

## Annex III to

### **Final Report**

#### Revision of the SPI Regulation

RMT.0679 – Surveillance, performance and interoperability  
December 2017



## Baseline Analysis Report

### RMT.0679 Revision of Surveillance Performance and Interoperability

Version 20 – 9 November 2017

#### BASIC INFORMATION

The rulemaking group for the Rulemaking Task 0679 “Revision of Surveillance Performance and Interoperability Implementing Rule” has initiated a series of activities to assess the scale of the issues with surveillance performance and interoperability in the EASA Member States. This provides a baseline scenario to describe the current situation and what would occur without new regulatory proposals.

The assessment of the baseline scenario was supported by surveys sent to the EASA Advisory Bodies (see survey map below) on 22 July 2016. These surveys were completed with additional studies and reports when the answers were not sufficient to assess the scale of the problem.

This results in a Baseline Analysis Report (BAR) to support the Regulatory Impact Assessment for RMT.0679.

The Agency would like to thank very much all the respondent who have enable by their answers to understand more in depth this issue and all the persons who contributed to the studies performed for the RMT.0679.

The Agency welcomes feedback on the evidences and estimates gathered in this report (contact: [impact.assessment@easa.europa.eu](mailto:impact.assessment@easa.europa.eu)).

#### Disclaimer

*The number of answers to this survey cannot ensure that the results are representative of the sector. Therefore the interpretation of the results has to be cautious. The Agency strongly recommends that you contact us ([impact.assessment@easa.europa.eu](mailto:impact.assessment@easa.europa.eu)) for any questions on the usage of the survey.*

Survey map	
Support for:	RMT.0679 Revision of Surveillance Performance and Interoperability
Audience:	ATM/ANS Providers Airspace Users Manufacturers NAAs, NSAs Military stakeholders Aviation associations
Addressees:	MABs, ...
Survey period:	22 July to 15 December 2016
Tools:	EUSurvey website Emails with word and excel files Studies developed for this RMT.



European Aviation Safety Agency

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## 1. Background and report structure

This report is part of the impact assessment process to support the RMT.0679 Revision of the Surveillance and Interoperability<sup>1</sup>.

It provides the support for the section “3.4 Issue analysis for the Regulatory impact assessment (RIA)” described in the Report “Revision of the SPI Regulation RMT.0679 – Surveillance, performance and interoperability”, November 2017.

The report has the following structure:

Chapters	Main content
1.Background	General information summarising: <ul style="list-style-type: none"><li>• the significance of each problem identified by the Rulemaking Group</li><li>• the stakeholder's feedback through the surveys</li></ul>
2.Objective of this report	
3.The problems to be addressed	
4.Overview of the outcomes of problems analysed	
5.Baseline scenario	
6.Future needs expressed by respondents	
7.Surveys: scope and answers overview	Information on the way the evidences were gathered
8.Lack of cost-efficiency for surveillance	
9.Surveillance datasharing between ANSPs	
10.Lack of sustainability of spectrum (with a special focus on 1030/1090 MHz)	Detailed assessment of the problem tree areas
11.Lack of performance and functionality targets	
12.Lack of interoperability	
13.Lack of security	
14.Interface with military surveillance	
15.Safety analysis	
16.Appendices	Additional information supporting the assessment of the problem tree

## 2. Objective of this report: define and assess the scales of the problem(s)

The first step of an impact assessment is to define and assess the scales of a problem. The problem definition looks at the causes of a problem and its consequences. Following the problem definition, the next step is the definition of the baseline scenario, i.e. the current situation and what would happen over time without new regulatory measures.

In order to document properly this problem definition:

- a problem tree was defined: see details in Section 3
- surveys were sent to stakeholders to assess the scales of the problem : see templates in Annex 2
- they were complement by studies when relevant
- a report (the current document) analyses and summarise the conclusions from this information

The outcomes of this report are:

- a revised problem tree taking into account the feedback from stakeholders
- a baseline scenario indicating what would happen without new regulatory measures

<sup>1</sup> [https://www.easa.europa.eu/system/files/dfu/ToR%20RMT\\_0679%20Issue%201.pdf](https://www.easa.europa.eu/system/files/dfu/ToR%20RMT_0679%20Issue%201.pdf)





### 3. The problems to be addressed

5 main problem areas have been defined in the field of surveillance performance and interoperability for the EASA Member States. These problem areas are:

1. lack of surveillance performance and functionality targets
2. lack of sustainability of spectrum (with a special focus on 1030/1090MHz)
3. lack of cost efficiency with the surveillance equipment
4. lack of interoperability between surveillance systems
5. lack of security of transmitted surveillance data

