ICAO

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FOR AIR NAVIGATION SERVICES

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TES HORIZON

The Engineering of the Invisible

Awareness and adoption of the radio spectrum as a new mode of operation for the aviation sector

Essential to sustain the quality, integrity and continuity of the service

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An infrastructure unlike any other

Invisible. Shared. Dynamic.

Unlike a runway, a tower or a navigation aid,
the spectrum has no visible boundaries and does not stay constant.

Its behavior changes with:

- Propagation
- Terrain
- Altitude
- External transmitters
- Time

Essential services operate over this environment:

- COM
- NAV
- SUR
- GNSS
- ILS
- VOR
- DME
- ADS-B

And it can be affected by:

- Accidental interference
- Congestion
- Jamming
- Spoofing
- New emissions

They are not just frequencies that were assigned.

It is the **invisible infrastructure** on which aviation operates.

Three simultaneous dimensions

Spectrum must now be understood at once as a regulated resource, critical infrastructure, and an operational domain.

1. Regulated resource

- Allocation
- Assignment
- Licensing
- Inspection
- Control

2. Critical infrastructure

- Invisible foundation of CNS services
- Availability
- Integrity
- Continuity

3. Operational domain

- Dynamic environment
- Continuous observation
- Contextual analysis
- Decision support

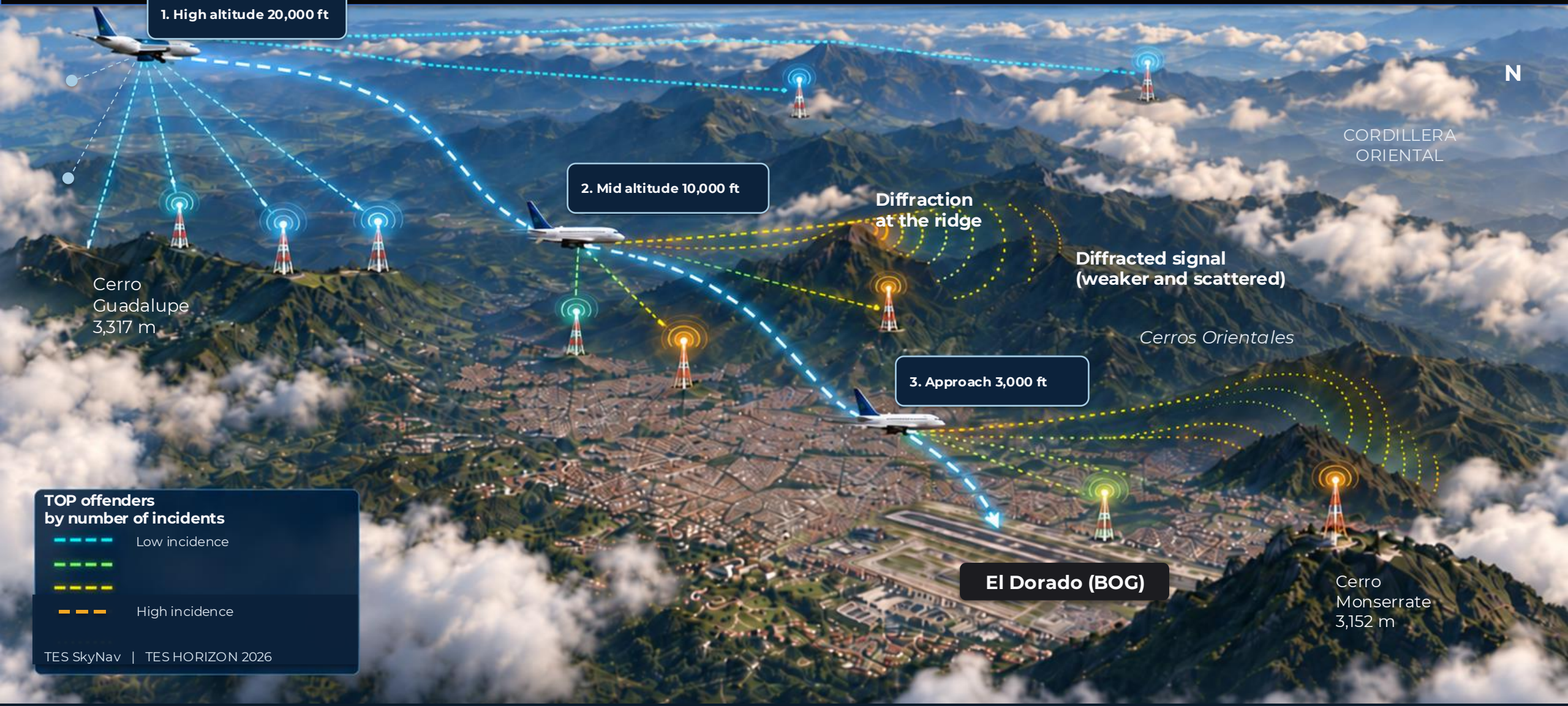
Regulation remains indispensable. On its own it does not provide a **continuous operational picture** of the real environment.

