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EUROCONTROL Specification for ATM Surveillance System Performance

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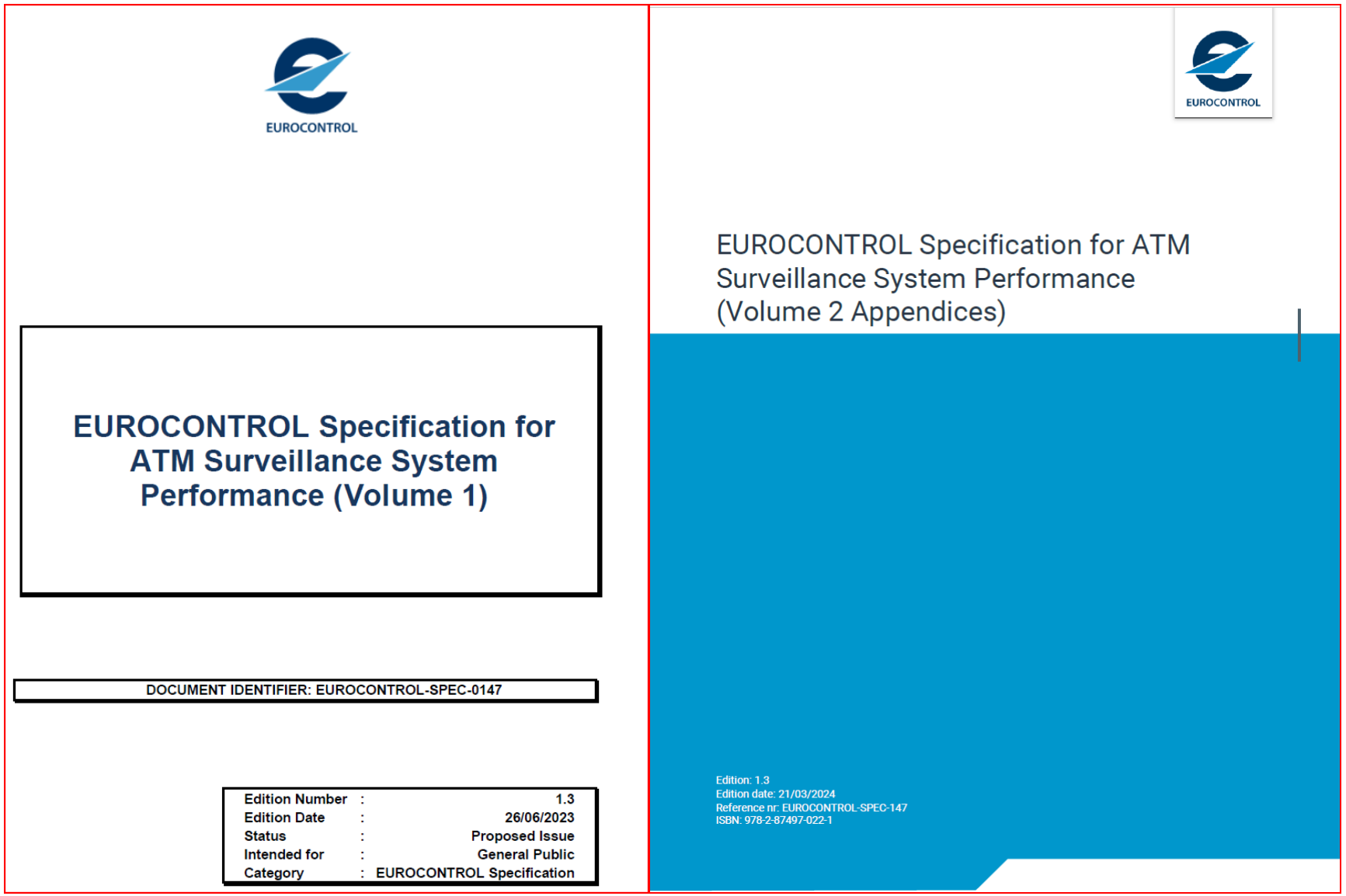

EUROCONTROL

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VOL 1 – INTRODUCTION

- The EUROCONTROL Specification for Air Traffic Management (ATM) Surveillance System Performance (ESASSP) - Vol 1, provides performance requirements when supporting horizontal separation applications for 3 and 5 NM.

- The specification defines how to assess compliance to the performance requirements listed in the document.

- This document may be referenced in the RFP process, with the implication on the vendor to ensure their systems comply with the documents.

- This is not a comprehensive list of all the issues which could be considered.

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CHAPTER 01

INTRODUCTION

1 – INTRODUCTION.

1.1 – Aim, Scope and Object of the document.

a) This document has been developed to specify performance requirements applicable to surveillance systems (i.e., the equipment only).

b) The document DOES NOT verify operational acceptability of surveillance systems and DOES NOT include a surveillance system generic safety assessment.

c) Various method are used to demonstrate compliance with each requirement in this specification.

d) For each quality-of-service requirement, a specific quality indicator is provided to assess the actual performance based on output data.

e) The performance requirements are minimum requirements independent of the environment – they are applicable to any surveillance system.

f) This document DOES NOT demonstrate that the supported operation is safe. Safe operation is proven through a local surveillance system safety assessment.

