

# Maximising the benefits of digitalisation in ATM

Thursday 29 April 2021

13:00 – 14:45 CEST

# Moderator



Eduardo Garcia

Manager European ATM  
Coordination & safety

CANSO



Torbjørn Henriksen,  
Operational Solution Manager  
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Programme  
Avinor Air Navigation Services



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Product Advisor for Tower  
Systems  
Indra



José Alberto Delgado  
Principal Architect (Air Traffic  
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Head of the Communications  
Division  
ENAIRES



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iTEC Systems Architect (Air  
Traffic Management – Air Traffic  
Control systems)  
Indra



Michal Kadlec,  
Product Manager AIM  
Indra Avitech



Dr. Tsvetan Penev  
Head of Product Management  
and SWIM Product Manager  
Indra Avitech

# Integrating digital and remote tower systems

# Speaker



Torbjørn Henriksen,  
Operational Solution Manager in the  
Remote Tower Programme

Avinor Air Navigation Services



# Towards a Digital ATM

Avinor ANS – our perspective

Torbjørn Henriksen  
Operational Solution Manager  
Avinor ANS - Remote Tower Programme



# Digital ATM – what about the Tower?



Getting from here....

To here....

Why and how?





# The WHY... and the HOW...

## GOALS

- Reduce future investments
- Reduce operational cost
- Flexible service delivery to airport customers

## ENABLERS

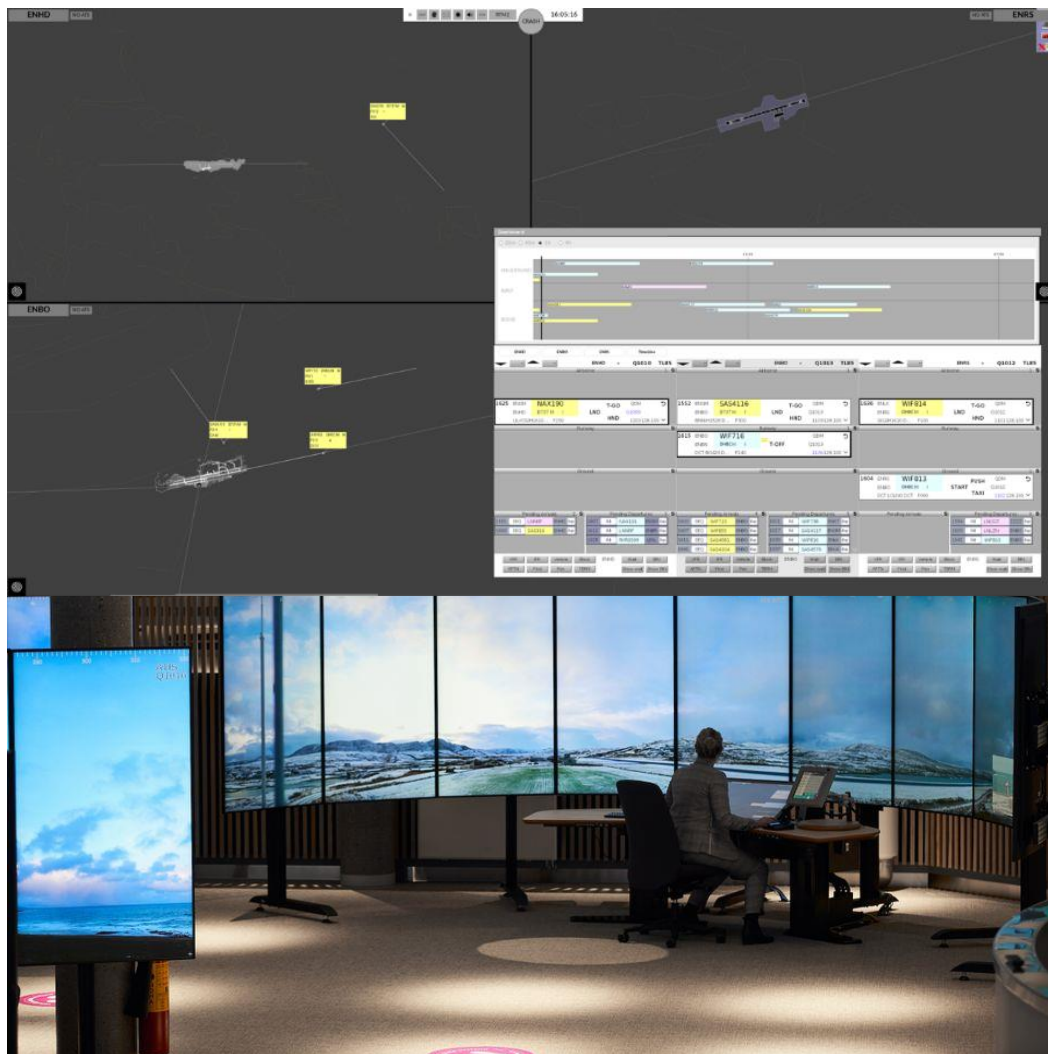
- More digital solutions – fewer buildings
- Standardisation of technology and systems
- More flexible rostering
- Multi airport service provision



## Traditional constraints...

- Multitude of legacy systems
- Airport specific differences
- Unit specific differences
- Variations in interfaces and HMI

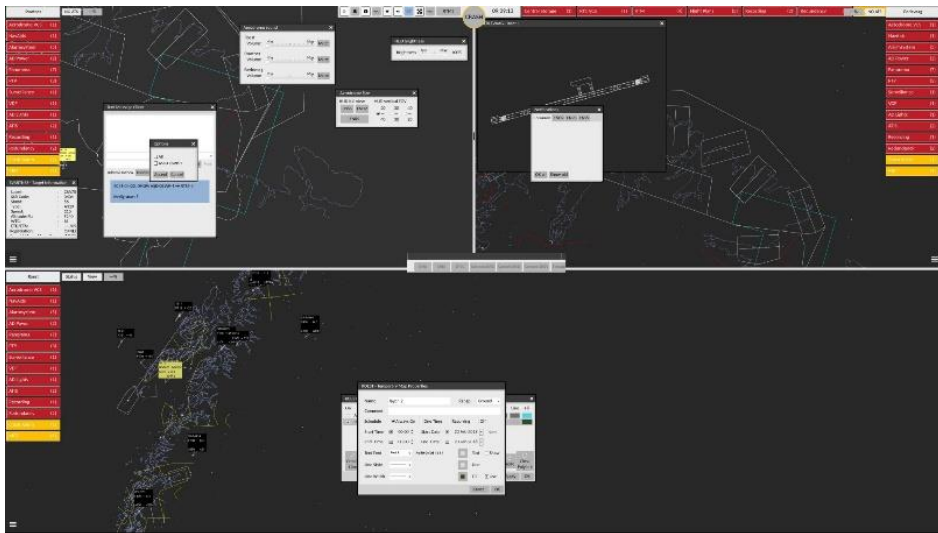
# Removing traditional constraints?



- 16 WP's for 15 airports – same layout
  - Removing old legacy systems
  - Airport/Unit differences - same basic HMI
  - EFS and surveillance – same system for all
  - Flexibility – all WP's facilitate all roles
- Single operation
- Two or three airports in multiple operation

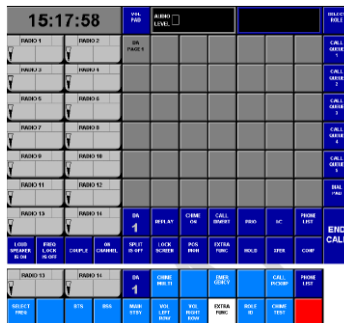
# Functional scopes

- Electronic Flight Strips
- Traffic Situation Display
- Aerodrome Lights, Nav aids, Power
- Weather sensors
- AWOS/ATIS
- System Operation (cameras, display, zoom)
- Alarm System (Aerodrome/Centre)
- Voice Communication System



Integrated workstation

Voice  
Communication  
System Panel



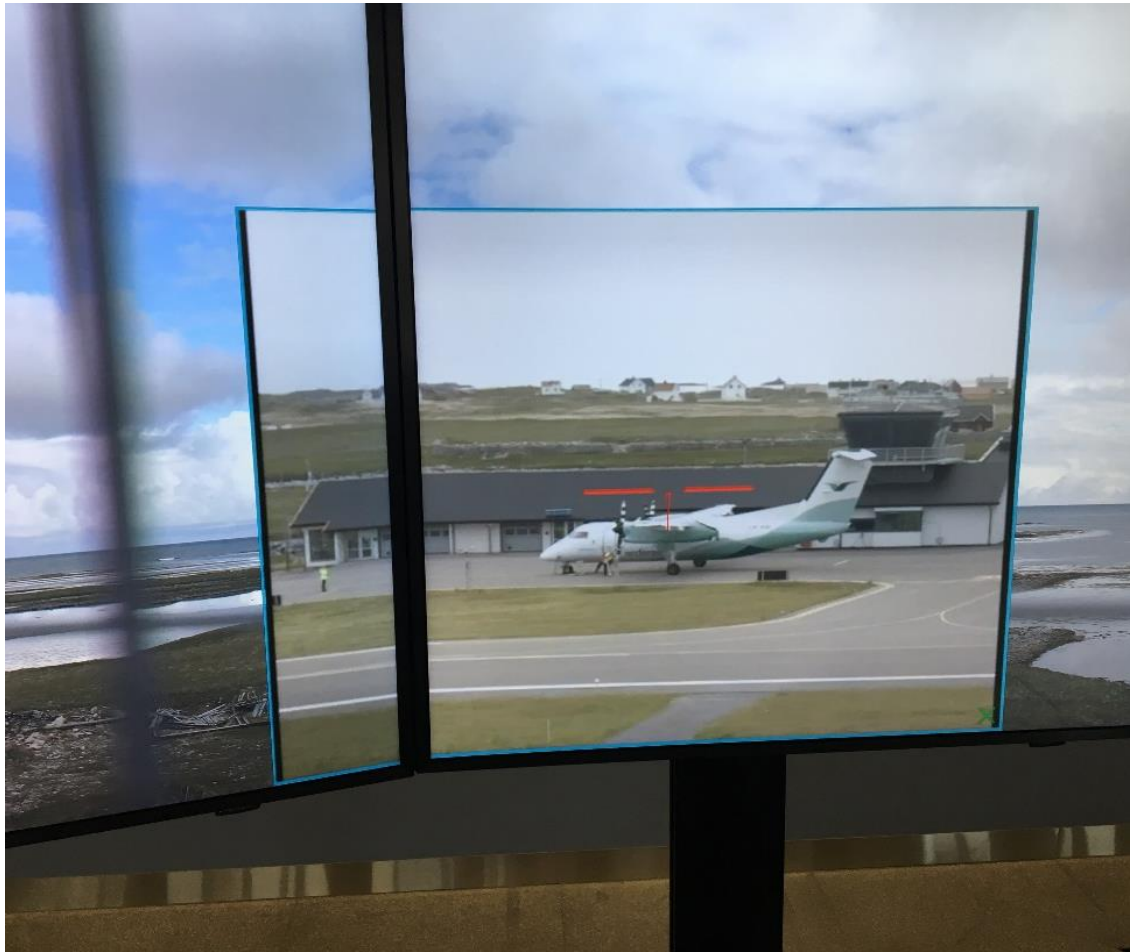




# Achieving cost-benefits

- Multiple aerodrome endorsements for each individual
  - More flexibility – also in single mode
  - Enabler for multiple mode
- One Unit Training Plan - as few local differences as possible
- Same tools and basic HMI for all aerodromes
- Common Unit Operational Procedures as far as possible

# Opportunities



- Availability of surveillance data (ADS-B/WAM/LAM)
- Ground surveillance at smaller airports at a reasonable cost?
- Datalink Communication
- More automation (Auto-METAR/ATIS, Safety Nets)
- Artificial Intelligence



Thank you for your attention

# Integrating digital and remote tower systems



# Speaker



David J. Roberts  
Product Advisor for Tower Systems

Indra

# Maximising the benefits of digitalization

Integrated working positions



# Why integration?



# Why integration?

- Too many displays, keyboards and mice...
- Trend to smaller towers or no tower at all...
- Information in the wrong place...
- HMI harmonization
- Costs





# Integration – nothing new

- Since early 2000
  - ATM + A-SMGCS
- Same servers
- Savings on:
  - Space
  - Interfaces
  - Maintenance and configuration costs



Display Maps Windows Colours Target Radar RIMCAS AFDS User

AIR GMC LPO Inset Inset Inset Inset O9R 27L 09L 27R GP Distance Quick Bow Rayth Deb NOOD

Map data: 29 May 2016

Target Information

Label: BAW44BK  
SSR Code: 5260  
Stand: 305R  
Type: A320  
Speed: 000  
Registration: GLEJN  
Mode S Callign: BAW44BK  
Flight level: AO01  
Mode S: 406674

	Arrival	Departure
AE66AV	A321M 0932	ACAS51 B788M 238 CYVC 0905
AIC131	B788M 0944	AMC101 A320M 421 LMNL 0950
BAW146	A321M 0945	DAL1 A320M 320 KJFK 0930
BAW23T	B772M 0933	DAL17 A320M 320 KDTW 0935
BAW393B	A320M FREE 0956	DLH5H A206M EDDF 0807
BAW537	A320M FREE 0937	DLH9AC A321M 220 EDDM 0955
BAW965	A320M FREE 0936	EIN5IL A320M 221 EDWW 0950
BC56718	A320M 0902	FIR2XR A320M 303 EPNN 0920
EWGAGC	A320M 226 FREE 0943	LOT282 B380M 219 EPNN 0915
JRA711	A306M 0955	MAS3 A320M 406 VMCK 0945
SHT3R	A321M FREE 0909	SAS804 B788M 223 ENGM 0920
SHT9Z	A320M FREE 0956	SZS9160 A206M ENSA 0935
SWR34E	A320M 219 FREE 0946	VIR103M A320M 319 KATL 1000

Inset 1

Windows:  
Main/Inset 1  
Ranges:  
1800m/15NM  
RIMCAS:  
OK / 27R 09L / 27L  
AFDS:  
Normal  
Visibility:  
09L 27L 09L 27R  
Profile:  
Air  
Radar selected:  
Raytheon

