

Everything you wanted to know about Radar – but were too afraid to ask

Wednesday 10 November 2021

09:00 – 10:00 CET

Moderator



Poh Theen Soh

Director Asia Pacific Affairs, CANSO

Speakers



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ATM International
Indra



Germán Ramón Villa Rivera

Primary Radars Product Management
Indra



Lola Carrillo Aguilera

ATM International
Indra

indra

Creating Skies Together

Indra ATM

A leading global technology and consulting company

We are the technological partner for core business operations of our customers world-wide

Main figures

2020



3,152 M€
in Revenues



+49,000
Professionals



+160
Countries

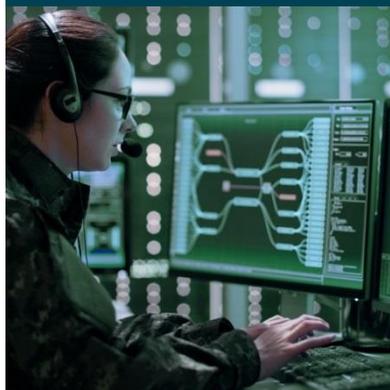


225 M€
in R&D

Two businesses joined by their technological nature

Transport & Defence

World-leader in providing proprietary solutions in specific segments in Transport and Defence markets



Defence and Security

Envisioning a safer tomorrow

Air Traffic

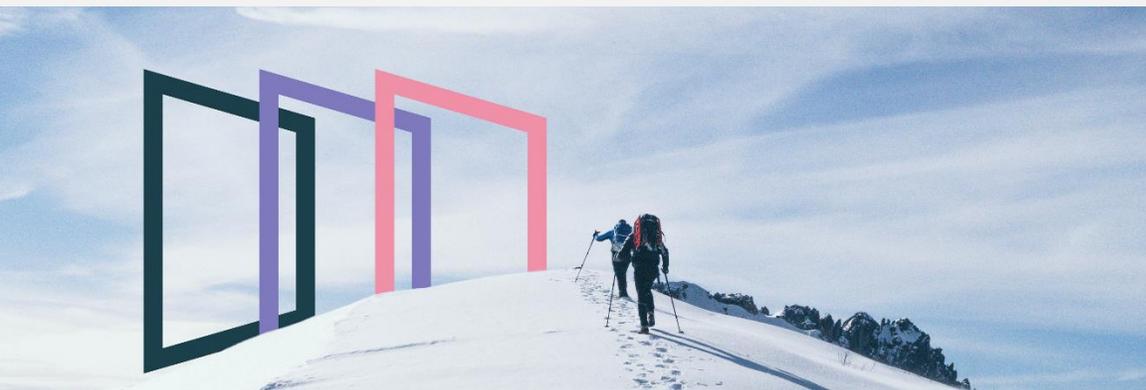
Creating skies together

Transport

Unlocking life in motion

Digital & Information Technologies

Leading firm in Digital Transformation and IT in Spain and Latin America, through its affiliate Minsait



minsait

An Indra company

Mark making the way forward

Air Traffic

Global player

Guaranteeing safe, efficient and profitable flights, in a difficult context with constantly increasing air traffic

Innovative solutions

For our partners business success which improve service resilience

Environmental benefit

Enabling flights CO2 and noise footprint reduction, whilst improving capacity



+5,000

Facilities in over 160 countries

+ 100

Years of experience in ATM solutions

+ 85%

World passengers travel making use of Indra ATM technology at any time of flight

Indra Air

Our solutions and services

Indra Air Solutions

The only company in the world with a technology portfolio that encompasses all the phases of a flight



Indra Air Automation

We are your reliable partner in ATM business



Indra Air Communication

We implement Full VoIP Dual Dissimilar VCCS solutions



Indra Air Navigation

We enable more than 100,000,000 safe landings



Indra Air Surveillance

We have deployed over 500 surveillance systems



Indra Air Drones

Connecting drones safely, creating a better airspace



Indra Air Information

We guarantee the right digital Aeronautical Information at the right time

Indra Air Surveillance

Over 580 systems deployed in more than 90 countries



PSR 2D
2D Primary Surveillance Radar



MSSR
Fully digital system with SMART integrated ADS-B



MLAT/WAM
Surface and Wide Area Multilateration



PSR 3D
3D Primary Surveillance Radar



Transportable Radar Station
Multiple standalone and co-mounted configurations



ADS-B
Automatic Dependent Surveillance



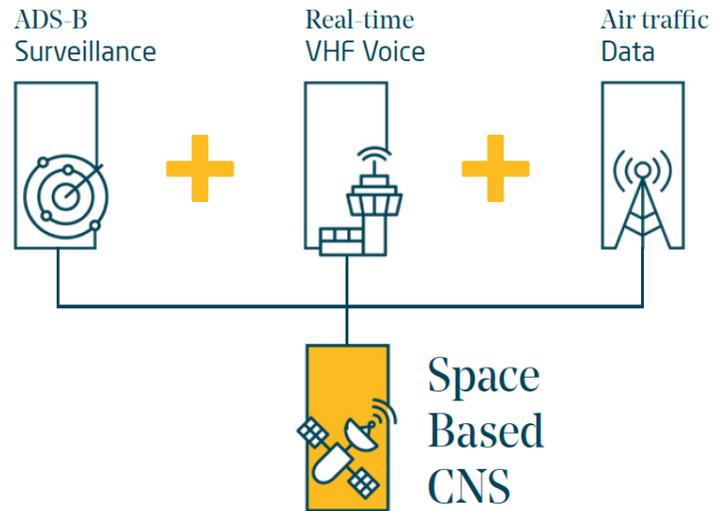
Resilient & Borderless Architecture for CNS

Space Based CNS

- Rationalization of Existing and Global Infrastructure
- Cost Efficient Infrastructure
- Hazards Avoidance

