

Airport Capacity — Into the Future

Dr. Bernardo Lisker
International Director

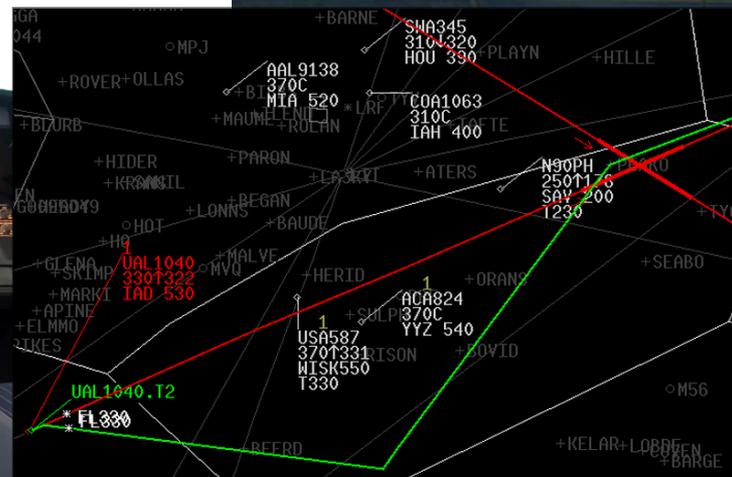
Global Aviation Cooperation Symposium (GACS)
Panel: Global Expansion of Airports: New Initiatives in Airport Operations

International Civil Aviation Organization (ICAO)
Montreal, Canada, 2 October 2014

A few words about MITRE...

■ Research organization

- Non-commercial, not-for-profit
- Origins at Massachusetts Institute of Technology (MIT)
- Established in 1958 - Works exclusively in the public interest
- ~7000 engineers, mathematicians, controllers, pilots, etc.

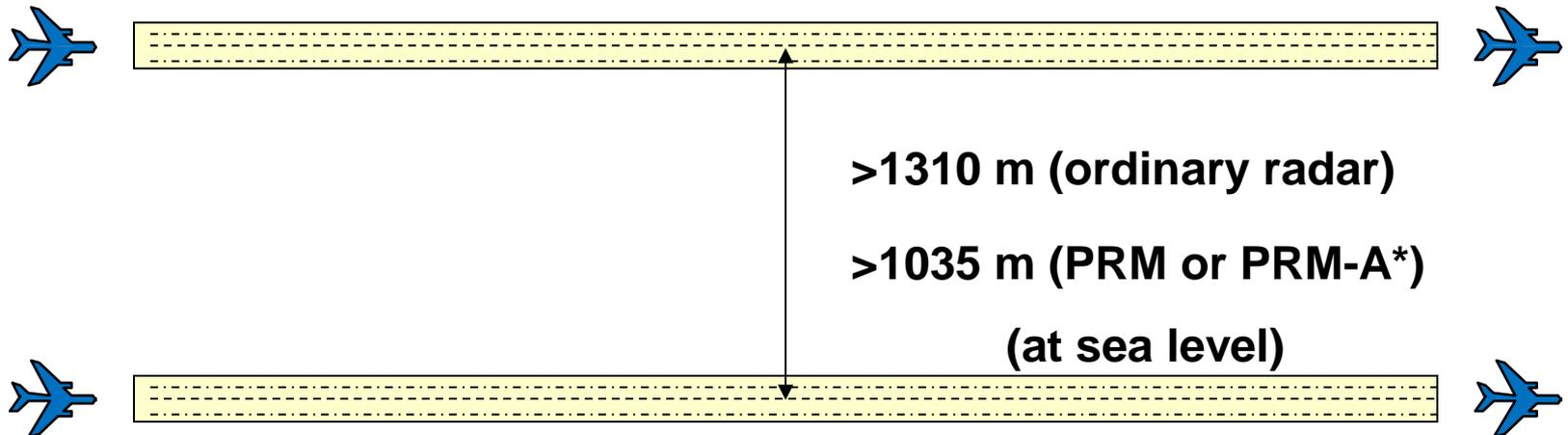


Airport Airside Capacity...