1.2 - The Supported Air Traffic Services and Functions.

This document addresses:

- 5 NM horizontal separation, 1000/2000ft vertical separation when providing an approach control or area control service.
- 3 NM horizontal separation, 1000 vertical separation when providing an approach control or area control service.

ATS services and functions based on surveillance information are described in ICAO PANS-ATM DOC 4444 and are summarised in VOL 2, RD1, Appendix III of this document.

1.3 - Category of Surveillance System.

This document focusses on cooperative surveillance systems.

Information on Non cooperative systems is captured in VOL 1 Annex D: Non-cooperative surveillance system legacy performance when supporting 3/5 NM separation.

1.5 – Intended Readers.

a) ANSP (CNS and ATS providers) responsible for procuring/designing, accepting, maintaining and evaluating ATM surveillance systems.

b) Regulatory authorities other ANSP departments responsible for verifying ATM surveillance systems.

c) International standardisation bodies.

d) Engineering industry for developing ATM surveillance systems and/or their components.

1.6 – Relationship with ICAO.

a) ICAO has recognised the benefits of this document and as a result a “Required air traffic services Surveillance performance (RESUR)” concept is being developed by ICAO.

CHAPTER 02

DOCUMENT DEVELOPMENT APPROACH AND ROLE.

Chapter 2 – Document Development Approach and Role.

2.1 - Document development context.

- This document takes in account lessons learnt from the EUROCONTROL Standard Document on Radar Surveillance in En-Route and Major Terminal Areas (See VOL 2 RD2).
- This updated version considers feedback on implementation of the compliance assessment method based on the results and conclusions of Working Cell NR-20 of SASS-C User group.

2.2 – Document development approach.

The document identifies a set of requirements that are:

2.2.1 - Service or function specific.

2.2.2 - Environment independent.

2.2.3 – Measurable.

2.2.4 - Interoperability and seamless operation.

2.2.5 - Design flexibility (See 2.2.1 to 2.2.5).

2.3 - Role of this document within the surveillance system design process.

- Performance requirements are an initial input into the process of designing a surveillance system.
- The surveillance system mandatory performance requirements in this document can be used as an input into the local surveillance system safety assessment.

2.4 – Choice of the category of surveillance system to deploy.

- The choice of surveillance system to deploy (cooperative, non-cooperative, combination of both) is the decision of the ANSP depending on local environment, constraints (equipage), traffic density, etc.

2.5 – Performance metrics/indicators.

- This document uses the International Organization for Standardization (ISO) Quality of Service framework – ISO 13236.
- ISO 13236 defines 8 generic quality of service characteristics. From that list the following 4 service characteristics have been selected and refined:
    a) Time – Translated in processing delay from the aircraft to surveillance system user on the ground.
    b) Coherence – Translated in time consistency of the provided aircraft positions.
    c) Integrity – Further refined into 3 performance characteristics. Core errors, correlated errors, and spurious/large errors of data items.
    d) Reliability – Further refined into availability and continuity of the data items and the complete surveillance system.

CHAPTER 03

PERFORMANCE REQUIREMENT SPECIFICATION FOR SURVEILLANCE APPLICATION.

3 – Performance Requirement Specification for Surveillance Applications.

Section 3 describes the data items and associated performance required to support 3 NM or 5 NM separation services.

- 3.1.1.1 - Operational Services.
  - This document supports the 3 NM and 5 NM horizontal separation services when supported by cooperative surveillance as specified in ICAO DOC 4444 Section 8.7.3.

The Table 2 provides the acronyms of the applications.

	Provided ATC service	
	5 NM horizontal separation	3 NM horizontal separation
Cooperative surveillance system	5N_C	3N_C

Table 2: Addressed applications

- 3.1.1.2.1 - Environmental Description.

a) The environment description combined with the operational service (3.1.1.1) constitute the Operational Service and Environment Description (OSED) for 3/5 NM separation.

b) A fundamental assumption of the OSED is that the operational service is provided to cooperative aircraft flying IFR/VFR that are fully compliant with the avionic requirements set in the state's rules. – assumes aircraft is following the rules set by the regulatory authority.

c) Any local surveillance system safety assessment will address instances in which an aircraft's surveillance avionics present an anomaly or suffer partial/total failure – e.g. MODE C Alt unserviceable, transponder failure or GPS failure.

d) Airspace classes in which separation is provided are described in Annex C – 5.1.

e) Airspace structure is defined in Annex C – 5.2 and traffic characteristics in Annex C – 5.3.

- 3.1.1.2.2 – Required and Optional Data – (described in ANNEX C).
  - Following information and data elements are required from the cooperative surveillance system for the provision of surveillance separation.

a) Positional data:
   i. Horizontal (2D) position (lat/long or XY).
   ii. Time of applicability of position (for compliance assessment).
   iii. Vertical position based on received pressure altitude (MODE C).
   iv. Time of applicability of vertical positions (for compliance assessment).

b) Operational identification:
   i. Aircraft identity (ACID, and/or MODE S, and/or MODE 3A) as reported by the aircraft.

c) Supplementary Indicators:
   i. Emergency indicator (Unlawful Interference - 7500, RTF - 7600, Gen EMG – 7700 *or EMG for DO260).
   ii. Special Position Identification (SPI or IDENT).

d) Surveillance data status (required to be provided but Optional to display):
   i. Cooperative/non-cooperative/combined.
   ii. Coasted/not coasted (2D position).

e) Optional data includes track velocity (GS), track velocity angle and rate climb/descent.

