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# ICAO SARPS AND GUIDANCE DOCUMENTS ON SURVEILLANCE SYSTEMS

MEETING/WORKSHOP ON AUTOMATIC DEPENDENT  
SURVEILLANCE – BROADCAST (ADS-B) IMPLEMENTATION  
(ADS-B/IMP)

(Lima, Peru, 13 to 16 November 2017)

ONOFRIO SMARRELLI  
SAM CNS REGIONAL OFFICER

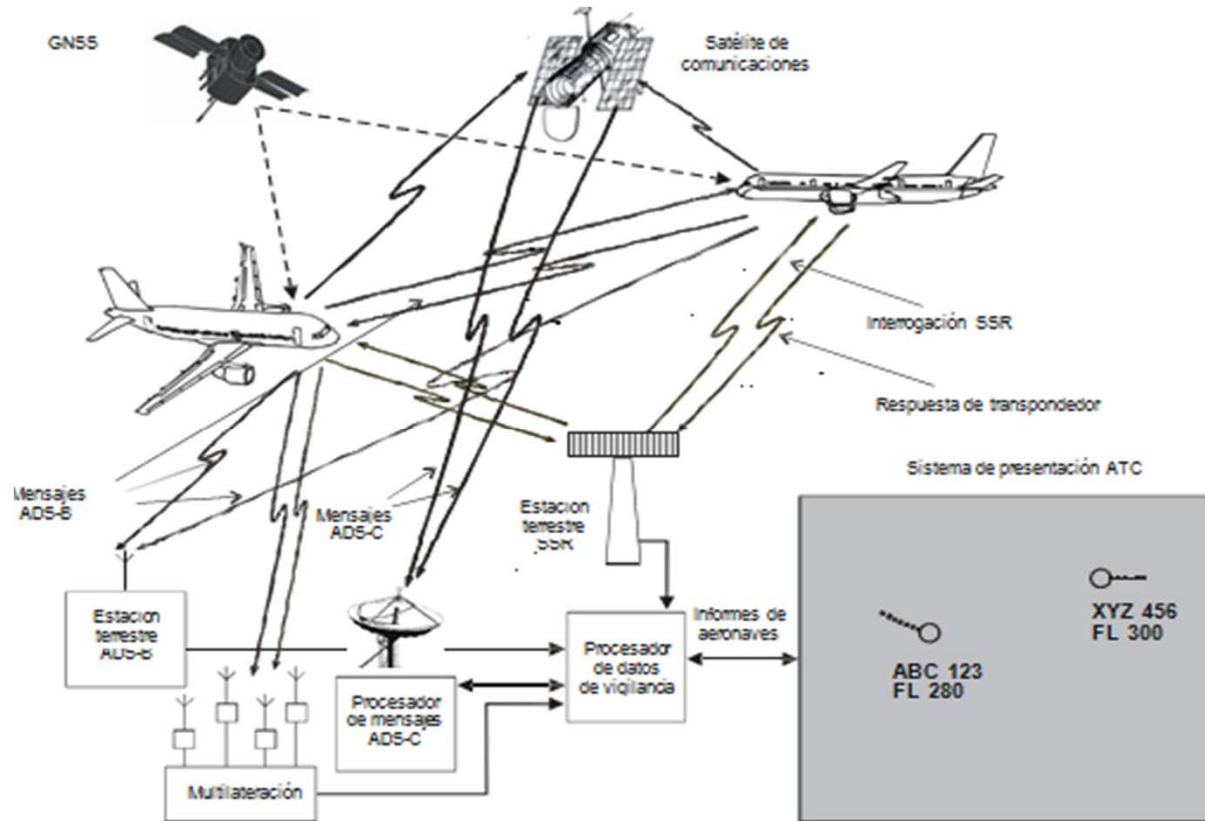


- **DEFINITION OF SURVEILLANCE SYSTEMS**
- **ICAO SARPS AND DOCUMENTS**
- **CONTENTS - ANNEXES AND DOCUMENTS**
- **DEVELOPMENT OF NEW ANNEX AMENDMENTS  
AND NEW DOCUMENTS**



# DEFINITION OF SURVEILLANCE SYSTEMS

A surveillance system may consist of a series of technologies that use **various ground and on-board emitter sensors** (e.g., primary surveillance radar (PSR), SSR, automatic dependent surveillance (ADS), multilateration technologies) together with **data-merging systems at the air traffic control centre (ATCC)**. The techniques to be used will depend on **air traffic service provider (ATS)** requirements, the suitability of technologies, and environmental demands (e.g., oceanic, continental or high traffic density).

