



ICAO

INTERNATIONAL CIVIL AVIATION ORGANIZATION

A UN SPECIALIZED AGENCY





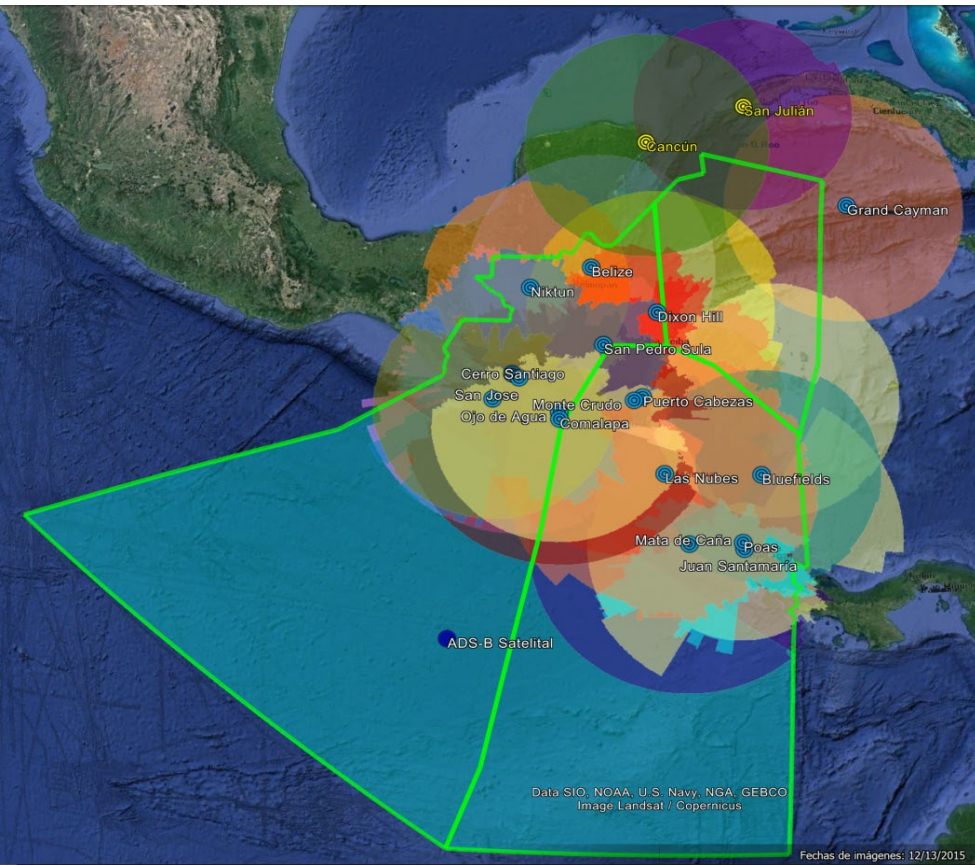
CORPORACIÓN CENTROAMERICANA DE SERVICIOS DE NAVEGACIÓN AÉREA (COCESNA)

NAM/CAR/SAM Meeting Workshop on the Development of the regulation for the implementation of Automatic Dependent Surveillance – Broadcast (ADS-B)

July 2023

ADS-B Enablers implementation:

- ADS-B Infrastructure
- Avionics
- Personnel Training
- Operational aspects



AGENDA



- **Introduction**



- **Enablers:**

- ADS-B Infrastructure
- Avionics
- Personnel Training
- Operational aspects



- **Conclusions**



- **Recommendations**

Introduction

COCESNA through its Integral Investment Plan has modernized the Central American Air Navigation Systems, including Area Control Centers, APP's, TWR's, as well as ground-based surveillance sensors including Mode S radars with ADS-B capability, ADS-B systems and a WAM with ADS-B capability, which has provided dual surveillance coverage Radar + ADS-B in radar and satellite-based ADS-B in the Pacific oceanic airspace, for the use and benefit of COCESNA and its Member States.

Enablers: Control Center infrastructure in Central America



BELIZE

- Centro de Control APP/TWR Aerop. Intr. Philip Goldson Belize

GUATEMALA

- Centro de Control APP/TWR Aerop. Intr. La Aurora
- Centro de Control APP/TWR Aerop. Intr. Mundo Maya

COSTA RICA

- Centro de Control APP/TWR Aerop. Intr. Juan Santamaria
- Consola APP/TWR Aerop. Intr. Daniel Oduber Quiros.
- TWR Aerop. Intr. Pavas

HONDURAS

- Centro de Control Área, CENAMER
- Centro de Control APP/TWR Aerop. Intr. Ramon Villeda Morales
- TWR's Aeropuertos Internacionales La Ceiba, Roatán y Palmerola
- Consola APP/TWR Aerop. Toncontin

EL SALVADOR

- Centro de Control APP/TWR Aerop. Intr. San Oscar Arnulfo Rivera y Galdámez (SOARG)
- TWR Aerop. Intr. Ilopango.
- Centro de Control Área/BACKUP CENAMER

NICARAGUA

- Centro de Control APP/TWR Aerop. Intr. Managua
- Consola APP/TWR Aerop. Bluefields
- TWR Puerto Cabezas

Enablers: Control Center infrastructure in Central America

- All ACC/APP/TWR Control Centers have been upgraded to process ADS-B data.
- ADS-B ground-based and satellite-based sensor data management.
- ADS-B processing capability DO-260, DO-260A and DO-260B versions.
- Asterix format processing capability CAT 021 editions 0.23,0.26,1.3, 2.1 and 2.4.
- Presentation of ADS-B tracks with elementary and enhanced Mode S surveillance (BDS records).
- Alarm generation by Figures of Merit, NICs, thresholds and data filtering.
- Thresholds and data filtering by Figure of Merit NUCp and NIC.
- Multisensor symbology MSSR+PSR+ADS-B+MLAT
- The ADS-B sensors applicable in each Control Center are currently configured.