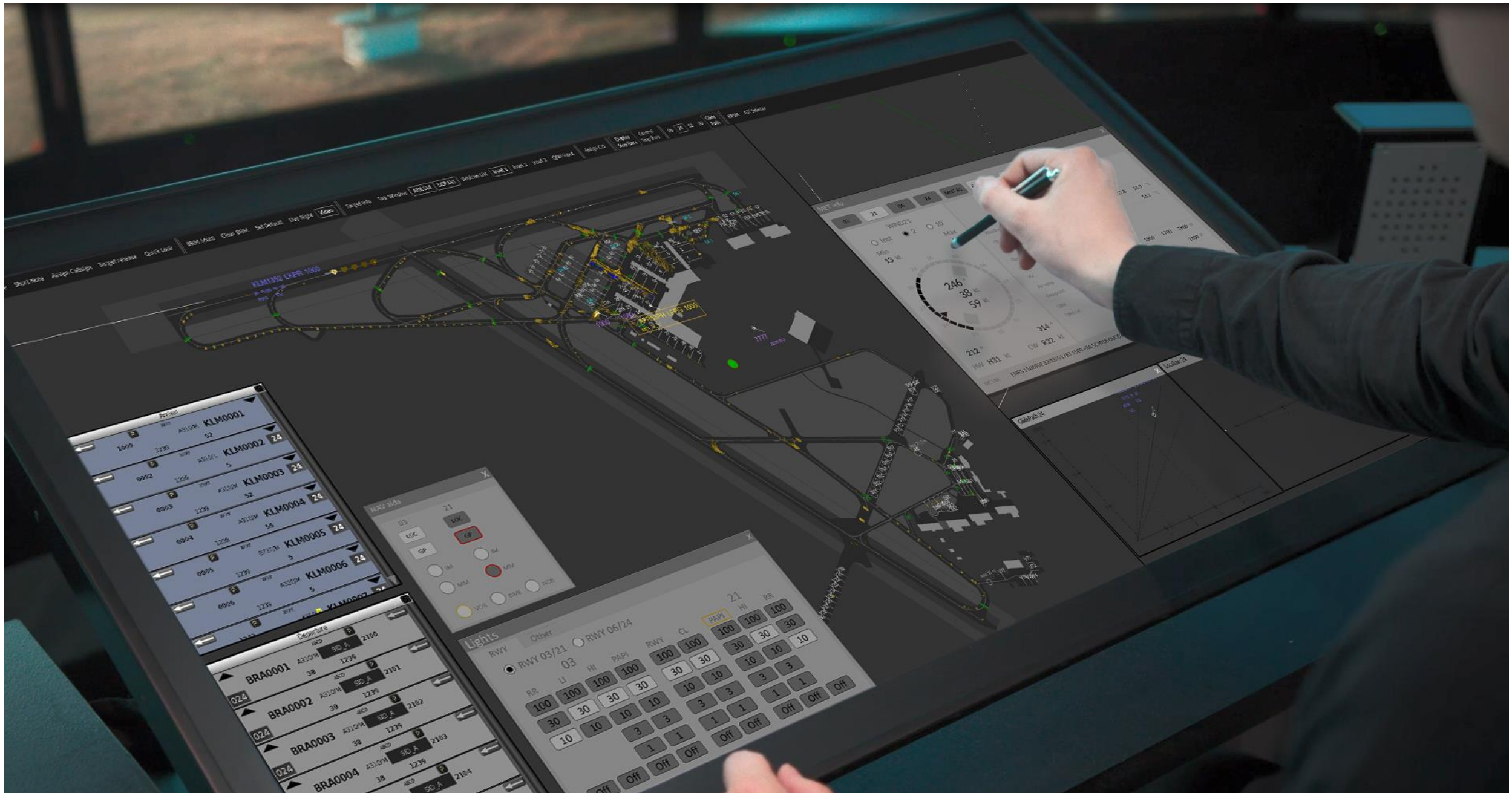
# Integration – future trends

- Monitoring
- Met
- AGL
- Information

The screenshot displays a flight simulator interface with several panels:

- MET Info:** Shows wind data for WIND21 and WIND03, and ground conditions. It includes a METAR display area.
- Lights:** A panel for configuring runway lights. It shows settings for RWY 03/21 and RWY 06/24, including RR, LI, HI, PAPI, and CL lights. The PAPI for RWY 03/21 is highlighted.
- Document viewer:** Displays a document titled "Bodø" and a "Document viewer" window showing a "BODØ INSTRUMENT APPROACH CHART - ICAO PLAN VIEW SCALE: 1:350 000". The chart includes various navigation aids and runway information.
- NAV aids:** A panel for configuring navigation aids. It shows settings for LOC, GP, IM, MM, VOR, DME, and NDB. The GP (Glide Path) is highlighted.







**indra**  
At the core

# Maximising the benefits of digitalisation in ATM

# Virtualization ATM and cybersecurity

# Speaker



José Maria Caro  
iTEC Systems Architect  
(ATM – ATC systems)

Indra



# Digitalisation of ATM – Virtualisation and Cybersecurity



# Advanced ATM Architectures



Airspace Architecture Study (**AAS**) envisages using latest technologies and architectures to provide **resilience** and a more **flexible** provision of ATM service

Efficient **adaptability** and **scalability** to evolving needs

## Technologies

Virtualization and Multi-cloud-ready

Standardization / ATM as a Service

Cyber-resilience

## Benefits

Balance service model to demand

Efficiency / rationalization of investments

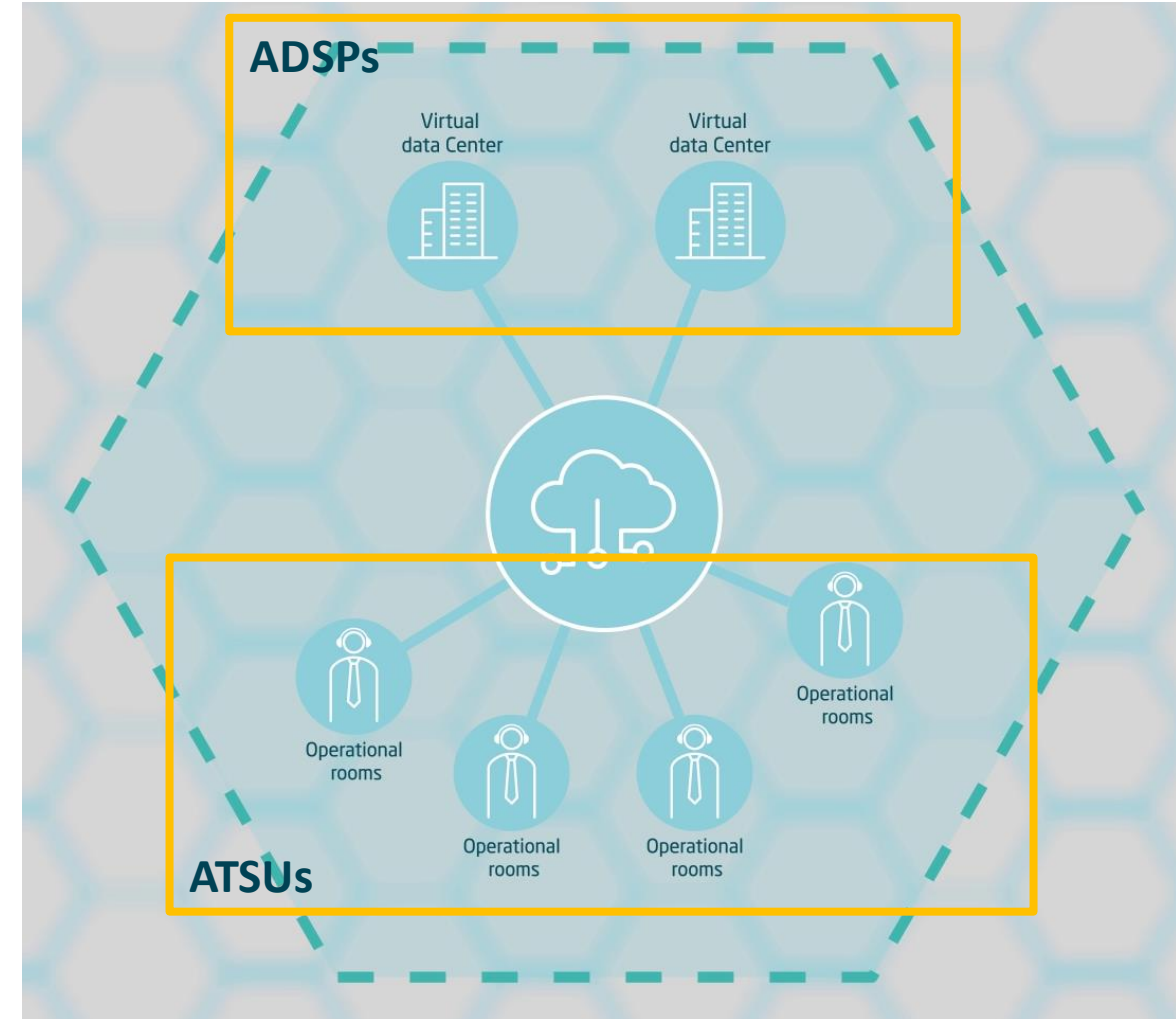
New Service and Business models

# Geo-Redundant Virtualised Data Centres (GVDC)

**Geographically unconstrained** ADSPs, decoupled from the location and the number of ATSUs

Main features:

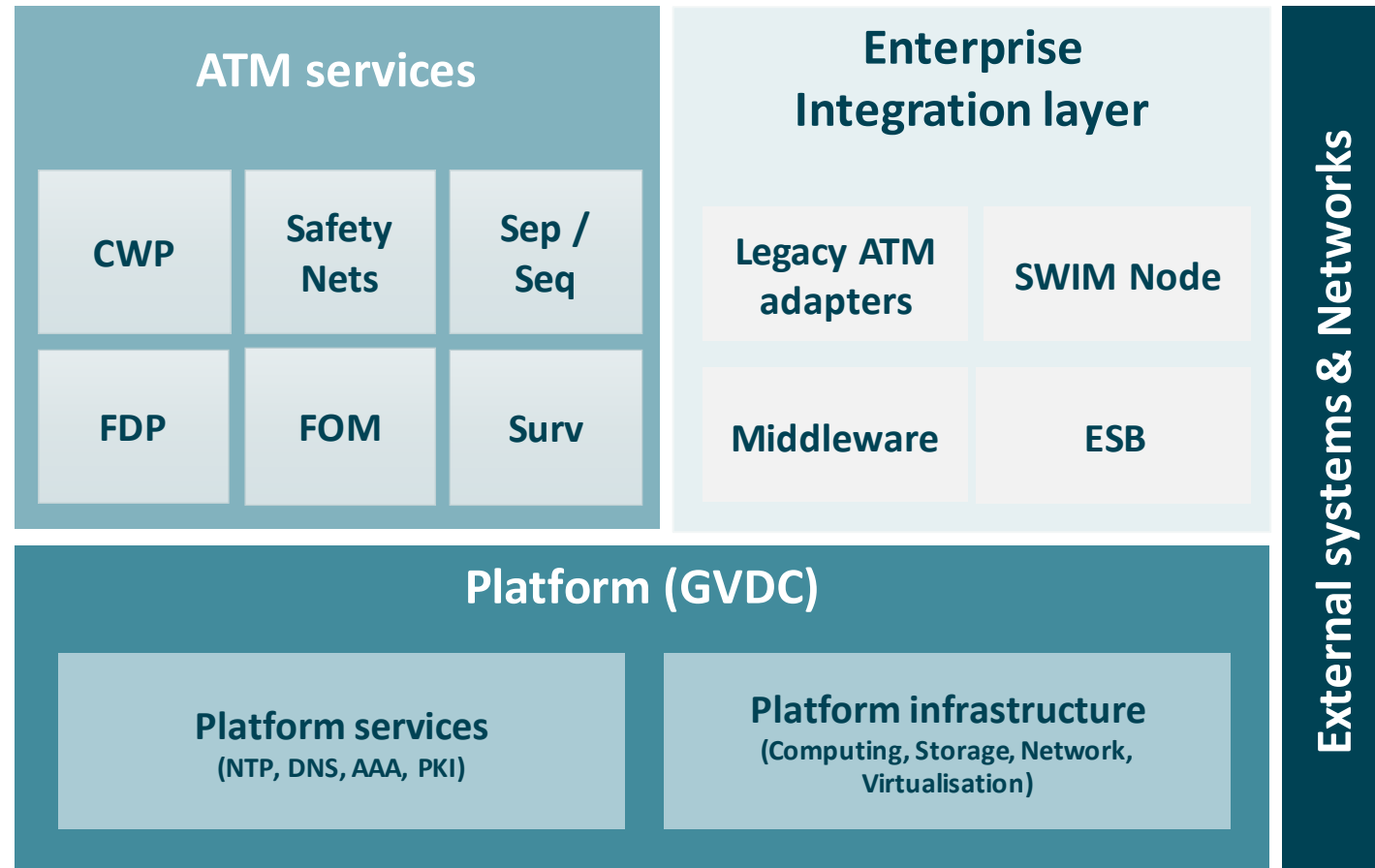
- **Virtualisation:** reducing environmental footprint
- **Automation:** optimising operational and maintenance costs
- **Scalability:** Dynamic and flexible provisioning
- **HMI remoteness:** provision of B2C services from data centres (ADSP) to end users (ATSUs)



# Service Oriented Architecture

**Service Oriented Architecture** approach at different layers:

- System Deployment based on **IaaS / PaaS** approach
- **ATM information** services provided on **SWIM** standards (i.e. FIXM/AIXM/iWXXM) and **ICAO** format specifications





# Short and Medium Term steps



iTEC V3

## Technological Enablers

Hybrid Cloud

Technology stack evolution

Technology for Virtual Centres

## Initial steps to realise the envisaged benefits

PoC  
Azure



Multi training environment  
ATC Validation and evaluation  
Testing and development