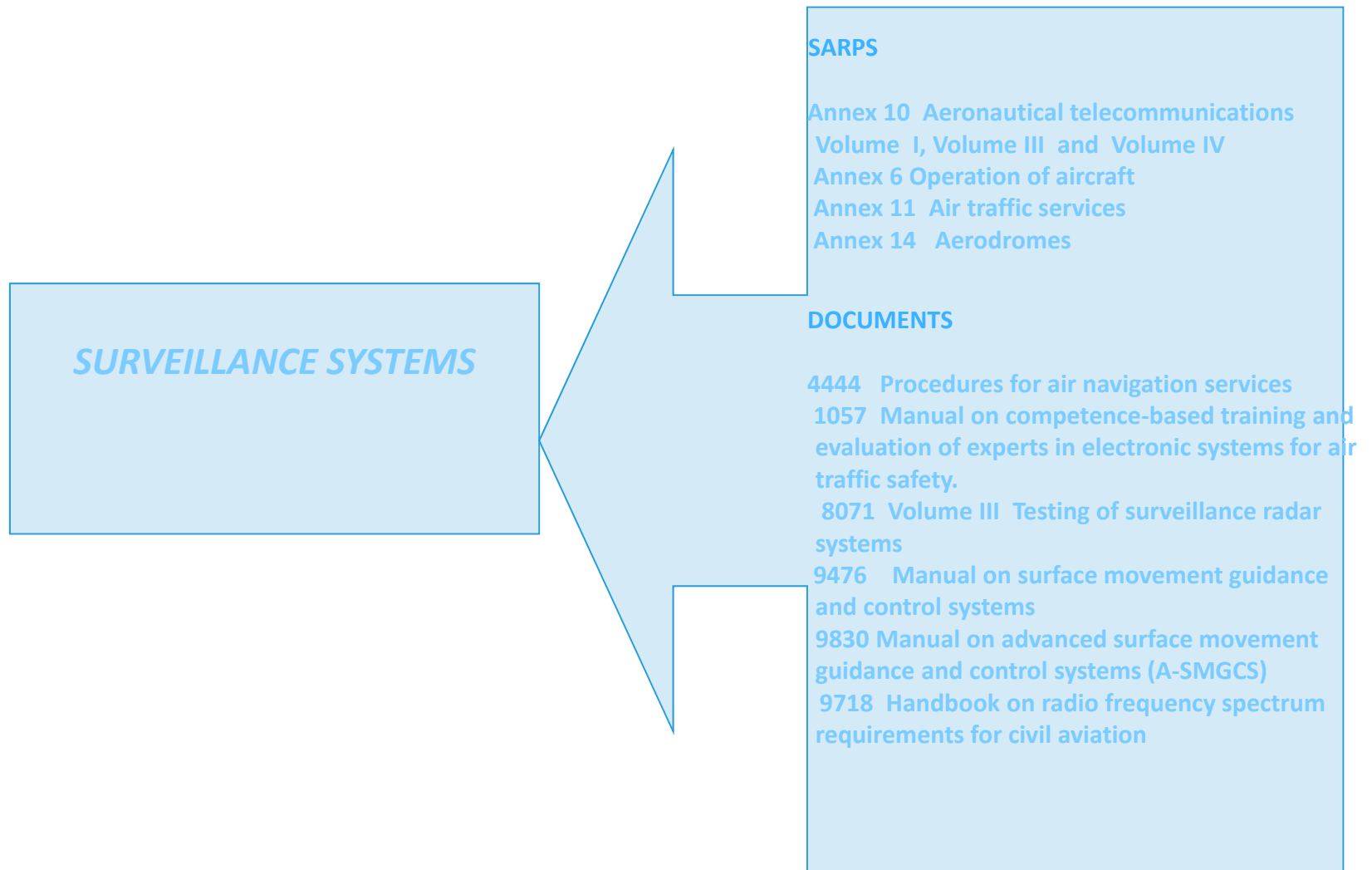




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# ICAO SARPS AND DOCUMENTS





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# ICAO SARPS AND DOCUMENTS

## *SURVEILLANCE SYSTEMS*

### DOCUMENTS (cont.)

Doc 9816 — Manual on VHF Digital Link (VDL) Mode 4

9863 Airborne collision avoidance system (ACAS) manual

9869 Performance based communication and surveillance (PBCS)

Doc 9861 — Manual on the universal access transceiver (UAT).

9871 Technical provisions for Mode S services and extended squitter

9924 Aeronautical surveillance manual

9994 Manual on airborne surveillance applications

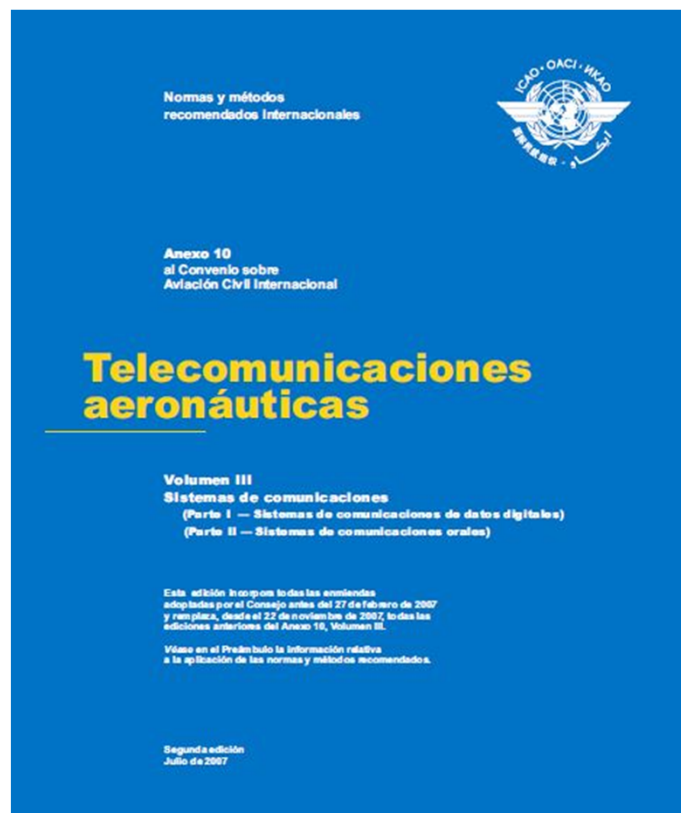
Circular 326/AN188.