Enablers: Control Center infrastructure in Central America

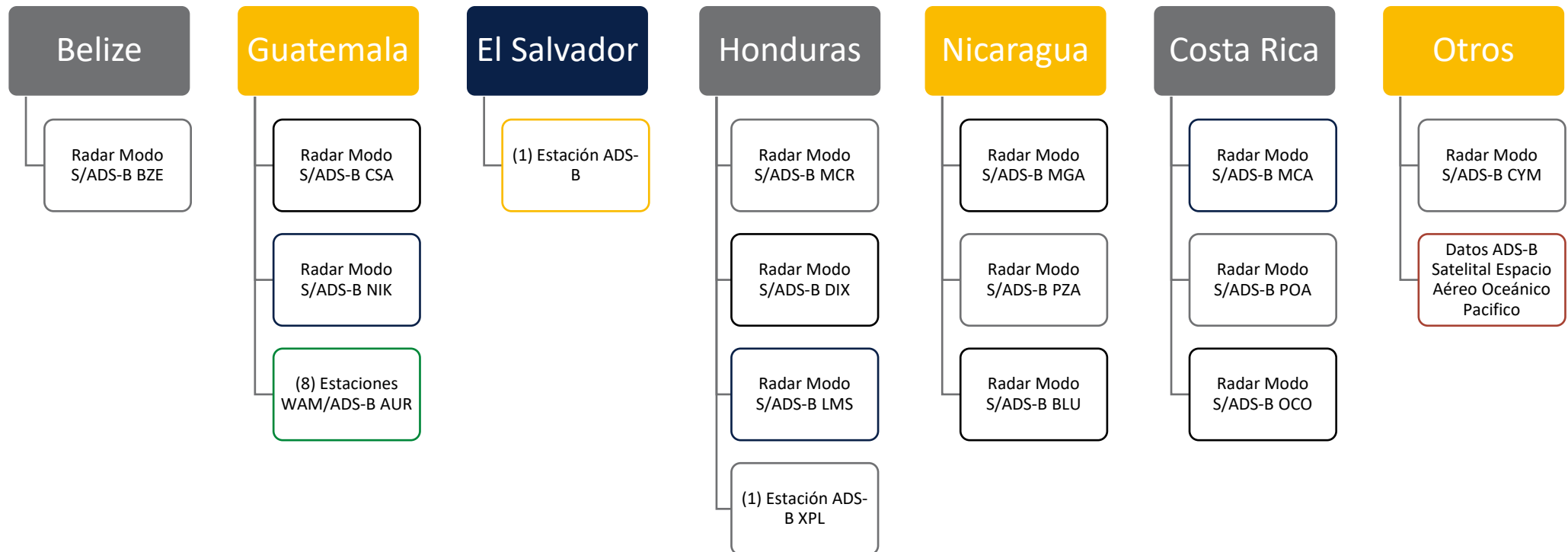
Important factors to consider:

- Have a surveillance communications network for Radar + ADS-B data sharing, between sensors and control centers using IP protocol and AST format.
- ADS-B data processing server to process and manage multiple ground and satellite based ADS-B sensors, identifying the data source with SAC/SIC.
- Improve data processing and filtering by ADS-B version and figures of merit according to the required performance rule for airspaces.
- Multi-sensor symbology, standard parameters and alarms.
- Availability of Control Center and Sensor updates for future DO-260C version and AST CAT 021 format, editions 2.5, 2.6 and future editions.

Enablers: Aeronautical Surveillance Systems

Mode S Surveillance radars and ADS-B that provides redundancy on aeronautical surveillance:

- (14) Mode S Secondary Radars with ADS-B capability
- (8) WAM Stations with ADS-B capability
- (2) Stand alone and redundant ADS-B stations
- (1) Space based ADS-B service

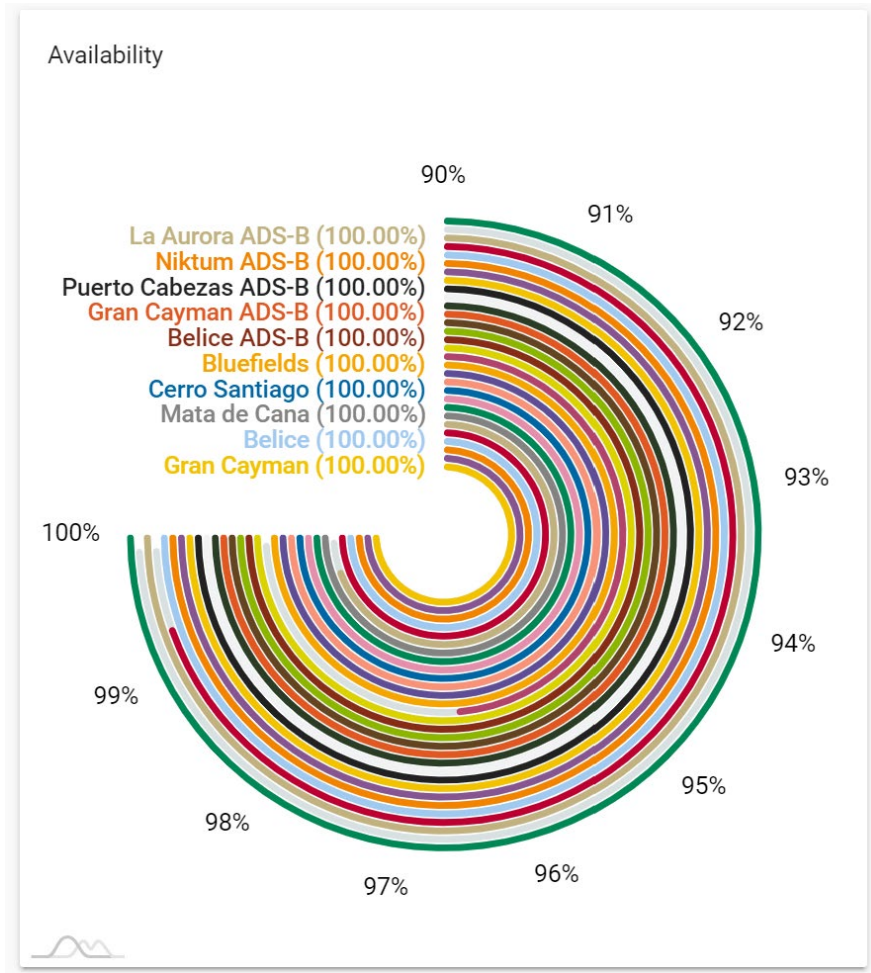
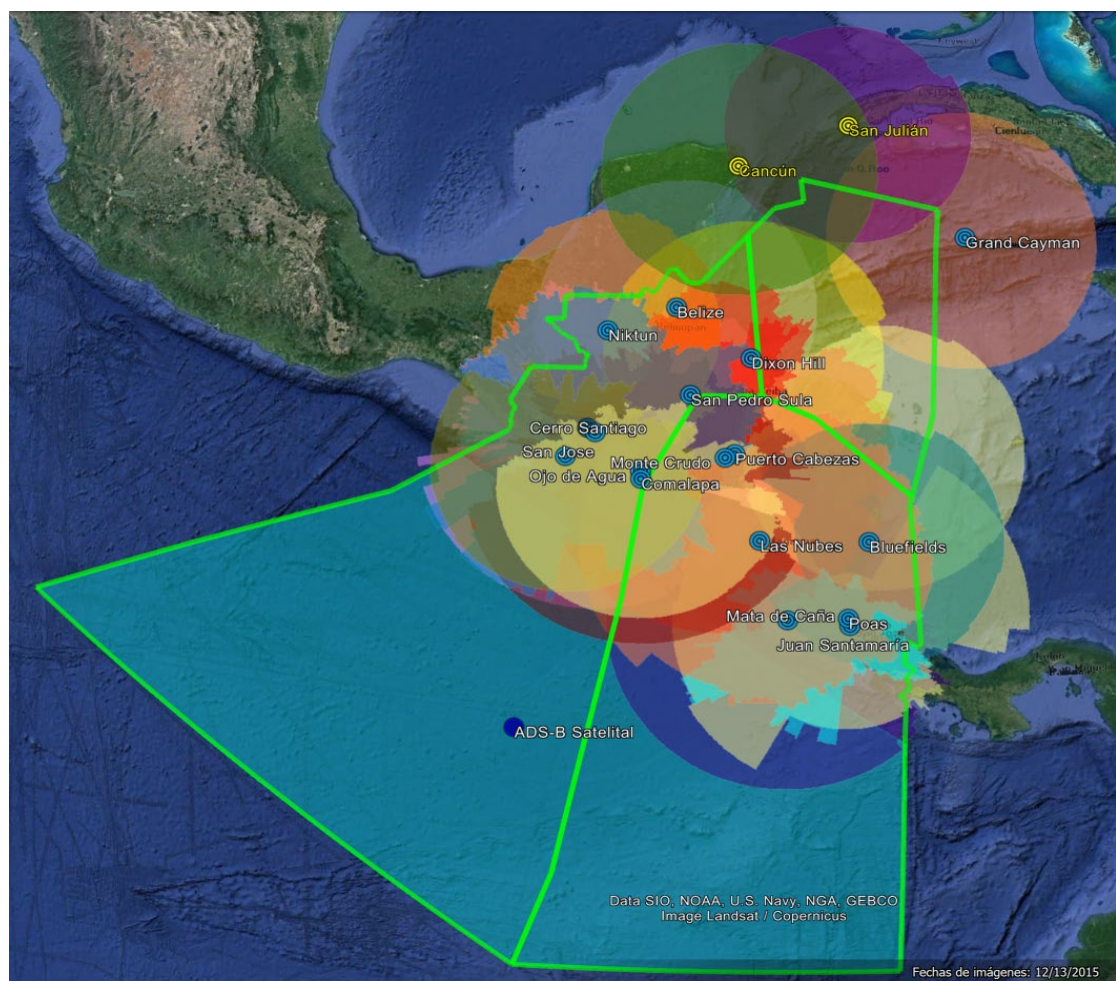