- This briefing focuses on airport movement capacity, given land scarcity close to centers served by major airports
- Solutions radically differ from as recently as 15 years ago
 - Modeling is replacing tables, rules of thumb, and “manuals”
 - Runway configuration and separation standards keep changing
 - Satellite navigation is changing old concepts
 - Runway bottlenecks are being gradually compounded by **airspace complexity**, as runways are added due to growing demand
- Chicago O’hare initiated independent (simultaneous) parallel dual operations in the 1960s
 - Half a century later, only a handful of non-U.S. airports operate “duals”
 - Let us talk a bit about “duals” and, just as important, “triples”

Parallel Runways

Independent Instrument Approaches

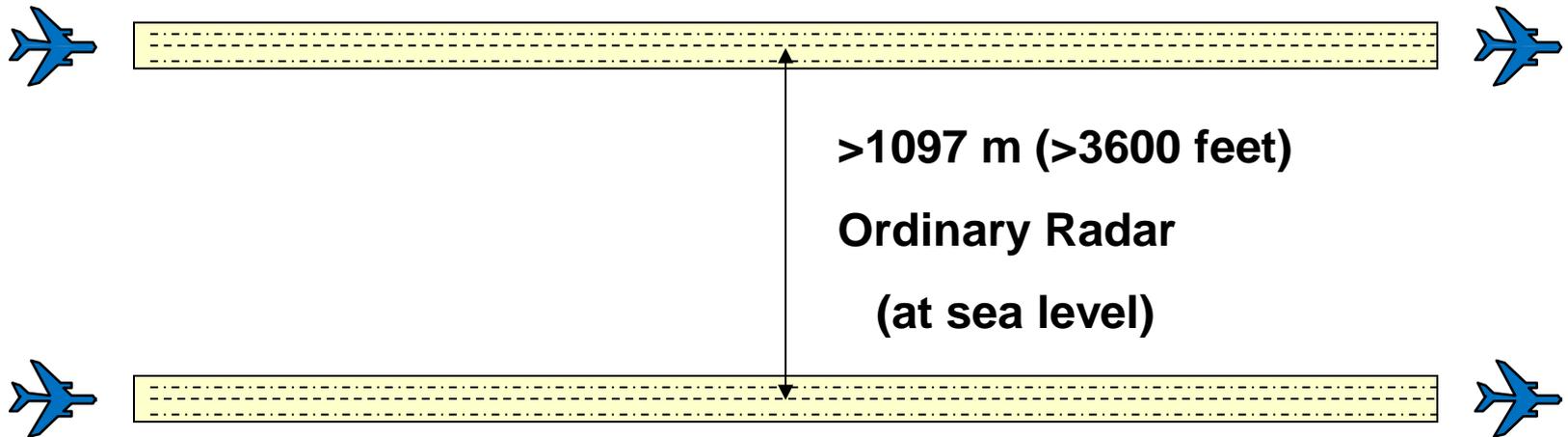


* **Multilateration-based Precision Runway Monitoring-Alternative (PRM-A)**

Note: The FAA allows, under certain conditions (offset Localizer), as little as a 914-meter centerline separation (3000 feet)

Parallel Runways

Independent Instrument Approaches – Latest (non-ICAO)