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## ANNEX 10 VOLUME I Second edition - July 2006 Amendment 90 - 11 November 2016

Aspects related to GNSS:

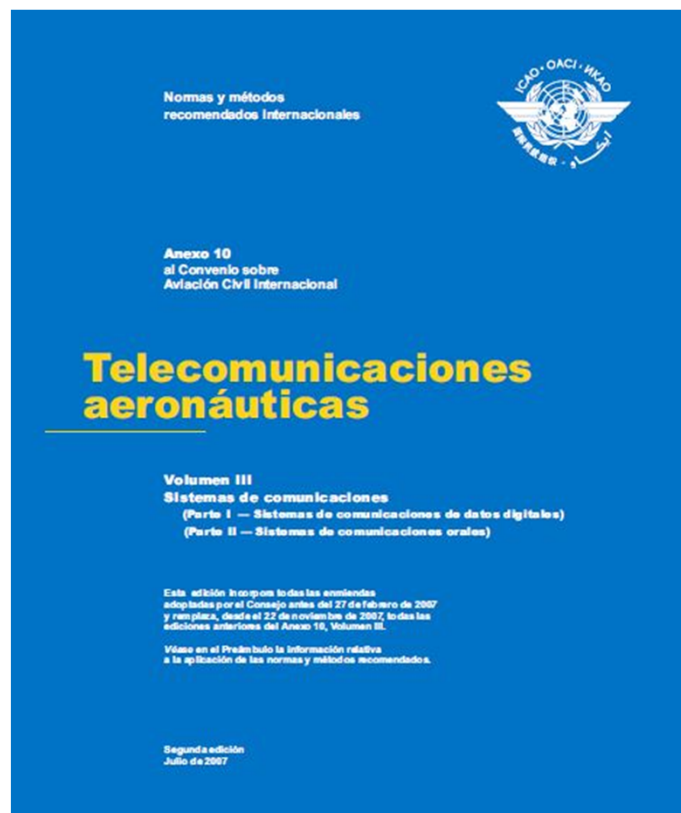
Chapter 3: Section 3.7 GNSS requirements  
Appendix B : GNSS technical specifications  
Annex D : Information and guidelines for the  
implementation of GNSS standards and recommended  
practices



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## ANNEX 10 VOLUME III

Second edition - July 2007

Amendment 90 - 11 November 2016

State letter SG ICAO AN 7/62.1.2-17/18 of 30/3/2017

Aspects related to surveillance:

### PART I: Digital data communication systems

Chapter 5: Mode S SSR data air-ground link

Chapter 6 : Air-ground VHF digital link (VDL)

Section 6.9 : VDL 4

Chapter 9: Aircraft addressing system

Chapter 12: Universal access transceiver (UAT)



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Normas y métodos  
recomendados internacionales



**Anexo 10**  
al Convenio sobre  
Aviación Civil Internacional

## Telecomunicaciones aeronáuticas

**Volumen IV**  
Sistemas de vigilancia y anticollisión

Esta edición incorpora todas las enmiendas adoptadas  
por el Consejo antes del 4 de marzo de 2014 y reemplaza,  
desde el 13 de noviembre de 2014, todas las ediciones  
anteriores del Anexo 10, Volumen IV.

Véase en el Preámbulo la información relativa a la  
aplicación de las normas y métodos recomendados.

Quinta edición  
Julio de 2014

Organización de Aviación Civil Internacional

### ANNEX 10 VOLUME IV

Fifth edition July 2014 Includes Amendment 89  
Proposal of amendment ICAO State letter SG  
AN/7/65.1.1-17/24 of 6/3/2017

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### Part I International commercial air transport – aeroplanes

**Tenth edition - July 2016 Amendment 41 (Effective 27/04/2017)**

Proposal of amendment Volume I and Volume II State letter SG AN/2.5-17/85 of 31 August 2017

#### Chapter 6 Aeroplane instruments, equipment and flight documents

##### 6.11 Pressurized aeroplanes when carrying passengers – weather radar

##### 6.18 Aeroplanes required to be equipped with an airborne collision avoidance system (ACAS II)

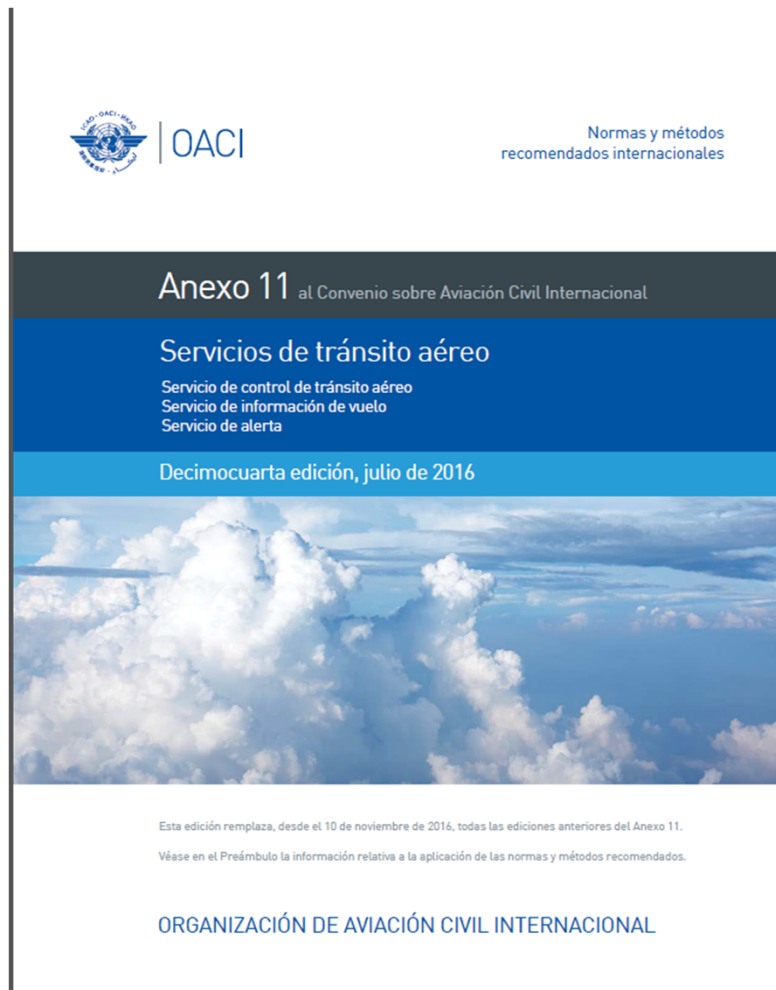
##### 6.19 Requirements concerning pressure-altitude reporting transponders