A joint venture of Enaire & Indra

- 200+ Satellites Constellation



- Seamless transition

startical



Indra in Asia



Asia and Pacific Footprint

● Indra's offices

MONGOLIA

Nav aids
ACC and VCS
Secondary Surveillance

AFGHANISTAN

Nav aids
VCS

PAKISTAN

Nav aids
ACCS and VCS
Primary and Secondary Surveillance

INDIA

Nav aids
APP, TWR and VCS
Secondary Surveillance

MALAYSIA

Nav aids
TWR and VCS

SINGAPUR

Nav aids
VCS

INDONESIA

Nav aids
APP, TWR and VCS
Primary and Secondary Surveillance

AUSTRALIA

Nav aids
ATM systems & VCS
Secondary Surveillance

CHINA

Nav aids
ACC and VCS
Primary and Secondary Surveillance

KOREA

Nav aids
ACC and VCS
Primary and Secondary Surveillance

NEPAL

VCS

TAIWAN

Nav aids

THAILAND

Nav aids
Secondary Surveillance

VIETNAM

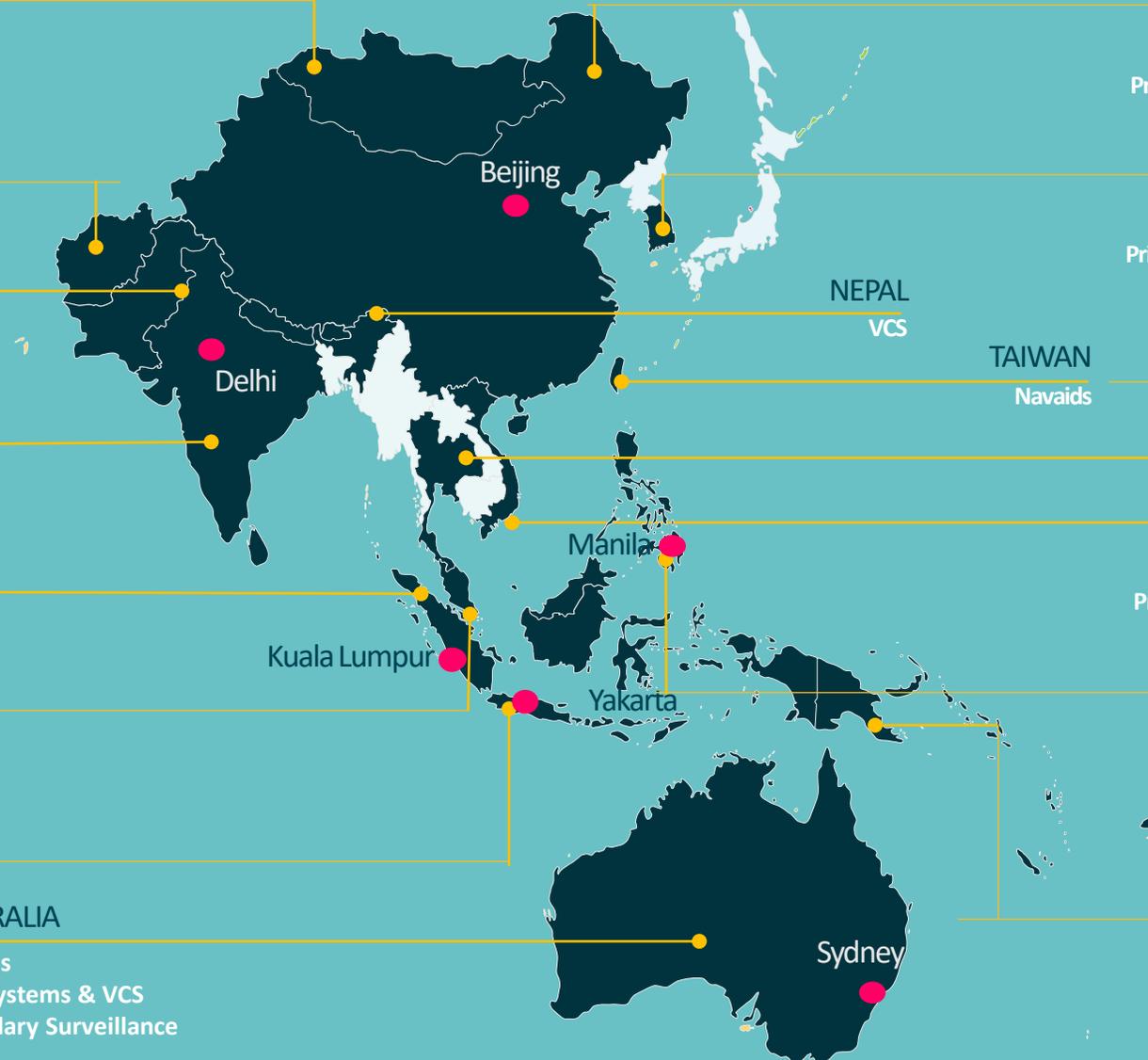
Nav aids
ATM and VCS
Primary and Secondary Surveillance

PHILIPPINES

Nav aids

PAPUA NEW GUINEA

Secondary Surveillance





Urumqi ACC
Operational
Room, China

Operational since 2008



Incheon APP,
Korea



Murun MSSR-S,
Mongolia

Operational since 2008



Phuket MSSR-S
Technical Room

Operational since 2000



Vietnam
PSR₂D/MSSR
counted

Incheon PSR
MSSR-S co-
mounted, Korea

Operational since 2016



MSSR
Shijiazhuan,
China



PSR/MSSR
Pudong, China



Thank you!





Germán Ramón Villa Rivera

Primary Radars Product Management
Indra

Everything you always wanted to know about Radar



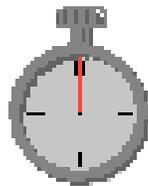
WHAT IS A RADAR?

RADAR: Radio Detection and Ranging

A radar system is a device that uses radio wave to determine the position (range) of an object.

Different technologies can be used depending on the object to be detected: Vessels, vehicles, weather, aircraft, missiles, etc..

Radar Technologies can be classified also according to their mission or operational concept.



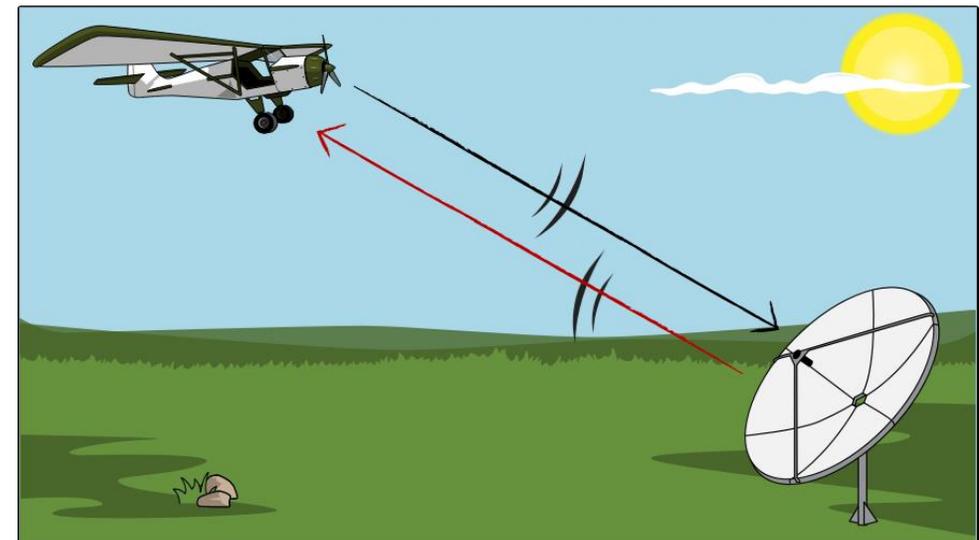
DIFFERENT RADAR TYPES

AIR Surveillance and Tracking Radar

When we focus on Radar Systems used for detection elements flying in the sky, we can make a simple division that it is important to have in mind:

- Non-Cooperative Radar, known normally as Primary Radars
- Cooperative Radar, known normally as Secondary Radars

Non-Cooperative Radar: No need for equipment in the aircraft, it is the radar by its own that detects targets thanks to the reflection of the radio wave in the aircraft structure.