The transformation of the radio environment

The problem is no longer an isolated interference.
It is a changing electromagnetic environment.

Risk changes during the flight

Position + altitude + terrain + visible transmitters = a different RF combination



Assessing a single point does not describe the operation. It describes one instant of it.

The operational gap

Aviation maintains operational awareness of almost everything that shapes its mission, yet it usually has no continuous picture of the radio environment

Complementary responsibilities

WRC-23 · Resolution 676
INSTITUTIONAL COLLABORATION

The regulator administers the resource. Aviation is accountable for service continuity.
Both need the same technical evidence.

National spectrum administration

- ✓ Allocation
- ✓ Assignment
- ✓ Licensing
- ✓ Inspection
- ✓ Control

MANAGES THE RESOURCE
Regulatory framework · oversight · measures

MEASURE · SIMULATE · UNDERSTAND

SHARED TECHNICAL EVIDENCE

Measurement · simulation · characterization
traceability · operational context

Aviation authority / ANSP

- ✓ Operational continuity
- ✓ Availability
- ✓ Integrity
- ✓ Operational safety
- ✓ CNS performance

PRESERVES THE MISSION
Continuity · integrity · safety

The aviation authority does not need to replace the regulator.
It needs **its own continuous knowledge** of the spectrum that supports its mission.

The mandate is already in place

FROM STANDARDS TO OPERATIONAL CAPABILITY

SAFER
AVIATION
A MORE
CONNECTEDWORL
D

14th Air Navigation Conference · Rec. 2.2/2

- Implement effective measures to mitigate interference to GNSS.
- Develop regional reporting mechanisms.
- Raise operational awareness of the affected areas.

42nd Assembly · WP/108 and Resolution 42-8

- Develop interference detection systems.
- Ensure that the spectrum of CNS systems, and of GNSS in particular, is free from harmful interference.
- Provide operators with timely and operationally relevant information.

Document	What it requires
Annex 10	Protect the aeronautical bands
Rec. 2.2/2 · 14th ANC	Detect and report
Resolution 676 · WRC-23	Regulator and aviation collaborate
Annex 19 · Doc 10159	Manage the risk

RESILIENT
AIR
SPACE
SAFER
OPERATIONS

The need is already recognized. **The challenge now is to turn the mandate into operational capability.**

ICAO

UNITING AVIATION
FOR A SAFER
AND MORE SUSTAINABLE
WORLD

From recommendation to practice

How to leverage the latest technology to begin building this **operational capability.**

ICAO Workshop · Lima, Peru · 2026
TES Horizon attending as a guest

OSA – Operational spectrum awareness

Continuous, current and contextualized knowledge
of the real state of the spectrum that supports the aviation mission

Continuity.

Intermittent interference only appears in the continuous record.

Characterization.

Detecting is not understanding:
what it is, where it comes from, which service it affects.

Traceability.

The data must withstand third-party scrutiny.

Translation.

From the spectrogram to operational language.

It is not a sensor, a database or a measurement campaign.

A permanent operational capability.