- 3.1.1.3 – Operational performance assessment (OPA) scenarios.

To be independent of traffic density the performance requirements are based on a set of elementary OPA scenarios derived from DOC 4444 [RD 9]. The following scenarios have been defined for both 3 NM and 5 NM horizontal separation:

a) Cross track scenarios (Volume 2 [RD 1] Appendix V - 1 and 2).
b) Same track scenario (Volume 2 [RD 1] Appendix V - 3 and 4).
c) Reciprocal track scenario (Volume 2 [RD 1] Appendix V - 5 and 6).
d) Vertical crossing track scenario (Volume 2 [RD 1] Appendix V - 7 and 8).

3.2 – Performance Requirements.

- 3.2.1 Introduction to performance requirements.

These performance requirements are defined from mainly radar experience gained in Europe over last decades, and specific studies undertaken to further refine performance when necessary. Performance requirements are listed in Table-3 (5 NM Separation) and Table-4 (3 NM Separation).

- Example of Table-3 Cooperative surveillance system requirements for supporting 5NM horizontal separation (5N_C).

3.2.2 Mandatory and recommended performance requirements for 5 NM horizontal separation provided by ATCO

Req. #	Quality of service	Mandatory performance	Recommended performance	Justif.	Assessment
5N_C-R1	Measurement interval for probability of update assessments (R2, R7 and R14)	**Less than or equal to 8 seconds**	Less than or equal to 6 seconds	**2.1.1** 2.1.2	4.2.1
5N_C-R2	Probability of update of horizontal position	**Greater than or equal to 97% for 100% of the flights, any flight below 97% shall be investigated as defined in R22 and**	Greater than or equal to 97% for 100% of the flights, any flight below 97% shall be investigated as defined in R22 and	**2.1.3** 2.1.4	4.2.2.1.2 4.2.2.2.2 Note 3
		Greater than or equal to 97% global, counting only target reports based on a horizontal position measurement with a data age lower than or equal to 10 sec	Greater than or equal to 99 % global		

- Column 1 = Unique requirements reference.
- Column 2 = Quality of service performance indicator.
- Column 3 = Mandatory performance requirements.
- Column 4 = Recommended performance requirements.
- Column 5 = Justification – links to Volume 2 [RD 1] Appendix II where further references and justification are found.
- Column 6 = Reference to relevant sub-section of Section 4 which describes the associated compliance assessment method.

Req. #	Quality of service	Mandatory performance	Recommended performance	Justif.	Assessment
5N_C-R1	Measurement interval for probability of update assessments (R2, R7 and R14)	**Less than or equal to 8 seconds**	Less than or equal to 6 seconds	**2.1.1** 2.1.2	4.2.1

- 5N_C-R1 = measurement interval for probability of update assessments (R2, R7 and R14).
  - # Note, R2, R7 and R14 indicates that the performance value used in R1 (either the mandatory or recommended) must then be used when assessing R2, R7 and R14 .
- Mandatory - less than or equal to 8 Seconds.
- Recommended – less than or equal to 6 Seconds.
- Justification – VOL 2 -2.1.1 Measurement interval mandatory requirements – for 5N_C-R1, OR
- Justification – VOL 2 -2.1.2 Measurement interval recommend requirements – for 5N_C-R1.
- Assessment – VOL 1 -4.2.1 Measurement interval – Parameter used to assess the probability of update of data items.
  - The applicable measurement can, as minimum, be selected to represent the update period of the surveillance system, and as a maximum a greater value not exceeding the maximum value defined in R1.

- Justification – VOL 2 -2.1.1 Measurement interval mandatory requirements – for 5N_C-R1

II - 2.1.1 Measurement interval mandatory requirements

Ref	Performance requirement statement/ Comment	Requirement threshold 1000 ft VSM	Requirement threshold 2000 ft VSM
5N_C-R1	The applicable measurement interval for performance assessments shall be set to **8** s or less.	8 s	
[RD 2] § 5.2.4	Requirement: Surveillance information updates shall enable the display updates to be less than or equal to 8 seconds in en-route airspace.	8 s	
[RD 12] SPR 19 § 3.5.2	Requirement: For 5 NM separation – The update interval for Surveillance Reports containing any new ADS-B position data associated with any single aircraft shall be no longer than 10s with a probability of 95%. Comment: For ADS-B only.	10 s	
[RD 26] Exigence 18	Requirement: The duration separating two screen refreshes relating to the same aircraft shall not in principle exceed the following: • 8 s for a target separation minimum M, if 3 NM < M ≤ 5 NM	8 s	