Web  
technologies



Microservices &  
containers

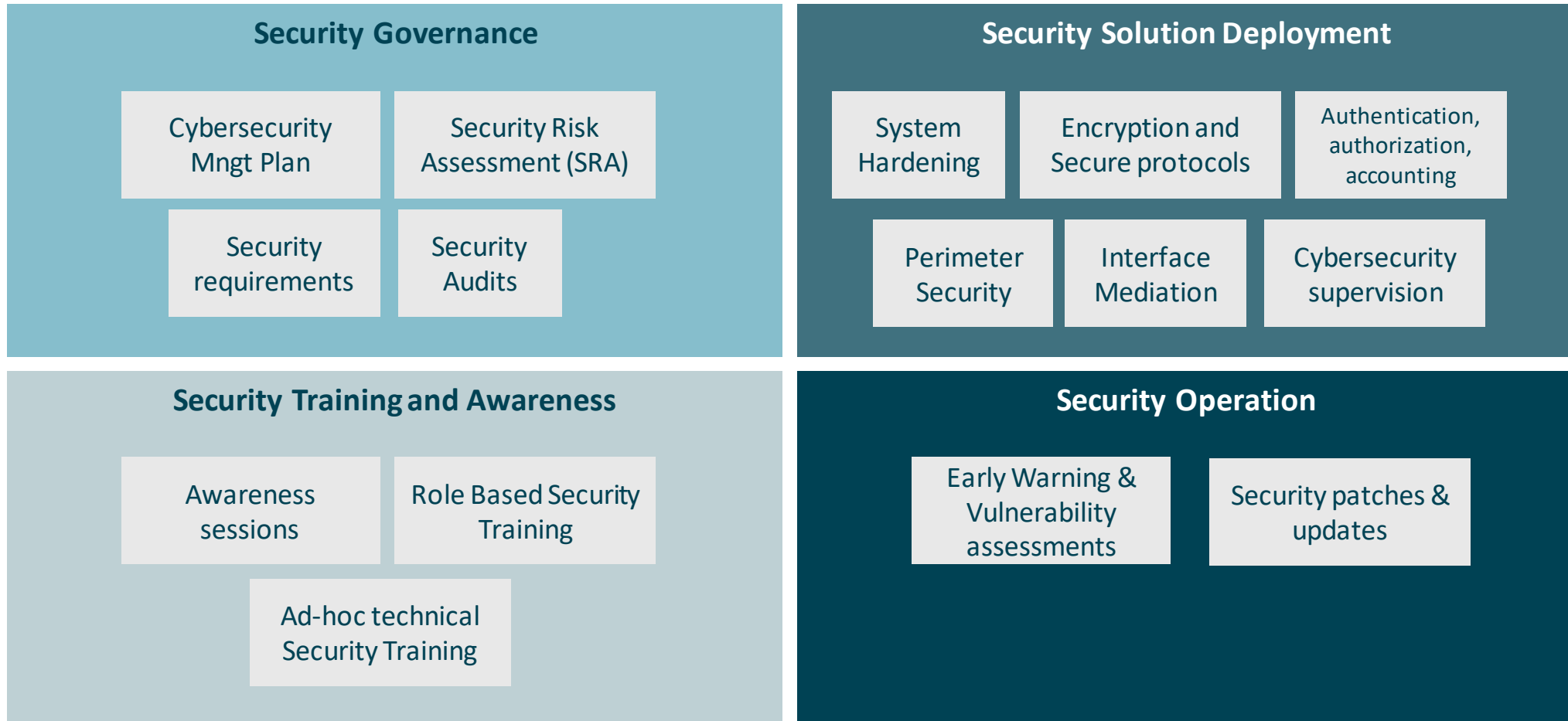
Technology for  
Virtual Centres



Services  
Standardization

# Cybersecurity

**Comprehensive** approach aiming to ensure confidentiality, integrity, and availability of information





# Maximising the benefits of digitalisation in ATM



# Indra voice IP solutions

# Speaker



José Alberto Delgado  
Principal Architect  
(ATM – VCS)

Indra

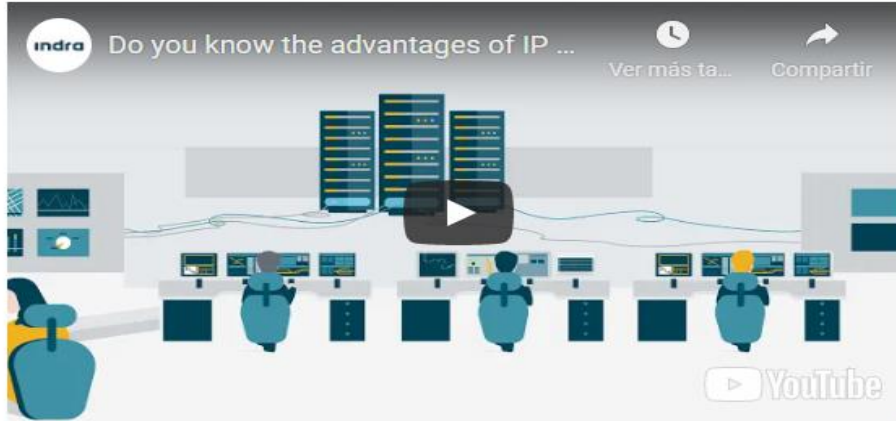
# Digitalization of ATM – Voice Communications



April 2021



# Why IP voice?



Voice communications are essential to the safety and efficiency of our airspace. However, voice technology and switching systems designed in the last century need to be upgraded to the future.

## The new IP architecture

An integrated voice service with the ATM data networks is key to increase network capacity and flexibility without compromising safety. It enables:



Unlimited and seamless scalability of the systems without necessity of wiring.



Interoperability between current stakeholders involved in the voice service, enabling future developments.



High availability and resilience, which facilitates the response in contingency scenarios.

## Becoming the sole transmission means:



Larger network capacity.

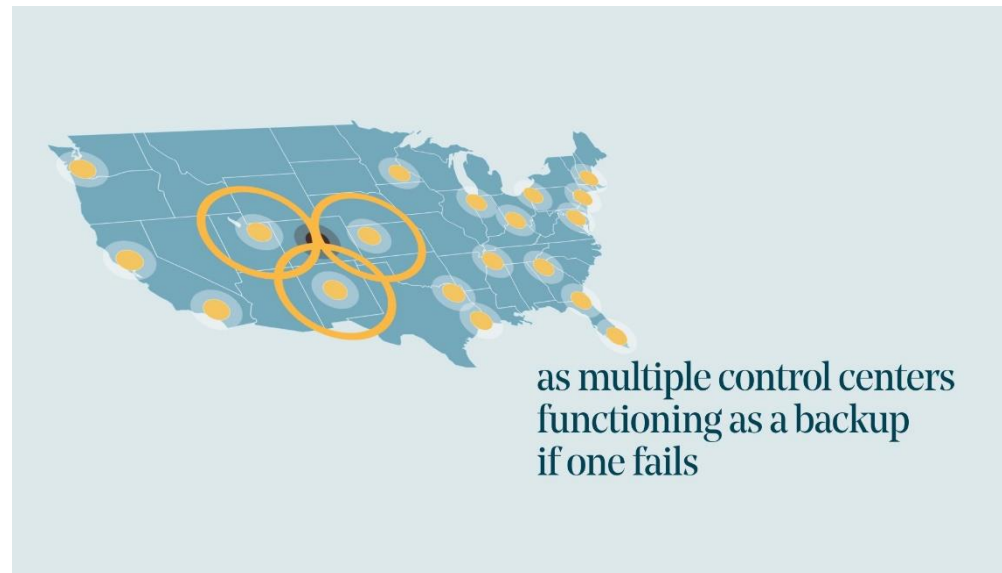
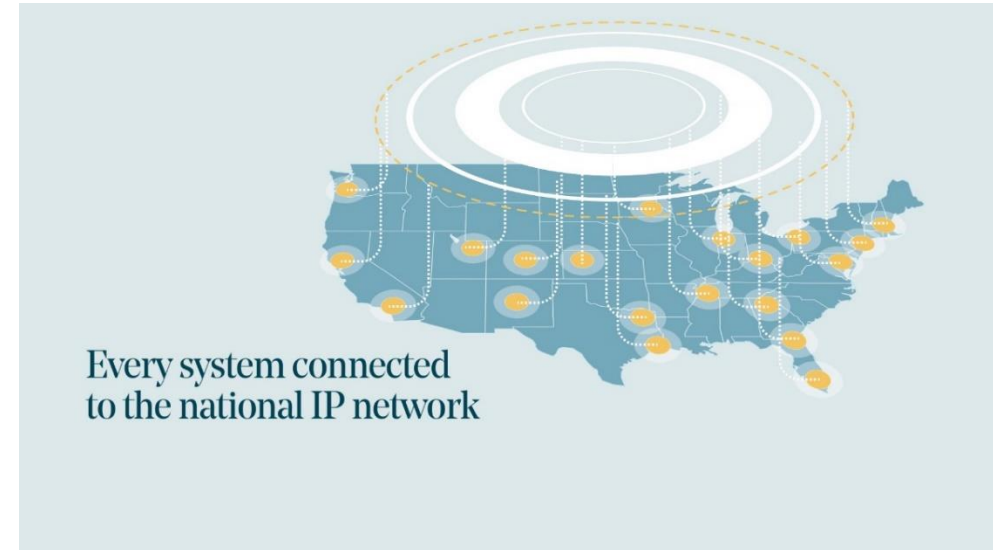
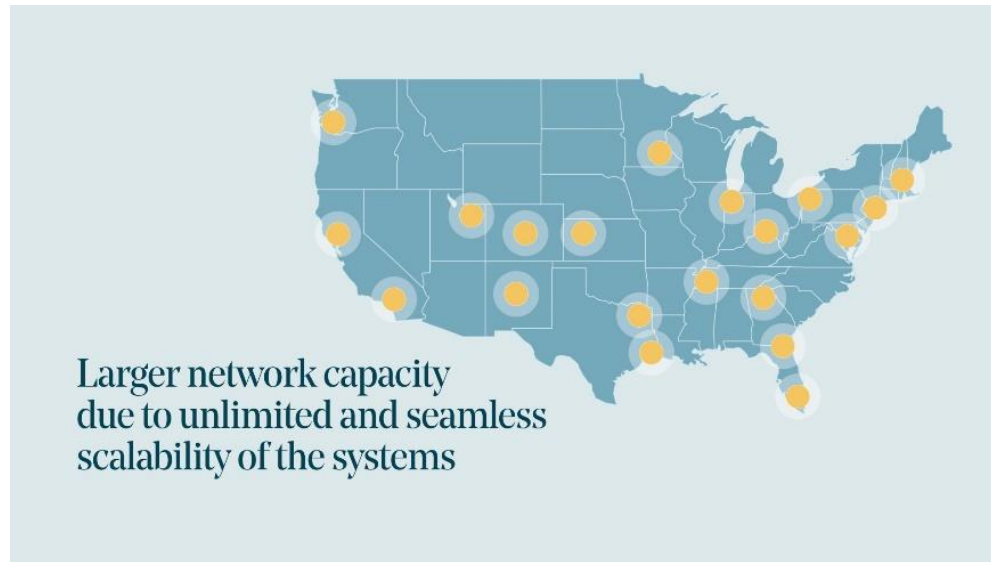


Every system connected to each other via IP network.

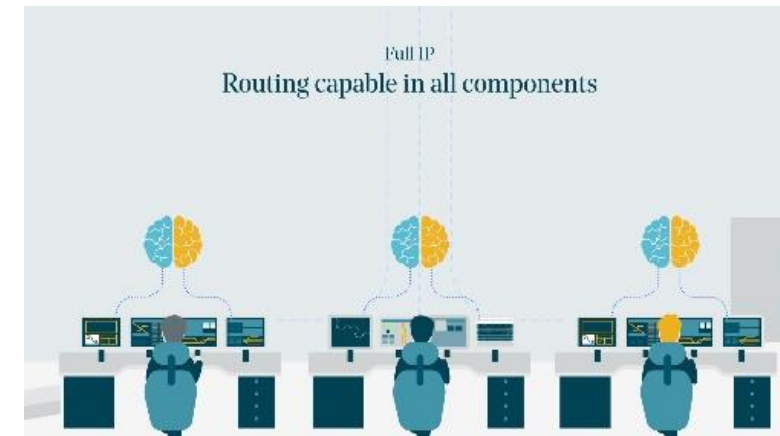
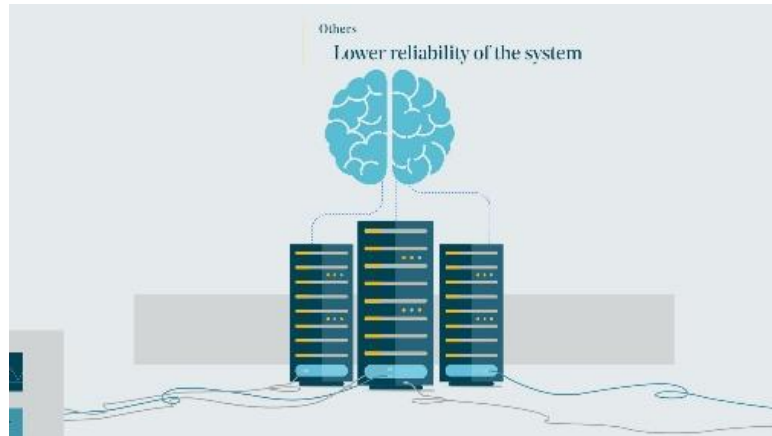


Multiple control centers can function as a backup if one fails.

# Benefits of full-IP voice switches



# Benefits of full-IP voice switches



# Benefits of full-IP voice switches





# Roadmap to the future

Creating today to be ready for tomorrow



## Fully integrated with ATC position

Simplify controllers workload by enabling a single integrated platform.



## UAV pilot communications

Improve the communication between the UAV pilot and ATC.



## Remote tower and Virtual Center

Increase efficiency through a Virtual Center solution.

Any question?