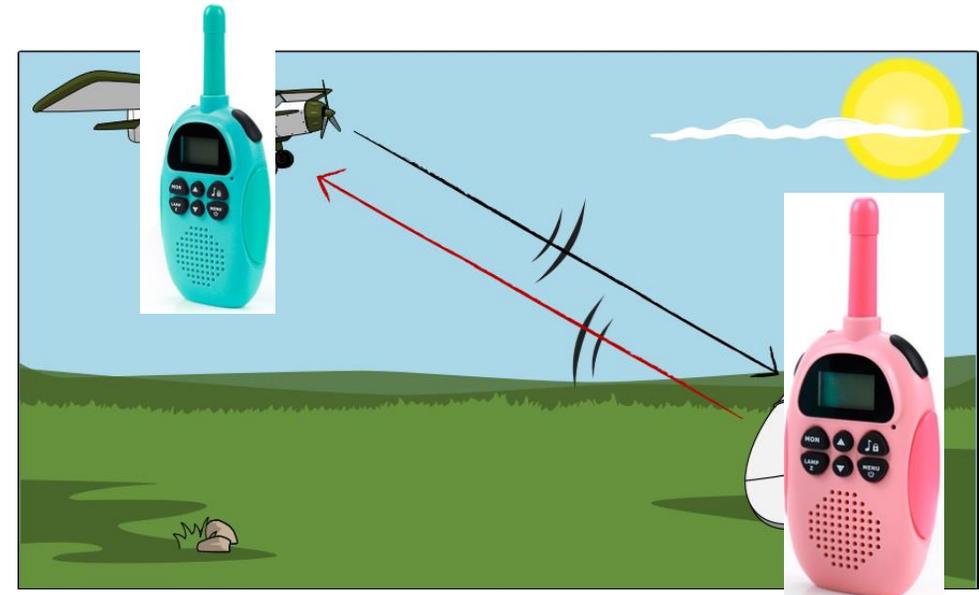
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Cooperative Radar: It is necessary to have on-board equipment in the aircraft. The radar interrogates the aircraft that receives the signal and answers the interrogation with additional information.



DIFFERENT RADAR TYPES



COOPERATIVE SURVEILLANCE CLASSIFICATION

- Independent Surveillance: SSR, MLAT, WAM
 - The Ground element needs to “interrogate” the aircraft to obtain information.
 - Position is calculated in ground stations based on the information received.

- Dependent Surveillance:
 - Ground stations are only receiving information from the aircraft.
 - Position is sent by the onboard equipment in the aircraft.
 - Dependent Surveillance mainly rely in the “good quality” of the onboard equipment.

DIFFERENT RADAR TYPES



DIFFERENCE OF MILITARY AND CIVIL USE

There are several differences to be remarked depending on the use of radar systems:

- Military purpose
 - Primary Radar is the main element
 - Altitude Reported by the system is very important
 - Data quality is less relevant but it is important to always have available the system
 - Secondary Radar (IFF – Identifier Friend or Foe) is use mainly to identify and accurately locate the target once has been detected by the PSR
- Civil purpose
 - Secondary Radar is the main element
 - Information like Aircraft ID, Altitude and other is obtained from Secondary Radar
 - Data quality is the most important: Better to not have data than incorrect data
 - Primary Radar is used to reinforce the SSR Radar and as a backup/safety layer for cooperative surveillance.

DIFFERENT RADAR TYPES



DIFFERENCE OF MILITARY AND CIVIL USE

Military and Civil are two different worlds about expectation related to radar systems.

But, why not have the best of both worlds?:



INDRA Lanza Family
(from early 80's)



Take out everything you do not need
&
Add important things for Civil Market

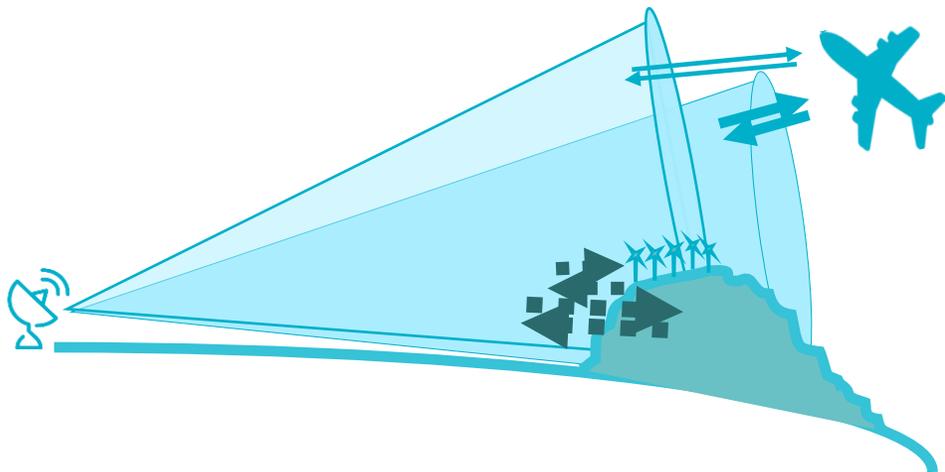
Obtain best radar option!!!



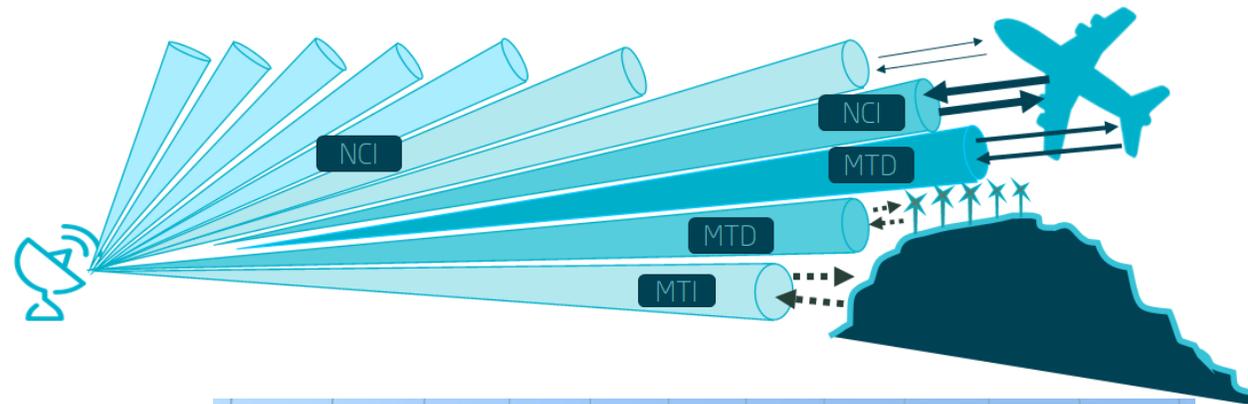
INDRA PSR3D ATM Civil
Radar

SOLUTION FOR PRIMARY RADAR

Radar PSR2D



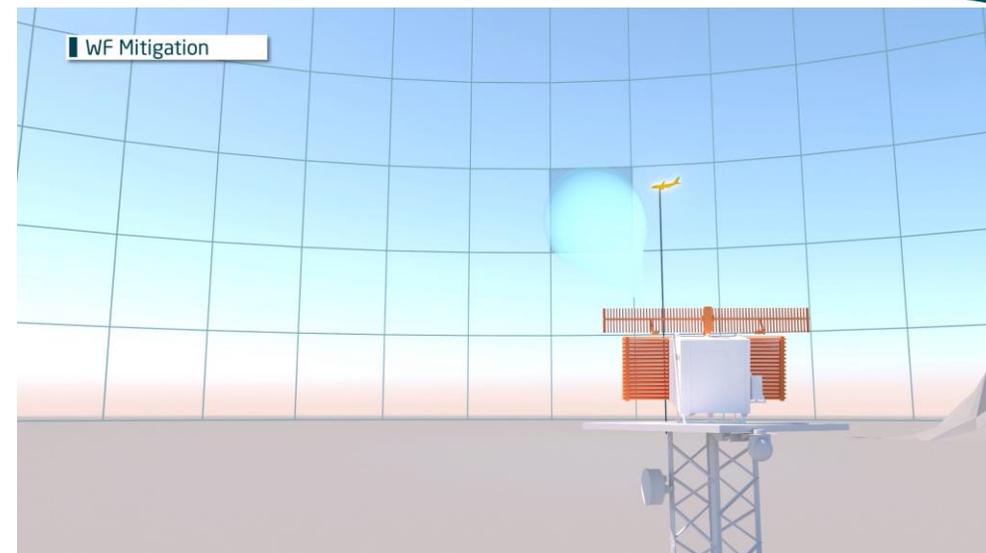
Radar PSR3D



Challenge for a Non-Cooperative Radar:
Distinguish between a Target Echo and Clutter Echo