Ref	Performance requirement statement/ Comment	Requirement threshold	
		1000 ft VSM	2000 ft VSM
5N_C-R1	The applicable measurement interval for performance assessments shall be set to **8** s or less.	8 s	
[RD 20] § 6.3.3	Proposed requirement: The maximum data age of pressure altitude measured at the output of the ground system is: • 1000ft separation = 5s • 2000ft separation = 8s Note: The different figures depending on the applied VSM were due to the the assumption of the same nominal aircraft vertical speed for 3 NM/1000 ft separation and 5 NM/1000 ft separation. The SSTF agreed that a lower nominal vertical speed should be assumed for 5 NM/1000 separation as the vertical capabilities of aircraft in the en-route airspace are lower.	5 s	8 s
[RD 13] SPR 49	Requirement: For 5 NM separation – The probability of providing a Surveillance Report containing newly received ADS-B Position data of sufficient quality associated with any aircraft in En Route airspace within 8 seconds shall be 97%. Comment: For ADS-B only.	8 s	
[RD 14] § 3.3.1	Requirement: The defined *Update interval* ***shall*** not exceed the following: • 8 seconds for the En-route application Comment: For WAM only.	8 s	

- Justification – VOL 2 -2.1.2 Measurement interval recommend requirements – for 5N_C-R1

II - 2.1.2	Measurement interval recommended requirements	
Ref	**Performance requirement statement/ Comment**	**Requirement threshold**
		1000 ft VSM / **2000 ft VSM**
5N_C-R1	The applicable measurement interval for horizontal position, pressure altitude and aircraft identity data items should be set to **6** s or less.	6 s
SSTF #12	It was agreed during SSTF meeting #12 that to take into account the future traffic increase in Europe it is needed to align the measurement interval for future system to the measurement interval currently applied in high-medium density airspace.	6 s

- 5N_C-R17 and 5N_C-R18

5N_C-R17	Track velocity speed (optional data item) RMS error	**Less than or equal to 6 m/s for straight line and less than or equal to 11 m/s for turn**	Less than or equal to 4 m/s for straight line and less than or equal to 8 m/s for turn	2.1.22	4.2.14 Note 5
5N_C-R18	Track velocity angle (optional data item) RMS error	**Less than or equal to 10° for straight line and less than or equal to 25° for turn**		2.1.22	4.2.14 Note 5

- 5N_C-R17 and 5N_C-R18 – Mandatory - 2.1.22

II - 2.1.22	**Track velocity errors mandatory requirement**	
Ref	**Performance requirement statement / Comment**	**Requirement threshold**
5N_C-R17 & 5N_C-R18	The RMS error of the track velocity and angle should be, respectively, equal to or less than **6 m/s and 10 °** for portions of trajectories in straight line and equal to or less than **11 m/s and 25 °** for portions of trajectories in turn. Note: this requirement needs to be verified only if the data is shown to the ATCo	**6/11 m/s 10/25 °**
SSTF #4.5 Edition 1.3	SSTF agreed to enlarge the mandatory value for the ground speed and use the stringent set as recommended performance.	**6/11 m/s 10/25 °**

Note 5 – If an optional data item is not displayed for use by ATC, the corresponding performance requirements do not need to be verified.

- 5N_C-R17 and 5N_C-R18

II - 2.1.23	Track velocity errors recommended requirement	
Ref	**Performance requirement statement / Comment**	**Requirement threshold**
5N_C-R17	The RMS error of the track velocity and track velocity angle should be, respectively, equal to or less than **4 m/s** for portions of trajectories in straight line and equal to or less than **8 m/s** for portions of trajectories in turn.	4/8 m/s°
SSTF #17	The objective of this requirement is to specify the error on the track velocity when this data item is provided by the surveillance system. The same value as for 3 NM separation (based on actual system performance) has been used although the speed accuracy should be worse in the case of 5 NM separation because of the longer measurement interval but on the other side it should be better because in this airspace the aircraft are less manoeuvring and there is also a higher level of sensor overlapping coverage in that airspace.	4/8 m/s

- 2.1.23 – SSTF #17 - refers to the recommended performance for 5N_C-R17 even though it is not indicated in the Justification section in VOL 1.

Assessment.

- VOL 1 – 4.2.14 RMS error of track velocity characteristics:
  - For a target report, the track velocity error is the difference between the reference aircraft velocity amplitude and the aircraft velocity amplitude provided in the target report.
  - For a target report, the track velocity error is the difference between the reference aircraft velocity angle and the aircraft velocity angle provided in the target report.

Example of the Daily report produced for Airways from Surveillance data showing compliance with 5N_C-R17 and 5N_C-R18.

Track Analysis Report - 5NM

Sensor	Reports	Positional Accuracy				Straight Velocity Accuracy		In Turn Velocity Accuracy		Sensor accuracy	
		Mean(m)	StdDev(m)	RMS(m)	Bad Pos	Speed(m/s)	Heading(degs)	Speed(m/s)	Heading(degs)	Range(m)	Azimuth(degs)
				5N_C-R4 (M) <500m	5N_C-R5 (R)<0.03%	5N_C-R17 (R) <4m/s	5N_C-R18 (R) <10degs	5N_C-R17 (R) <8m/s	5N_C-R18 (R) <25degs		
SYS	4758312	9.98	13.42	16.72	0.002%	0.53	0.60	1.15	2.19	0.00	0.000
AAB	356	9.96	18.42	20.94	0.000%	0.70	0.38	0.34	3.08	1.55	-0.196
AAM	198	66.94	25.06	71.48	0.000%	2.22	1.92	2.93	4.66	6.99	1.359
ATB	1462468	10.87	18.41	21.38	0.000%	0.24	0.59	0.57	4.42	-0.06	-0.001
BA1	1299848	11.00	19.25	22.18	0.000%	0.21	0.54	1.35	4.22	-4.98	-0.000
BA2	1382366	10.01	15.83	18.74	0.000%	0.19	0.45	1.34	4.00	-6.83	0.000
BAL	228134	193.31	208.00	283.96	0.355%	4.61	5.25	7.61	26.29	-37.32	-0.046

3N_C-R17 and 3N_C-R18.