Spectrum
operational intelligence

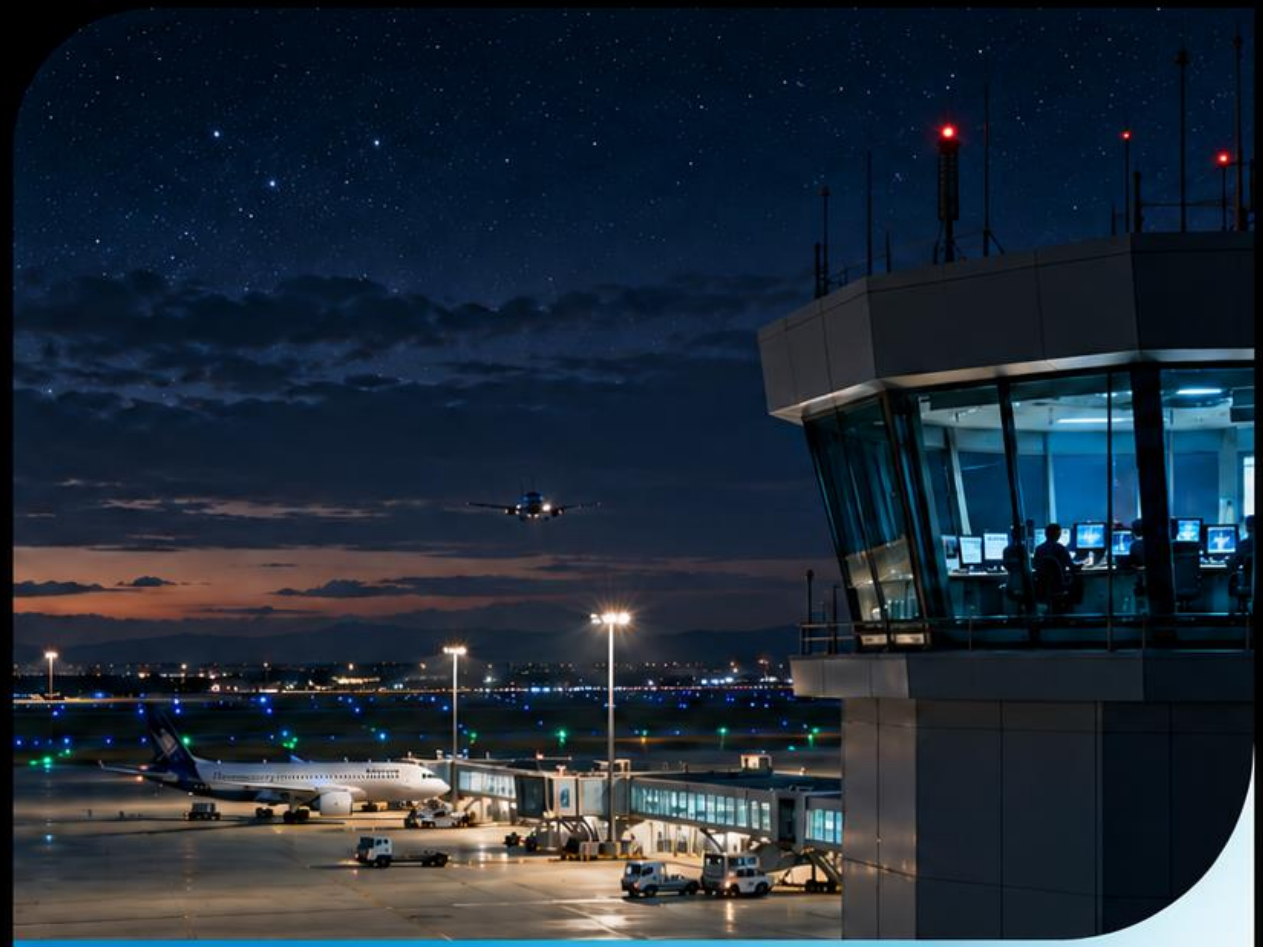
What it means: what is happening and what action it requires

Correlate, contextualize, analyze and assess.

Generate evidence that supports institutional decisions.

Awareness answers what is happening. Intelligence answers what it means.

It does not decide autonomously and does not replace the specialist.



The decision always remains with the competent authority.

FROM REACTING TO INTERFERENCE TO MANAGING THE ENVIRONMENT PREVENTIVELY

Observation, simulation and shared evidence make it possible to act across different horizons

EX POST

1

What caused this interference?

Diagnosis and traceability

CONTINUOUS

2

What is happening right now?

Alerts and online access

EX ANTE

3

What could happen if the environment changes?

Preventive simulation

SHARED EVIDENCE

4

What do aviation and the regulator need to coordinate?

Evidence-based decision

NEW FM STATION — Can it generate intermodulation products over COM/NAV?