PSR2D: Targets echoes always received together with clutter echoes

PSR3D: Electronic Vertical Exploration
Targets and Clutter are received from different pencil beams



INDRA VISION about Performance Based Surveillance

Safety

- No Cooperative Surveillance for TMA
- Double layer C S : ICS +DCS
- Performance Monitoring

Efficiency

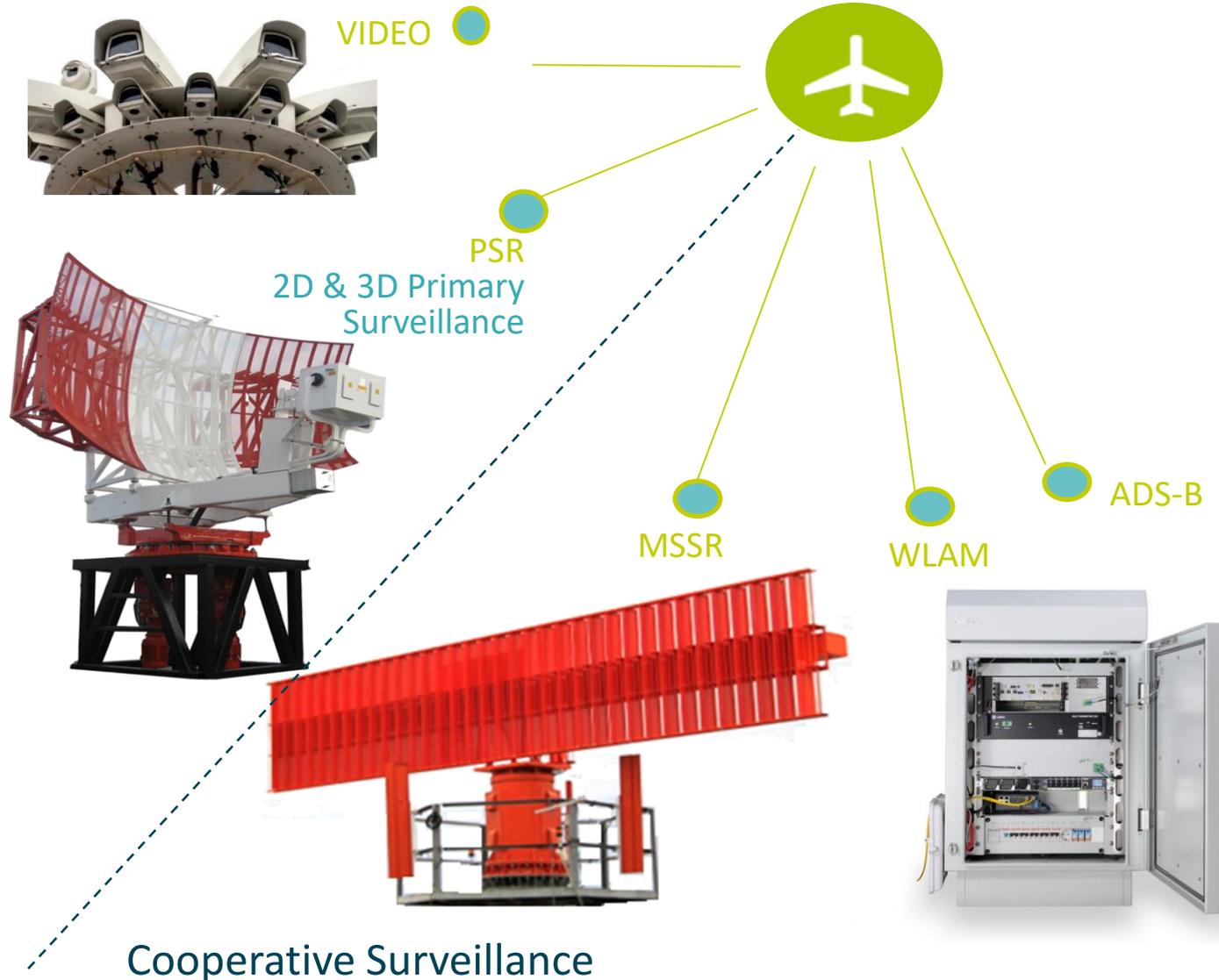
- Minimal infrastructure
- New Maintenance Policies
- Surveillance as service?

SOLUTIONS FOR ATM SURVEILLANCE

- PSR (L-Band and S-Band)
- MSSR mode S - Composite
- WAM //MLAT //ADS-B - Composite
- Drone detection
- Video Surveillance



No Cooperative Surveillance



Indra PSR3D L-Band

*Enhanced performances
and clutter mitigation*



indra
At the core

SOLUTION FOR PRIMARY RADAR

Solutions

- TMA Application → S Band System & PSR3D L Band System
- Approach Application → S Band System & PSR3D L Band System
- En-Route Application → PSR3D L Band System



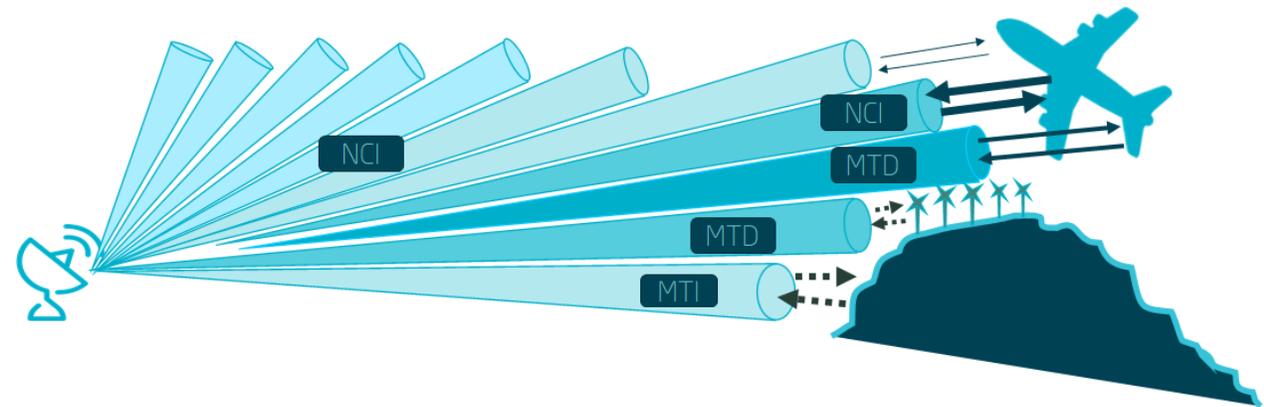
SOLUTION FOR PRIMARY RADAR

Expectations from a Non-Cooperative Surveillance System?

- Good Detection of probability
- Good Accuracy for Target Detection
- Low False alarm Rate
- Weather Information with high refresh rate (updated in the order of seconds)

Typical Non-Cooperative Surveillance System Problems?