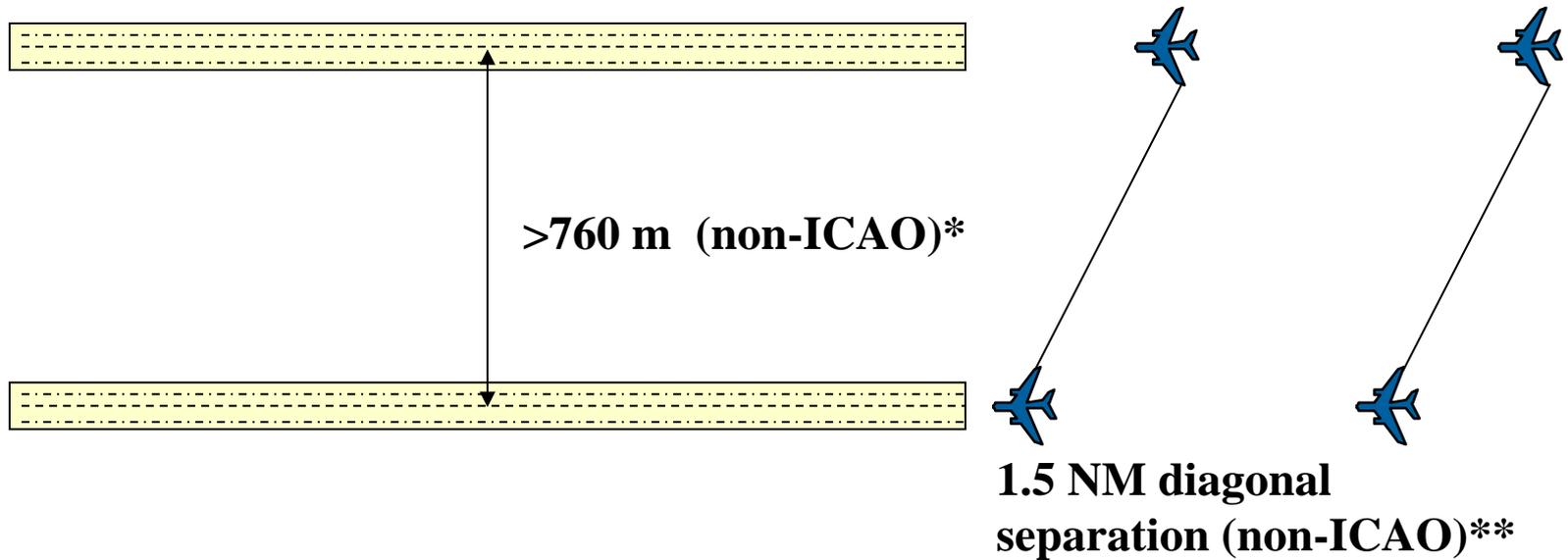
FAA Notice N_JO_7110.625

Effective 19 August 2013

“Simultaneous Independent Close Parallel Approaches – High Update Radar Not Required”