Enablers: Aeronautical Surveillance Systems

Important factors to consider:

- Identification of sensors, SAC/SIC .
- DO-260, DO-260A and DO-260B capable ADS-B sensors.
- Upgrades for future DO-260C version and enhancements.
- Asterix CAT 021 data formatting versions 2.1, 2.4
- Upgrades for future Asterix CAT 021, 2.5, 2.6 and future editions.
- Remote system management and monitoring system, Asterix CAT 023 for service messages.
- ADS-B performance assurance system, to evaluate availability and performance of Radar MSSR/PSR/ADS-B/WAM, ADS-B Satellite systems, including latency.

Enablers: Aeronautical Surveillance Systems Systems Performance Assurance

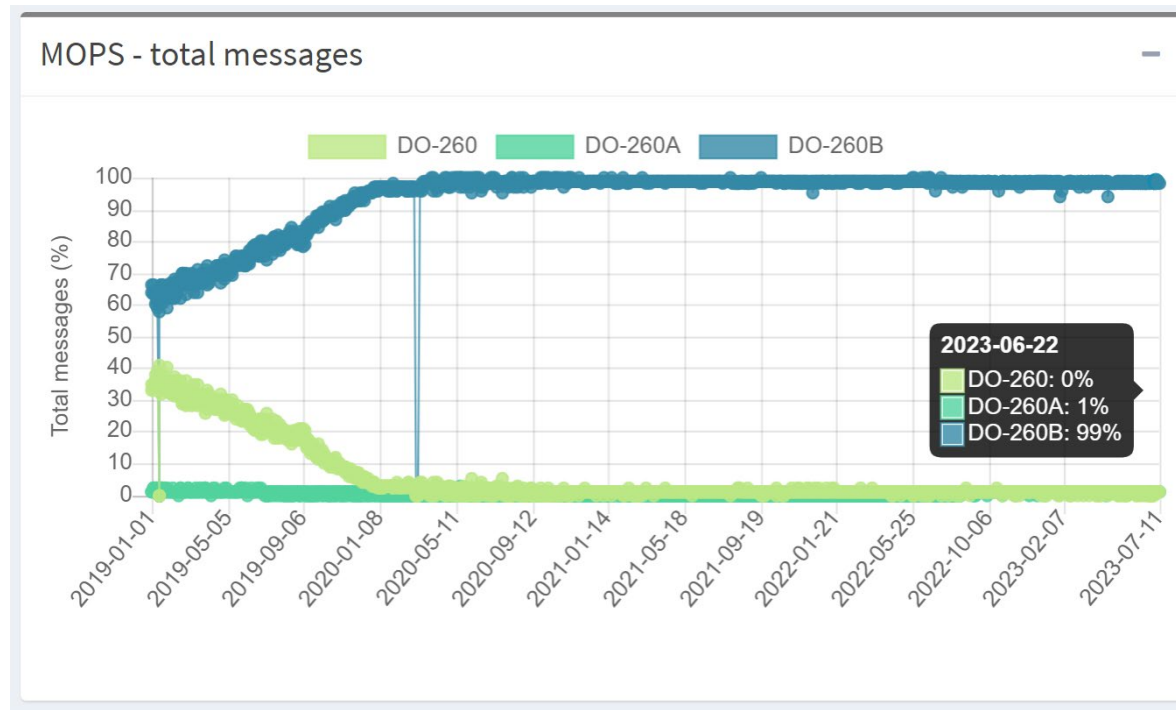
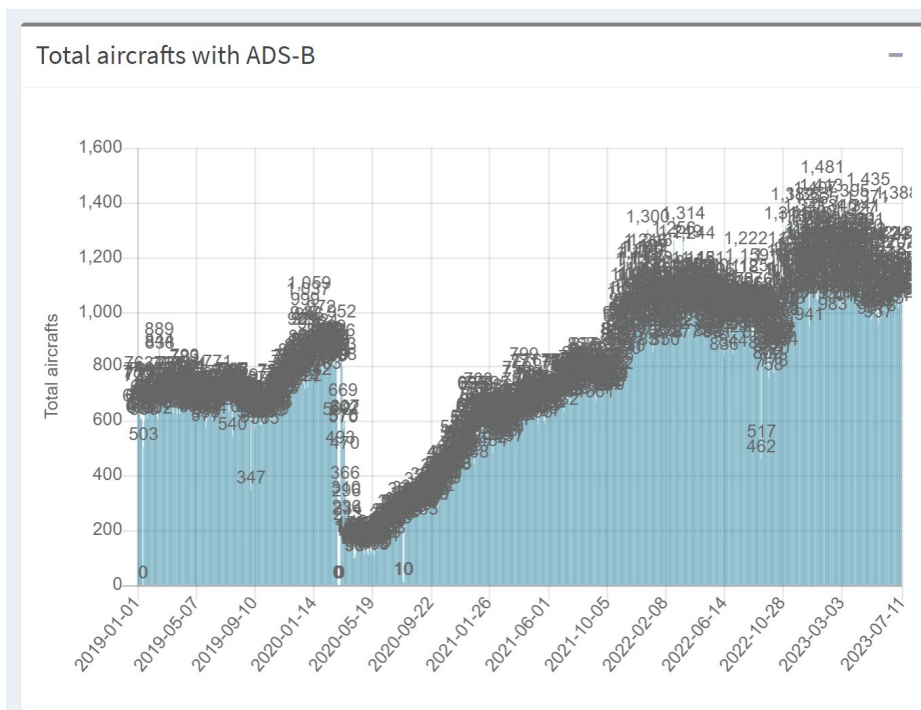