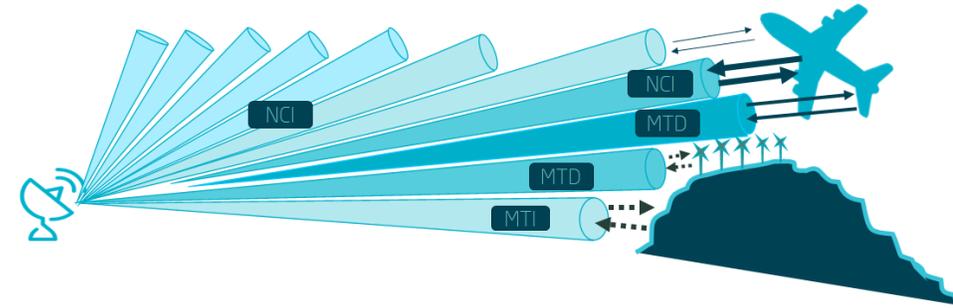
- Difficult adaptation to hard sites environment
- Installation infrastructure necessary
- System Maintainability and Availability



SOLUTION FOR PRIMARY RADAR

Probability of Detection & Accuracy

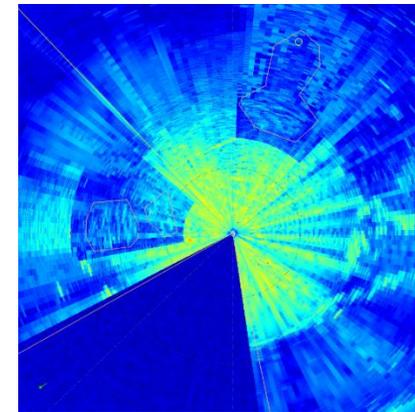
- Improved detection algorithms:
 - PSR L-Band 3D Radar:
 - Accurate Non-cooperative altitude target report
 - Improved Detection accuracy with Monopulse Techniques
 - Drone Detection Capabilities in a PSR3D System



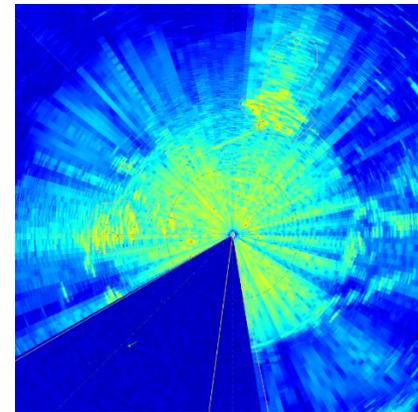
False Target Rate and Detection Improvement in clutter environments

- Advanced Tracking algorithms
- PSR L-Band 3D Radar
 - Inherent clutter mitigation due to vertical coverage exploration
 - Enhanced Synthetic Null Generation, better clutter rejection

Processing **ON**.



Processing **OFF**.

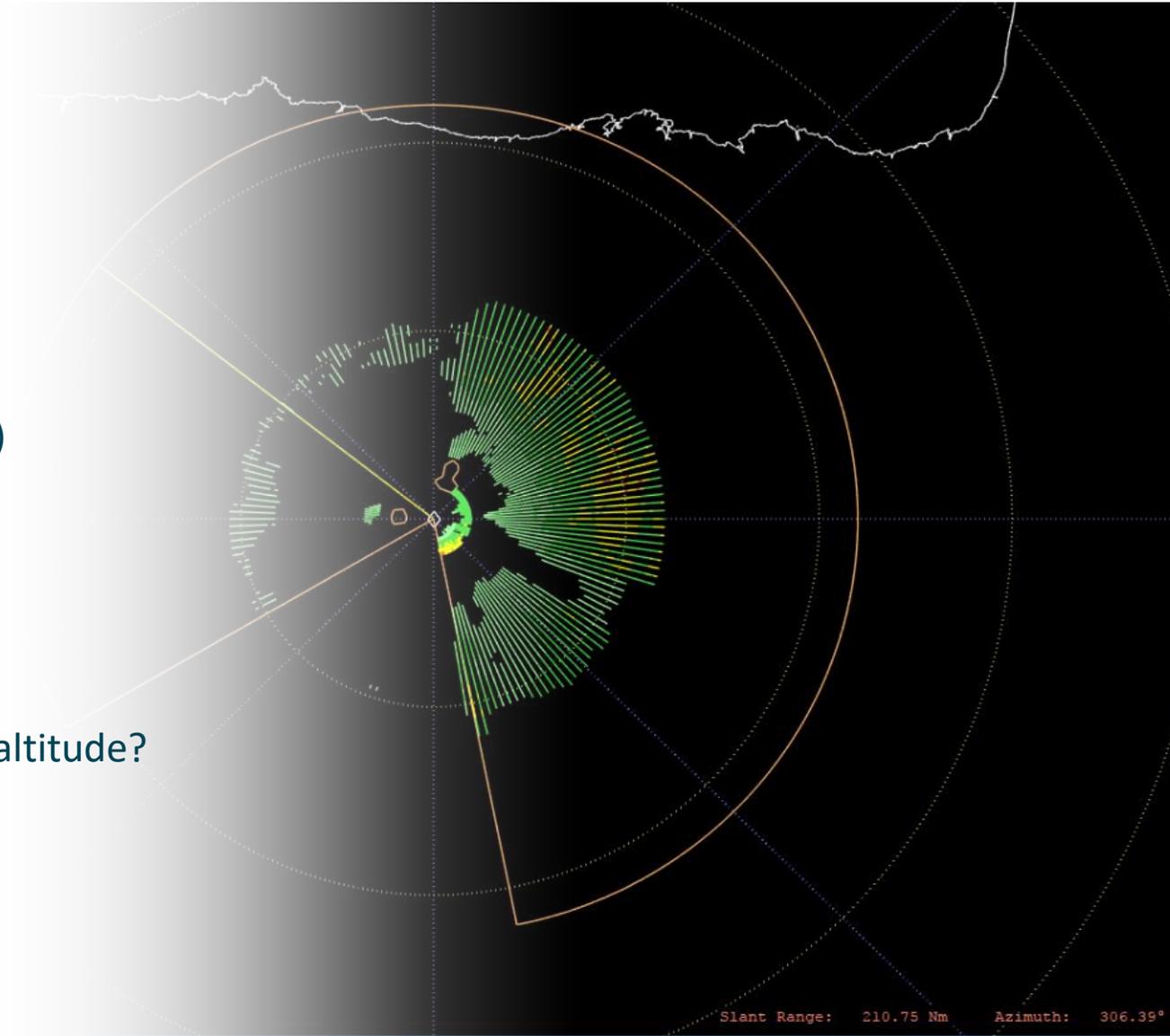


SOLUTION FOR PRIMARY RADAR

Weather Detection

- Calibrated 6 Levels Weather Channel according to NWS
- Integrated in the Systems: No additional package required
- Configurable update interval (From 1 picture each 6 scans)

- Indra PSR3D L-Band
 - Estimation of weather Altitude
 - Helps controller decision: Change route / change altitude?



PSR3D - BENEFITS

SMALL ANTENNA SIZE

- 5.5 x 2.2 meters.
- Instead of “traditional” 13 x 8 meters.
- Easier installation.
- No radome required.
- Tower costs reduction.