Parallel Runways

Dependent Instrument Approaches

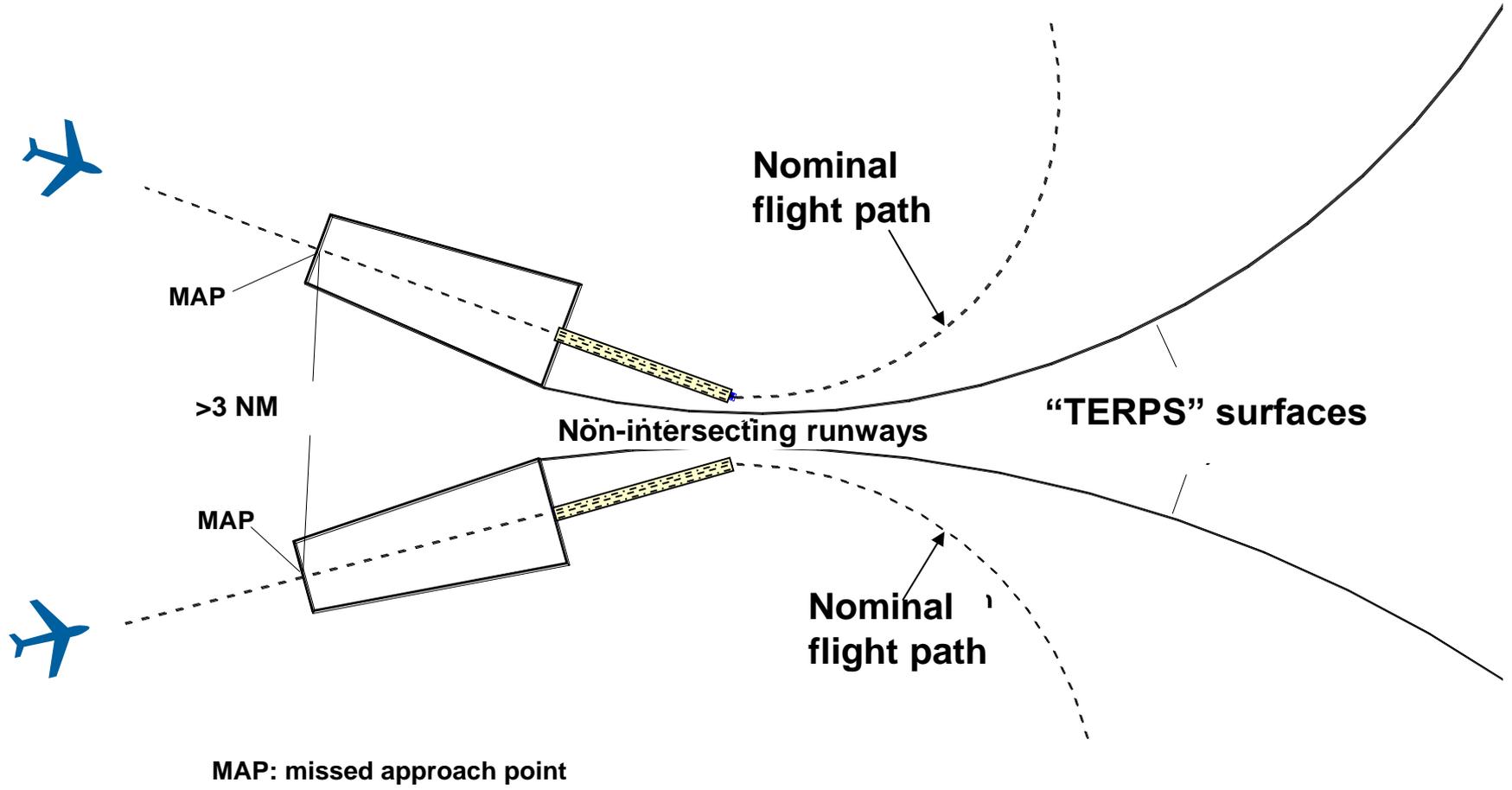


* ICAO requires 915 m

** ICAO requires a 2.0 NM separation

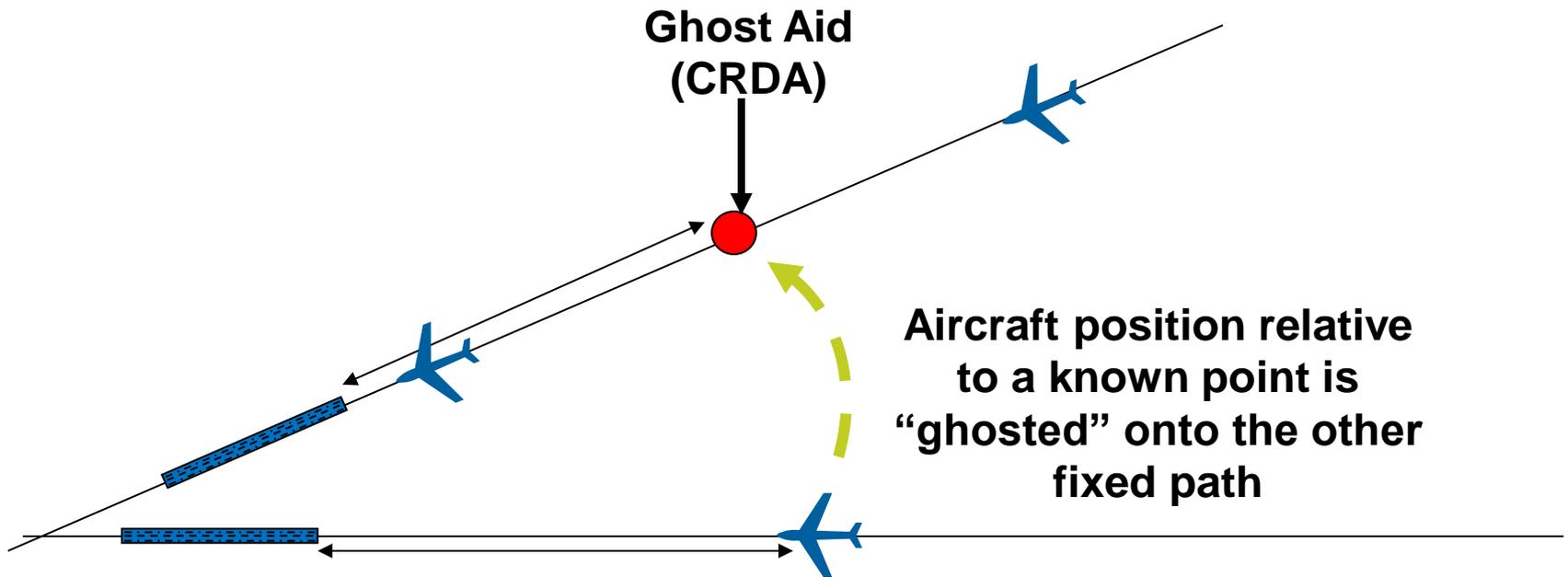
Converging Runways

Independent Instrument Approaches (non-ICAO)