# Indra voice IP solutions

# Speaker



Manuel Garcia Martin  
Head of the Communications Division

ENAIRES



# VoIP deployment in ENAIRE

CANSO

**EN**AIRE 

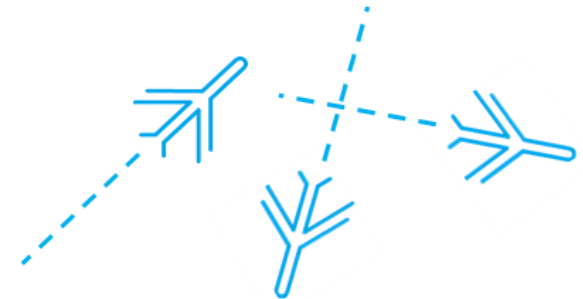
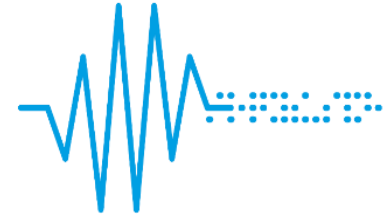
[enaire.es](http://enaire.es)



# VoIP benefits



- Digital technology, aligned with the state-of-the-art, and providing better voice quality.
- Better scalability and flexibility to cope with the capacity increase of ATS communications
- Decrease of exploitation costs and optimization of capacity/cost ratio

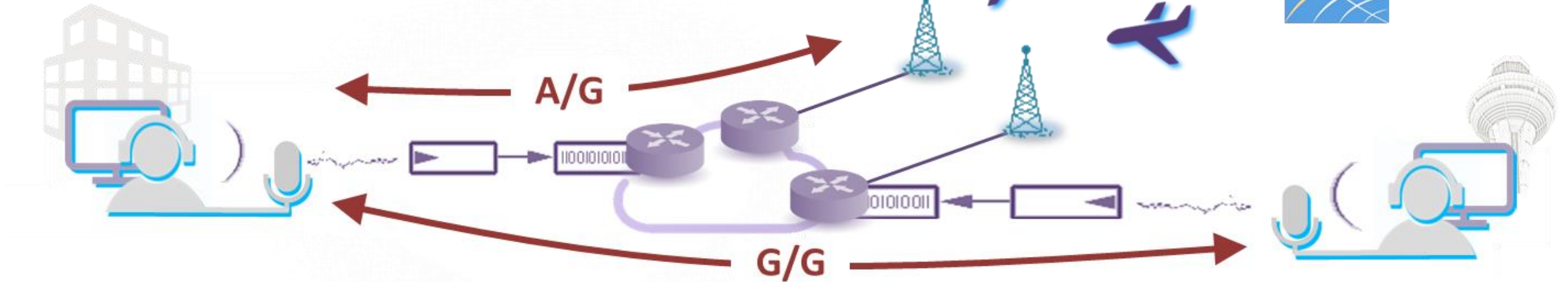


# VoIP scenario



- Use of **VoIP** protocol (radio and telephony)

Defined in EUROCAE WG67 standards



- Integrate all voice services in an **IP ground communication network**

- Native VoIP (final scenario)

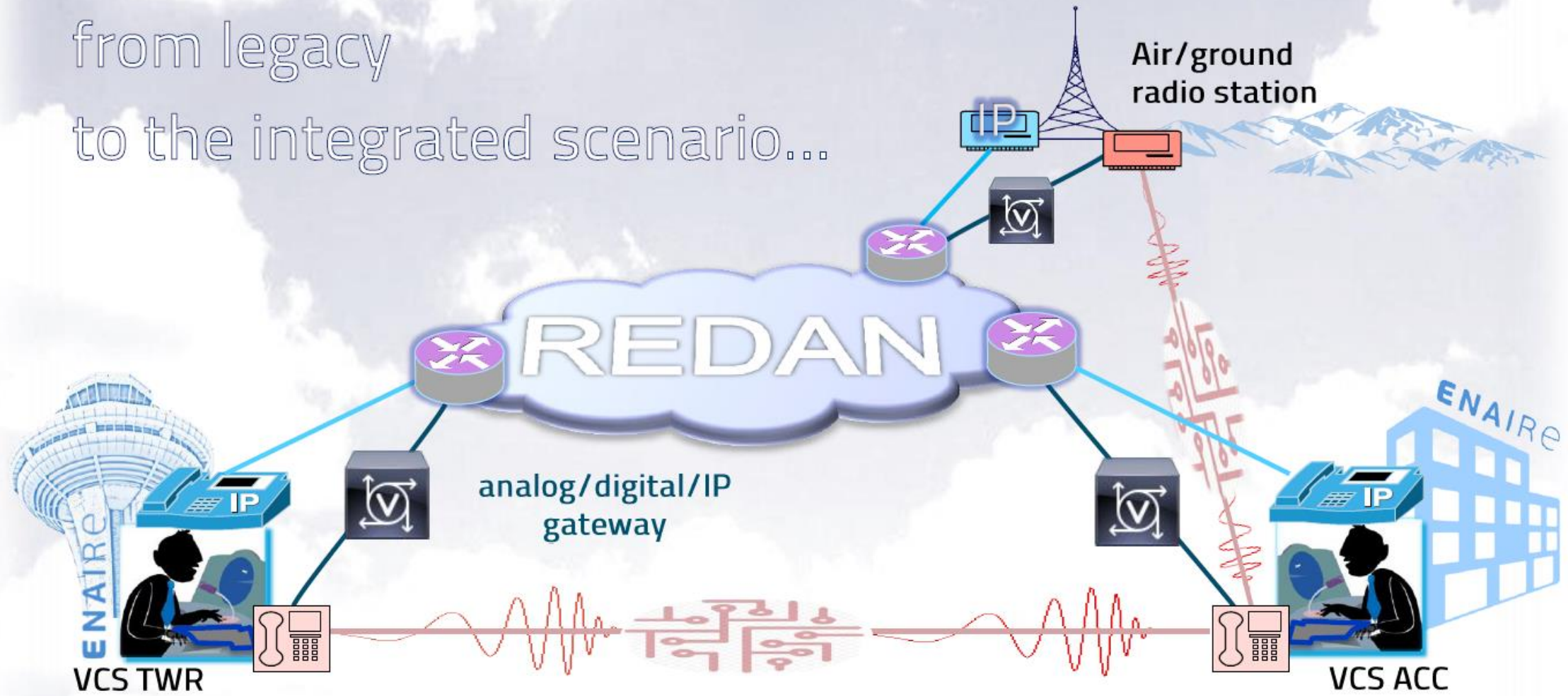
- Legacy protocols →

Gateways to convert legacy protocols to VoIP according to EUROCAE WG67 standards.

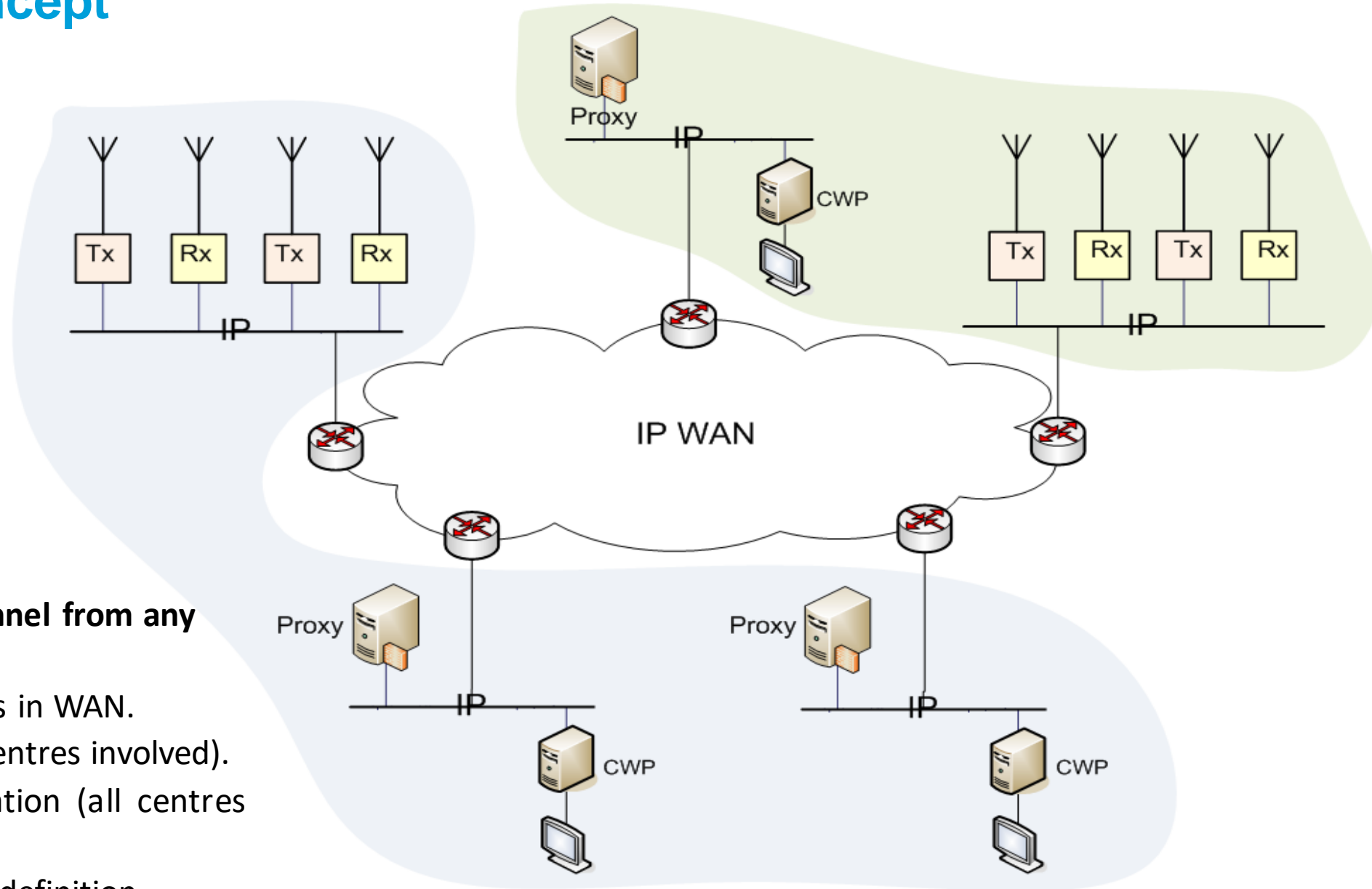
# VoIP: smooth and seamless transition



from legacy  
to the integrated scenario...



