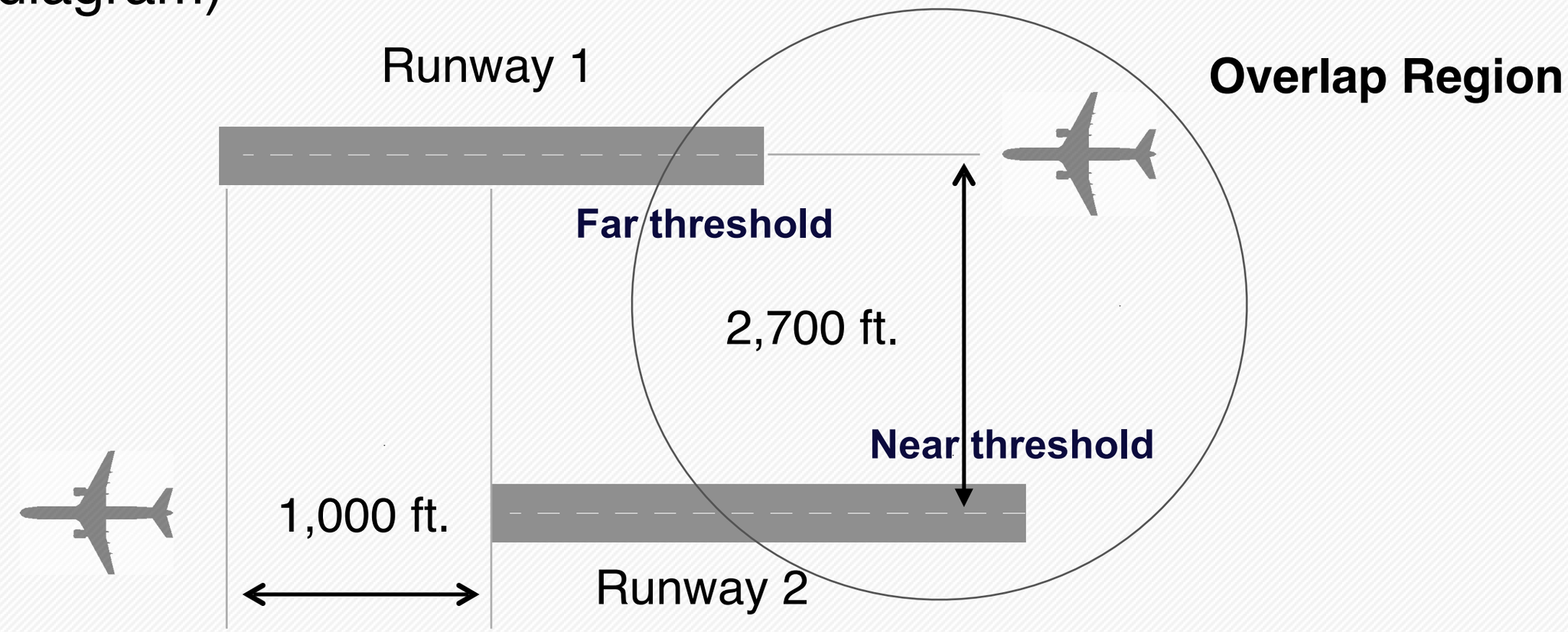
Staggered Runways Rule (Decreasing Separation)

- If two parallel runways are staggered (i.e., their runway thresholds are offset) use:
- **Decrease runway centerline separation by 100 ft. for every 500 ft. of stagger**



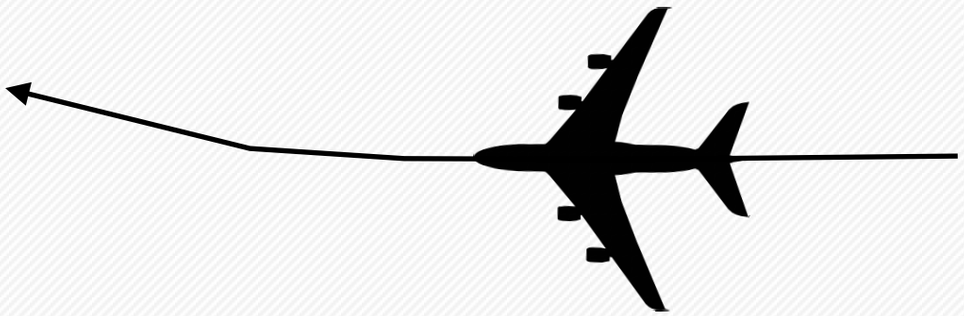
Staggered Runways Rule (Increasing Runway Centerline Separation)

- If two parallel runways are staggered (i.e., their runway thresholds are offset) use:
- Increase runway centerline separation by 100 ft. for every 500 ft. of stagger if an overlap region exists between arrival and departures (see diagram)