3N_C-R17	Track velocity speed (optional data item) RMS error	**Less than or equal to 6 m/s for straight line and less than or equal to 11 m/s for turn**	Less than or equal to 4 m/s for straight line and less than or equal to 8 m/s for turn	2.2.22	4.2.14
3N_C-R18	Track velocity angle (optional data item) RMS error	**Less than or equal to 10° for straight line and less than or equal to 25° for turn**		2.2.22	4.2.14

II - 2.2.22 Track velocity errors mandatory requirement

Ref	Performance requirement statement / Comment	Requirement threshold
3N_C-R17 & 3N_C-R18	The RMS error of the track velocity and angle should be, respectively, equal to or less than **6 m/s and 10 °** for portions of trajectories in straight line and equal to or less than **11 m/s and 25 °** for portions of trajectories in turn. Note: this requirement needs to be verified only if the data is shown to the ATCo	**6/11 m/s 10/25 °**
SSTF #4.5 Edition 1.3	SSTF agreed to enlarge the mandatory value for the ground speed and use the stringent set as recommended performance.	**6/11 m/s 10/25 °**

II - 2.2.23	Track velocity errors recommended requirement	
Ref	**Performance requirement statement / Comment**	**Requirement threshold**
3N_C-R17	The RMS error of the track velocity and angle should be, respectively, equal to or less than **4 m/s** for portions of trajectories in straight line and equal to or less than **8 m/s** for portions of trajectories in turn.	4/8 m/s
SSTF #17	The objective of this requirement is to specify the error on the track velocity when this data item is provided by the surveillance system. These figures have been derived from the performance achieved by systems in operation providing 3 NM horizontal separation.	4/8 m/s

Track Analysis Report - 3NM

			Positional Accuracy				Straight Velocity Accuracy		In Turn Velocity Accuracy	
Terminal	Sensor	Reports	Mean(m)	StdDev(m)	RMS(m)	Bad Pos	Speed(m/s)	Heading(degs)	Speed(m/s)	Heading(degs)
					3N_C-R4	3N_C-R5	3N_C-R17	3N_C-R18	3N_C-R17	3N_C-R18
					(M) <300m	(R)<0.03%	(R) <4m/s	(R) <10degs	(R) <8m/s	(R) <25degs
ATM	SYS	876738	7.86	6.32	10.08	0.000%	0.28	0.69	0.48	2.41
	ATB	794909	6.61	8.09	10.44	0.000%	0.27	0.82	0.59	4.56
	RU1	851927	5.99	6.61	8.91	0.000%	0.21	0.55	0.47	3.11
	RU2	744955	8.91	14.14	16.72	0.000%	0.40	0.95	0.89	7.90
	RUA	130049	84.73	60.82	104.30	0.000%	3.07	3.74	4.75	20.13
	WTB	863324	5.90	6.76	8.97	0.000%	0.18	0.49	0.38	2.50

Example of the daily report produced for Airways from Surveillance data showing compliance with 3N_C-R17 and 3N_C-R18.

CHAPTER 04

COMPLIANCE ASSESSMENT.

- 4.1.1 Compliance Assessment Approaches.

The compliance assessment of surveillance systems can be undertaken by one or more of the following approaches according to its associated priority:

- Opportunity Traffic (P1).
- Flight Trials (P2).
- Proof through system design files or system design assurance (P3).
- Test Transponder (P4).
- Injected Test Targets (P5).

See ANNEX – E Compliance Assessment Approaches for greater detail on each.

Priorities are allocated on the basis of operational relevance.

- Opportunity traffic has P1 as it fully represents operational traffic and the operational environment.
- P3 to P5 are only partially representative of operational traffic and the operational environment.

- 4.1.2 Compliance Assessment Volume.

For 3/5NM surveillance separation this is the airspace where the service is provided and supported.

- 4.1.3 Compliance Assessments Datasets.

Data produced by the surveillance system under evaluation covers a volume of airspace greater than the CAV.

The data is representative of traffic and the environment, including for example:

- Aircraft mix,
- Traffic density (peak hour), and
- Different weather conditions.

- 4.1.3.3.1 - For a 3NM or 5NM assessment using targets of opportunity the dataset used should contain at least 36,000 measurement intervals collected from all eligible flights.

- 4.1.5 Compliance Assessment Periodicity.

Assessments shall be made periodically on each ground surveillance system, and after each system or environment modification that may impact on its performance.

  - In NZ we run a daily report automatically from the ATMS, which is provided to the relevant sections (Surveillance Engineering, Software, ANS Requirements and ATSEP) via email.