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Fourteenth edition – July 2016

Amendment 50 A 10 November 2016 (PBCS)

### Chapter 3 Air traffic service

3.6 Transfer of responsibility for control  
(Coordination of transfer (ADS C ADS B  
radar) )

3.8 Control of persons and vehicles at  
aerodromes

3.9 Provision of radar and ADS B

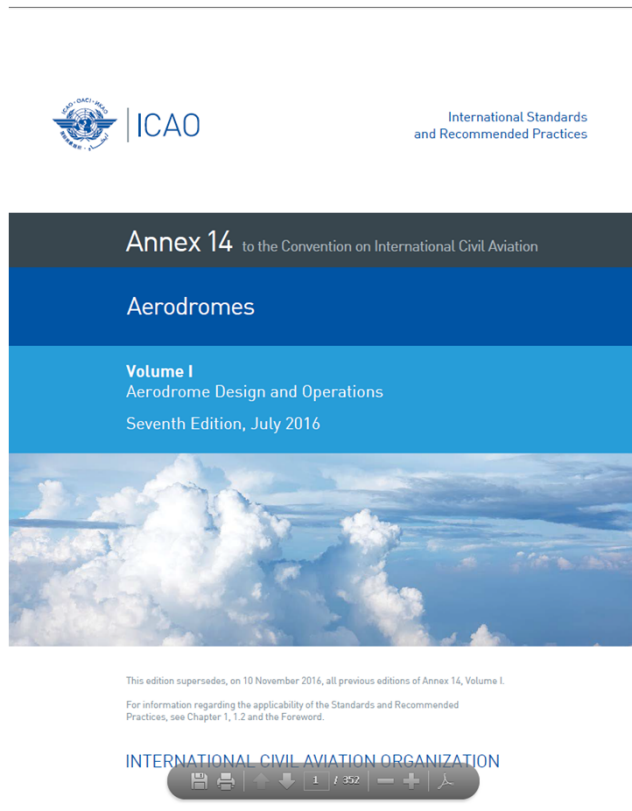
3.10 Use of surface movement radar (SMR)



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## ANNEX 14 AERODROMES

### Volume I Aerodrome design and operations Seventh edition - July 2016 Amendment 13 (10-11-2016)

Chapter 9 Aerodrome operational services,  
equipment and installations

Section 9.7 Aerodrome vehicle operations

Section 9.8 Surface movement guidance  
and control systems



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OACI



## Doc 4444 Procedures for air navigation services: Air traffic management

Sixteenth edition 2007 Amendment 6 13-11-2014

Proposal for amendment State letter SG AN/13/2.5-17/85 3/8/17

### Chapter 4 Responsibility for the provision of air traffic control service

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##### 4.11.5 Contents of ADS- C reports

##### 4.11.6 Data format of ADS B messages (Annex 10 Volume III and IV)

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#### 8.2 Situation display

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#### 8.5 Use of SSR transponders and ADS-B transmitters

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#### 8.7 Use of ATS surveillance systems in the air traffic control service

#### 8.8 Emergencies, hazards and equipment failures

#### 8.9 Use of ATS surveillance systems in the approach control service

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#### 8.11 Use of ATS surveillance systems in the flight information service

### Chapter 13 Automatic dependent surveillance – contract ADS C services



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## ATS SURVEILLANCE SERVICES - DOC 4444

### 8.1 ATS SURVEILLANCE SYSTEMS CAPABILITIES

8.1.1 ATS surveillance systems used in the provision of air traffic services shall have a very high level of reliability, availability and integrity. The possibility of system failures or significant system degradations which may cause complete or partial interruptions of service shall be very remote. Backup facilities shall be provided.

8.1.3 ATS surveillance systems should be capable of integration with other automated systems used in the provision of ATS, and should provide for an appropriate level of automation with the objectives of improving the accuracy and timeliness of data displayed to the controller and reducing controller workload and the need for verbal coordination between adjacent control positions and ATC units.

8.1.4 ATS surveillance systems should provide for the display of safety-related alerts and warnings, including conflict alert, minimum safe altitude warning, conflict prediction and unintentionally duplicated SSR codes and aircraft identification.

8.1.5 States should, to the extent possible, facilitate the sharing of information derived from ATS surveillance systems in order to extend and improve surveillance coverage in adjacent control areas.

8.1.8 PSR systems should be used in circumstances where other ATS surveillance systems alone would not meet the air traffic services requirements.

8.1.12 The provision of ATS surveillance services shall be limited to specified areas of coverage and shall be subject to such other limitations as have been specified by the appropriate ATS authority. Adequate information on the operating methods used shall be published in aeronautical information publications (AIP), as well as operating practices and/or equipment limitations having direct effects on the operation of the air traffic services.



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## DOC 1057 Manual on competence-based training and evaluation of experts in electronic systems for air traffic safety

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**DOC 8071 VOLUME III**  
**First edition 1998**  
**Amendment 31/12/2006**



A description is provided of methods for assessing the technical and operational performance of surveillance systems in general and, in the current version, of surveillance radar systems, especially with advanced primary radar signal processing (such as mobile target detection (MTD) Doppler processing, digital plot extraction and tracking) and advanced SSR techniques [such as monopulse azimuth processing and selective (Modo S) interrogation].

### CONTENTS OF THE DOCUMENT

- a) Organization of surveillance sensor systems;
- b) Sensor system performance test methodology;
- c) Test application;
- d) Detailed radar test methods (testing of individual parameters);
- e) Impact of test results on the operational use of radar systems;
- f) Impact of transponder characteristics on radar performance





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### DOCUMENT 9476

Amendment 2 1/12/87

#### SISTEMAS DE GUIA Y CONTROL DEL MOVIMIENTO EN LA SUPERFICIE (SMGCS)

PRIMERA EDICION — 1986



The manual has been developed to facilitate the application of specifications related to surface guidance and control systems (SMGC) that appear in the various Annexes and in the PANS-RAC.