Enablers: Avionics

Activities performed:

- ADS-B capable aircraft monitoring SW.
- Generation of aircraft report with ICAO address from CA countries with ADS-B capability.
- Generation of registration list of ADS-B capable aircraft by Member States
- Workshop consultation on ADS-B upgraded aircraft and cost.
- Statistical analysis of ADS-B equipment implementation, using the following information:
 - Flight plan operations log - Billing ATM log.
 - ADS-B operations log - ADS-B sensor log.
 - Log of operations identified by other data sources.
 - Request for additional information from suppliers.

Enablers: Avionics ADS-B data monitoring system



HaEnablers: Avionics Aircraft register

Important factors to consider:

- 24-bit ICAO address assignment and registration.
- Registration of aircraft with avionics information in a regionally standardized manner.
- Registration of aircraft certification for ADS-B.
- BI and ADS-B aircraft monitoring system.

Enablers: Avionics – Costa Rica Equipment

Registro de Aviónica por matricula TI

Conclusions:

Almost 100% of commercial aircraft have ADS-B capability.

There is growth in the % of general aviation aircraft with ADS-B capability.

According to preliminary results in Costa Rica, 46.5% of aircraft are already equipped with ADS-B by the first half of 2023.

| Matricula | Fabricante | Modelo | Fabricante | Modelo | Modo S | WAAS/GPS | ADS-B |
|-----------|--------------------|----------------------|------------|----------|--------|----------|-------|
| TI-ADA | CESSNA | 182 | GARMIN | GNX375 | SI | SI | SI |
| TI-AFQ | PIPER | CHEROKEE 180 | BENDIX | KT74 TSO | SI | SI | SI |
| TI-AHF | CESSNA | 182 | GARMIN | GTX335 | SI | SI | SI |
| TI-AHN | PIPER | PA28-235 | GARMIN | GTX335 | SI | SI | SI |
| TI-AHQ | PIPER | PA-28-180 | GARMIN | GTX335 | SI | SI | SI |
| TI-AHU | PIPER | PA-34-200T | GARMIN | GTX335R | SI | SI | SI |
| TI-ALM | CESSNA | R172K | GARMIN | GTX335 | SI | SI | SI |
| TI-AMT | PIPER | PA-32RT-300 Lance II | GARMIN | GTX 335 | SI | SI | SI |
| TI-APD | CESSNA | TU-206-F | GARMIN | GTX345 | SI | SI | SI |
| TI-AUM | CESSNA | 172K | GARMIN | GTX335 | SI | SI | SI |
| TI-AWM | Beechcraft | King Air F90 | GARMIN | GTX335 | SI | SI | SI |
| TI-AZF | AIRBUS HELICOPTER | H130 | BENDIX | KT74 | SI | SI | SI |
| TI-AZI | Beenchcraft | C90B | BENDIX | KT74 | SI | SI | SI |
| TI-BBE | CESSNA | T206H Stationair TC | BENDIX | KT 74 | SI | SI | SI |
| TI-BBO | CESSNA | R172K Hawk XP | GARMIN | GTX 345 | SI | SI | SI |
| TI-BBU | Airbus Helicopters | AS-350B3 | GARMIN | GTX335 | SI | SI | SI |
| TI-BCX | CESSNA | C208B | GARMIN | GTX-335 | SI | SI | SI |
| TI-BCY | CESSNA | C208B | GARMIN | GTX-335 | SI | SI | SI |
| TI-BDL | CESSNA | C208B | GARMIN | GTX-335 | SI | SI | SI |
| TI-BDW | CESSNA | C208B | GARMIN | GTX-335 | SI | SI | SI |
| TI-BDX | CESSNA | C208B | GARMIN | GTX-335 | SI | SI | SI |
| TI-BDY | CESSNA | C208B | GARMIN | GTX 335 | SI | SI | SI |
| TI-BEJ | PIPER | PA-28-181 Archer II | GARMIN | GTX 335 | SI | SI | SI |
| TI-BEL | PIPER | PA-34-220T | GARMIN | GTX 335 | SI | SI | SI |
| TI-BEM | PIPER | PA-18 SUPER CLUB | GARMIN | GTX 335 | SI | SI | SI |
| TI-BET | Robinson | R66 | GARMIN | GTX 335 | SI | SI | SI |
| TI-BEZ | PIPER | PA-28-181 Archer II | GARMIN | GTX 335 | SI | SI | SI |

Enablers: Avionics – Costa Rica Equipment

Conclusions for CR:

The cost of the Garmin GTX-335 transponders directly with the manufacturer is approximately \$3,800.00 USD, this equipment has built-in Mode S, WAAS and ADS-B.

The air operator Sansa to upgrade their equipment to the GTX-335 model through CESSNA, each equipment had a cost of approximately \$2,500.00 USD, commenting that it was implemented in one month.

The cost of the Bendix King KT74 transponders directly with the manufacturer is approximately \$2,000.00 USD, this equipment has built-in Mode S and ADS-B, with an input interface for the aircraft GPS signal.

One of the authorized workshops in Costa Rica was contacted, indicating that the cost for each equipment installed, including the configuration and the equipment, is approximately \$6,000.00 USD.

ADS-B implementation costs are considered to be affordable.

The extension of the implementation period for the mandatory use of ADS-B, between 6 and 12 months, is being analyzed; this period will be established according to the implementation progress made in the second half of 2023 and the delivery deadlines of the transponder manufacturers.