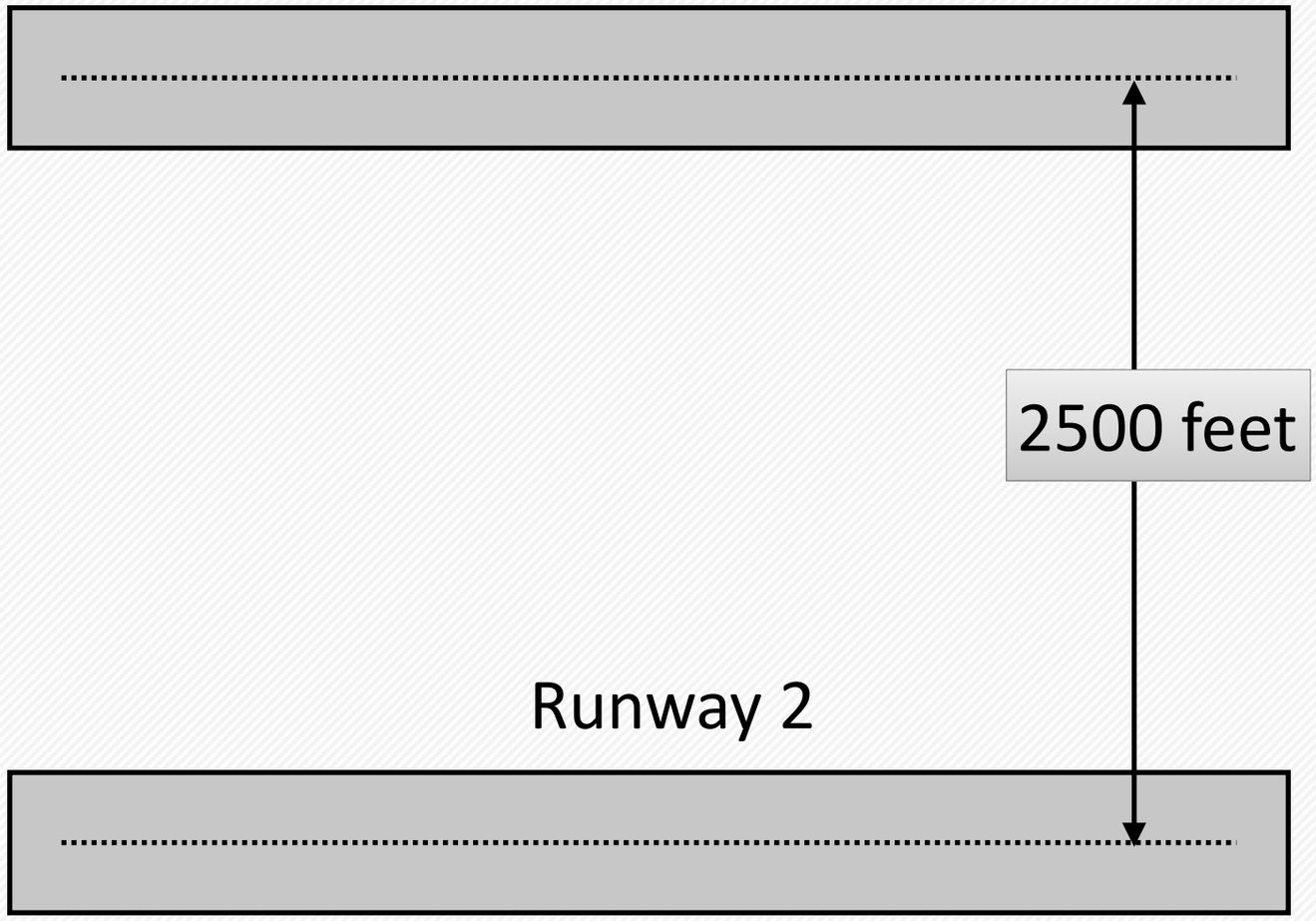


Simultaneous Independent Departures

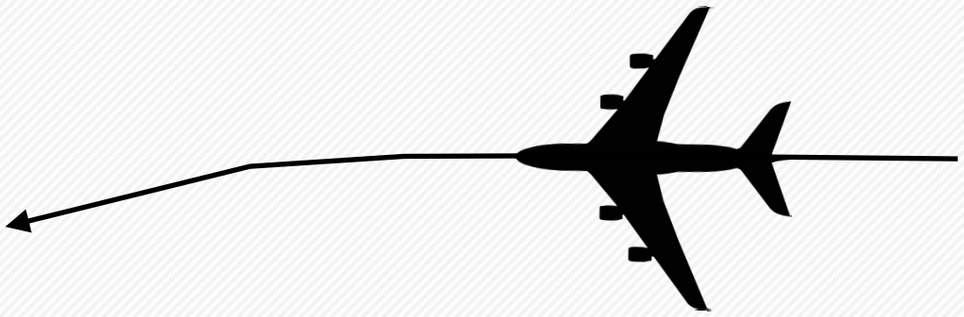
- Use a standard airport surveillance radar or ADS-B
- Air traffic control tower



Runway 1



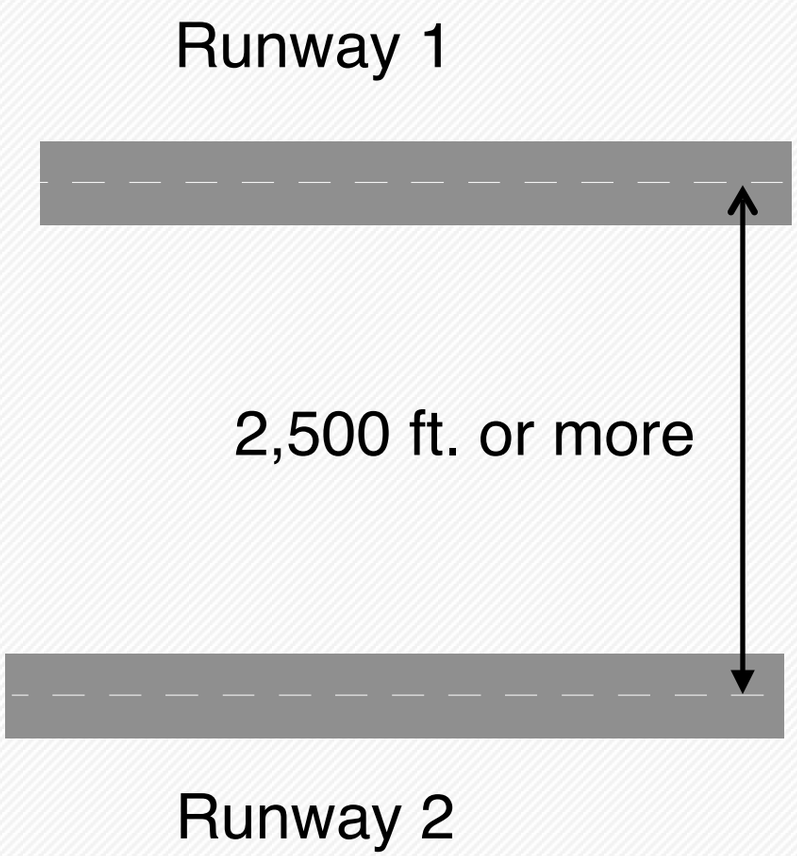
Aircraft are instructed to fly diverging headings after departure (typically 15 degrees)