#### 4.6 The role of surface movement radar (SMGC)

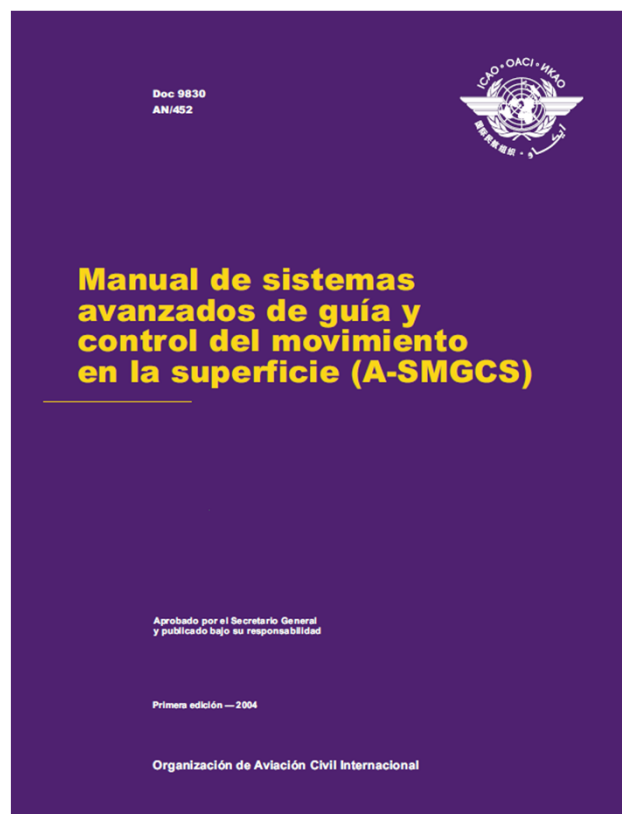




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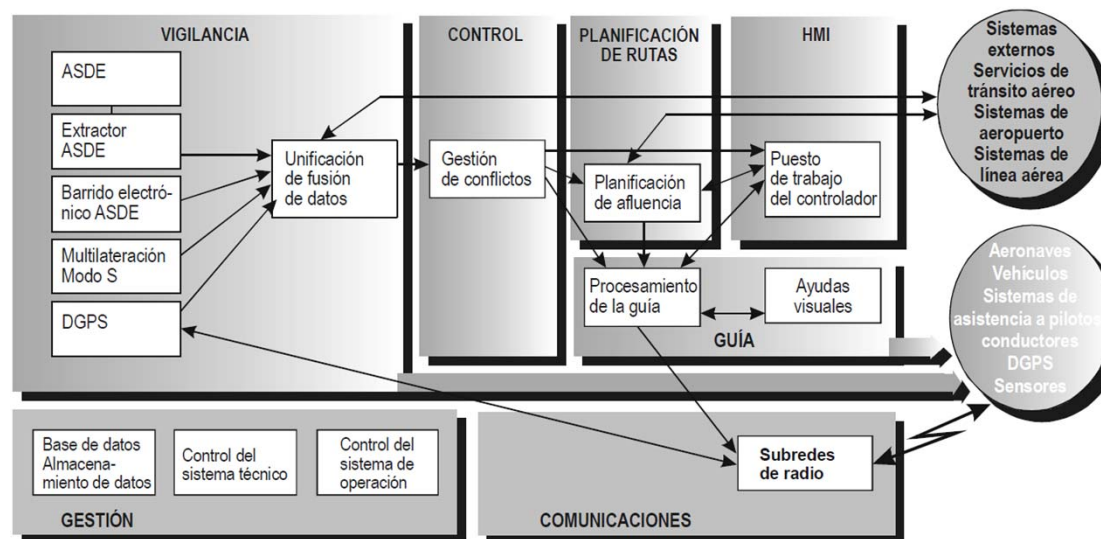
# CONTENTS – ANNEXES AND DOCUMENTS



## DOC 9830

First edition 2014

This manual is a guidance document to enable manufacturers, operators and certifying authorities to develop and introduce A-SMGCS based on local circumstances and taking into account global interoperability requirements for international civil aviation operations.





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### DOC 9718

First edition 2014

Amendment 1 21 /8/15

Second edition 2017 (draft)

This handbook contains the ICAO strategy and policy statements relevant to the aviation requirements for radio frequency spectrum, as approved and amended by the ICAO Council.

The handbook is intended to assist States and ICAO in preparing for ITU conferences.

Chapter 8 contains the ICAO spectrum strategy and addresses future requirements of frequencies for civil aviation.

Doc 9718  
AN/957



**Manual relativo  
a las necesidades  
de la aviación civil  
en materia de espectro  
de radiofrecuencias**

**Volumen I  
Estrategia de la OACI en materia  
de espectro, declaraciones de política  
e información correspondiente**

Aprobado por el Secretario General  
y publicado bajo su responsabilidad

Primera edición — 2014

Organización de Aviación Civil Internacional



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ICAO SPECTRUM STRATEGY FOR AERONAUTICAL SURVEILLANCE SYSTEMS			
FREQUENCY BAND	AERONAUTICAL USE	TIMEFRAME	ICAO SPECTRUM STRATEGY
1 030 MHz and 1 090 MHz	SSR	Long term	Secure the continuing availability of the 960–1 215 MHz frequency band, which is allocated to the aeronautical radio navigation service, for use by SSR on a global basis.
1 215–1 350 MHz	Primary surveillance radar	Long term	Secure the continuing availability of the 1 215–1 350 MHz frequency band, which is allocated to the radio navigation and aeronautical radio navigation service, for use by primary surveillance radar on a global basis.
2 700–2 900 MHz	Primary surveillance radar	Long term	<p>Secure the continuing availability of the 2 700–2 900 MHz frequency band, which is allocated to the aeronautical radio navigation service, for use by primary surveillance radar on a global basis.</p> <p>Where mobile systems are in use (e.g. WIMAX and LTE) in adjacent frequency bands, secure protection of radar stations from harmful interference from mobile systems operating in adjacent bands.</p>
9 000–9 200 MHz	Primary surveillance radar	Long term	Secure the continuing availability of the 9 000–9 200 MHz frequency band, which is allocated to the aeronautical radionavigation service, for use by ground-based radar systems on a global basis.