# Virtual VCS concept

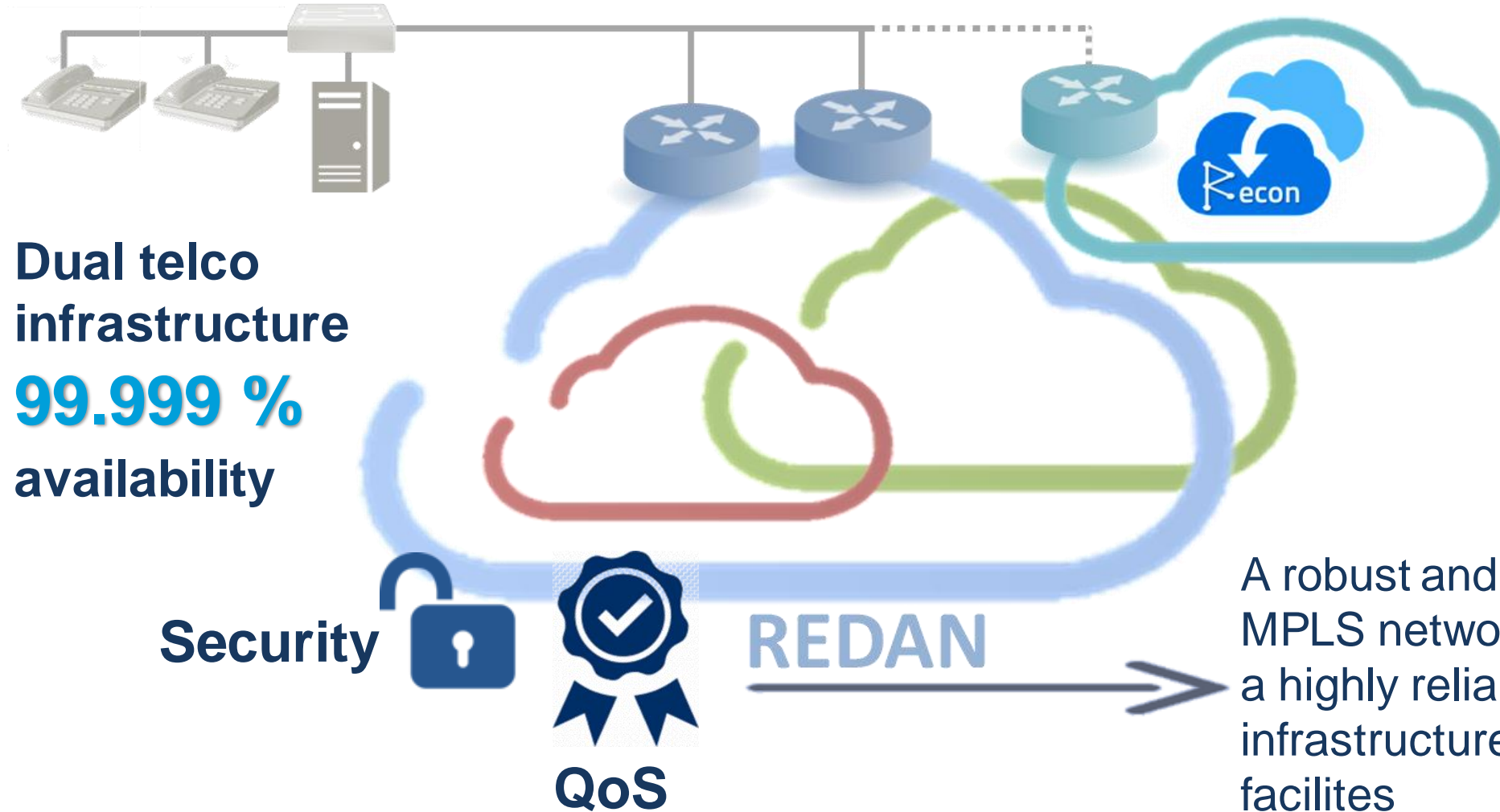


**Virtual VCS concept: “Any Channel from any Sector from any Centre”:**

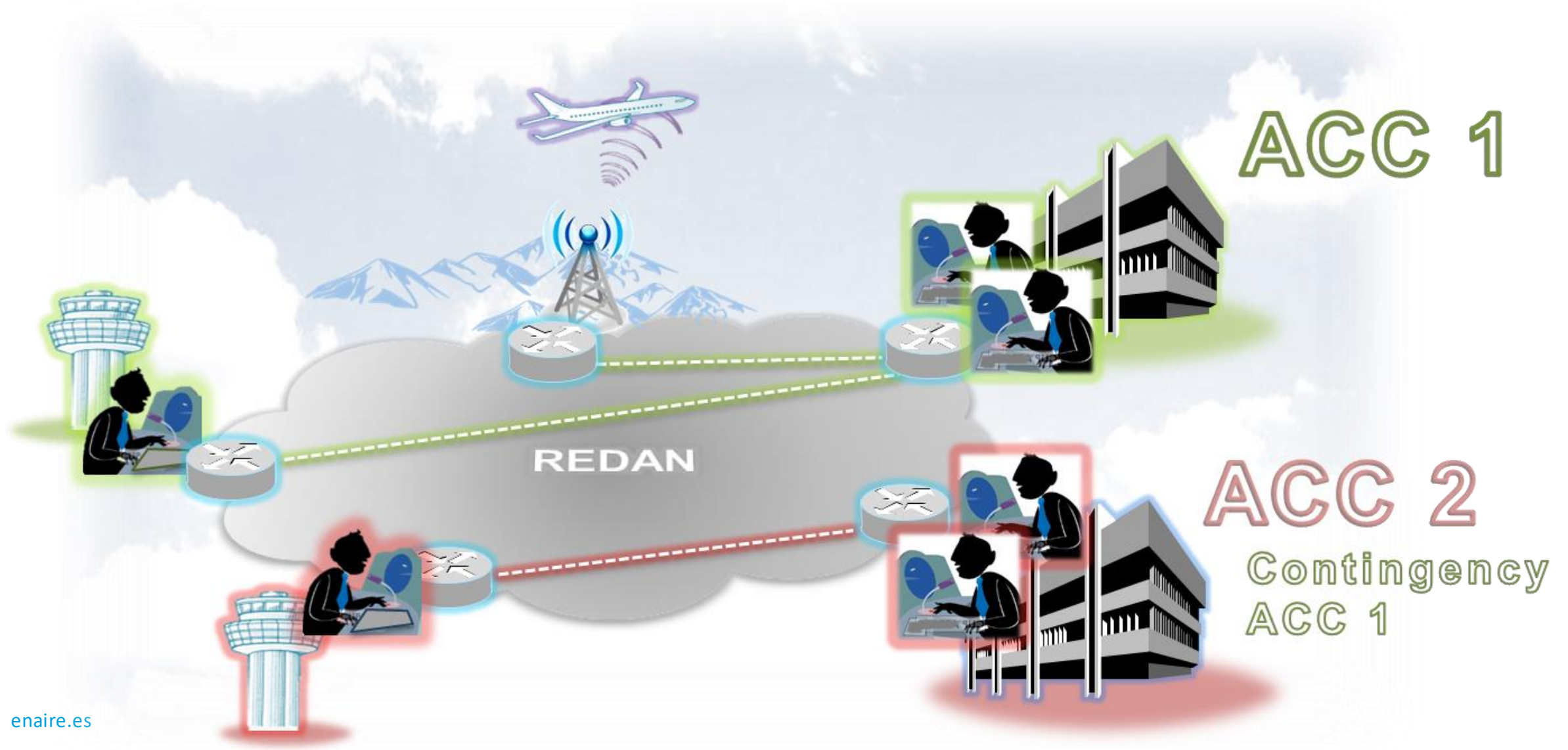
- Distributed VCS: VCS nodes in WAN.
- Global Configuration (all centres involved).
- Global on-line reconfiguration (all centres involved).
- On-line dynamic “sectors” definition.
- On-line resources allocation.



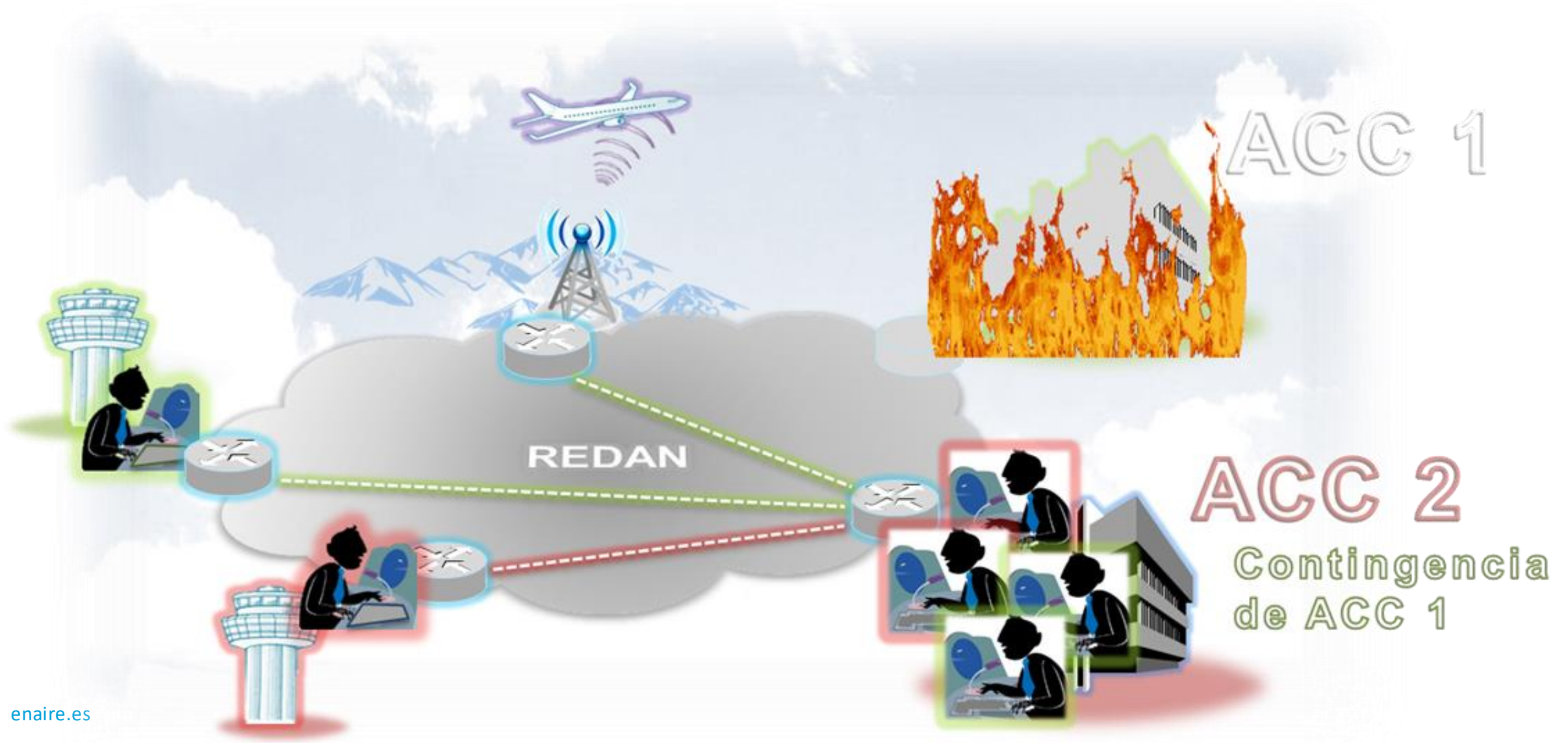
# REDAN: VoIP underlying transport network



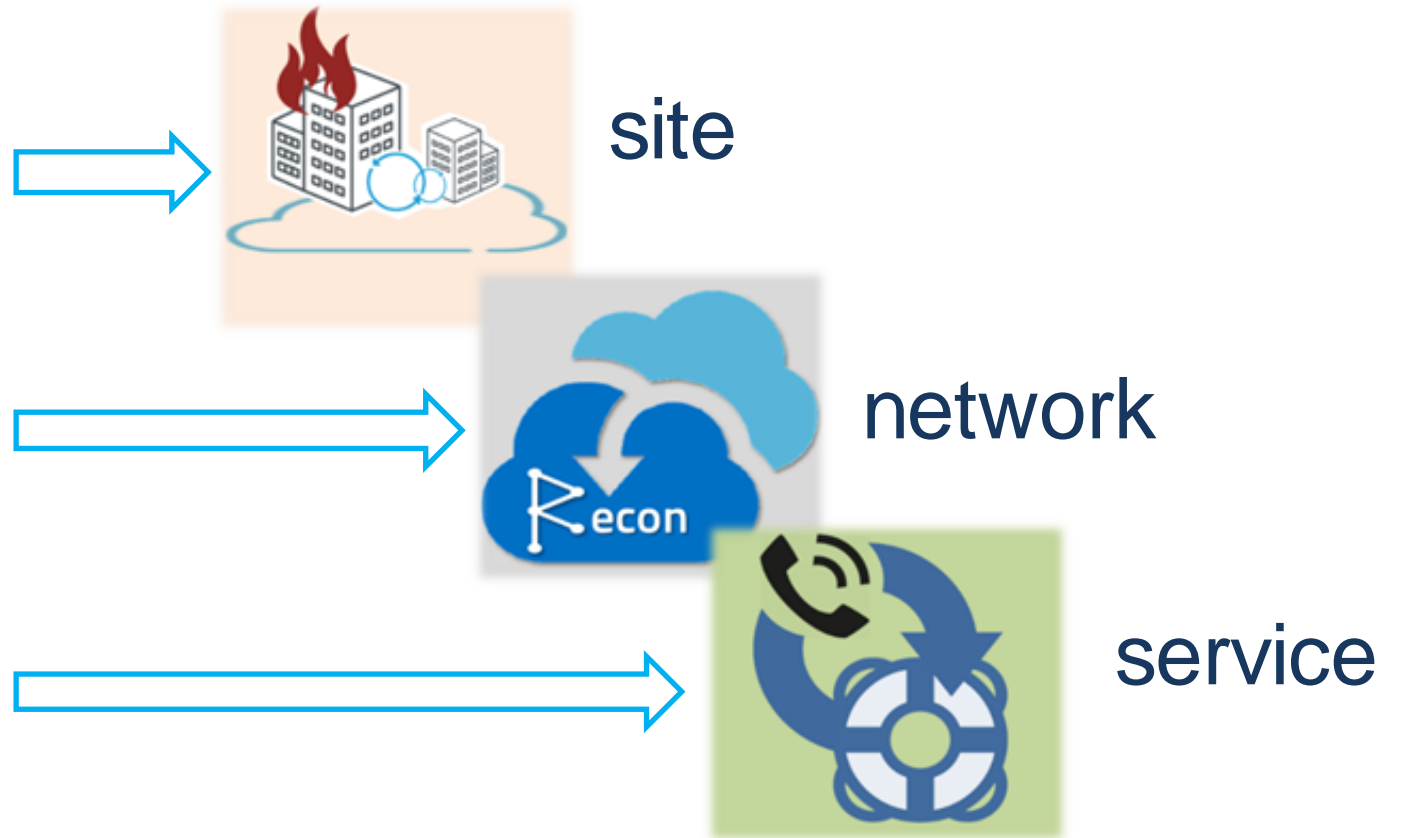
# An interesting VoIP use case: ATC contingency (1)



## An interesting VoIP use case: ATC contingency (2)



# ATC voice: multi-level contingency strategy





# Thank you





# Maximising the benefits of digitalisation in ATM

# Digital NOTAM and SWIM

# Speaker



Dr. Tsvetan Penev  
Head of Product Management and  
SWIM Product Manager

Indra Avitech

# System Wide Information Management (SWIM) and Digital NOTAM

Michal Kadlec – Product Manager AIM

Dr. Tsvetan Penev - Head of Product Management / SWIM Product Manager



# ICAO SWIM

SWIM consists of **standards, infrastructure and governance** enabling the management of ATM related **information** and its **exchange** between qualified parties via **interoperable services** [SESAR & ICAO].

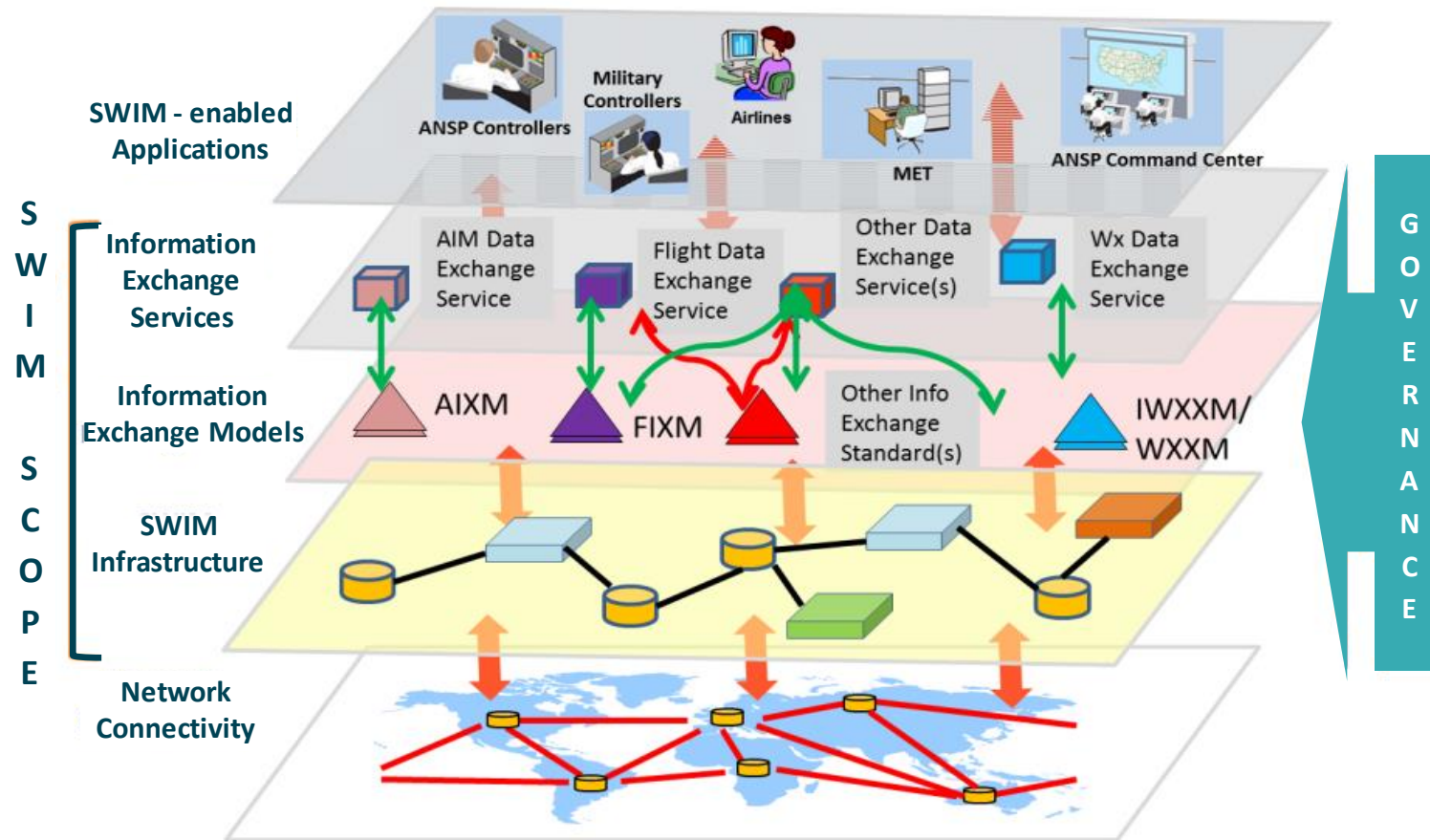
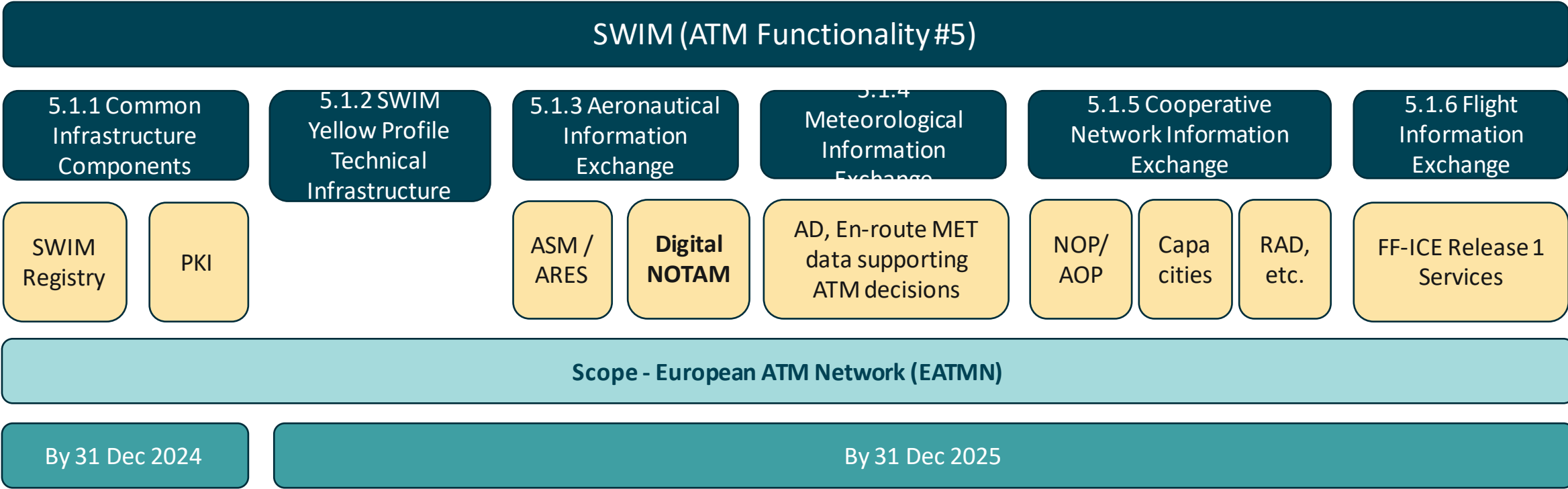