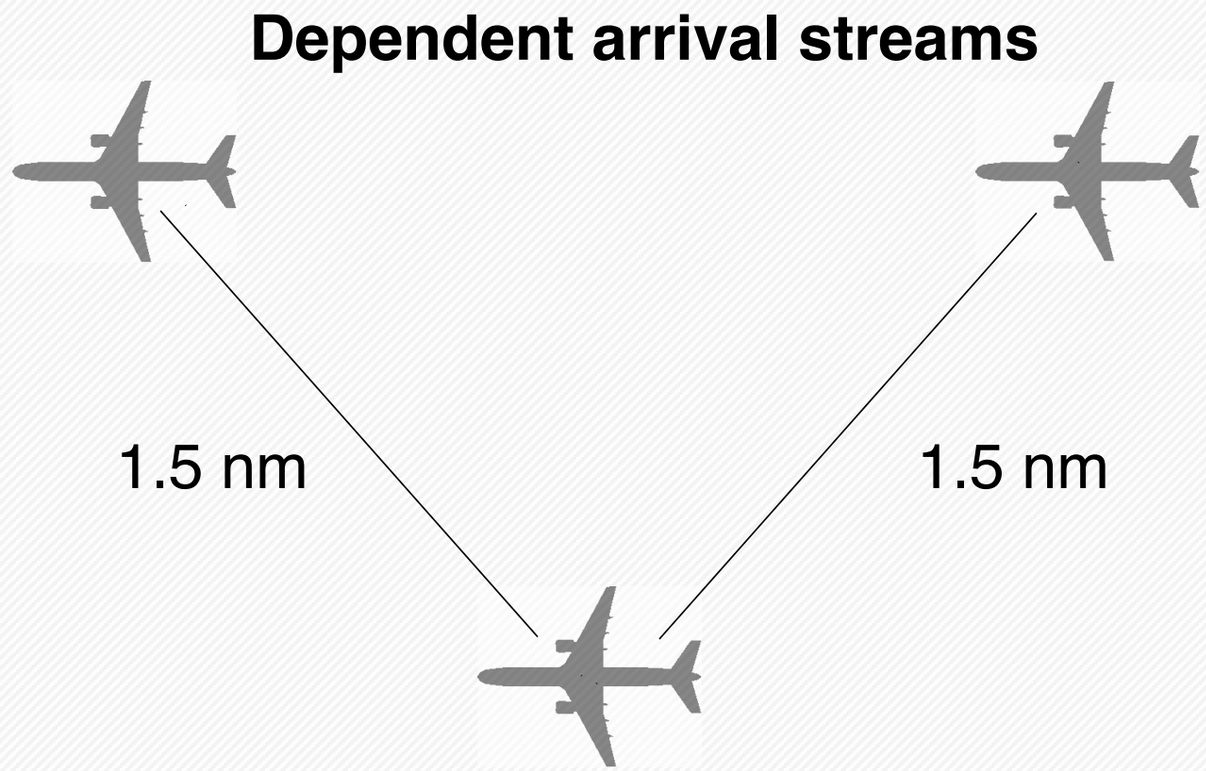


Runway 2

Dependent Approaches to Parallel Runways (IFR)

- Procedures allows dependent arrivals when runway separation is below 3,200 ft. and above 2,500 ft. (standard radar or ADS-B)
- A 1.5 nm diagonal separation is enforced between arrivals