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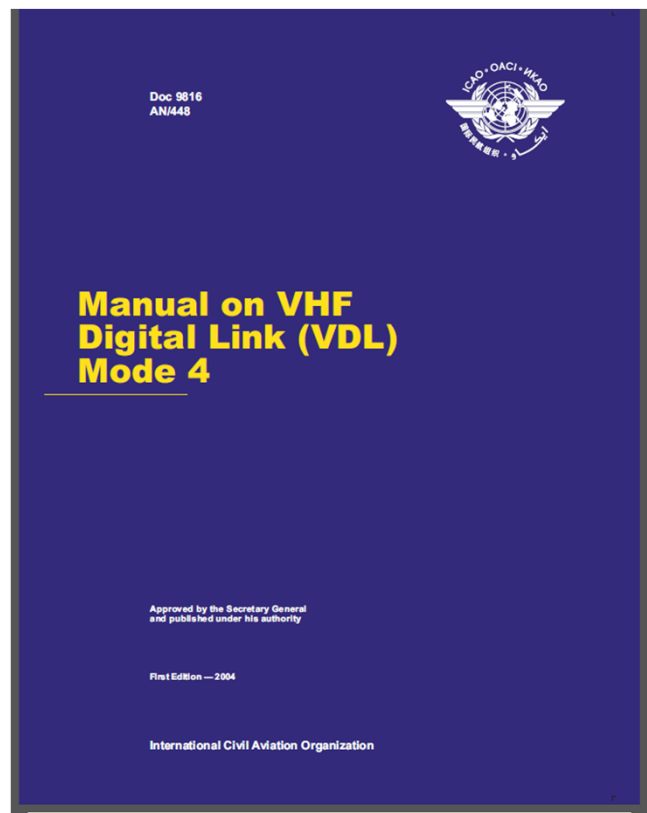
ICAO SPECTRUM STRATEGY FOR GLOBAL NAVIGATION SATELLITE SYSTEMS			
FREQUENCY BAND	AERONAUTICAL USE	TIME SCALE	ICAO SPECTRUM STRATEGY
9 300–9 5 00 MHz	Primary surveillance radar	Long term	Secure the continuing availability of the 9 300– 9 500 frequency band, which is allocated to the aeronautical radio navigation service for use by airborne weather radar and ground-based radar on a global basis.
15.4–15.7 GHz	Primary surveillance radar	Long term	Secure the continuing availability of the 15.4– 15.7 GHz frequency band, which is allocated to the aeronautical radio navigation service, for use by ground-based radar systems on a global basis.
31.8–33.4 GHz	Primary surveillance radar	Long term	Secure the continuing availability of the 31.8–33.4 GHz frequency band, which is allocated to the radio navigation service and used by primary surveillance radar, to support airport surveillance detection equipment (radar ASDE) on a global basis..



ICAO SPECTRUM STRATEGY FOR AERONAUTICAL AIRBORNE (STAND-ALONE) [RADAR] SYSTEMS			
FREQUENCY BAND	AERONAUTICAL USE	TIMEFRAME	ICAO SPECTRUM STRATEGY
4 200–4 400 MHz	Radio altimeter	Long term	Secure the continuing availability of the 4 200–4 400 MHz frequency band, which is allocated to the aeronautical radio navigation service, for use by airborne radio altimeters on a global basis.
5 350–5 470 MHz	Airborne weather radar	Long term	Secure the continuing availability of the 5 350–5 470 MHz frequency band, which is allocated to the aeronautical radio navigation service, for use by airborne weather radar on a global basis.
8 750–8 850 MHz	Airborne Doppler and ground-mapping radar	Long term	Secure the continuing availability of the 8 750–8 850 MHz frequency band, which is allocated to the aeronautical radio navigation service, for use by airborne Doppler radar and ground mapping radar on a global basis.
9 300–9 500 MHz	Airborne weather radar	Long term	Secure the continuing availability of the 9 300–9 500 MHz frequency band, which is allocated to the aeronautical radio navigation service, for use by airborne weather radar and ground-based radar on a global basis.
13.25–13.4 GHz	Airborne Doppler and ground mapping radar	Long term	Secure the continuing availability of the 13.25–13.4 GHz frequency band, which is allocated to the aeronautical radio navigation service, for use by airborne Doppler radar and ground mapping on a global basis.