Costo de actualización ADS-B Aviónica

| Transpondedor | | |
|---------------|---------|-----------------|
| Fabricante | Modelo | Costo reportado |
| Garmin | GTX-335 | \$3800 |
| Garmin | GTX-330 | \$2500 |
| Garmin | GTX-33 | \$2500 |
| Garmin | GTX345 | \$8900 |
| Garmin | GTX45R | \$4300 |
| Trig Avionics | TT21 | \$2500 |
| Trig Avionics | TT22 | \$2700 |
| Bendix King | KT74 | \$2000 |

| Transpondedor | | | |
|---------------|----------------|---------------|--------------|
| Fabricante | Tiempo entrega | Desalmacenaje | Tiempo total |
| GARMIN | 5 MESES | 2 semanas | 22 semanas |
| Bendix King | 1 MES | 2 semanas | 6 semanas |

Enablers: Avionics. Equipment and cost Belize

Conclusions:

In the case of BZE for the different vendors, the required equipment and prices for avionics upgrades have been identified. The reported cost is between US\$ 5,000.00 and US\$ 7,000.00

| COMPANY | QUANTIT Y | ACFT MODEL | TRANSPONDER | ADS-B OUT | Retrofit Transponder | Price |
|---------------------|-----------|--------------------|---------------------|--------------|----------------------|------------|
| Cari-Bee | 1 | V3-HET Piper PA32 | Appaero Stratus ESG | ADS-B OUT | | |
| | 2 | V3-HEQ Piper PA32 | Garmin GTX327 | MODE A and C | GTX330ES | \$2,385.00 |
| | 3 | V3-HES Cessna C206 | King KT76 | MODE A and C | GTX330ES | \$2,385.00 |
| Astrum Helicopters | 1 | V3-AHA | GTX335 STANDARD | ADS-B OUT | | |
| | 2 | V3-AHD | GTX330ES | ADS-B OUT | | |
| | 3 | V3-AHE | GTX345 | ADS-B OUT | | |
| | 4 | V3-AHF | GTX345R | ADS-B OUT | | |
| Belize Aviation LTD | 1 | 7ECA | ----- | MODE A and C | NGT-9000 | \$6,800.00 |
| | 2 | PA 32-300 | ----- | MODE A and C | GTX-345 | \$4,995.00 |
| | 3 | N36FF | Bendix King KT74 | ADS-B OUT | | |
| | 4 | V3-AKT/ CESSNA | ----- | MODE A and C | GTX-345 | \$4,995.00 |
| | 5 | N8285U/CESSNA | ----- | MODE A and C | | |
| Tropic Air | 1 | V3-HHC/C208B | GTX33 | MODE S | GTX-345 | \$4,995.00 |
| | 2 | V3-HHE/C208B | GTX33 | MODE S | GTX-345 | \$4,995.00 |
| | 3 | V3-HHG/C208B | GTX33 | MODE S | GTX-345 | \$4,995.00 |
| | 4 | V3-HHI/C208B | GTX33 | MODE S | GTX-345 | \$4,995.00 |
| | 5 | V3-HHK/C208B | GTX33 | MODE S | GTX-345 | \$4,995.00 |
| | 6 | V3-HHL/C208B | GTX33 | MODE S | GTX-345 | \$4,995.00 |
| | 7 | V3-HHM/C208B | GTX33 | MODE S | GTX-345 | \$4,995.00 |
| | 8 | V3-HHV/C208BEX | GTX33 | MODE S | GTX-345 | \$4,995.00 |
| | 9 | V3-HHW/C208B | GTX33 | MODE S | GTX-345 | \$4,995.00 |
| | 10 | V3-HHX/T 182T | GTX33 | MODE S | GTX-345R | \$5,895.00 |
| | 11 | V3-HHY/T 182T | GTX33 | MODE S | GTX-345R | \$5,895.00 |
| | 12 | V3-HHZ/C208BEX | GTX33 | MODE S | GTX-345 | \$4,995.00 |
| | 13 | V3-HIG/C208BEX | GTX345R | ADS-B OUT | | |
| | 14 | V3-HIH/208BEX | GTX33 | MODE S | GTX-345 | \$4,995.00 |
| | 15 | V3-HII/208BEX | GTX345R | ADS-B OUT | | |
| | 16 | V3-HIM/208BEX | GTX345R | ADS-B OUT | | |
| | 17 | BEACHCRAFT 1900D | GTX345R | ADS-B OUT | | |
| Maya Island Air | 1 | V3-HHA/C208B | KT70/KT71 | MODE S | GTX-345 | \$4,995.00 |
| | 2 | V3-HGO/C208B | KT70/KT71 | MODE S | GTX-345 | \$4,995.00 |
| | 3 | V3-HGQ/C208B | KT70/KT71 | MODE S | GTX-345 | \$4,995.00 |
| | 4 | V3-HIA/C208BEX | GTX335R | ADS-B OUT | | |
| | 5 | V3-HIB/C208BEX | GTX335R | ADS-B OUT | | |
| | 6 | V3-HIC/C208BEX | GTX335R | ADS-B OUT | | |
| | 7 | V3-HID/C208BEX | GTX335R | ADS-B OUT | | |
| | 8 | V3-HIE/C208BEX | GTX335R | ADS-B OUT | | |
| | 9 | V3-HIN/C208BEX | GTX335R | ADS-B OUT | | |
| | 10 | V3-HIO/C208BEX | GTX335R | ADS-B OUT | | |

Enablers: Avionics – Equipment Honduras

Conclusions:

The information provided by the Honduran Civil Aeronautics Agency on aircraft with HR registration that are equipped with transponders with ADS-B capabilities is shown.

Roster of Aircraft with HR Registrations

Anexo 1
AGENCIA HONDUREÑA DE AERONÁUTICA CIVIL
PLAN DE DIRECCIONES DE AERONAVE 24 BITS
SOLICITUD DE CÓDIGOS PARA TRANSPONDEDORES
MODOS - ÚNICAMENTE

A. Datos del Dueño/ Operador de la Aeronave

Nombre dueño / Operador de la aeronave: SERVICIOS AÉREOS VIP S DE R.L.

Dirección dueño / Operador de la aeronave: Residencial El Trapiche Calle Principal Contiguo Iglesia CCI, Tegucigalpa HN.

B. Datos de la aeronave

| | | | |
|--------------------------|--------|------------|-------|
| Matrícula de la aeronave | HR-HSG | No. Serie | 56320 |
| Modelo de Aeronave | 407GX1 | Fabricante | BELL |
| Certificado Tipo | H-92 | | |

C. Datos del (de los) transpondedores modo S instalado en la aeronave.

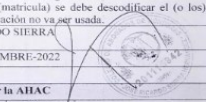
| Transpondedor No. 1 | | | |
|---------------------|--------------|-----------------|-----------|
| Modelo del Tx | GTX335R | Fabricante | GARMIN |
| Numero de Parte | 010-01215-04 | Número de Serie | 3EF024812 |
| Transpondedor No. 2 | | | |
| Modelo del Tx | | Fabricante | |
| Numero de Parte | | Número de Serie | |

Nota:

- En el caso de aeronaves con dos o más transponder, deben transmitir el mismo código.
- En caso de cambio de transponder debe ser codificado con el mismo código binario.
- En el caso de venta de la aeronave o cambio de registro (matrícula) se debe descodificar el (o los) Transpondedor(es), y ser notificado a la AHAC que la codificación no va ser usada.