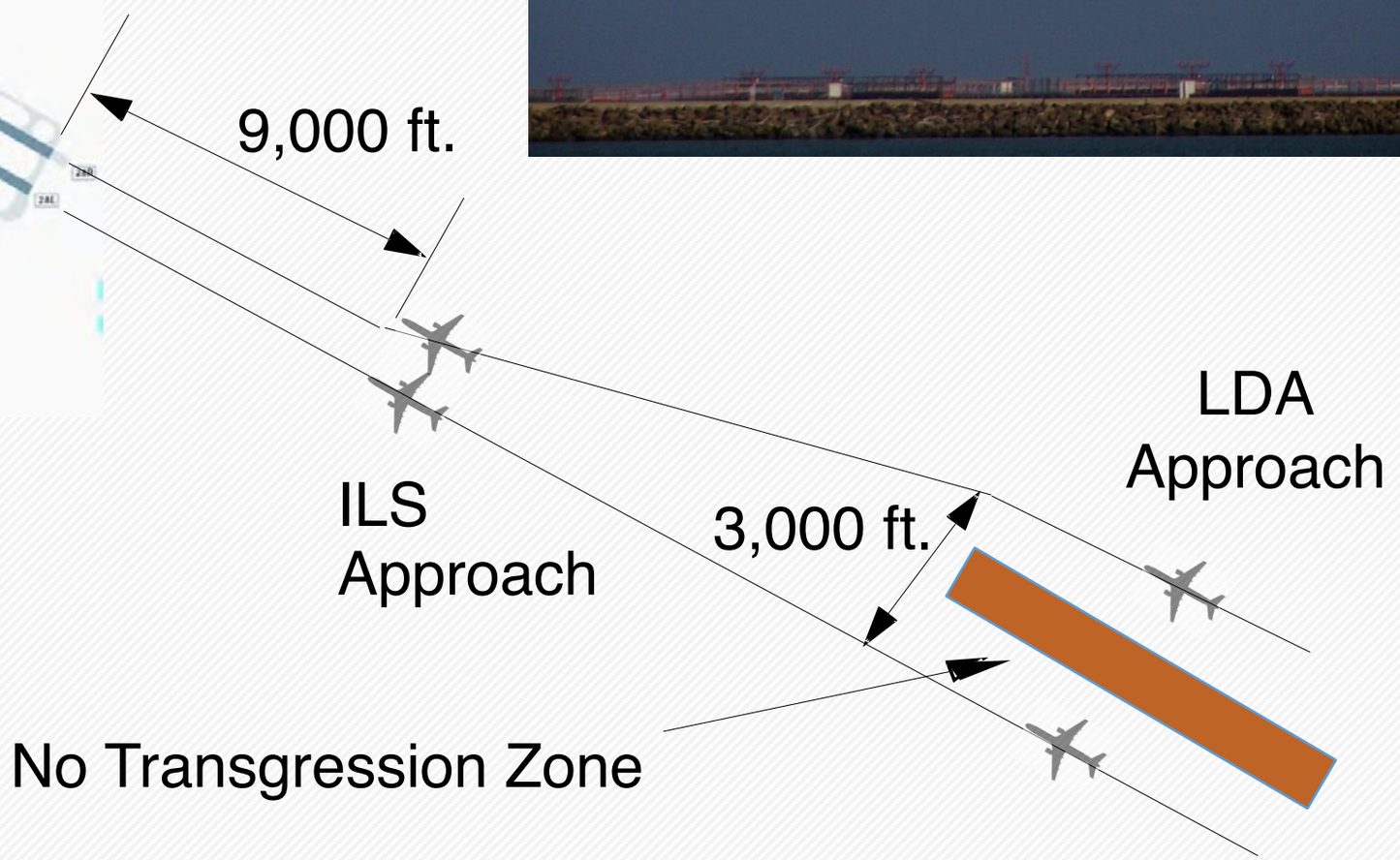


Simultaneous Offset Instrument Approaches (SOIA)

- Allows simultaneous approaches to runways spaced less than 3,000 ft. but more than 750 ft.
- San Francisco International airport was the first airport approved for the procedure (see diagram on next page)

- Requirements:
  - Pilot training
  - Dual communications
  - ATC software/hardware (PRM radar)

Simultaneous Offset Instrument Approaches (SOIA)



Runway Configuration at SFO Airport

Simultaneous Offset Instrument Approaches (SOIA) at SFO

Boeing 737-800 landing on runway 28R

Gulfstream 500 landing on runway 28L

A.A. Trani

Simultaneous Offset Instrument Approaches (SOIA) at SFO

- The idea behind SOIA is to bring aircraft side by side to avoid wake effects
- SOIA procedures require special crew training, a PRM radar and ATC instrumentation (i.e., no transgression zone display and alerts)

Airbus A320 landing on runway 28L

Embraer 175 landing on runway 28R

A.A. Trani

Recent FAA Directive that Affect Runway Capacity at US Airports

- Converging Runway Operations (CRO)
- Following four incidents at Las Vegas (Nevada), the FAA developed more conservative guidelines for operations on converging runways

NOTICE

U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION
Air Traffic Organization Policy

N JO 7210.860

Effective Date:
January 15, 2014

Cancellation Date:
January 14, 2015

SUBJ: Converging Runway Operations

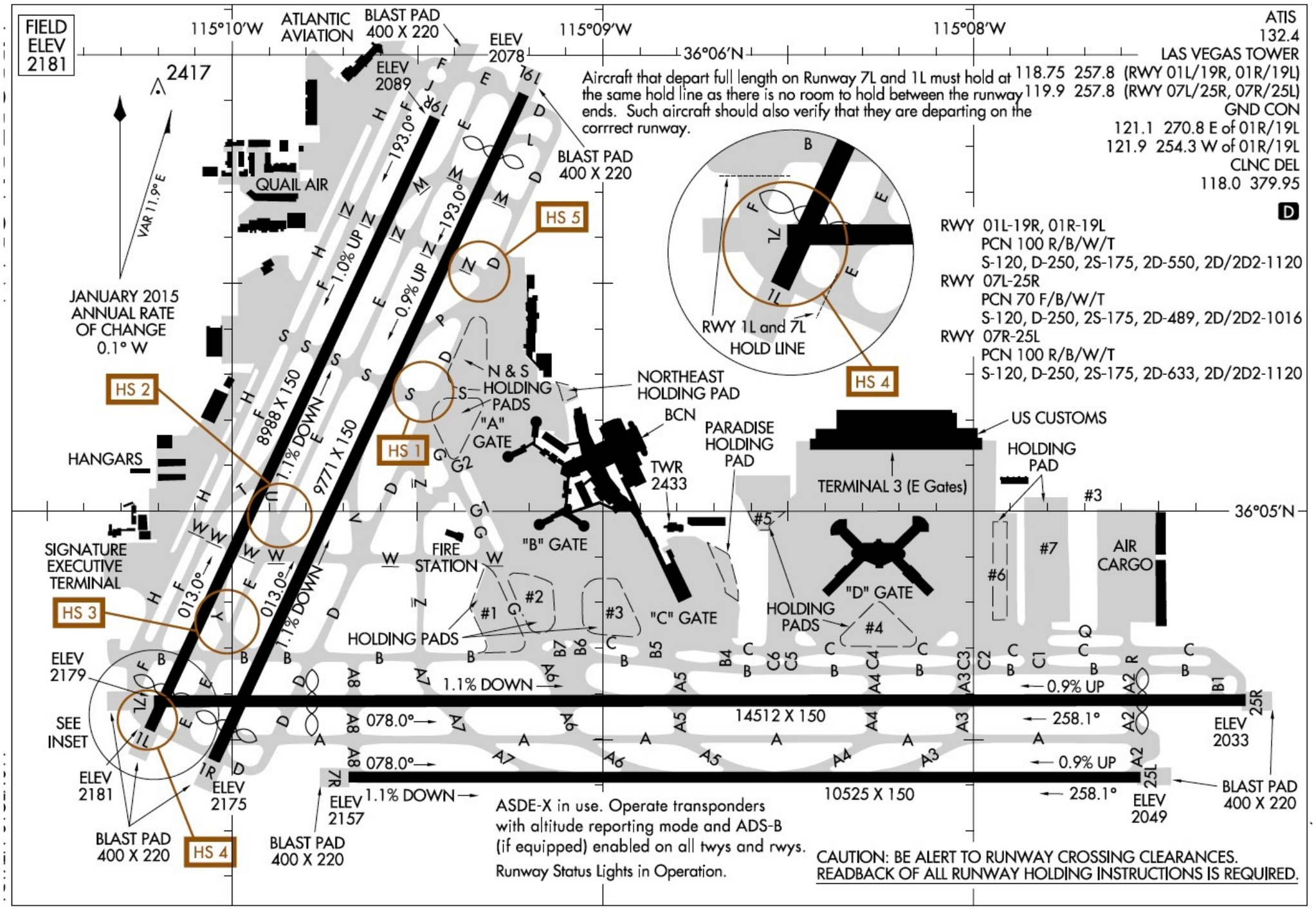
1. Purpose of This Notice. This notice amends Federal Aviation Administration (FAA) Order JO 7210.3, Facility Operation and Administration, paragraphs 3-7-3, Display Map Data, and paragraph 10-3-14, Go-Around/Missed Approach.