Typical L-Band antenna reflector



Indra PSR3D L-Band antenna

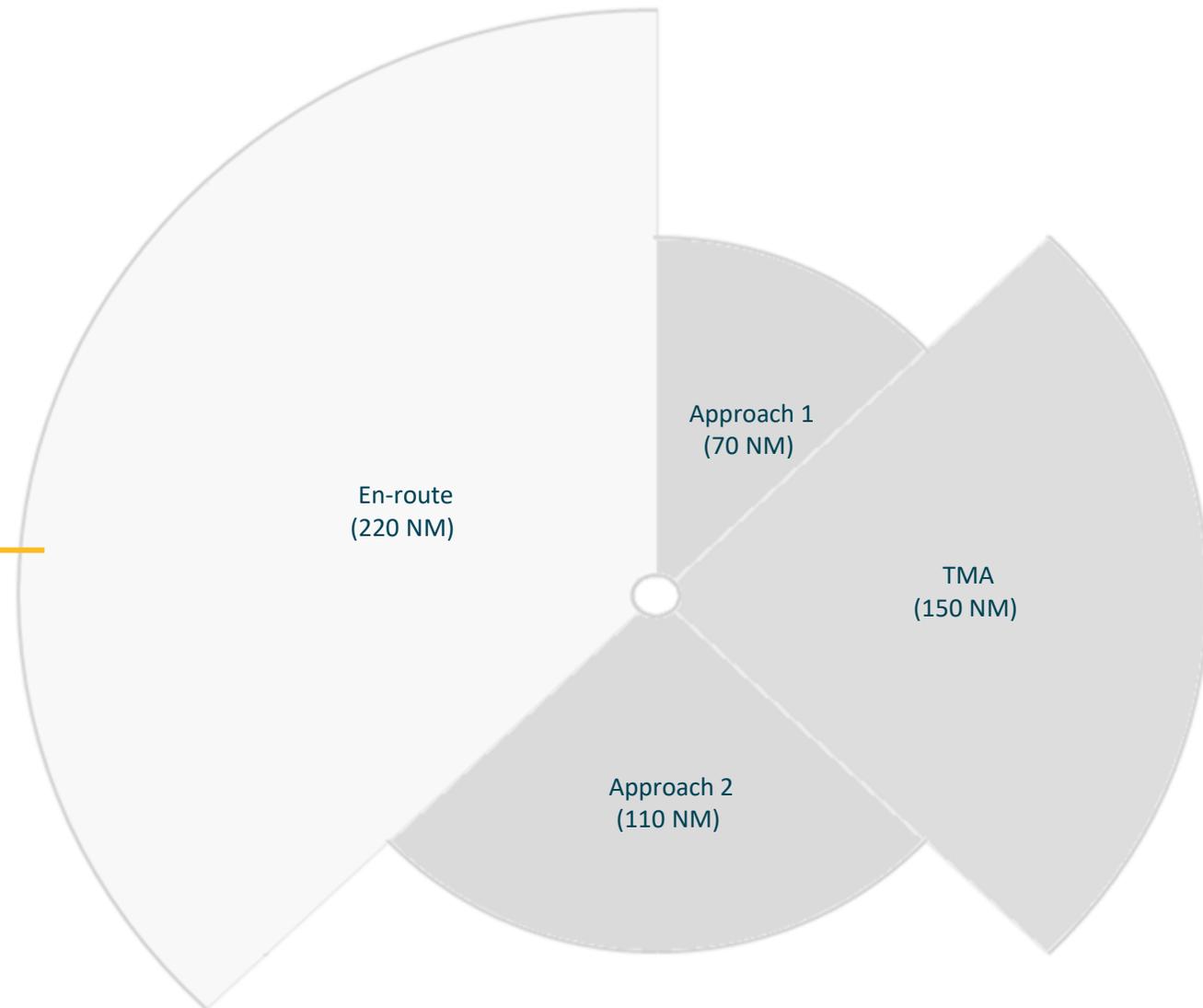
PSR3D - BENEFITS

EXPLORATION MODES

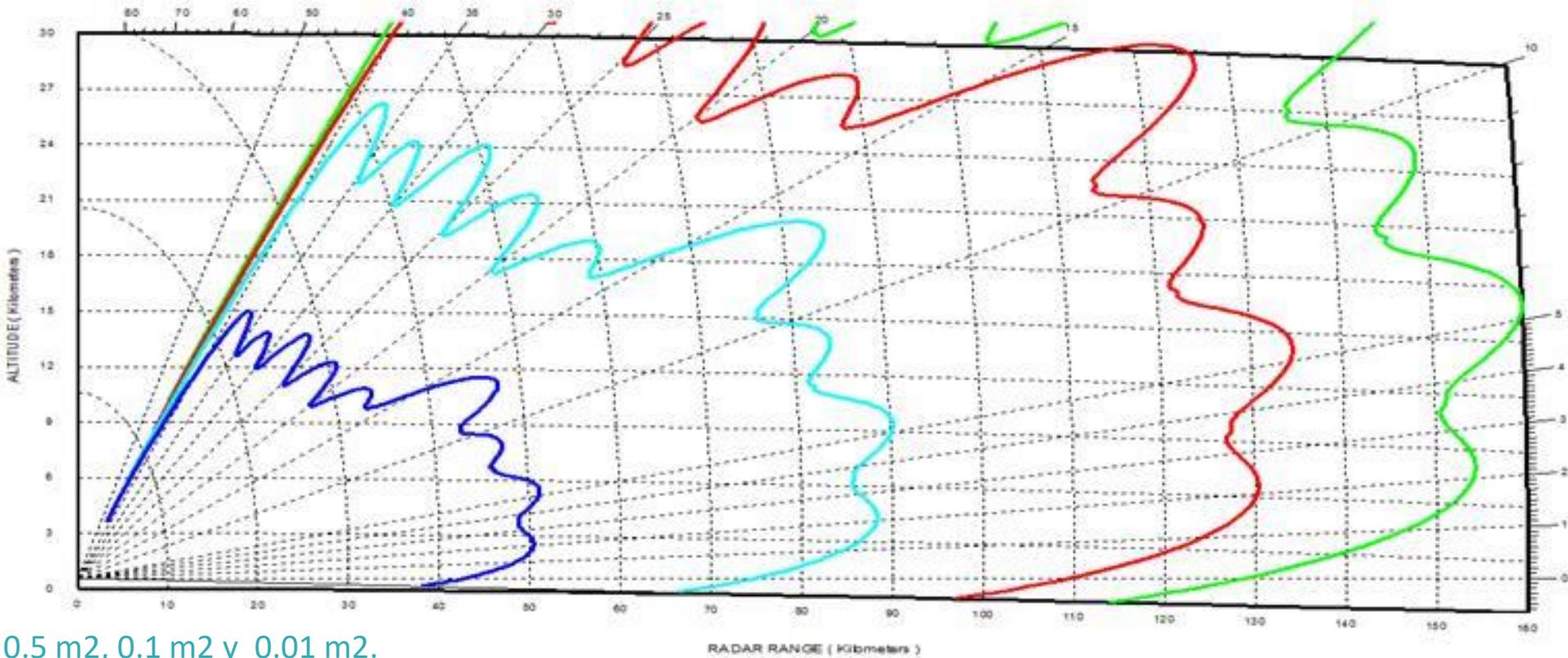
- Able to be configured for different objectives
- En-route surveillance (high range and high RCS)
- Approach or TMA surveillance (lower range and lower RCS)
- Sectorized Electronic Antenna Tilt

MULTIPLE RANGE CONFIGURATIONS

- Desired Probability of Detection
- Transmitted energy
- Antenna rotation speed (from 4 to 15 rpm)
- Traffic characteristics (civil and military)
- Flying altitudes relative to the location