Nombre de la persona que presenta solicitud: RICARDO SIERRA

Fecha de Solicitud: 15-DICIEMBRE-2022

Firma del Solicitante: 

D. Espacio para ser usado por la AHAC

Nombre del Jefe RAN: _____ Firma: _____

Código binario asignado a la aeronave: _____

Nombre del Inspector verificador de Estándares de Vuelo: _____ Firma: _____

LISTADO DE AERONAVES REGISTRADAS EN HONDURAS CON INFORMACION DEL TIPO DE TRANSPONDER 24 BITS INSTALADO EN CADA UNA DE ELAS

| EMPRESA | MATRICULA | MODELO AERONAVE | TRANSPONDER | ADS-B OUT |
|---|-----------|---------------------|-------------|-----------|
| SERVICIOS AEREO VIP S DE R.L | HR-HSG | 407GX1 | GTX335R | MODE S |
| AEROCARIBE DE HONDURAS S.A | HR-AIQ | C-182R | GTX327 | MODE S |
| D AVIATOR, SOCIEDAD ANONIMA DE CAPITAL VARIABLE | HR-AVP | CESSNA 172 | GTX 335 | MODE S |
| LANSHA | HR-AYX | JETSTREAM 4100 | RNZ-850 | MODE S |
| LANSHA | HR-AYV | JETSTREAM 3200 | TDR94D | MODE S |
| GERARDO ENRIQUE INESTROZA EUCEDA | HR-AET | PA-28-235 | AT165 | MODE S |
| SERVICIOS AEREO PROFESIONALES | HR-AVD | P210N | GTX 327 | MODE S |
| SELIM PINOT ORDOÑEZ | HR-ACT | 182R | GTX 320 | MODE S |
| CORPORACION PETROLERA MONTECRISTO S.A DE C.V | HR-GMC | R66 | GTX 345 | MODE S |
| JOSE OSMAN PAZ CANAHUATI | HR-NCH | U206U | GTX 345 | MODE S |
| SERVICIOS AEREO VIP S DE R.L | HR-VIP | BELL 407 GXP | GTX 33H | MODE S |
| INVERSIONES MATERIALES S. DE R.L DE C.V | HR-NAM | T210N | GTX 345 | MODE S |
| SOLUCIONES AEREAS DE HONDURAS S.A DE C.V | HR-AXS | 407 | GTX 33H | MODE S |
| ISLEÑA DE INVERSIONES S.A DE C.V | HR-AYM | ATR72-212A | RCZ-852 | MODE S |
| ISLEÑA DE INVERSIONES S.A DE C.V | HR-AYJ | ATR72-212A | RCZ-852 | MODE S |
| AVIACION TECNOLOGIA S.A DE C.V | HR-AVR | B737-200 | TRA 67A | MODE S |
| INVERSIONISTAS TECNOLOGICOS UNIDOS (ITUSA) | HR-AXL | KING AIR C90 | GTX-330 | MODE S |
| INVERSIONISTAS TECNOLOGICOS UNIDOS (ITUSA) | HR-CLQ | KING AIR B200 | TDR-94D | MODE S |
| INVERSIONISTAS TECNOLOGICOS UNIDOS (ITUSA) | HR-GCA | BELL 429 | GTX-330 | MODE S |
| JASER FRANK GOFF AMADOR/ GOFF AIRWAY | HR-AUS | U 206G | KT 70 | MODE S |
| FUERZA AEREA HONDUREÑA | FAH-021 | C208B GRAND CARAVAN | GTX 345R | MODE S |

| EMPRESA | MATRICULA | MODELO AERONAVE | TRANSPONDER | ADS-B OUT |
|---|-----------|-----------------|-------------|-----------|
| FUERZA AEREA HONDUREÑA | FAH-019 | 208 B | GTX 33 | MODE S |
| FUERZA AEREA HONDUREÑA | FAH-025 | 208 B | GTX 330 | MODE S |
| FUERZA AEREA HONDUREÑA | FAH-020 | 208B | GTX 33 | MODE S |
| FUERZA AEREA HONDUREÑA | FAH-950 | UH-1H | NGT-9000 | MODE S |
| FUERZA AEREA HONDUREÑA | FAH-951 | UH-1H | NGT-9000 | MODE S |
| FUERZA AEREA HONDUREÑA | FAH-980 | BELL 412 EP | MST 67A | MODE S |
| FUERZA AEREA HONDUREÑA | FAH-953 | UH-1H | NGT-9000 | MODE S |
| FUERZA AEREA HONDUREÑA | FAH-952 | UH-1H | NGT-9000 | MODE S |
| INVERSIONES DEL PADRO S.A DE C.V | HR-REM | C152 | STRATUS ESG | MODE S |
| INVERSIONES DEL PADRO S.A DE C.V | HR-AXX | C414 | GTX 330 | MODE S |
| GLOBAL SKY, S. DE R.L | HR-AYK | PA-31-350 | GTX 327 | MODE S |
| DISTRIBUIDORA DE VEHICULOS S.A DE CV | HR-AUM | 206L4 | KR87 | MODE S |
| DISTRIBUIDORA DE VEHICULOS S.A DE CV | HR-ASU | 206B3 | KR87 | MODE S |
| SERVICIOS AEREO VIP S. DE R.L | HR-FLY | BELL407 | GTX327 | MODE S |
| SOCIEDAD MERCANTIL AGROPECUARIA MONTELIBANO | HR-ATF | BELL 206 B3 | KT76A | MODE S |
| AEROLINEAS SOSA | HR-HJS | 340B | TDR-94D | MODE S |
| INVERSIONES DEL PADRO S.A DE C.V | HR-AVV | C172 | GTX330ES | MODE S |
| EQUIPO, DESARROLLO E INVERSIONES S DE R.L DE CV | HR-AXW | R44 RAVEN II | KT76C | MODE S |
| AEROLINEAS SOSA | HR-AWW | CRJ-100 | TDR-94D | MODE S |
| SERVICIOS AEREO FLY VIP | HR-GCE | BELL 407 GXI | GTX 335R | MODE S |

Enablers: Avionics – Equipment Nicaragua

Conclusions:

The information provided by INAC regarding aircraft registration is shown.