This notice incorporates changes that will be applied at LAS, CLT, JFK, IAD, IAH, ORD, and BOS beginning January 15, 2014. Secondly, this change will apply to DFW, MSP, DEN, BWI, HNL, MEM, MIA, PHL, SLC, and TPA beginning April 2, 2014. Lastly, this change will apply to all additional affected airports beginning July 9, 2014.

Information of N JO 7210.860 is now part of the FAA Task Order 7110.65 (ATC Handbook)

Airports affected by new CRO rule

Las Vegas International Airport



NTSB Reports that Prompted CRO

NTSB Identification: OPS13IA071

Incident occurred Thursday, July 04, 2013 in Las Vegas, NV
Probable Cause Approval Date: 03/10/2015
Aircraft: GULFSTREAM GIV - UNDESIGNAT, registration:
Injuries: Unavailable

"A Boeing 737 (737) executing a go-around from runway 25L and a Gulfstream 4 that had just departed from runway 19R experienced an airborne conflict. When passing over runway 25L, the 737 pilot announced his intention to go around because the airplane was encountering a 20-knot tailwind.

The tower controller responsible for runway 25L acknowledged the report, immediately advised the pilot of traffic "just lifting off" from runway 19R, and instructed the pilot to report the traffic in sight. The tower controller then instructed the pilot to fly the runway heading and climb to 7,000 ft. The pilot read back the clearance and reported the traffic in sight. The controller told the pilot to maintain visual separation from the traffic. The 737 subsequently completed another approach and landed."

NTSB Reports that Prompted CRO

NTSB Identification: OPS13IA071

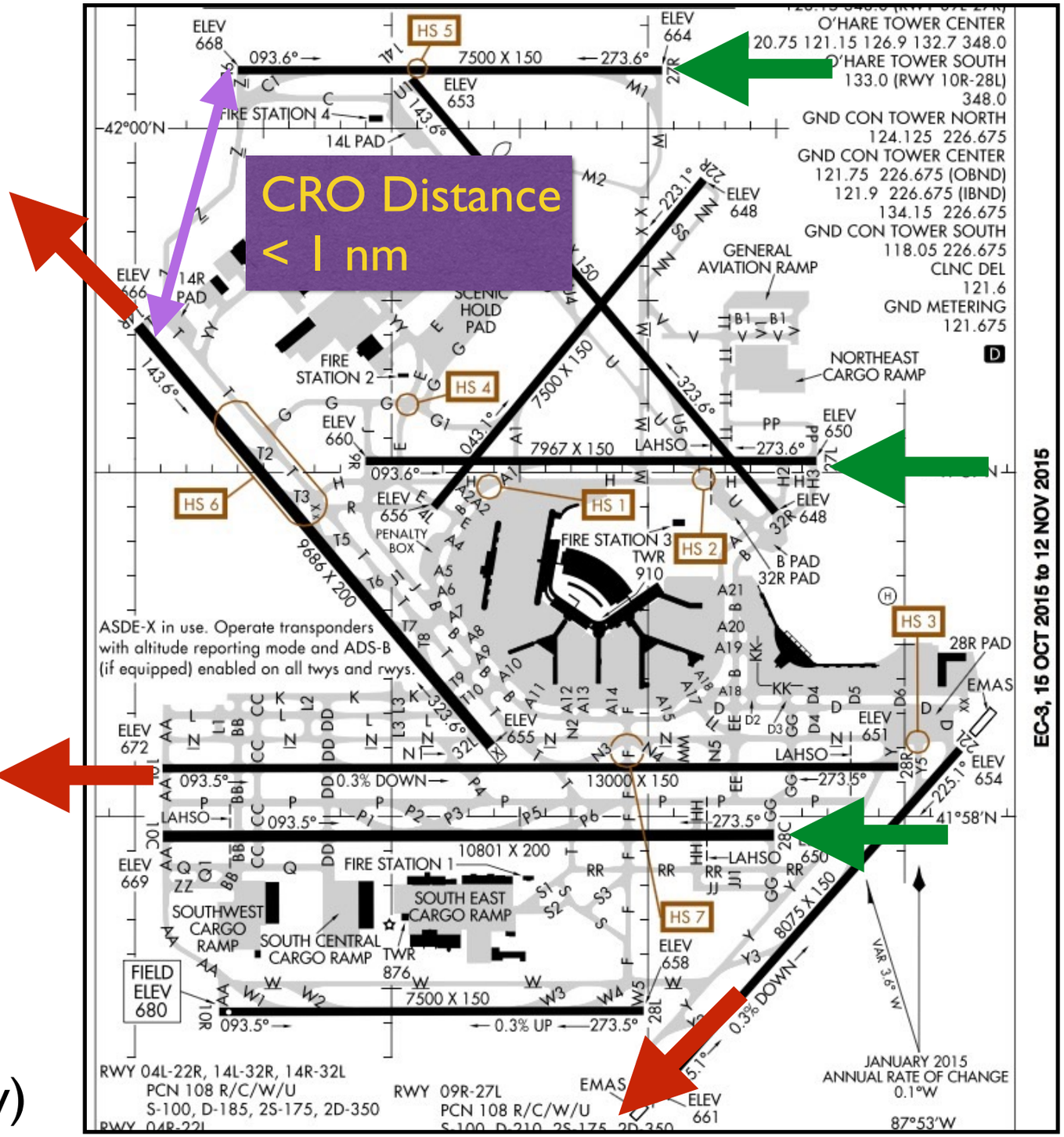
Incident occurred Thursday, July 04, 2013 in Las Vegas, NV
Probable Cause Approval Date: 03/10/2015
Aircraft: GULFSTREAM GIV - UNDESIGNAT, registration:
Injuries: Unavailable

"At the time of the incident, the FAA did not have procedures requiring specific separation between aircraft operating on nonintersecting runways where flightpaths may intersect despite the occurrence of several previous similar incidents.