Converging Runways

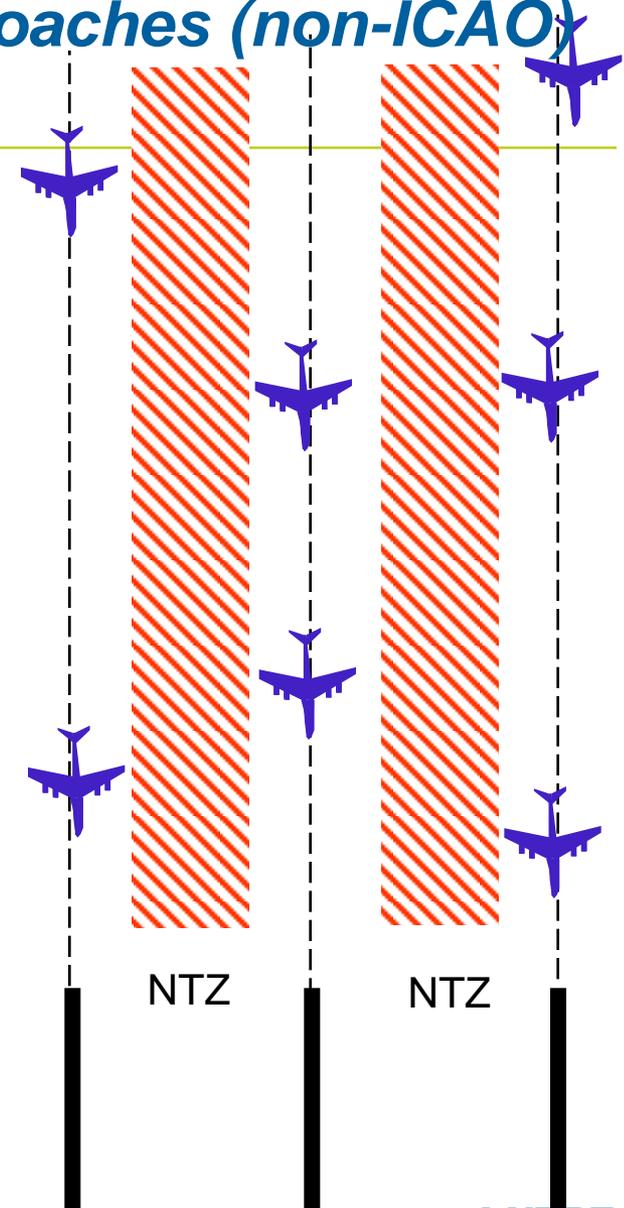
Dependent Instrument Approaches (non-ICAO)



Parallel Runways

Independent Triple Instrument Approaches (non-ICAO)

- **Minimum runway spacing of 1525 m**
 - 1310 m with standard radar and improved display
 - No Transgression Zones (NTZ)
- **Airport elevation restricted to less than 1000 ft without a separate safety assessment**
- **Five U.S. airports routinely operate “triples”**



Independent Parallel Approaches

General Requirements

■ **Operational/airspace**

- Straight-in landings and 30-degree maximum intercept angle (20-degree maximum for triple approaches)
- 1000 ft altitude separation turning onto final approach
- 2000 ft wide (610 m) NTZ between runways

■ **Equipment**

- ILS for each runway
- Monitor displays (usually one per runway), specialized for 1310 m runway spacing
- Dedicated frequency or override capability

■ **Staffing**

- Separate controller for each runway to monitor approaches

Testing for Independent Parallel Approaches

■ Real-time simulations

- Qualified controllers using realistic display and communications equipment
- Current airline pilots flying approved flight simulators
- Computer-generated traffic for additional controller workload
- ~200 blunders

■ Fast-time simulations

- Use human response times from real-time simulations
- Extend results to several hundred thousand blunders

■ Post-simulation statistical analysis

- Maximum acceptable estimated accident rate is 1 in 25,000,000 approaches

Simultaneous Instrument Approach Model (SIAM)