Figure: Global Interoperability Framework [Doc 10039]



# SWIM Rollout in EUROPE

- EU Reg 716/2014 - Pilot Common Project (PCP)
- EU Reg 116/2021 - Common Project 1 (CP1)



# EUROCONTROL Airport Data Toolkit

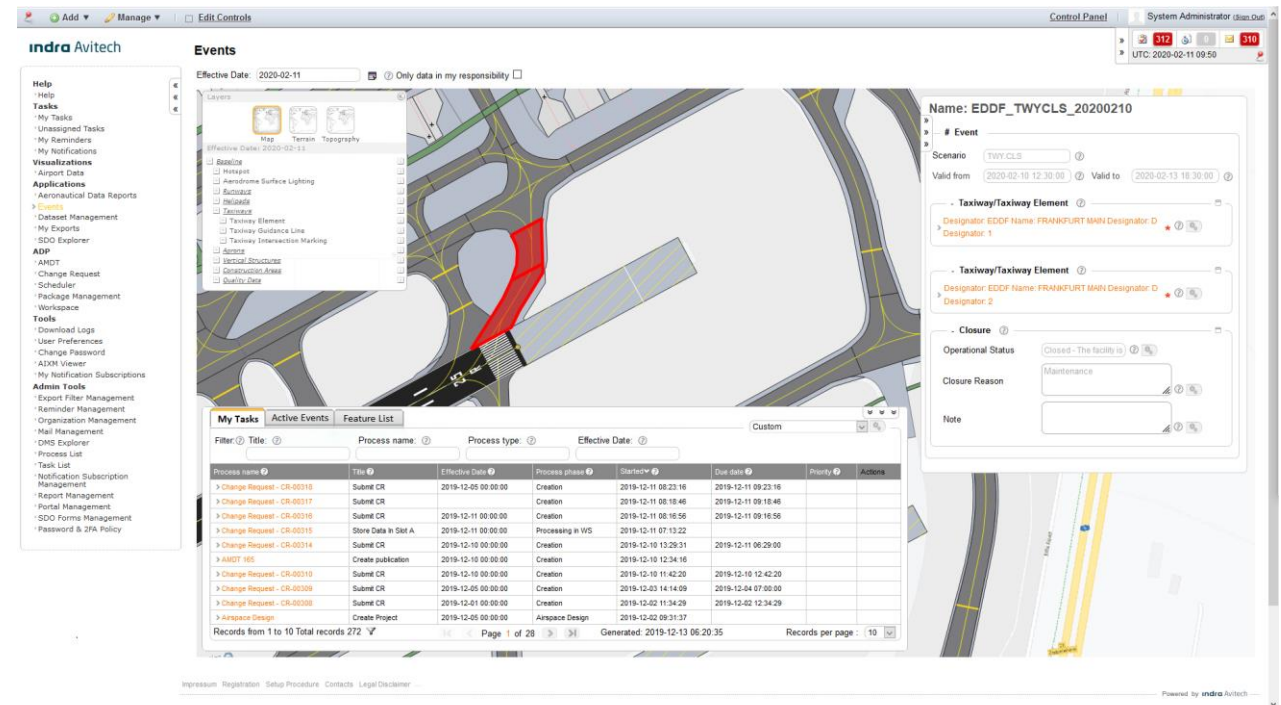
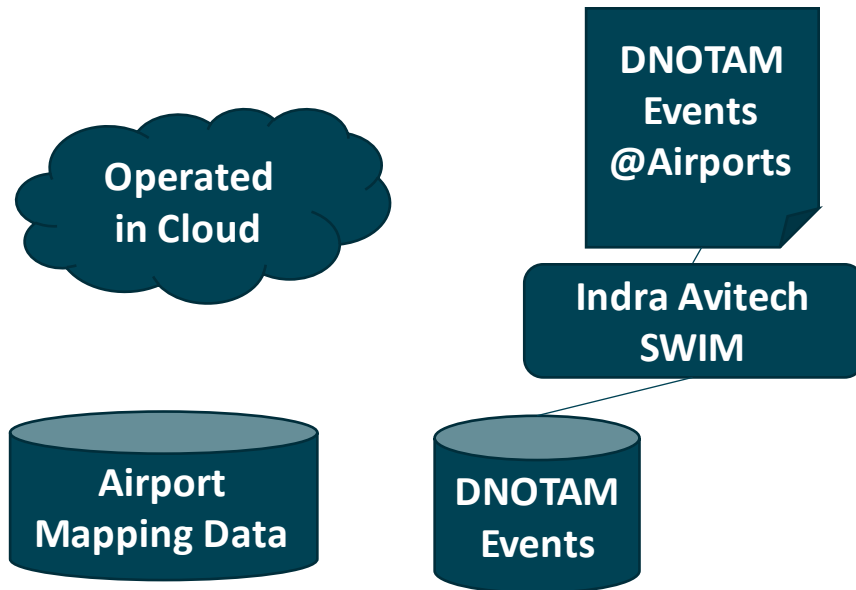
- Project initiated by EUROCONTROL to develop a prototype for Digital NOTAM origination and Airport Mapping Data sharing at PCP airports and following the EUROCONTROL SWIM Standards.



Airport Data Toolkit



Co-financed by the Connecting Europe Facility of the European Union



Indra Avitech DNOTAM Application

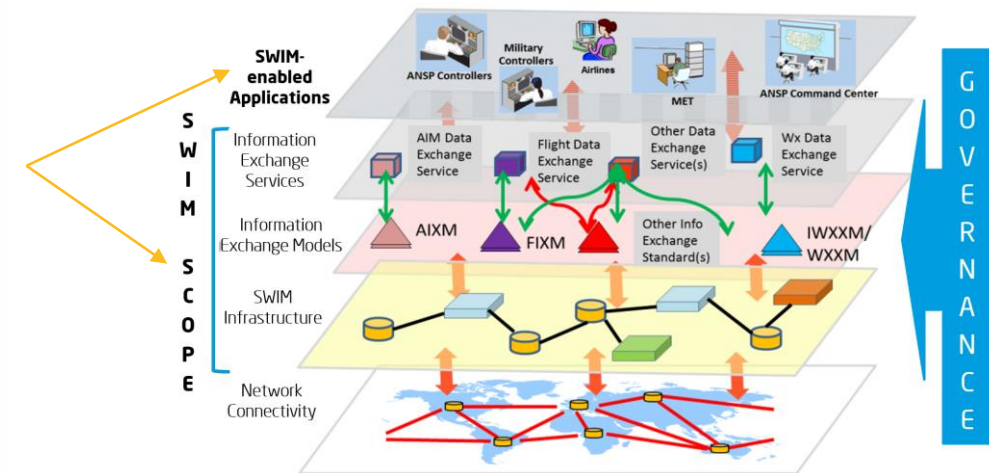
Project details => [https://ext.eurocontrol.int/aixm\\_confluence/display/ADTKIT/Overview](https://ext.eurocontrol.int/aixm_confluence/display/ADTKIT/Overview)

# Indra Avitech SWIM – The Aeronautical Exchange Layer (AXL)



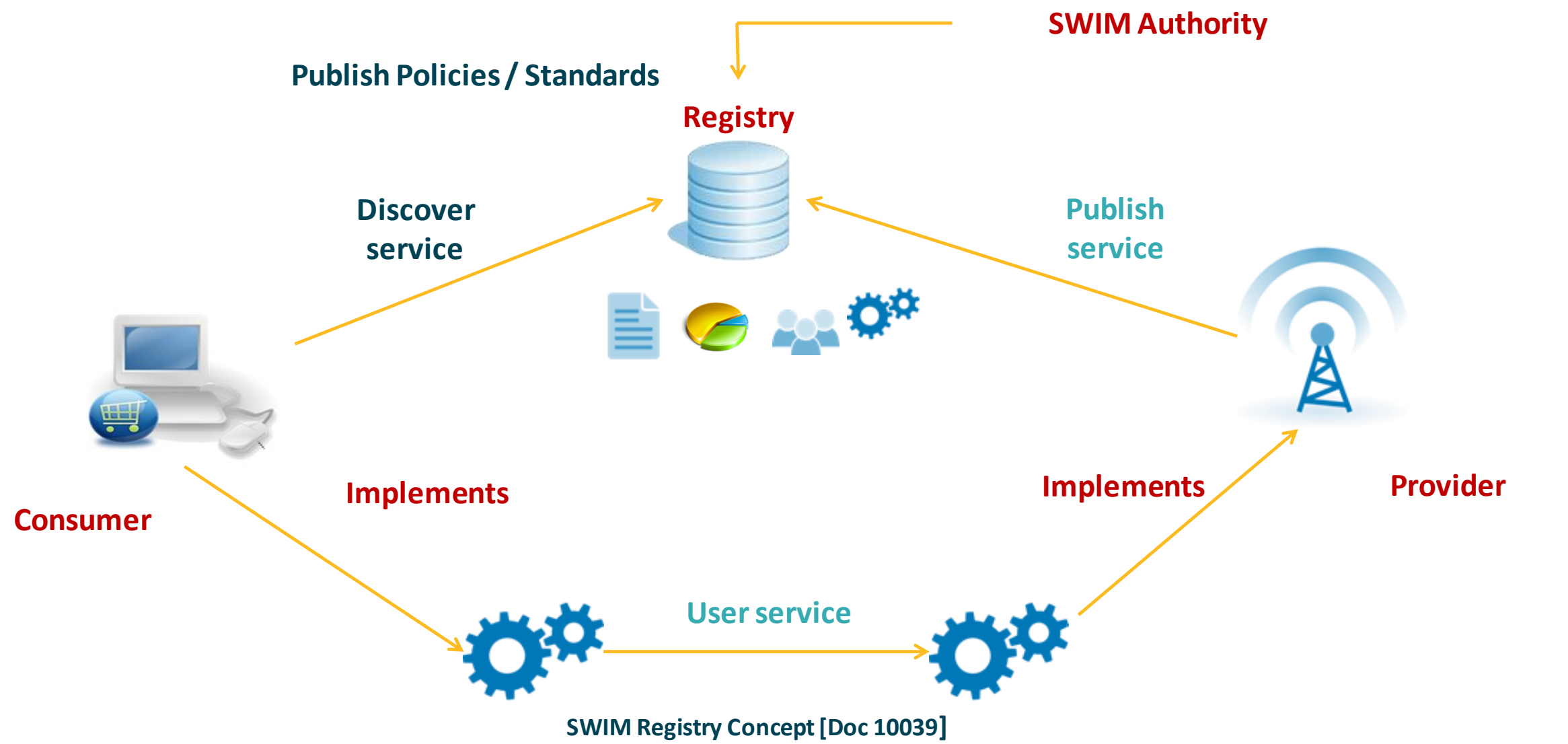
- **AxL**
  - Follows EUROCONTROL SWIM Technical Infrastructure Yellow Profile
  - A portfolio of **30** services (AIS/AIM, MET, FPL, AMHS/SWIM, etc.)
- **For instance, Web Feature Service (WFS) 2.0**
  - AxL WFS 2.0 – reference implementation with OGC
  - Supports AIXM 5.1, WXXM, IWXXM and any GML application schema
  - Request/Reply and Publish/Subscribe extension
- **WFS-TE**
  - Supporting complex temporal queries, respecting AIXM 5 Temporality Model

# SWIM Applications



- SWIM Global Demo 2016 – Indra Avitech, Luciad, MCAA
- Live recording on Youtube: <https://www.youtube.com/watch?v=BhMxx-FA0as>

# SWIM Registry Concept





# EUROCONTROL SWIM Registry

The screenshot displays the EUROCONTROL SWIM Registry website. The header features the logo, navigation links (Services, Documents, Contact), a search bar, and a user profile (Tsvetan Penev). The main content area is titled 'Services' and shows the URL 'https://eur-registry.swim.aero/services'. Below this are buttons for 'Filters', 'Add Service', and 'Import Service'. Two service cards are visible: 'Arrival Sequence Service' (Version: 1.02, Organisation: EUROCAE) and 'AirportDataToolkitEventService' (Version: 4.7.0, Organisation: Indra Avitech). The footer includes the EUROCONTROL logo, a European Union flag, and text indicating co-financing by the Connecting Europe Facility. Navigation links for 'Services' and 'Documents' are also present.