Following this incident and another similar incident, the FAA amended FAA Notice 7110.65, "Air Traffic Control," by adding paragraph 3-9-9, "Non-Intersecting Converging Runway Operations," which directed changes in converging runway operations to prevent similar reoccurrences."

Example of CRO Effect (ORD Airport)

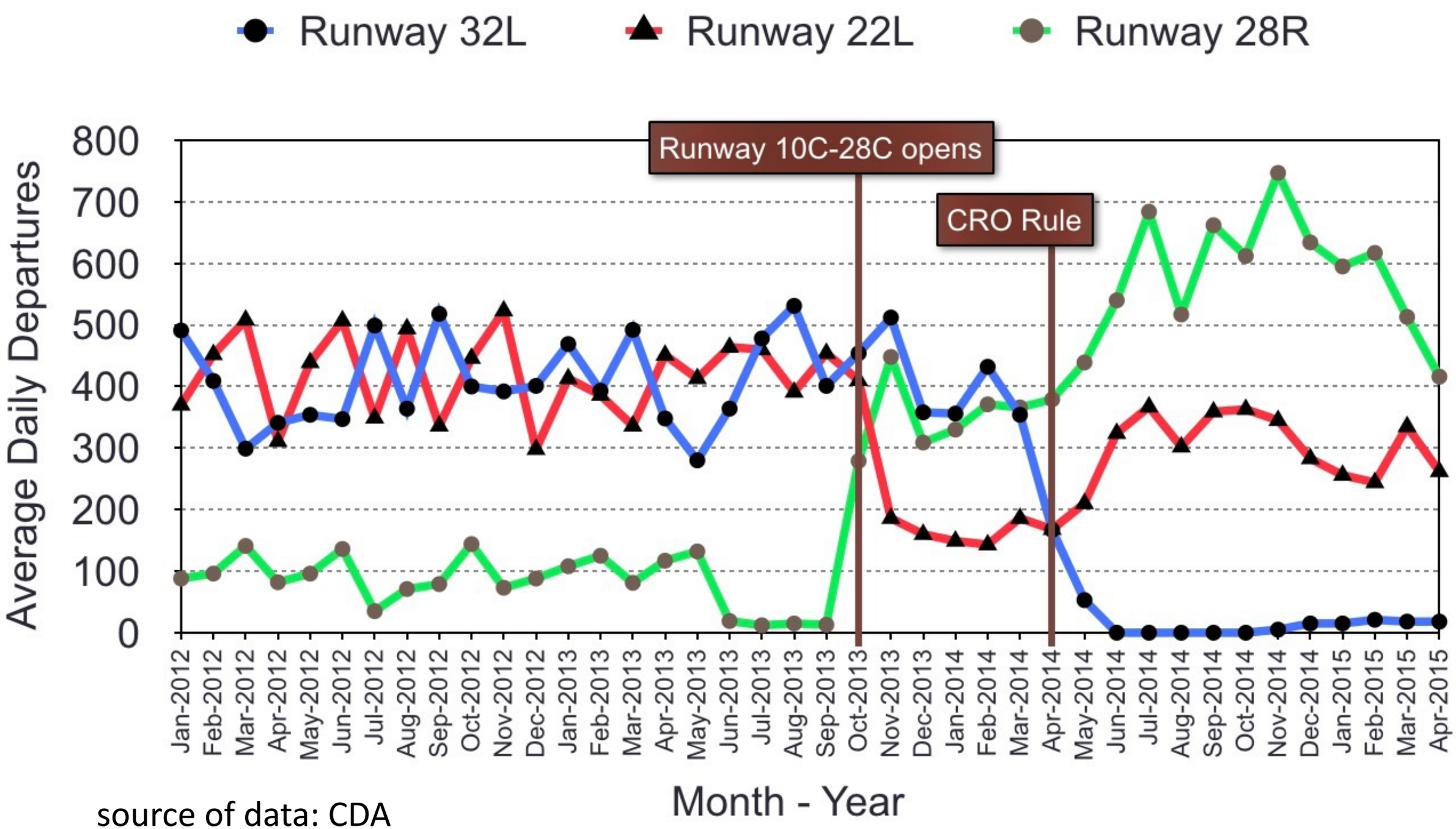
- In the summer 2014, ORD lost 1/3 of its departure capacity for one of the most heavily used configurations
- Runway 32L become almost unusable during daytime hours



Arrival runways (west flow)