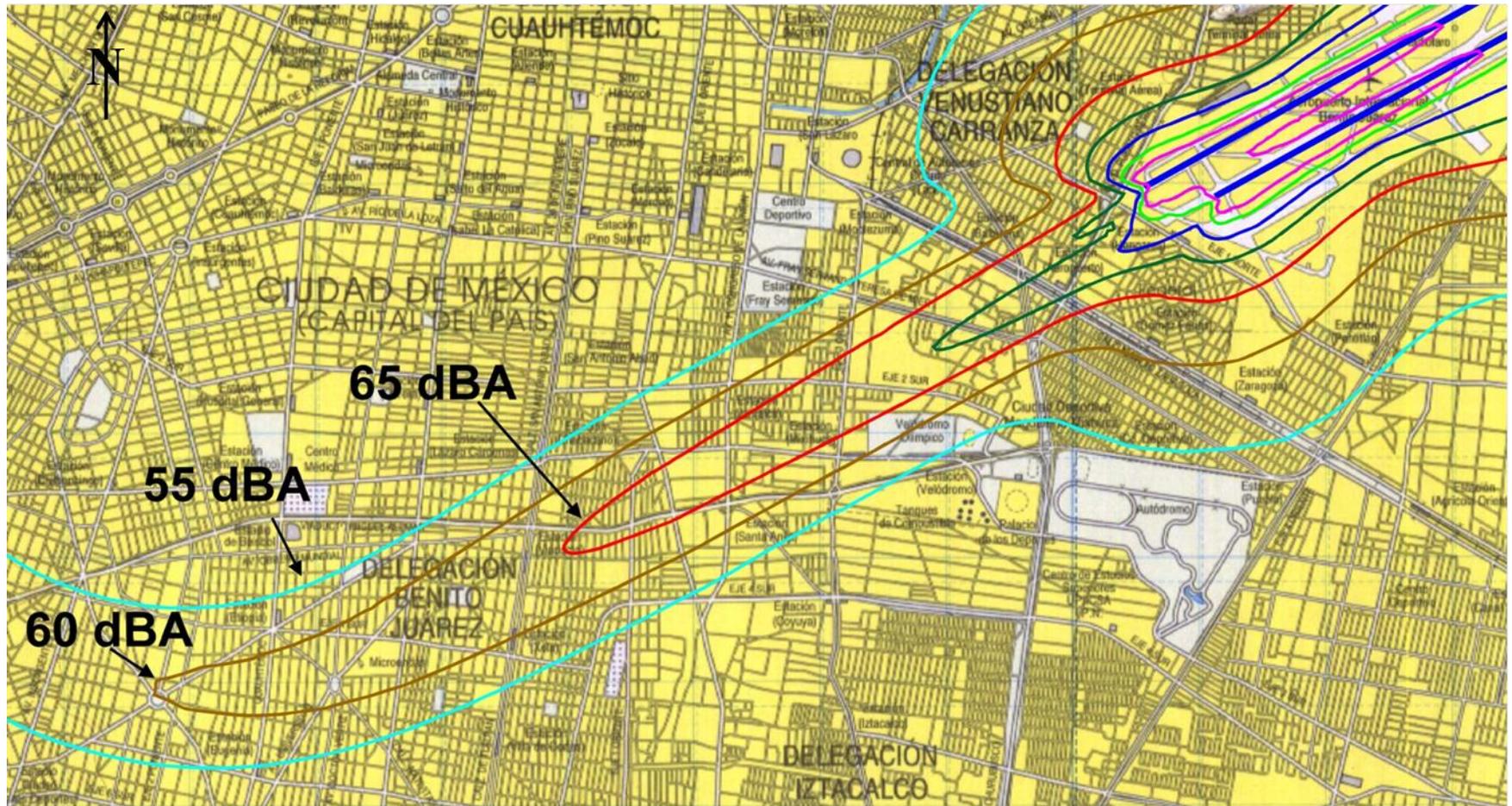
- **Created by MITRE**
 - Utilized during the development of independent approach standards for the Federal Aviation Administration (FAA)
 - Utilizes human response from U.S. controllers
- **Fast-time simulation model**
 - Simulates deviations from final approach course and subsequent reactions by monitor controllers and pilots

Mexico City International Airport (AICM)