- 4.1.6 Compliance Assessment Measurement Point.

Performance is assessed at the point where surveillance is used to provide the service – i.e., at the ATCO display level.

- 4.1.7 – Definitions – includes:
  - Valid data item,
  - Outlier target report,
  - False target reports.

- Compliance Assessments Methods.
  - **Discussed already as part of Chapter 3. This section includes all the items listed as references for 5 NM and 3 NM separation.**

- Annex A – Surveillance System Function and Scope.
  - Used to provide Air Traffic Services (e.g., horizontal separation) and/or perform ATC functions (e.g., safety nets).
- Annex B – Reference Documents and Acronyms.
- Annex C – Definitions.
- Annex D – Non-Cooperative Surveillance System Legacy Performance when supporting 3/5NM Separation.
- Annex E – Compliance Assessment Approaches – refers back to section 4.1.1
- Annex F – Specification Update Procedures.

VOLUME 2.

Appendix – I Justifications of the Specified Performance.

I – 1 Approaches for defining performance requirement criteria.

1. As horizontal separation is provided between two (or more) individual aircraft, the performance requirements for cooperative surveillance have been defined as far as possible per flight/aircraft.
2. This approach is considered necessary as the performance of cooperative surveillance is reliant upon the performance of the aircraft domain components – both SSR, and ADS-B.

I – 3 Measurement Interval.

1. Aircraft separation is reliant on the regular provision, at a given measurement interval of surveillance information on the aircraft being separated.
2. The values required are copied from the Eurocontrol Standard for radar surveillance in EN-route and Terminal airspace (RD-2) and are retained for ADS-B RAD and WAM systems.

I-4 Probability of update of Horizontal Position.

1. Provision of a separation service relies on the horizontal position of the aircraft being horizontally separated.
2. For 3 and 5NM the value per flight is specified in RD 13 (ED-161).

FIG 1 – Aircraft position probability of update.

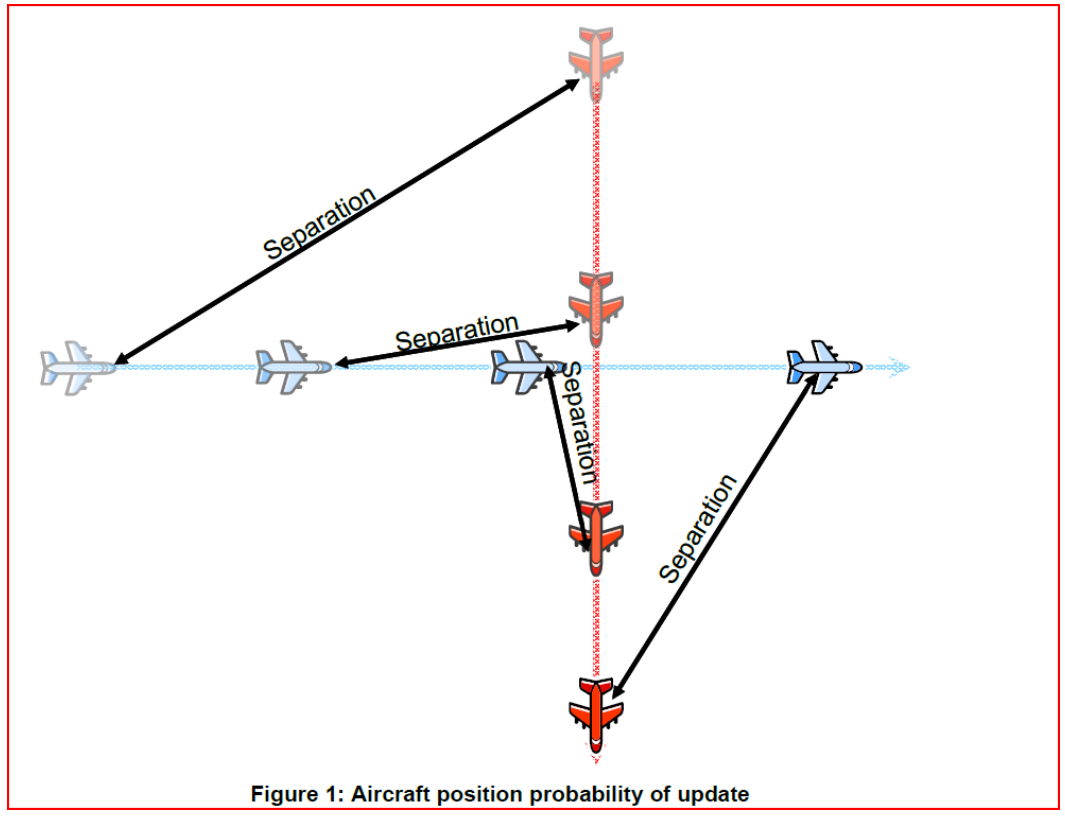

Figure 1: Aircraft position probability of update

I – 7 Ratio of target reports involved in sets of consecutive correlated horizontal position errors.

- A set of correlated errors in the same direction may invalidate predictions made by the controller. Display position of aircraft in bright colour, whereas the real blue aircraft is in the shaded colour.