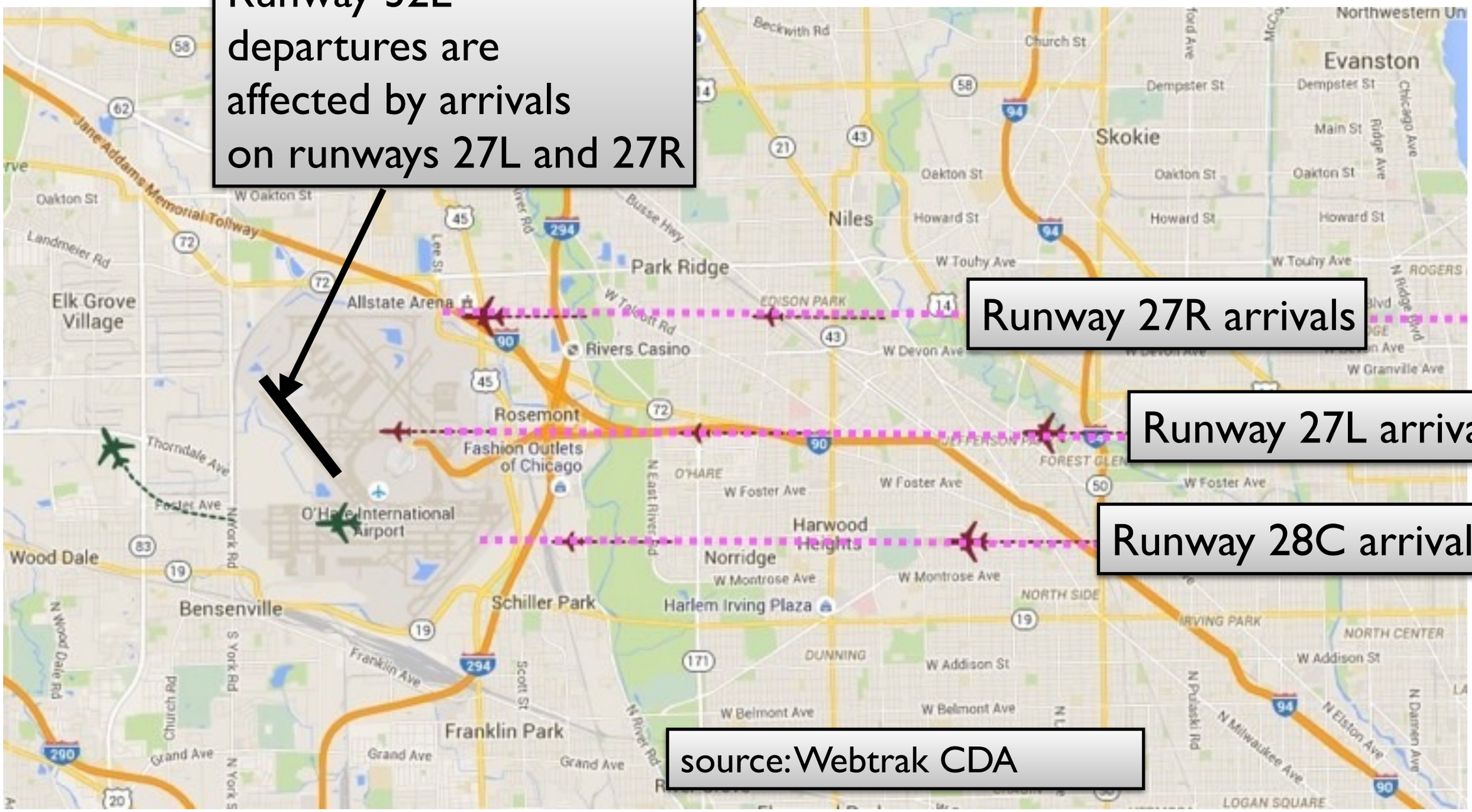
Departure runways (west flow)

Example of CRO Effect (ORD Airport)