NEW 5G TOWER — Can it alter compatibility around an airport or navigation aid?

Observation knows the present · Simulation explores the future · Operational intelligence unites both

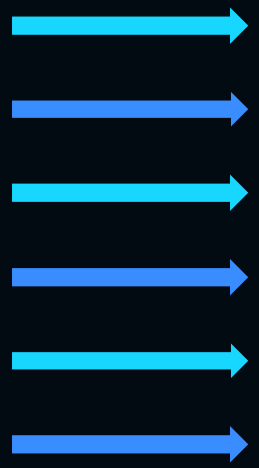
WHAT WAS ONCE IMPRACTICAL IS NOW COMPUTABLE

Computing power changes the scale of the aeronautical spectrum problem

MILLIONS

of RF scenarios

Hundreds of signals · multiple transmitters · flight paths · altitudes · terrain · diffraction



CLOUD COMPUTING

It turns combinations that cannot be evaluated manually into preventive simulations executed in seconds.

Technology changed the scale of the problem

It is now possible to identify complex FM interference in advance and to assess the potential impact of new infrastructure, such as 5G towers.

TODAY WE CAN MAKE THE INVISIBLE OBSERVABLE

Technological convergence builds an operational representation of the radio environment

DIGITAL

DIGITAL TWIN

Terrain, infrastructure, transmitters, airports, routes and navigation aids.

RF

RADIO PROPAGATION

Calibrated models of terrain, diffraction and RF behavior.

CLOUD

MASSIVE COMPUTING

Millions of calculations and scenarios executed automatically in the cloud.

DB

AUTHORIZED ENVIRONMENT

Assignments, frequencies, sites and known infrastructure.

SENSOR

CONTINUOUS OBSERVATION

Distributed sensors with high performance and a cost compatible with wide-scale deployment.

AI

MACHINE INTELLIGENCE

Correlation, classification, alerts, prioritization and clear reporting.

SIMULATE THE EXPECTED + OBSERVE THE REAL + KNOW THE AUTHORIZED

TECHNOLOGY ALONE IS NOT THE SOLUTION

Expert knowledge integrates these capabilities into a decision-oriented operational chain

MODEL
Build the digital twin

SIMULATE
Compute propagation and risk

OBSERVE
Measure continuously and in real time

FUSE
Cross authorized, expected and real

UNDERSTAND
Determine source and impact

ANTICIPATE
Assess before the event

DECIDE
Deliver evidence to the authority

MEASURING IS NOT UNDERSTANDING

Intelligence emerges when measurement is placed in context with the model, the assignments and the risk to the aeronautical service.

The decision remains with the authority and the specialist

TES SkyNav

The technological materialization of OSA and OSI for the aeronautical environment

SOPHISTICATED YET SIMPLE

SIMULATE | OBSERVE | UNDERSTAND | ANTICIPATE | EVIDENCE

Digital twins · RF simulation · Assignments · Continuous monitoring · Real time · AI

More than 25 years of TES experience
RF engineering · Cloud + Edge · Automation + AI

TES SkyNav: WHAT IT IS AND WHAT IT IS NOT

A clear operational boundary prevents confusing spectrum awareness with control of air operations

IT IS

OSA + OSI CAPABILITY (intelligence)

It makes the RF environment observable and turns it into operational intelligence.

INTEGRATING PLATFORM

It brings together digital twin, simulation, assignments, continuous measurement and real time.

EVIDENCE TO ACT ON

It generates alerts, analysis and traceable reports for aviation and the regulator.

CONNECTING LAYER

It integrates with existing systems and sensors and extends their value.

IT IS NOT

IT IS NOT ATC

It does not control aircraft, routes, separation or air traffic.

IT DOES NOT DECIDE AUTONOMOUSLY

The authority and the specialist retain the decision and the responsibility.

IT IS NOT MONITORING ALONE

Measuring spectrum without context, simulation and assignments does not produce OSI.

IT DOES NOT REPLACE CURRENT SYSTEMS

It connects them, enhances them and builds shared evidence.

SkyNav supports the decision: it does not replace the authority

Know. Understand. Anticipate.

Service continuity cannot depend solely
on someone reporting an interference.

Aviation made aircraft, airports and airspace observable.
The next domain that must become observable is the spectrum.

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