PSR3D – DRONE DETECTION EXAMPLES



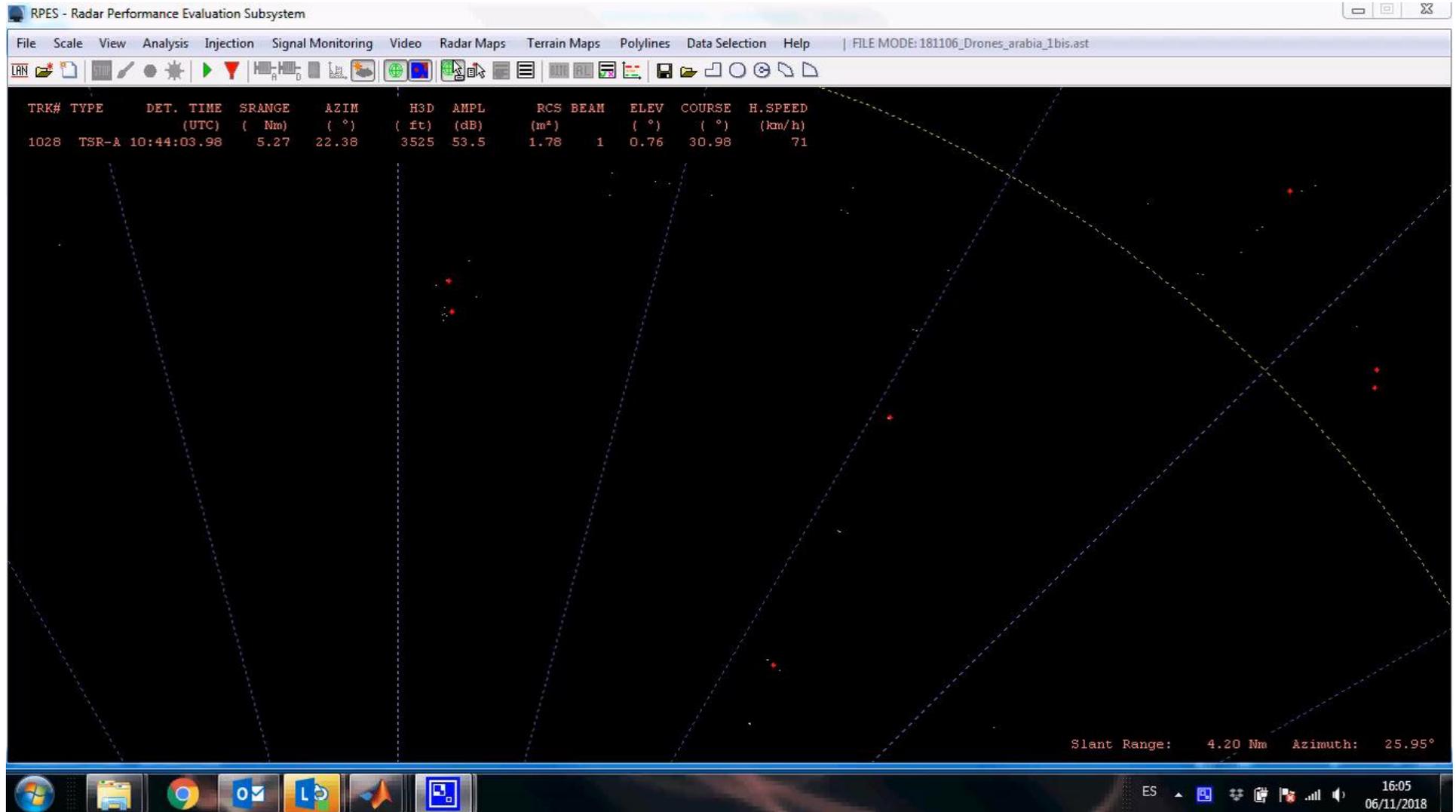
RCS :1m² , 0.5 m², 0.1 m² y 0.01 m².

Swerling 1

Pd = 0.8

PFA = 10⁻⁶.

PSR3D – DRONE DETECTION EXAMPLES



PSR & MSSR – TRANSPORTABLE SYSTEMS

- **FAST DEPLOYMENT AND HIGH QUALITY SERVICE PROVISION**
 - TRANSITIONS//BACK-UP//CONTINGENCY//EMERGENCY
 - PEAK OR TRAFFIC CHANGE



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Remote Management and Monitoring System RMMS



Basic Functions



Supervision

- HMI adapted to every device:
 - Detailed status Information
 - Alarm Presentation
 - Operative Configuration presentation

Control

- Change selection and parameter adjustment of the supervised elements.
- Different user level access according to different roles