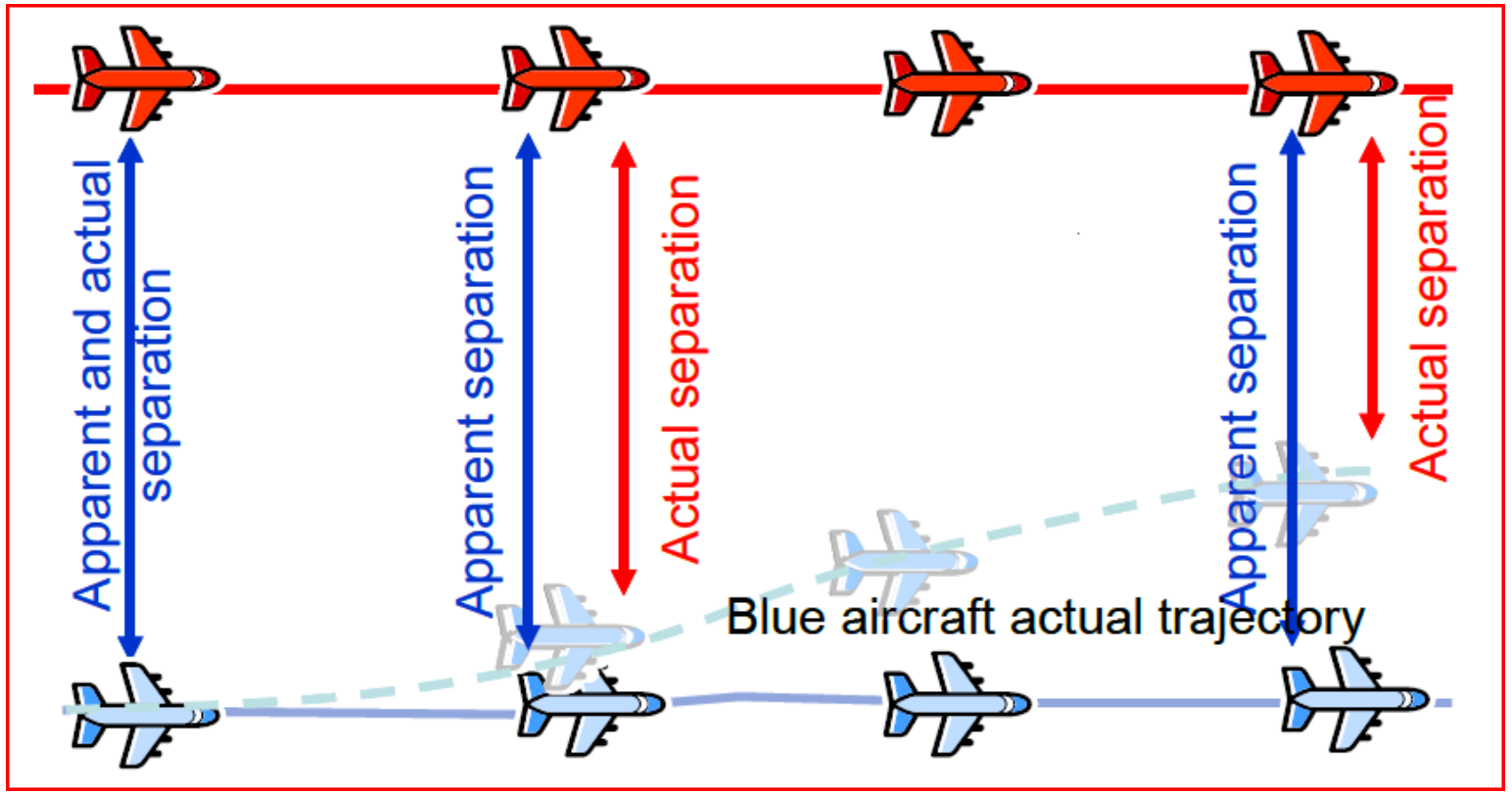

FIG 4 – Correlated error position in Parallel route scenario.

Performance requirements in this appendix (I-1 to I-20) include the following:

I – 5 Ratio of Missed Reports involved in long gaps.

I – 6 RMS error of Horizontal position.

I – 8 Relative time of Applicability of close horizontal positions.

I – 9 Date age and ratio of incorrect pressure altitude and I – 10 Unsigned error of pressure altitude.

I – 11 Delay in transmission of SPI and Emergency Indicators and I – 12 Delay in transmission of change of Aircraft Identity.

I – 13 Probability of update of correct aircraft identity and I – 14 Ratio of incorrect aircraft identity.

I – 15 RMS errors of rate of climb/descent.

I – 16 RMS error of track velocity vector components.

I – 17 Density of uncorrelated false target reports.

I – 18 Number of falsely confirmed tracks close to true tracks.

I – 19 Probability of update and Data age of Indicated Air Speed.

I – 20 Time variation between horizontal position updates.

Appendix – II Traceability and Justification Matrix.

- Already discussed in VOL 1.

Appendix – III Air Traffic Services.

- Contains definitions related to ATS, extracted from ICAO PANS-ATM [RD 9].
- Also identifies functions based on surveillance data and integrated into the ATC system:
  - Short Term Conflict Alert (STCA).
  - Minimum Safe Altitude Warning (MSAW).