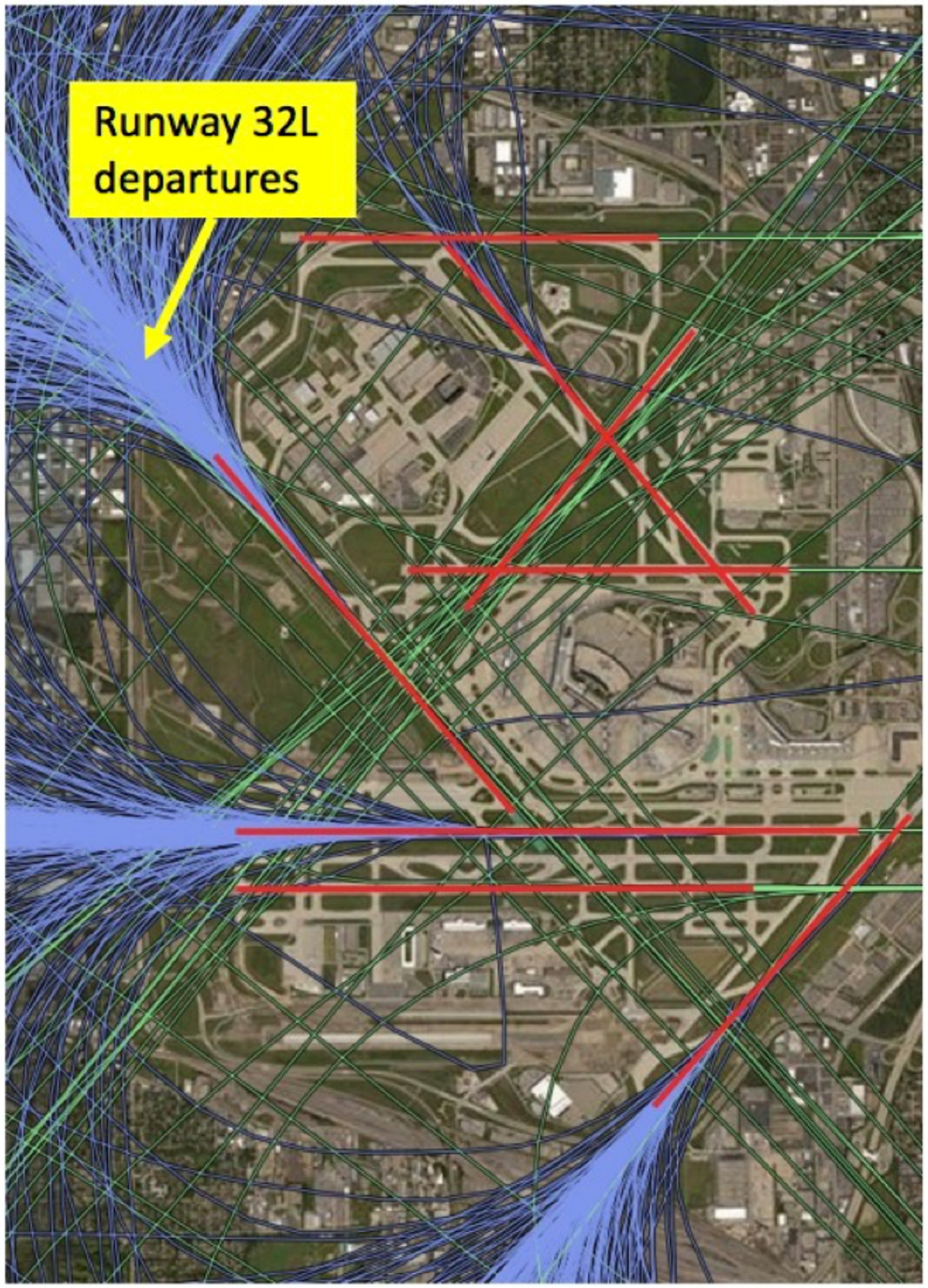


source of data: CDA

Example of CRO Effect

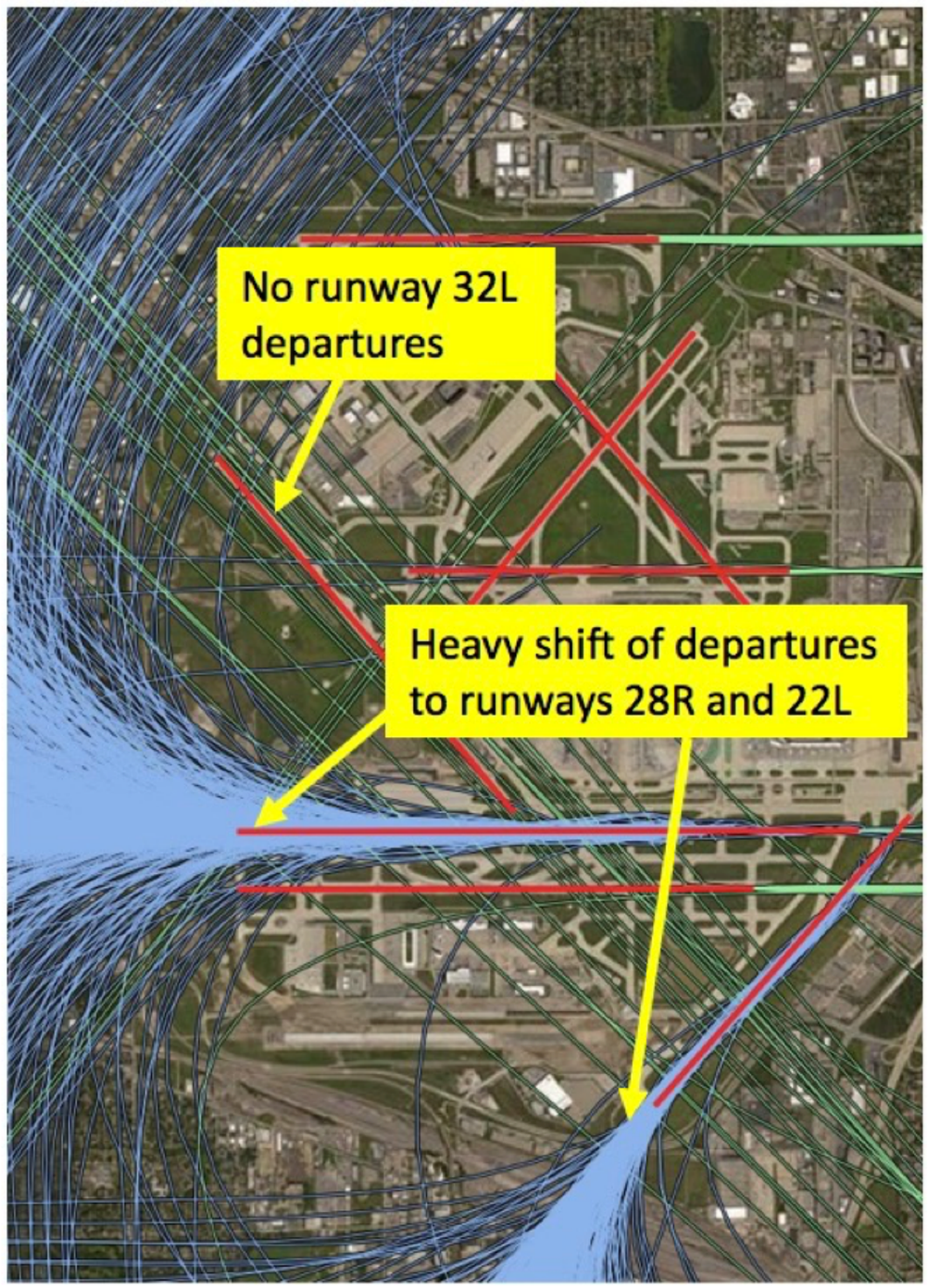


CRO Rule at Chicago O'Hare Intl. Airport



Before CRO Rule

source of data: CDA



After CRO Rule

ICAO Aerodrome Reference Code

ICAO Aerodrome Reference Code used in Airport Design

Code Number	*Aeroplane Reference Field Length (meters)*
1	*Less than 800*
2	*800 but less than 1200*
3	*1200 but less than 1800*
4	*More than 1800*

ICAO Aerodrome Reference Code
Code Element 2

Design Group	Wingspan (m)	Outer Main Landing Gear Width (m)	Example Aircraft
A	< 15	< 4.5	All single engine aircraft, Some business jets
B	15 to < 24	4.5 to < 6	Commuter aircraft, large business jets (EMB - 120, Saab 2000, Saab 340, etc.)
C	24 to < 36	6 to < 9	Medium-range transports (B727, B737, MD-80, A320)
D	36 to < 52	9 to < 14	Heavy transports (B757, B767, MD-80, A300)
E	52 to < 65	9 to < 14	Heavy transport aircraft (Boeing 747, A340, B777)
F	65 to < 80	14 to < 16	A380, Antonov 225

Runway Separations According to ICAO Standards (Visual Conditions)

Where parallel **non-instrument** runways are to be provided for simultaneous use, the following separations are recommended:

- **120 meters** (394 ft) for Aerodrome Runway Code 1
- **150 meters** (492) for Aerodrome Runway Code 2
- **210 meters** (689 ft) for Aerodrome Runway Codes 2 and 4

Note: In the US we use 700 feet for visual operations for all runway categories

Runway Separations According to ICAO Standards (Non-Visual Conditions)

Parallel **non-instrument** runways that meet PANS-ATM Doc 4444 and PANS-OPS 8168, the following separations are recommended:

- **1035 meters** (3395 ft) for independent parallel approaches
- **915 meters** (3000 ft) for dependent parallel approaches
- **760 meters** (2493 ft) for independent parallel departures
- **760 meters** (2493 ft) for segregated operations

Note: **In the US we use 2500 feet** for independent parallel departures and also for independent segregated operations