**Services** <https://eur-registry.swim.aero/services>

Filters Add Service Import Service

**Arrival Sequence Service**

Version: 1.02  
Organisation: **EUROCAE**

The Commission Implementing Regulation (EU) No 716/2014 requires the upgrade of existing AMAN to provide connection with cooperative En-Route Air Traffic Service Units (ATSU) to coordinate the actions to be taken by the cooperative ATSUs to make the...

**AirportDataToolkitEventService**

Version: 4.7.0  
Organisation: **Indra Avitech**

The service supports the Digital NOTAM concept and allows, for instance, vendors of D-NOTAM viewer applications to consume D-NOTAM data in AIXM 5.1.1 format. Together with the information provided by the AMIS and AFIS services, consumers become a...

EUROCONTROL Co-financed by the Connecting Europe Facility of the European Union

Services Documents

© EUROCONTROL, 2020 Policy and Disclaimer

# SWIM Takeaways

- Quality assured data is a pre-requisite for SWIM. SWIM cannot increase the quality of data
- Interdependencies between AIM/MET/Flight in a SWIM world need to be considered
- Sharing data in a SWIM-compliant manner is the first step
- SWIM is a driver for digitalization
- Once all start to share information, we will all reap the benefits!

# Digital NOTAM

# Speaker



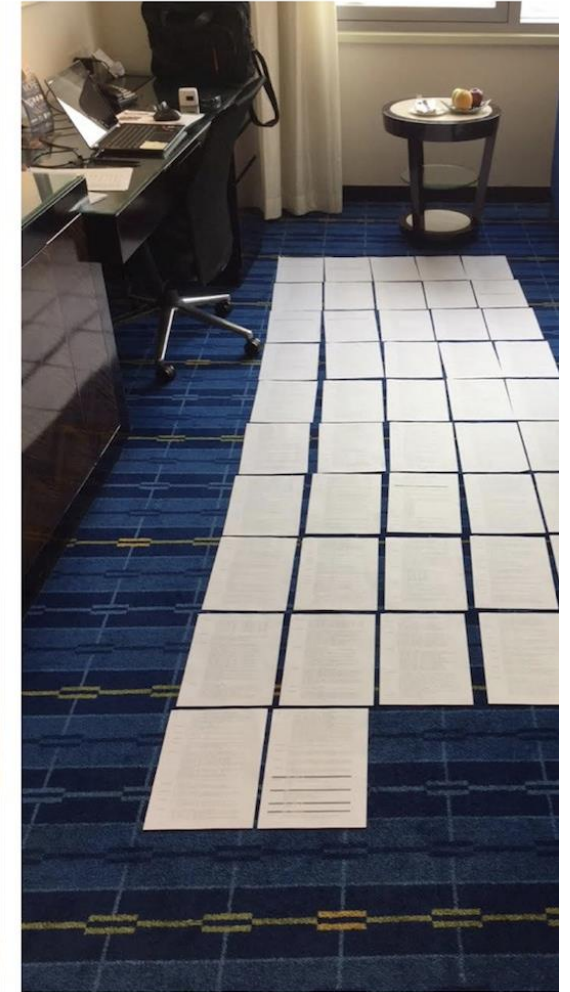
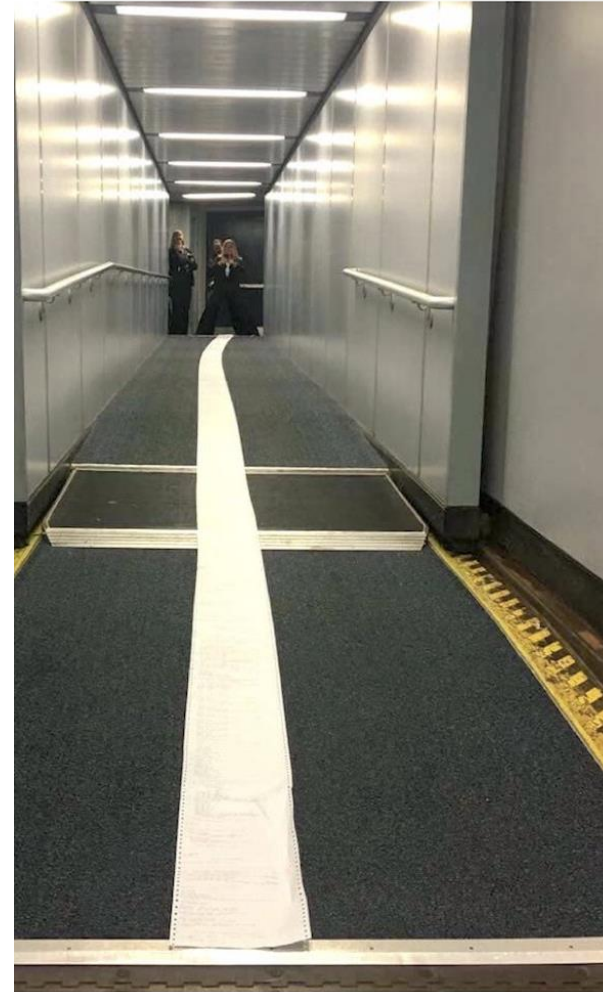
Michal Kadlec,  
Product Manager AIM

Indra Avitech

# Why we need Digital NOTAM?

## Issues with text ICAO NOTAM:

- Too many
  - Irrelevant
  - Long term changes
- Too hard to read
  - ALL CAPS
  - Overuse of abbreviations
  - Different coding of same events
- Questionable Quality
  - Verifying the quality requires manual effort
- It is not 100% machine readable and requires significant effort to process



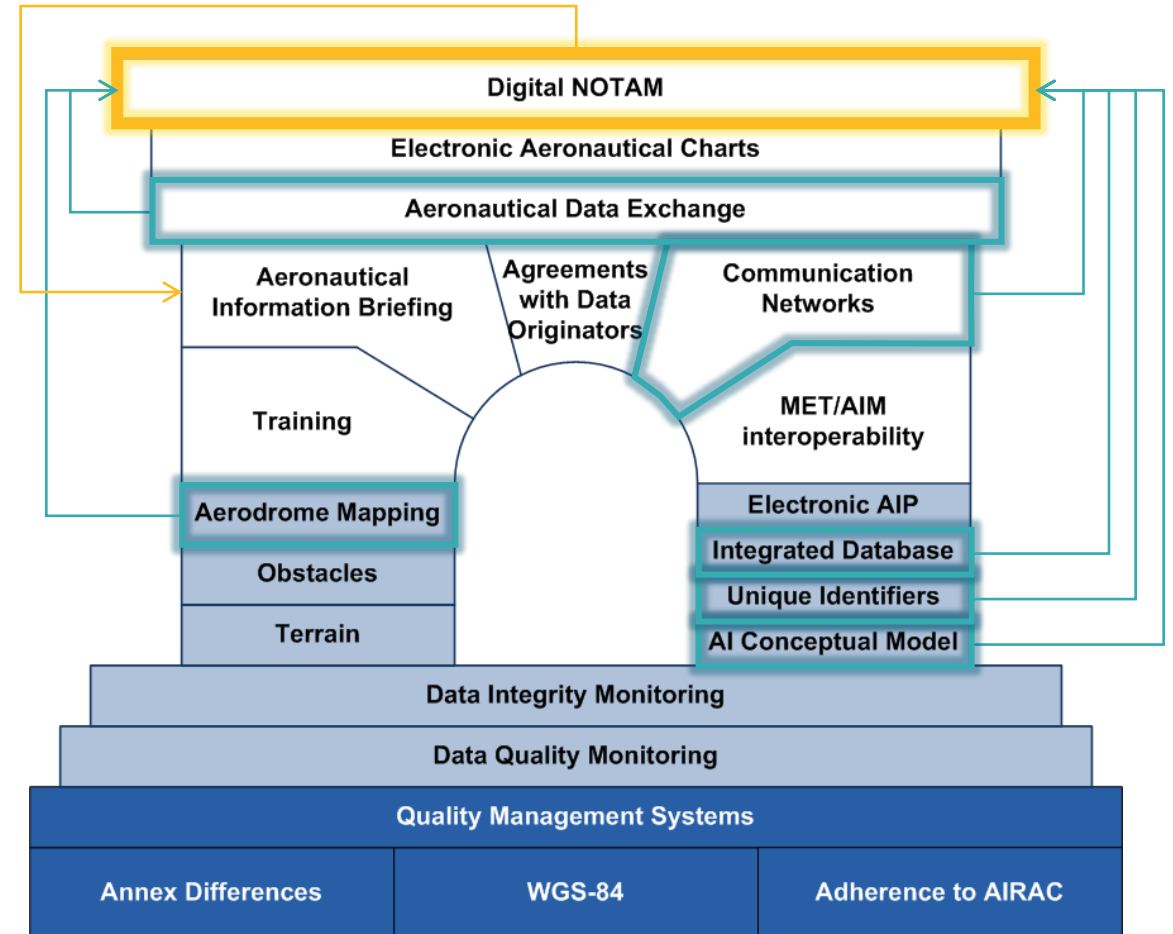
Source: <https://fixingnotams.org/reel-of-telegrams/>



# What is Digital NOTAM?

ICAO AIS to AIM Roadmap defines Digital NOTAM as

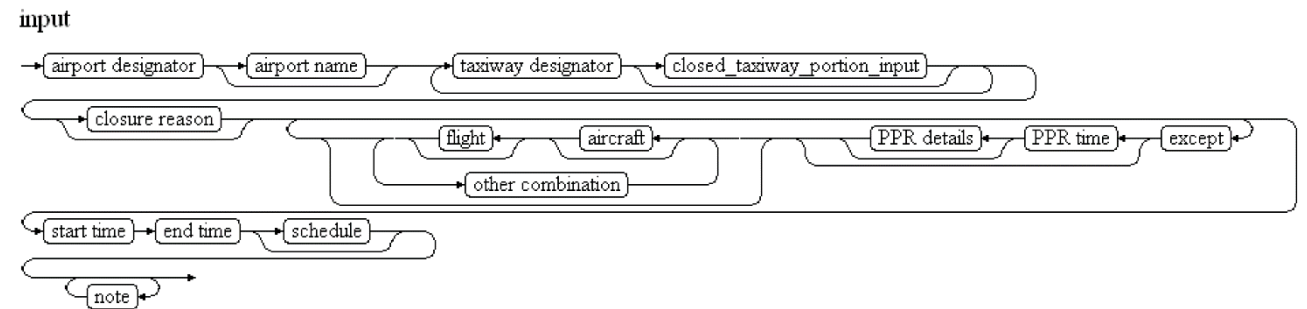
“... a **data set** that contains information included in a NOTAM in a **structured format** that can be fully **interpreted by a computer system** for accurate and reliable updates of the aeronautical environment representation both for automated information equipment and for aviation personnel.”



# Digital NOTAM – Event Scenario Specification

Contains:

- Event scenario definition
- Event Data to be collected - EBNF Diagram with mapping to AIXM Model
- Assumption for baseline data
- Business rules for validation
- Data encoding rules (AIXM data set)
- Text NOTAM production rules



Source: [https://ext.eurocontrol.int/aixm\\_confluence/display/DNOTAM/%5BTWY.CLS%5D+Taxiway+-+closure](https://ext.eurocontrol.int/aixm_confluence/display/DNOTAM/%5BTWY.CLS%5D+Taxiway+-+closure)

# Digital NOTAM Capabilities

- DNOTAM Originators

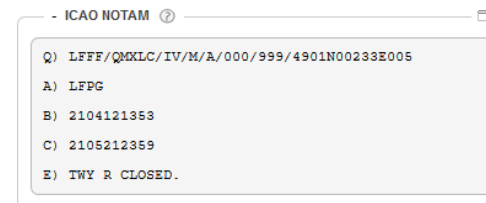
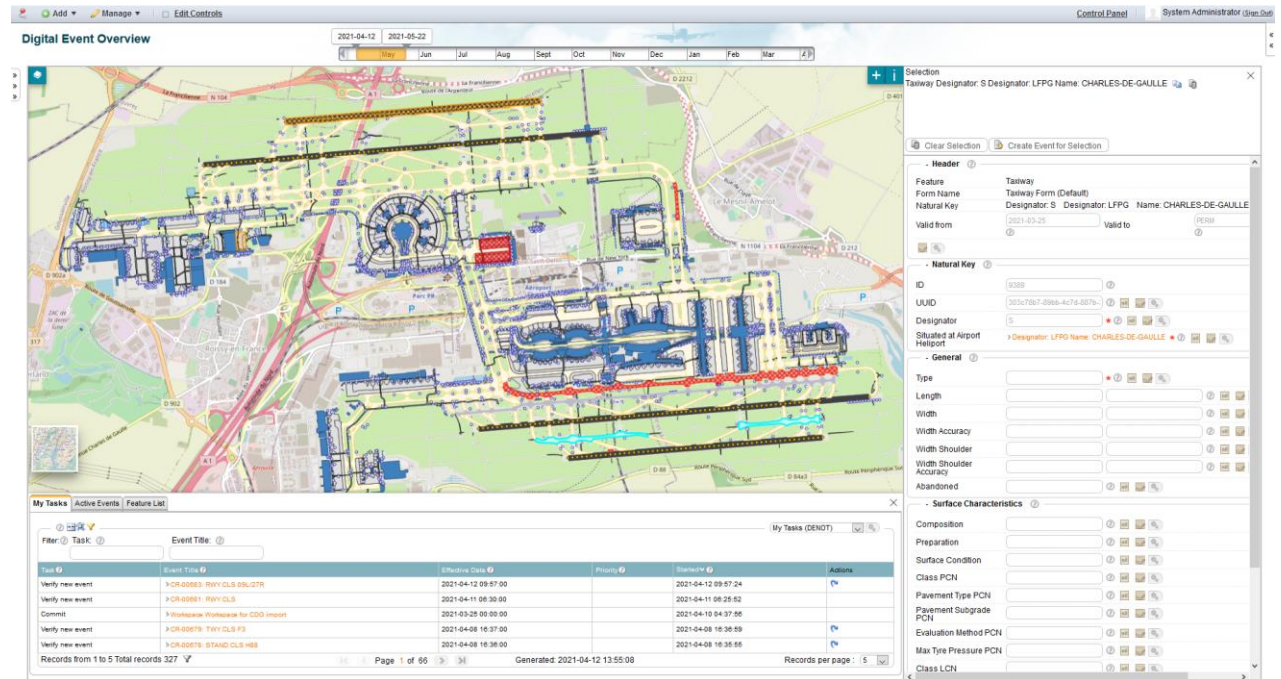
- Creation of Digital NOTAM events using tailored configurable event forms
- Build in customizable approval and distribution workflows
- Generation of ICAO NOTAM and AIXM message
- Postponement, copy and cancellation support