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AICM's Severe Noise Impact



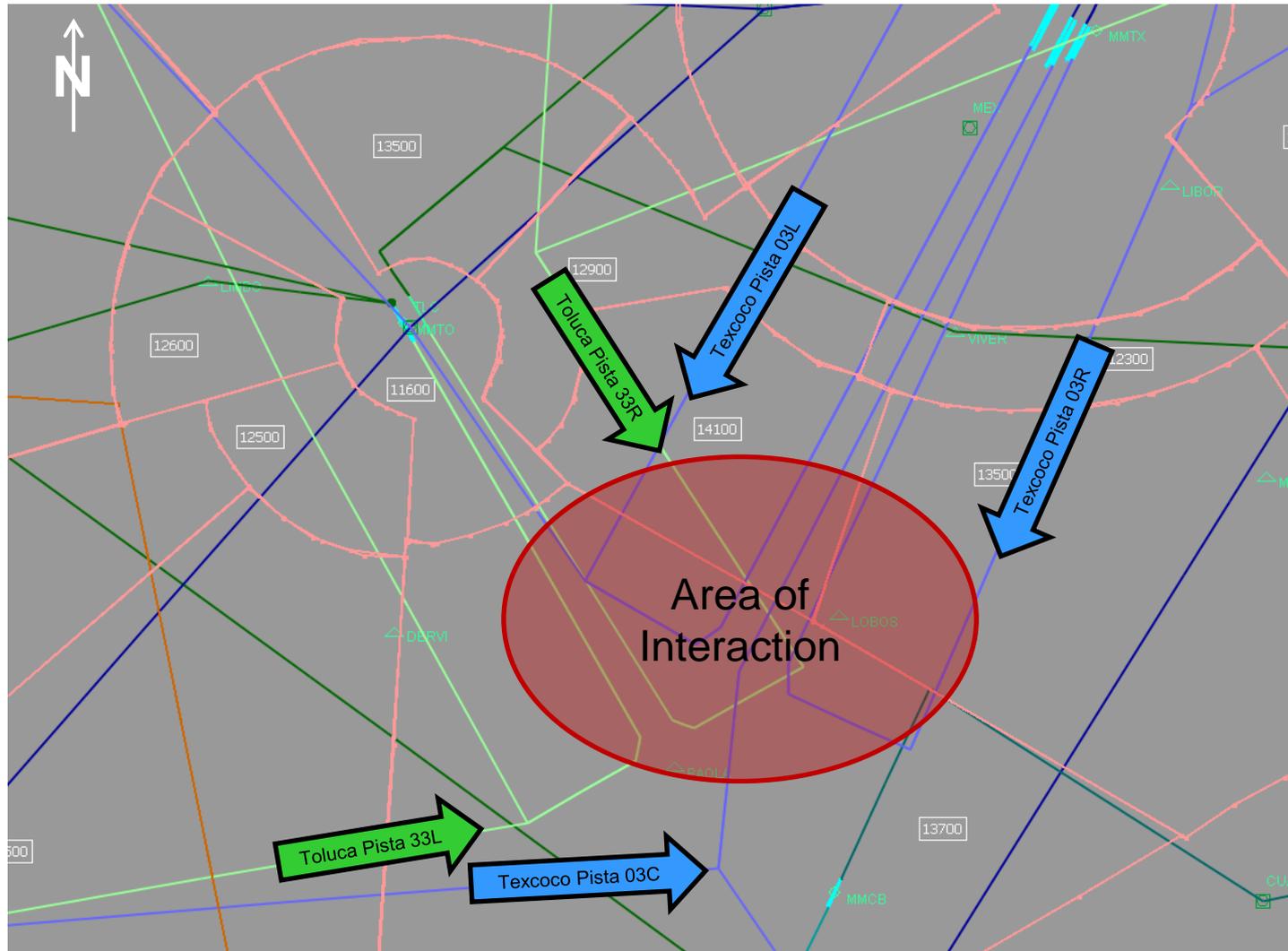
New AICM Location



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Airspace Complexity...

New AICM vs. Toluca Airport (North Flow, 34° Case)



Observations

- **Airspace saturation is becoming a paramount issue, often times no less complex than runway and taxiway saturation**
- **The design methodologies of the past are rapidly being replaced by computer modeling**
 - Buyer beware: not all models are sufficiently validated before their release
- **Advanced navigation, under many guises, is going to be one of the great dividers between the old and the new regime**
- **Analytical work and detailed planning take years before any construction and testing can start**
 - Land-use planning in terms of high buildings, antennas, noise sensitive areas, etc. should attempt to consider airspace complications decades ahead

Contact

This MITRE document should be read and treated with caution, as many points were only discussed verbally.

For any questions, please contact the author at bernard@mitre.org

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