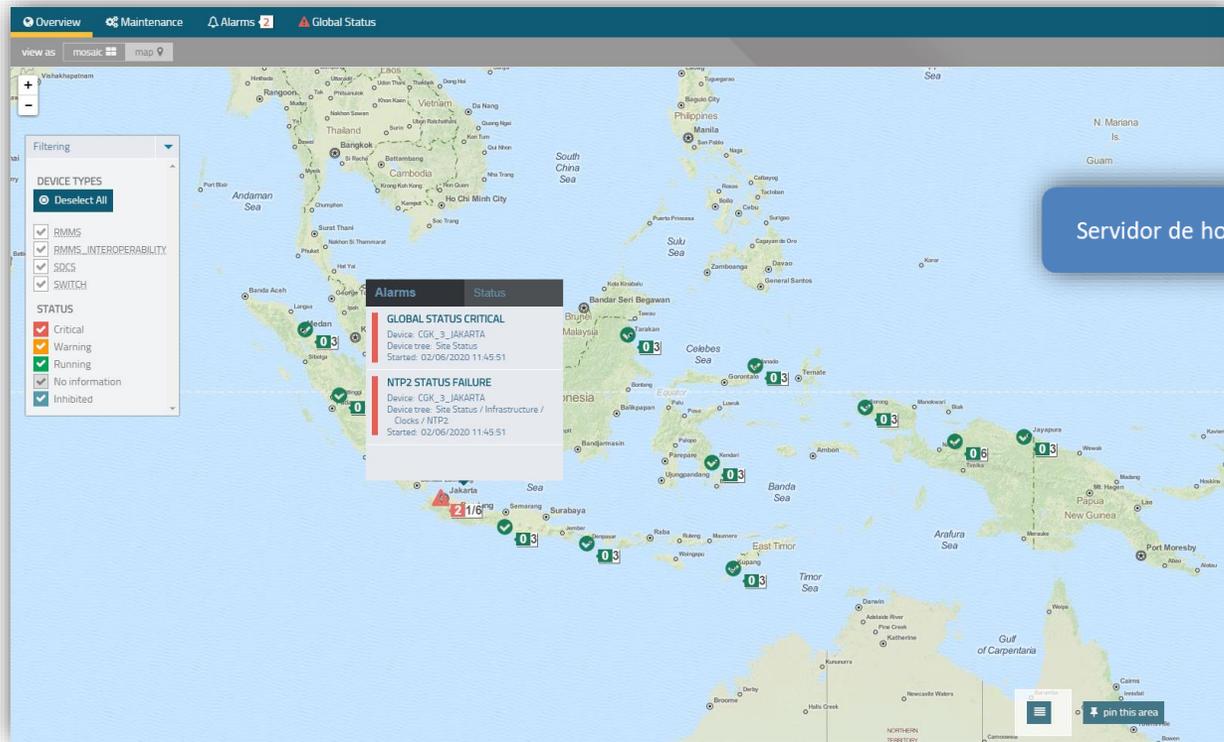
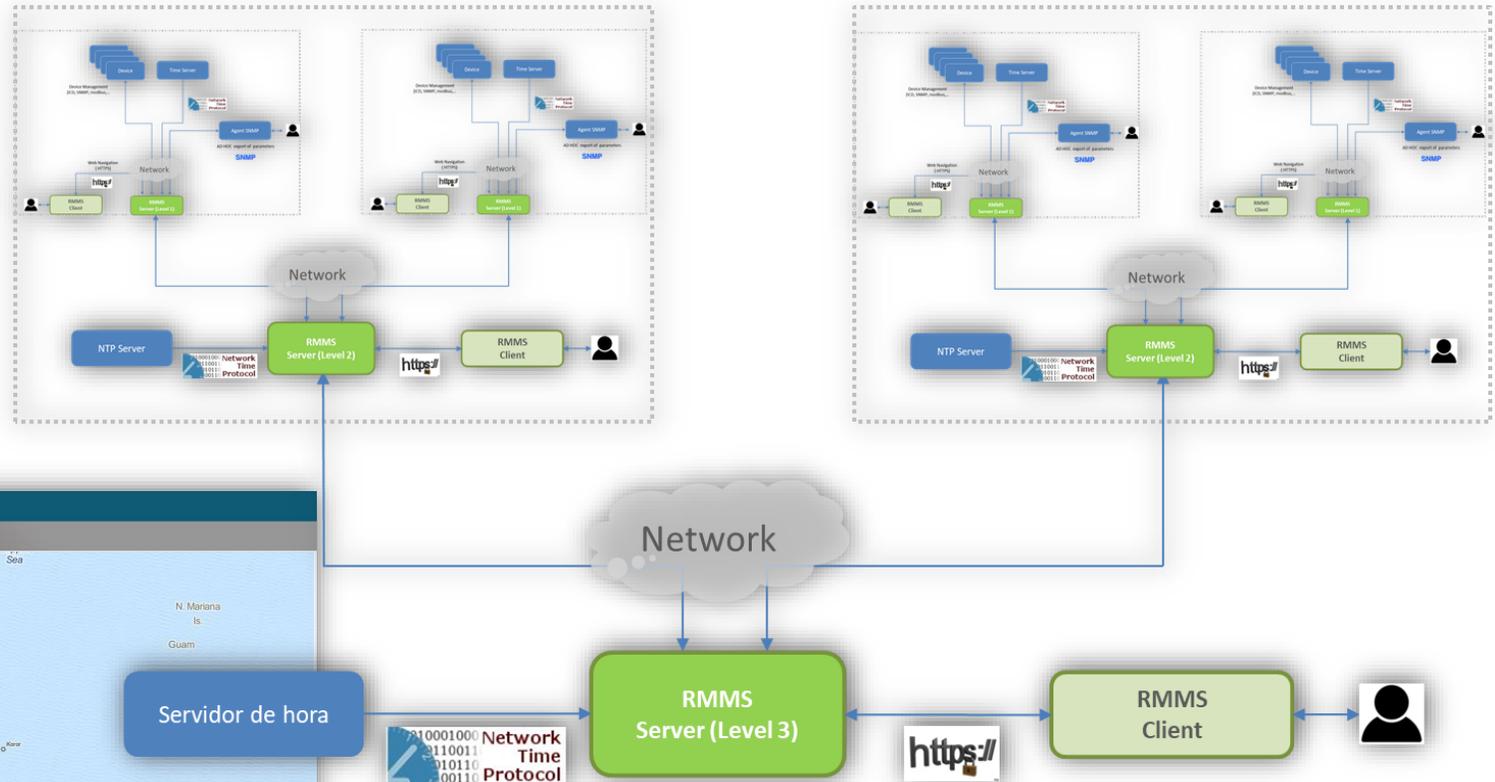
Maintenance

- Failure Management
 - Detection
 - Isolation
 - Correction
- Remote Test

The screenshot displays the Indra HMI interface for MSSR-5 equipment. The main panel shows the 'ESTADO PRINCIPAL' (Main Status) with a block diagram of the equipment. The diagram includes two channels: 'CANAL 1 Operativo' and 'CANAL 2 Reserva'. Each channel contains modules for SAU, SDU, TRA, EMU, and CTU. A central 'UTS' (User Terminal Station) block is connected to the channels. The interface also shows a 'CONFIGURACIÓN PSR' (PSR Configuration) panel with various settings like 'Transmisión', 'Modo de Frecuencia', and 'Modo de Polarización'. A 'CADENA ACTIVA' (Active Chain) panel at the bottom allows for manual control of various components like EPG, RXG, MWG, PRPA, TSU, TXCU, and Encoder for both CANAL 1 and CANAL 2. The top navigation bar includes 'Vista de conjunto', 'Mantenimiento', 'Alarmas', and 'Estado global'. The right sidebar shows a list of alarms, including 'PÉRDIDA DE COMUNICACIÓN', 'GPS NO SINCRONIZADO', and 'FALLO DE ANTENA'.

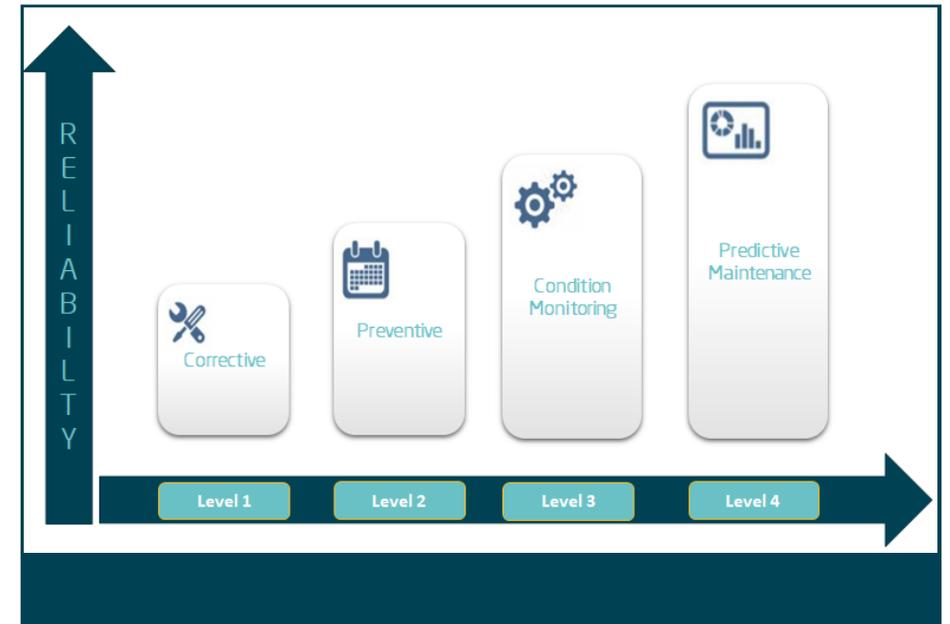
RMMS- Multi level

- Complete network (Service)



Advanced Features - Troubleshooting

- Troubleshooting integrated for each surveillance device
- Benefits
 - Reduction of failure reparation times
- Hardware/Firmware/Software Configuration
- Preventive Maintenances- Interactive/Automatic
- Corrective Maintenances- Manual
- Benefits of Predictive and CBM Maintenance



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At the core

INDRA SOLUTION FOR ATM-RADARS





QUESTIONS AND ANSWERS



Poh Theen Soh

Director Asia Pacific Affairs, CANSO



THANK YOU

CANSO
SHAPING OUR FUTURE SKIES

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