## DOC 9816 VDL 4 (English only) SECOND EDITION 2012



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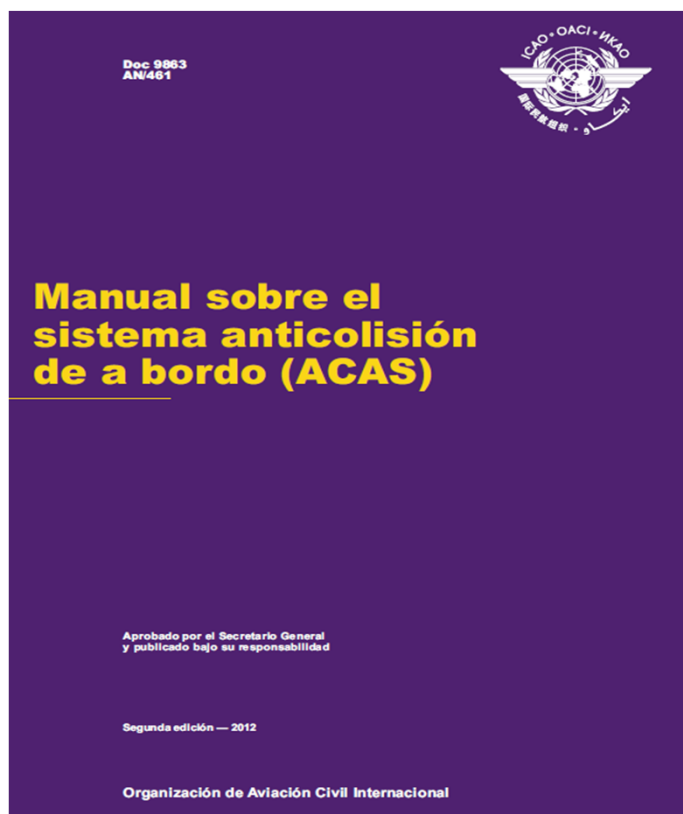
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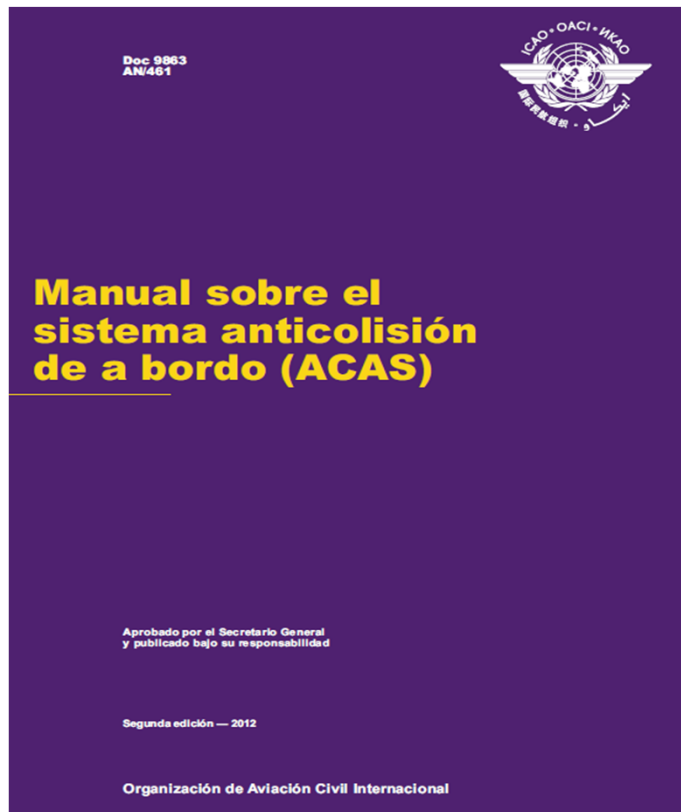
## DOC 9863 SECOND EDITION 2012



- The material contained in this manual supplements ACAS standards and recommended practices (SARPS) and procedures contained in Annex 10 — Aeronautical Telecommunications, Volume IV — Surveillance radar and collision avoidance systems, Procedures for Air Navigation Services — Air traffic management (PANS-ATM, Doc 4444) and Procedures for air navigation services — Aircraft Operations (PANS-OPS, Doc 8168).
- This manual includes a detailed description of ACAS and associated technical and operational issues in order to facilitate correct operation and operational surveillance, as well as training of personnel.



## DOC 9863 SECOND EDITION 2012



- The material contained in this manual supplements ACAS standards and recommended practices (SARPS) and procedures contained in Annex 10 — Aeronautical Telecommunications, Volume IV — Surveillance radar and collision avoidance systems, Procedures for Air Navigation Services — Air traffic management (PANS-ATM, Doc 4444) and Procedures for air navigation services — Aircraft Operations (PANS-OPS, Doc 8168).
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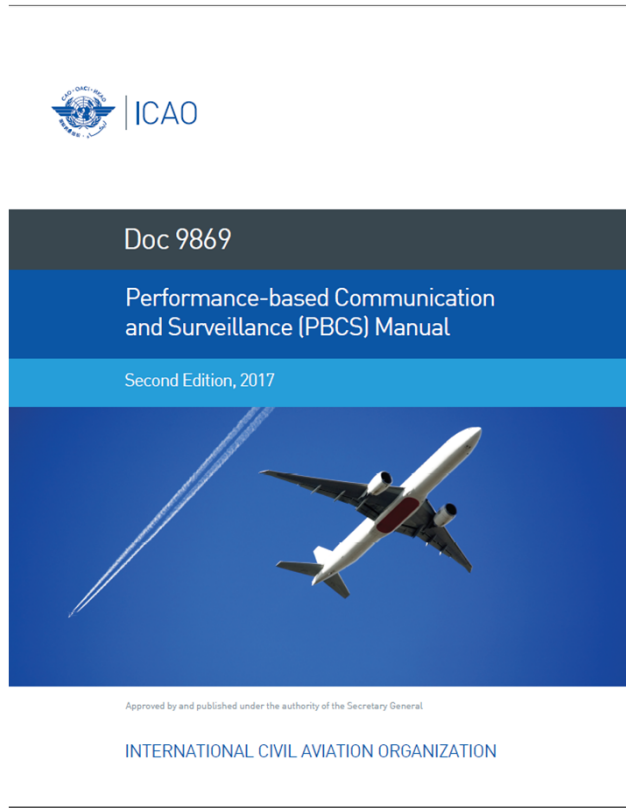




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# AMENDMENTS TO ICAO ANNEXES



This Manual replaces the current Doc 9869, which only includes RCP

The PBCS manual offers guidance and information on PBCS operations and is intended to facilitate uniform implementation of the standards and recommended practices contained in Annex 6 – Operation of aircraft, Annex 10 – Aeronautical telecommunications, and Annex 11 – Air traffic services, Air traffic management (PANS -ATM , Doc 4444 ) and, when so required, the Regional supplementary procedures (Doc 7030).

This guidance material is intended to improve safety and maximise operational benefits, promoting the PBCS concept and its general application to the new communication and surveillance technologies in support of ATM operations.