Register of aircrafts, provided by INAC

| Instituto Nicaraguense de Aeronautica Civil | | | | | | | | | | | | | |
|---|------------------------|---------------------------------|----------------------|-----------|-----------|--|----|-----|-----|----|------------|--------------------|--------------------|
| Asignador deCodigo Binario de 24 bits para aeronaves de Nicaragua | | | | | | | | | | | | | |
| No | Propietario / Compañía | Fabricante | Aeronave Tipo | Matricula | Serie No. | Codigo Binario 24 bits ATC transponder | | | | | | Direccion Aeronave | Codigo Hexadecimal |
| 1 | La Costeña | Cessna AirCRAFT Company | Grand Caravan 208B | YN-CHX | 208B2389 | 0000 | 11 | 000 | 000 | 00 | 0000000000 | 786432 | 0C0000 |
| 2 | EGTRACSA | Robinson Helicopter Company | Robinson 44 Raven II | | 13350 | 0000 | 11 | 000 | 000 | 00 | 0000000001 | 786433 | 0C0001 |
| 3 | La Costeña | Aerospatiale Aeronautique Avion | ATR 42-320 | YN-CIE | 400 | 0000 | 11 | 000 | 000 | 00 | 0000000010 | 786434 | 0C0002 |
| 4 | La Costeña | Aerospatiale Aeronautique Avion | ATR 42-320 | YN-CHG | 323 | 0000 | 11 | 000 | 000 | 00 | 0000000011 | 786435 | 0C0003 |
| 5 | BANPRO, S.A. | Bell 407 | BELL 407 GCM | YN-CIU | 54309 | 0000 | 11 | 000 | 000 | 00 | 0000000100 | 786436 | 0C0004 |
| 6 | Agro Energia S.A. | Air Tractor | AT-502B | YN-CIV | 502B-3046 | 0000 | 11 | 000 | 000 | 00 | 0000000101 | 786437 | 0C0005 |
| 7 | La Costeña | Cessna AirCRAFT Company | Grand Caravan 208B | YN-CHU | 208B2327 | 0000 | 11 | 000 | 000 | 00 | 0000000110 | 786438 | 0C0006 |
| 8 | La Costeña | Cessna AirCRAFT Company | Grand Caravan 208B | YN-CHV | 208B2324 | 0000 | 11 | 000 | 000 | 00 | 0000000111 | 786439 | 0C0007 |
| 9 | La Costeña | Cessna AirCRAFT Company | Grand Caravan 208B | YN-CHW | 208B2363 | 0000 | 11 | 000 | 000 | 00 | 0000001000 | 786440 | 0C0008 |

Enablers: Avionics – Equipment El Salvador

Conclusions:

The Civil Aeronautics Authority of El Salvador provided the records of the following companies and private operators of which it maintains control of their aircraft equipment.

The companies include PANAL, Dargonza, ASA, Flight Training, AEROSAL, CAAA and CEA shown in the attached image.

Aircraft Registration Provided by the CAA of the Aeronautical Training Center, CEA

| | | | | | |
|------------------------|--------------------|-------------------------|--------------------|-------------------------|---------------|
| YS-448-P | TRANSPONDER | GPS/COMM/NAV | GPS/COMM/NAV | GPS | ELT |
| Fabricante: CESSNA | Fabricante: | Fabricante: GARMIN | Fabricante: GARMIN | Fabricante: N/A | Fabricante: * |
| Modelo: T182T | Modelo: | Modelo: G1000 | Modelo: G1000 | Modelo: N/A | Modelo: * |
| YS-445-P | TRANSPONDER | COMM/NAV | NAV | GPS | ELT |
| Fabricante: BEECHCRAFT | Fabricante: GARMIN | Fabricante: KING | Fabricante: N/A | Fabricante: GARMIN | Fabricante: * |
| Modelo: SKIPPER 77 | Modelo: GTX 327 | Modelo: KX 170B | Modelo: N/A | Modelo: GPS 150 XL | Modelo: * |
| YS-450-PE | TRANSPONDER | COMM/NAV | GPS/COMM/NAV | GPS | ELT |
| Fabricante: PIPER | Fabricante: GARMIN | Fabricante: KING | Fabricante: GARMIN | Fabricante: N/A | Fabricante: * |
| Modelo: PA-28-181 | Modelo: GTX 327 | Modelo: KX 170B | Modelo: GNS 430 | Modelo: N/A | Modelo: * |
| YS-446-P | TRANSPONDER | COMM | GPS/COMM/NAV | DME | ELT |
| Fabricante: PIPER | Fabricante: GARMIN | Fabricante: NARCO | Fabricante: GARMIN | Fabricante: NARCO | Fabricante: * |
| Modelo: PA28-161 | Modelo: GTX 327 | Modelo: COM 120 | Modelo: GNS 430 | Modelo: DME 890 | Modelo: * |
| YS-449-P | TRANSPONDER | COMM/NAV | GPS/COMM/NAV | GPS | ELT |
| Fabricante: PIPER | Fabricante: GARMIN | Fabricante: BENDIX/KING | Fabricante: GARMIN | Fabricante: BENDIX/KING | Fabricante: * |
| Modelo: PA23-250 | Modelo: GTX 327 | Modelo: KX 155 | Modelo: GNS 530 | Modelo: KLN 90B | Modelo: * |

Enablers: CENAMER Training

AUTOMATIC DEPENDENT SURVEILLANCE – BROADCAST IMPLEMENTATION (ADS-B) IN THE UPPER AIRSPACE OF THE CENTRAL AMERICAN FIR, AIC Serie A, 64/21 (1 Sep 2021)

The following activities were carried out:

- Roadmap for ADS-B implementation
- CONOPS ADS-B ground-based ADS-B Surveillance for RUTA
- CONOPS Space-based ADS-B surveillance for enroute, Pacific Ocean Airspace.
- Safety Case and Arguments
- Operational Procedures Update
- ADS-B Transition Plan
- ADS-B Training Plan
- ADS-B Ground and Space ADS-B Data Integration ATS Simulator
- On-the-job ADS-B theoretical and practical training
- ADS-B Ground and Space Based ADS-B Data Integration Operational System

Enablers: CENAMER Training

AUTOMATIC DEPENDENT SURVEILLANCE – BROADCAST IMPLEMENTATION (ADS-B) IN THE UPPER AIRSPACE OF THE CENTRAL AMERICAN FIR, AIC Serie A, 64/21 (1 Sep 2021)

Transition Plan:

Goal: To ensure that the transition to the provision of ATS service using ADS-B capability is acceptably safe. The FIR CENAMER, in a first stage the use of ADS-B data in the OCEAN airspace and in a second stage the Continental airspace.

- Planning and roadmap
- Publication of the AIC
- Integration of ground and space-based ADS-B data ATS Simulator
- Socialization of ATS staff on planning, responsible and change management.
- Updating of operational procedures: use of ADS-B, minimum separation, contingency procedures, safety case actions,
- Theoretical and practical training on the ADS-B workstation.
- Pre-operational and operational phase: Integration of ADS-B data from ground and space-based Operational System for service provision.

Enablers: CENAMER Training

AUTOMATIC DEPENDENT SURVEILLANCE – BROADCAST IMPLEMENTATION (ADS-B) IN THE UPPER AIRSPACE OF THE CENTRAL AMERICAN FIR, AIC Serie A, 64/21 (1 Sep 2021)

Training Plan:

Objective: to strengthen the competencies of Air Traffic Services personnel in relation to the use of the ADS-B surveillance system as part of the new technologies to be implemented in the service provided by CENAMER Control. Planning and roadmap. *This plan applied to all air traffic controllers and aeronautical station operators of the CENAMER Control Center.*

Plan components and operational structure

- Planning and scheduling phase
- Theoretical phase
- Practical phase
- Evaluation

Enablers: CENAMER Training

AUTOMATIC DEPENDENT SURVEILLANCE – BROADCAST IMPLEMENTATION (ADS-B) IN THE UPPER AIRSPACE OF THE CENTRAL AMERICAN FIR, AIC Serie A, 64/21 (1 Sep 2021)

Training Plan, content:

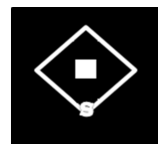
- What is ADS-B;
- Information content on the ADS-B label;
- Use of the information in the provision of the service;
- Explain the Figure of Merit usable for Air Traffic Services;
- Minimal separation using ADS-B information;
- Adjacent Dependency Requirements (ADS-B Type, Codes in Box 18 filed on FPL);
- Amendment to Doc.4444;
- Examples of control centers using ADS-B information;
- Integrity/reliability of ADS-B information (NIC/NUC values);
- Differences between radar data and ADS-B data.
- Phraseology

Enablers: CENAMER Training

- In general terms, the aim was to provide CENAMER's operational ATS personnel with the necessary knowledge regarding the use of the surveillance system, recognition of the symbols, application of procedures and ADS-B separations, in order to provide a quality and excellent service.
- On-the-job inductions and recurrent training courses were held. Among other aspects, the identification in the Automation System of the different tracks, ADS-B, ADS-B+SSR, ADS-C, synthetic, etc., was addressed.