- DNOTAM Users

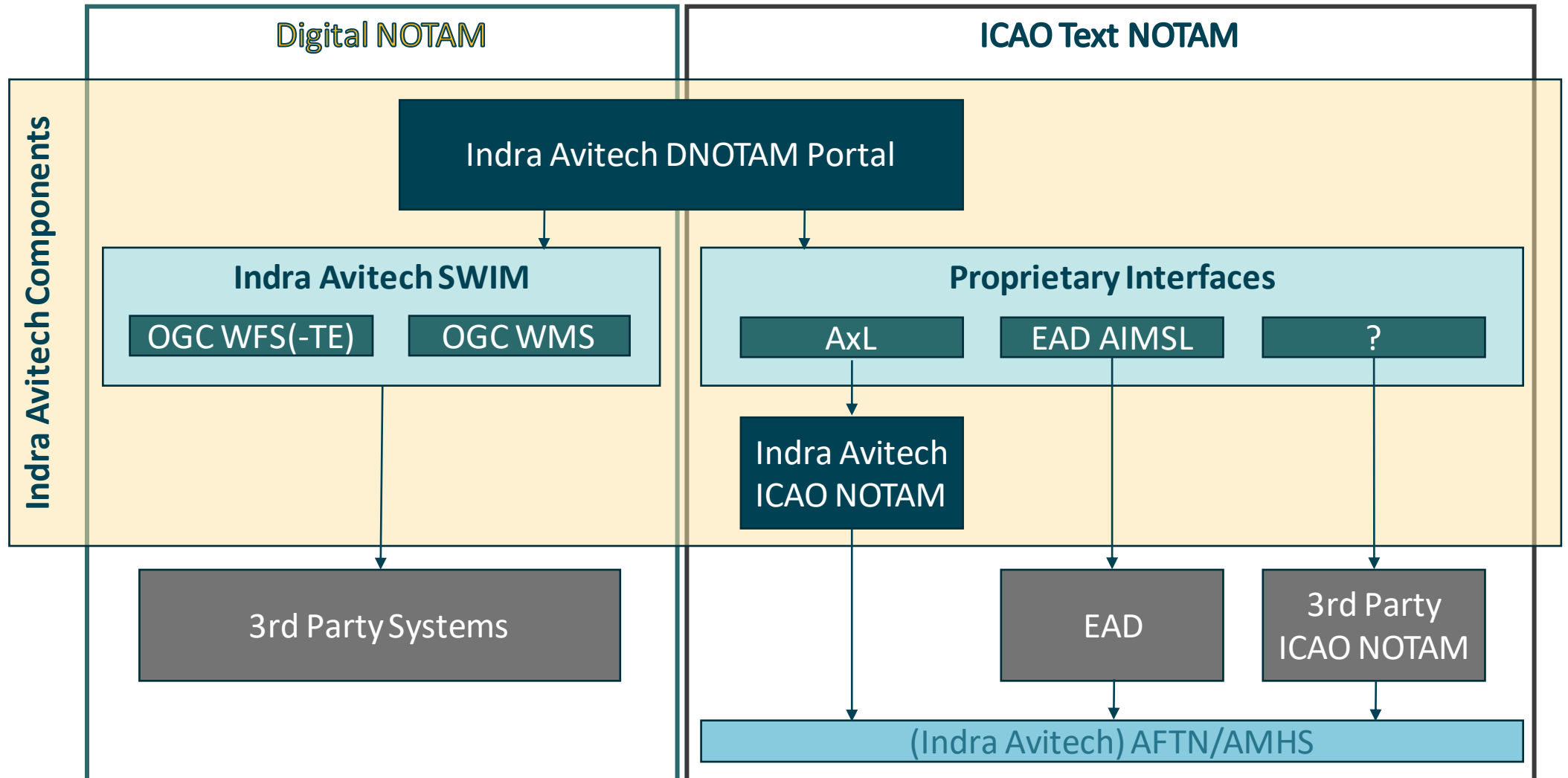
- Visualization of proposed and valid digital NOTAM for specific time period and area of interest
- Visualization of static aeronautical and airport layout (AMDB) data

- 3rd Party Systems

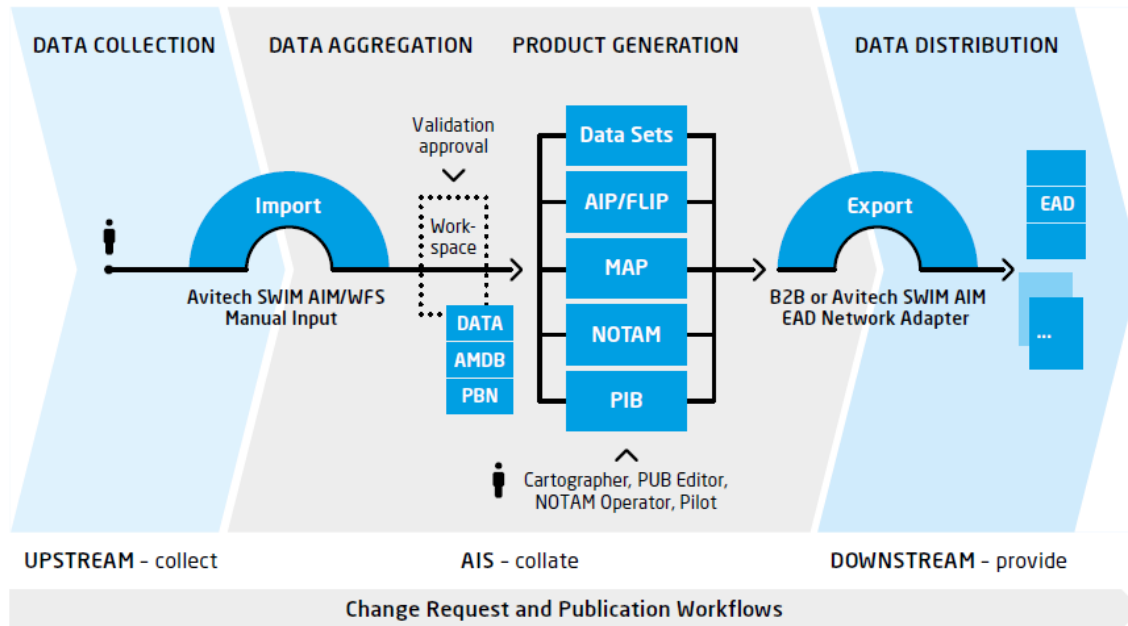
- SWIM Interfaces for obtaining baseline and Digital NOTAM data (WSF, WMS)



# DNOTAM Distribution Options



# Indra Avitech AIM Solutions



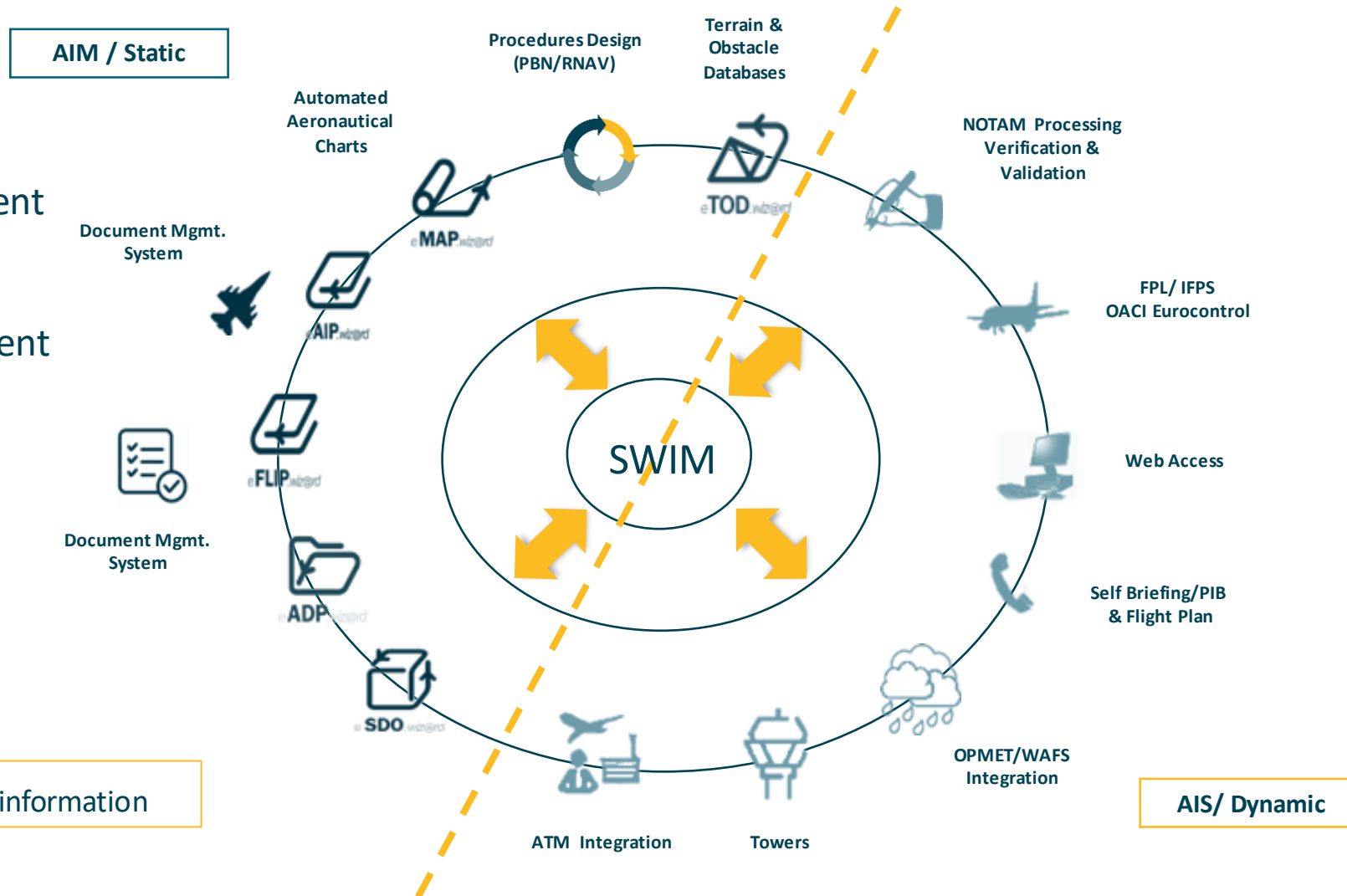
- Unified management of PERM and TEMP AIS data controlled by configurable workflows
- Data managed: baseline aeronautical data, temporal status and condition changes, AMDB, obstacles, terrain, topography
- Human and system interfaces for collection of raw data
- Production of aeronautical products: publications, charts, dataset
- Distribution over SWIM and other interfaces



# Indra Avitech Product and Services Portfolio

- Message Handling Systems (MHS)
- Aeronautical Information Management (AIM) Systems
- System Wide Information Management (SWIM)
- Tower Information Management Systems
- Training and Consulting Services

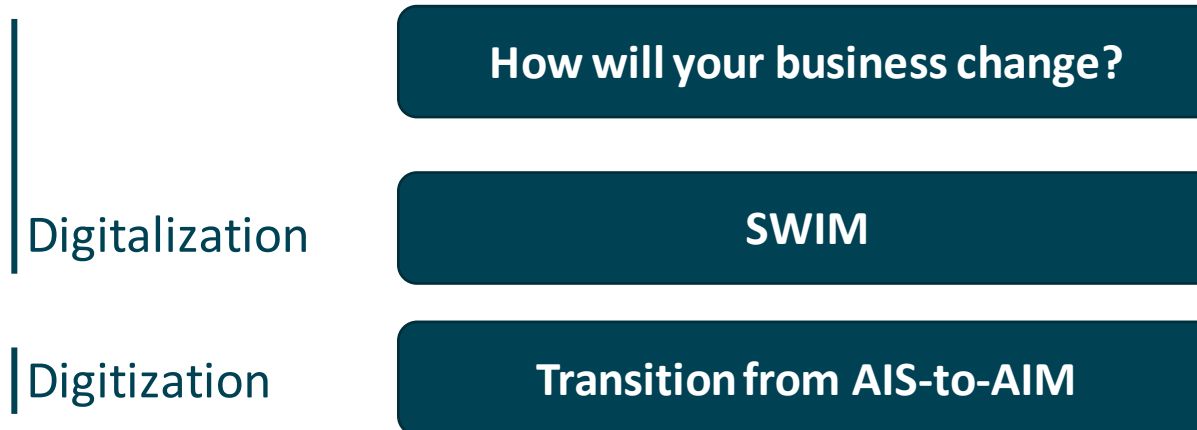
<https://www.indracompany.com/en/indra-air-information>



# From Digitization to Digitalization

“**Digitization** is the process of changing from analog to digital form...” – Gartner<sup>1</sup>

“**Digitalization** is the use of digital technologies to change a business model and provide new revenue and value-producing opportunities” – Gartner<sup>2</sup>



<sup>1</sup> <https://www.gartner.com/en/information-technology/glossary/digitization>

<sup>2</sup> <https://www.gartner.com/en/information-technology/glossary/digitalization>



# Questions and Answers

# Thank you for joining us

Please do not hesitate  
to contact us if you  
have any questions or  
want to learn more.



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# Thank you

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