The PBCS concept provides a framework for communication and surveillance performance management in accordance with global required communication (RCP) and surveillance (RSP) performance. The RCP/RSP specifications contained therein are initially intended for automatic dependent surveillance - contract ( ADS- C ), (CPDLC) and SATVOICE communications in support of ATM operations in airspace where procedural separations are being applied.



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### DOC 9861 Second edition 2012



The second edition of this manual (2012) contains updated information on UAT technical specifications and implementation issues.

The universal access transceiver (UAT) is a broadband broadcast data link operating on 978 MHz with a channel modulation rate of just over 1 Mbps.

By design, the UAT supports multiple broadcast services, including flight information services (FIS-B) and traffic information services (TIS-B), in addition to automatic dependent surveillance — broadcast (ADS-B).



**Doc 9871**  
**Second edition 2012**  
**Amendment 9/1/2017**



The purpose of this manual is to specify technical provisions for the **formats and associated protocols** used in Mode S services and extended squitter. These detailed technical provisions supplement the requirements contained in Annex 10 — Aeronautical telecommunications, Volume III (Part I — Digital data communication systems), and Volume IV — Surveillance and collision avoidance systems, and are necessary to ensure global interoperability.

The second edition (2012) of this manual introduces a new version of extended squitter formats and protocols (Version 2).

The first edition of the manual specified the previous versions of extended squitter messages (versions 0 and 1).

The formats and protocols of Version 2 were developed in order to improve integrity and accuracy reporting. In order to support the identified ADS-B operational requirements not covered in Version 1, several additional parameters were included in Version 2. Furthermore, several parameters were modified and others were eliminated since they were no longer deemed necessary to support ADS-B applications.

The manual also includes guidance on implementation, as well as information on future Mode S and extended squitter services that are under developed.



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Doc 9924

Aeronautical Surveillance Manual

Second Edition, 2017



Approved by and published under the authority of the Secretary General

INTERNATIONAL CIVIL AVIATION ORGANIZATION

## Doc 9924 2nd Edition (English only)

The manual is a reference document on aeronautical surveillance for ATM purposes. The chapters contain:

- a) an explanation of aeronautical surveillance;
- b) the identification of operational services supported by surveillance;
- c) guidance on surveillance system performance;
- d) a description of the different components of an air-ground surveillance system;
- e) a description of the different components of an air-air surveillance system; and
- f) a discussion on issues related to deployment of surveillance systems

Manual on the SSR Systems (Doc 9684)

Manual on Mode S Specific Services (Doc 9688)

Superseded by Doc 9924

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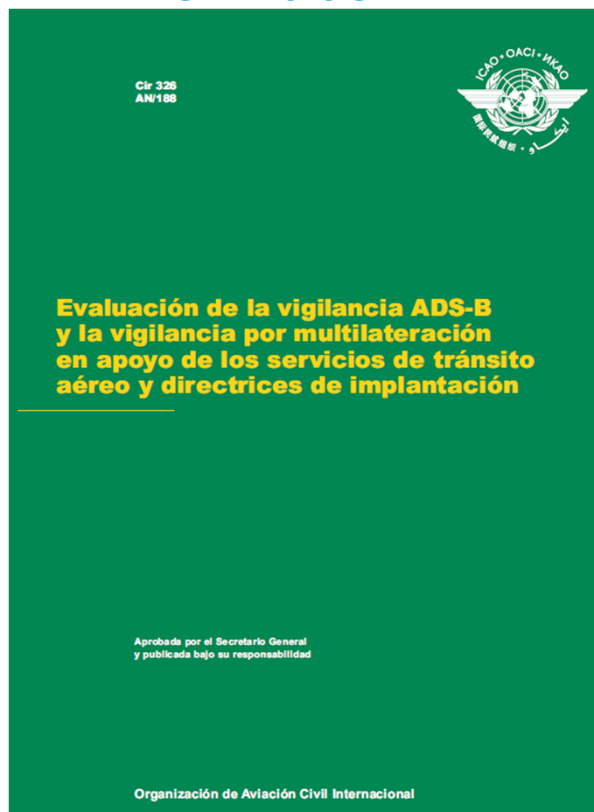


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# CONTENTS – ANNEXES AND DOCUMENTS

## CIRCULAR 326 2012 Edition



This circular describes the comparative assessment conducted by the Separation and airspace safety panel (SASP), from which it may be concluded that, under certain circumstances, ADS-B and MLAT can be used for ATS surveillance purposes, including separation. The SASP assessment also concluded that ADS-B can be used for achieving a separation minimum of five nautical miles (5 NM) .

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## SURVEILLANCE PANEL (SP)

Aeronautical Surveillance Working Group (ASWG)

Airborne Surveillance Working Group (AIRB)

**ASWG** (ASWG/5 Japan, Tokyo, 27-30 March 2017)

- Proposal to modify Annex 7 Certificate of registration 24-bit aircraft address
- Correction military use descending form DF=19 no ADS B message  
Proposed changes: Amendment Annex 10 Volume IV, Doc 9871 and Doc 9924 (2020). This revision will take place together with other changes in RTCA/EUROCAE standards
- Use of X pulse Proposal to modify Annex 10 Volume IV (November 2018) and Doc 9924
- Clarification of military use 1030/1090Mhz Proposal to modify Doc 9924
- Updating of Doc 8071 Volume III
- Updates to Doc 9863

Next ASWG/6 meeting (Montreal, Canada, 16-20 October 2017)



## **SURVEILLANCE PANEL (SP)**

**AIRB** ( AIRB/3 Tokyo, Japan, 30-31 March 2017)

- Proposal to modify Doc 9924
  - Revision reference section
  - AIRB/VSA benefits
  - IM (Interval management) New chapter (3)
  - Revision SURF-IA text

Next AIRB/4 meeting, Montreal, Canada, 11-13 October 2017





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Thank You