ADS-B

ADS-B
+ SSR

SSR



ADS-C



SINETICA

Enablers: CENAMER Training

During the inductions, the visualization of the CENAMER Situation Screens was explained in detail on how to visualize the different tracks.

ADS-B Plot

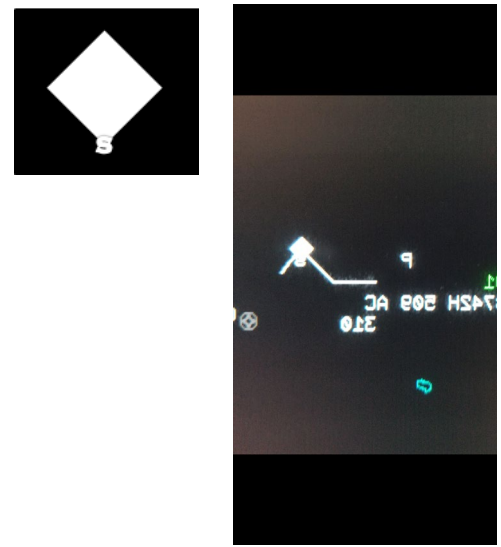












Tabla 4.1.2.1-1. Símbolos de la Pista

| SIMBOLO | TIPO DE PISTA |
|---|---|
|  | Primario |
|  | Secundario |
|  | Secundario combinado con Primario |
|  | Correlado |
|  | Sintético |
|  | Pistas con Código SSR Especial (1200 y código para vuelos visuales) |
|  | ADS-B |
|  | ADS-B Combinado con Primario |
|  | ADS-B Combinado con Secundario |
|  | ADS-B Combinado con Primario y con Secundario |

Enablers: CENAMER Training

- During the inductions, the visualization of the CENAMER Situation Screens was explained in detail on how the different tracks are displayed.

ADS-B + SSR plot



- Finally, the technical characteristics of the ADS-B equipment installed and integrated in the air traffic units and the ADS-B performance were reviewed.



Enablers: Operational aspects – Doc 4444

Document 4444 states when ADS-B may be used.

8.1.7 Los sistemas de vigilancia ATS como el radar primario de vigilancia (PSR), el radar secundario de vigilancia (SSR), ADS-B y los sistemas MLAT podrán utilizarse solos o en combinación para proporcionar servicios de tránsito aéreo, incluido lo relativo a mantener la separación entre las aeronaves, siempre que:

- a) exista cobertura confiable dentro del área;
- b) la probabilidad de detección, la precisión y la integridad de los sistemas de vigilancia ATS sean satisfactorias; y
- c) en el caso de ADS-B, la disponibilidad de datos de las aeronaves participantes sea adecuada.

8.1.10 La ADS-B sólo se utilizará para suministrar el servicio de control de tránsito aéreo cuando la calidad de la información que contenga el mensaje ADS-B supere los valores que especifique la autoridad ATS competente.

8.1.11 La ADS-B podrá utilizarse sola, incluso para proporcionar una separación entre las aeronaves, siempre y cuando:

- a) se establezca y mantenga la identificación de la aeronave equipada con ADS-B;
- b) la medida de la integridad de los datos en el mensaje ADS-B sea adecuada para apoyar la mínima de separación;
- c) no exista un requisito de detección de aeronaves que no transmitan ADS-B; y
- d) no exista el requisito de determinar la posición de la aeronave que es independiente de los elementos de determinación de la posición de su sistema de navegación.

Enablers: Concept of Operations

Supporting documentation is available:

- PANS/ATM "Air Traffic Management" (ICAO document 4444).
- Concept of Operations (CONOPS) for Automatic Dependent Surveillance - Broadcast (ADS-B), developed by the ICAO Surveillance TF
- Concept of operations CONOPS surveillance ADS-B Satellite and CENAMER risk analysis.
- CENAMER operational manuals.
- Member States' RACs and Member States' AIP publications.

Conclusions

- According to the information gathered, there is a significant increase in ADS-B equipment for general and domestic aviation aircraft.
- It is considered feasible to implement ADS-B as a secondary layer for aeronautical source and a regulation for mandatory aircraft equipment, as was done by CENAMER for airspace in RUTA.
- It is necessary to improve the assignment and registration of the 24-bit ICAO address. Cases have been found of erroneous or unassigned addresses from ADS-B data.
- Aircraft registration needs to be improved, including information on ADS-B + GNSS avionics and their certification.
- Although there is significant growth in the percentage of aircraft equipage, there is still a significant gap in general aviation and domestic airlines.
- The cost of equipping aircraft with ADS-B is not significant, but the acquisition and installation times can be significant.
- There are local workshops in several CA countries that have been equipping aircraft with ADS-B, so it is feasible to equip them.
- In general terms, adequate control is maintained and the provisions regarding the univocal identification of surveillance data sources through the SIC/SAC are followed.

Recommendations - Actions

- Publish the use of ADS-B as a secondary surveillance source in radar airspace according to the roadmap and as a phase prior to the mandatory use of ADS-B avionics, considering the degree of implementation of ADS-B enablers.
- States should revise the 24-bit code request and assignment procedures, incorporating additional on-board equipment information, notifications and code release in the records; such modification could be done by means of an AIC.
- Based on the information gathered from ADS-B, notify operators whose transponders do not present a correct 24-bit code, so that they can request and update the code in the equipment, including notifying the Civil Aviation Authorities of those aircraft identified with foreign registration and that present a national 24-bit code for the corresponding adjustments.
- In the case of establishing a mandate for a registry of unequipped aircraft, the deadlines for their equipment should be considered given the capacity of the existing workshops, suppliers, among other aspects.
- It is necessary to maintain control and follow-up at the Regional level of the assignment of surveillance data sources with their SIC/SAC as established by ICAO.
- It is necessary to continue with the support of the Member States, identifying the workshops that carry out transponder installation work with ADS-B capabilities, the approximate cost, the equipment available and the estimated duration of the work.



Thank You!