Appendix – IV Conformity Assessment of Specific Designs.

- Assesses conformity of specific surveillance systems – e.g.; ADSB.
  - IV - 3 Single ADS-B ground station based on [RD 12] (ADS-B NRA).
  - IV – 4 SINGLE ADS-B ground station based on [RD 13] (ADS-B RAD).

Appendix – V Detailed Description of the Operational Performance Assessment Scenarios.

- provides samples of 5 or 3 NM separation scenarios:

V - 1 Crossing track scenario 5 NM separation detailed description

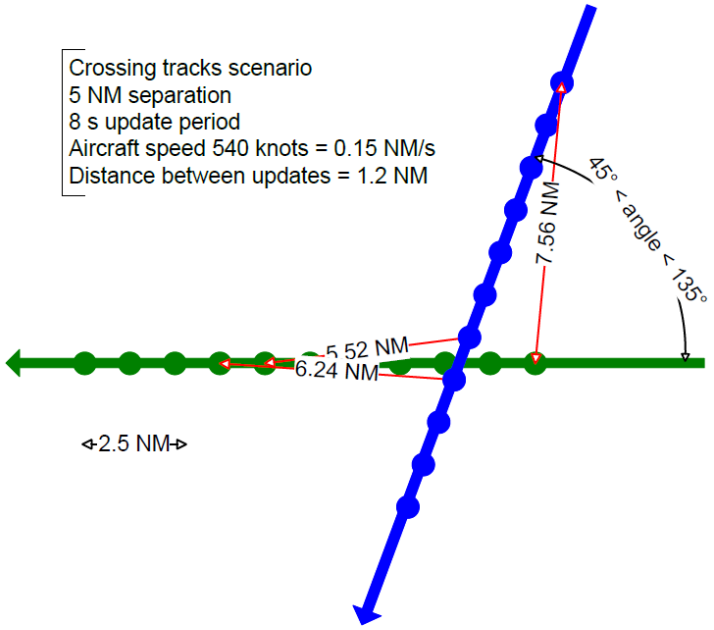

Figure 16: Crossing track scenario 5 NM separation

V - 2 Crossing track scenario 3 NM separation detailed description

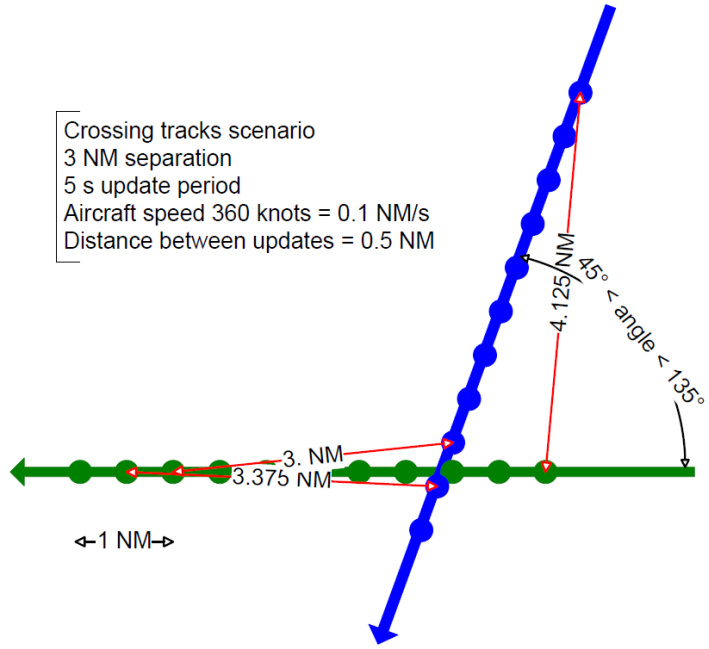

Figure 17: Crossing track scenario 3 NM separation

Appendix – VI An approach to Justify Requirements based on the Model described in [RD 22] and [RD 18].

- This annex provides an example, based on a specific horizontal position error model, of a top-down approach justifying a subset of the requirements in this specification. – Report RD 22 has been produced to justify using a top-down approach.

Example of this method are shown in:

- VI – 3 Model parameters and model results for 5 NM separation.
- VI – 4 Model parameters and model results for 3 NM separation.

- Appendix – VII An approach to Justify Minimum Sample Size.

This appendix attempts to identify and determine a recommended minimum sample size for assessing performance in each service separation.

- VII – 3.2 3 and 5 NM
  The sample size for each metric ensures there is a 10% probability the underperforming system will have a measured performance that exceeds the requirement.

Req #	Global Metric	Requirement	Underperforming system	Min Samples
R2	Probability of update of horizontal position	97%	96.25 %	1,100
R3	Probability of Long Gap	0.5%	0.55 %	35,650
R7	Probability of update of pressure altitude	96%	95 %	800
R10	Ratio of incorrect forwarded pressure altitude	0.1%	0.2 %	3,300
R14	Probability of update of Correct Identity	98%	97.5 %	1,700
R15	Ratio of incorrect identity Identity	0.1%	0.2 %	3,300

Table 2. Recommended sample size for 5NM and 3NM separation.

- Appendix VIII – Reference documents.

Thank You

ICAO