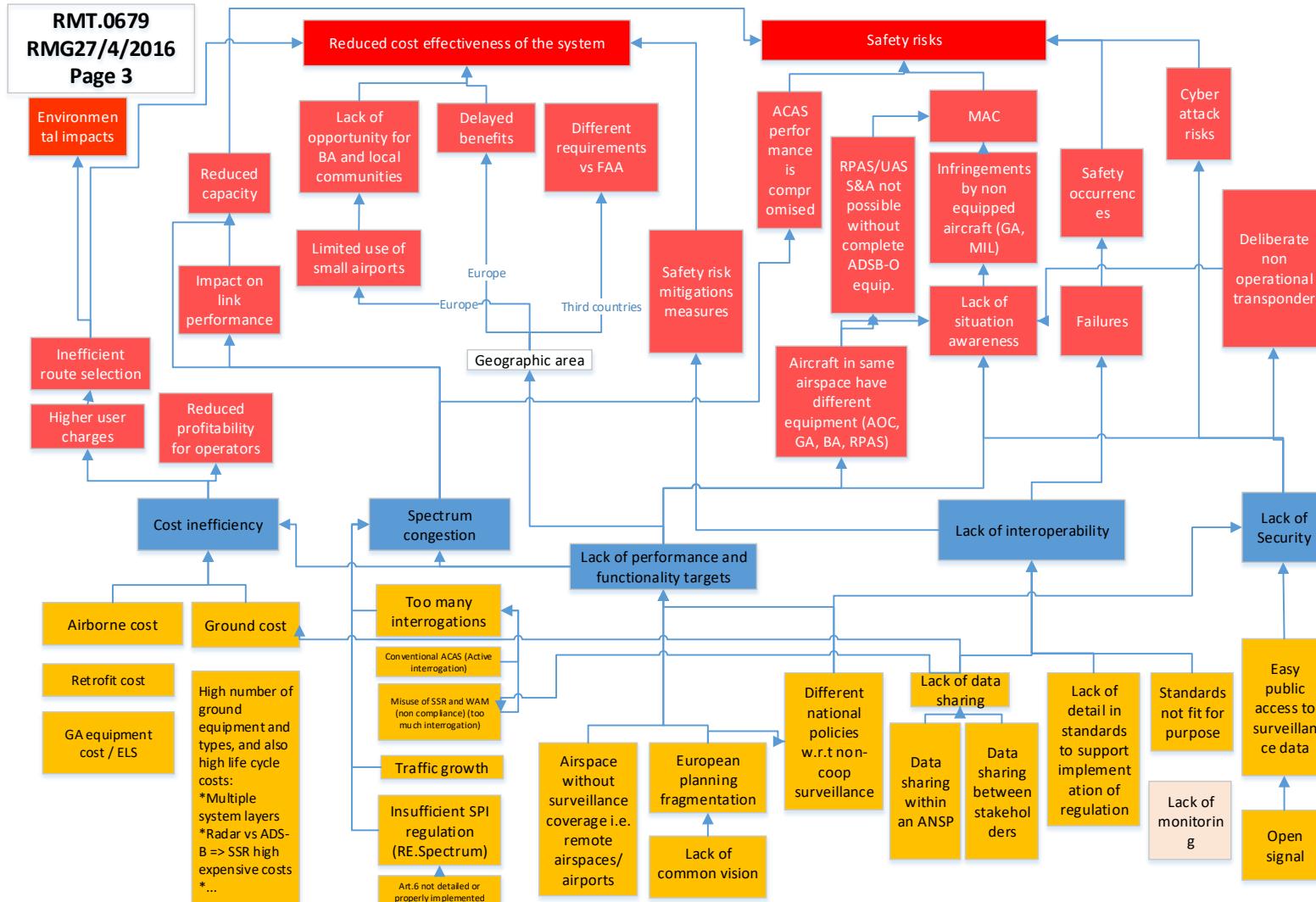
The problems are displayed in blue in the following problem tree. The lower part (orange colors) indicate the causes of the problems. The top part (in red) indicate the consequences of the problems.





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Figure 1 – Initial problem tree analysis for RMT.0679 Revision of SPI IR (source: Rulemaking Group)





## 4. Overview of the outcomes of problems analysed

After an analysis of the available information to assess the significance of each problem area (see details in the following chapters), it is concluded the following.

### 4.1. Problem area “lack of cost efficiency with the surveillance equipment”

The cost problem is highly significant with the current SPI IR:

- 1 Billion € investment by 2020 to get civil EASA MS fleet >5.7 tonnes MTOW compliant with the current SPI IR in terms of ADS-B equipage (no maintenance and operational costs)
- In addition, there is an industrial capacity issue to meet the 2020 deadline:
  - Only 14% of the current fleet was estimated to be SPI IR compliant regarding ADS-B requirements at the end of 2016<sup>2</sup>
  - approximately 150 aircraft per month to be retrofit with ADS-B before June 2020 : there is a strong concern that industry capacity are not sufficient
- Surveillance datasharing status: while most of the ANSP share data (see below), the purpose for sharing data though is mainly to enhance quality of these data rather than to rationalise radar stations. There are liability issues on data quality and availability between ANSPs which prevent to make a significant ground sensor rationalisation. When the respondents answer to their future expectations<sup>3</sup>, several indicate that data sharing should be improved to be more cost-efficient.
- No significant benefits identified with the current SPI IR (no ground rationalisation, ADS-B applications development are only at an early stage, ...)
- ADS-B stations are not homogeneous deployed in EASA Member States. The WAM deployment contributes to a higher coverage of the reception of the ADS-B signal transmitted by aircraft, however the full coverage of reception of ADS-B signal by the surveillance infrastructure is not complete (at least x MS without such capabilities currently).

In addition, a survey made for the GA fleet estimates that:

- 100% of the IFR aeroplanes are equipped with transponder: 80% with Mode S, 20 % with Mode A/C
- 90% of the VFR aeroplanes are equipped with transponder (VFR flights are not subject to the current SPI IR): 40% with Mode S, 60 % with Mode A/C
- 25% of the sailplane are equipped with transponder (in that case nearly all are Mode S)
- The transponder estimates for the other types of aircraft cannot be provided due to too few answers.
- in terms of Traffic Warning System, very few aeroplanes are equipped in comparison with sailplanes where FLARM is commonly installed in 90% of the sailplanes.
- 40% of the aeroplanes are equipped with GPS, compared to 85% for the sailplanes.

#### Feedback from some FAB activities in terms of infrastructure rationalisation<sup>4</sup>

Blue MED FAB<sup>5</sup> has ongoing harmonisation plans with a technical analysis expected by 2018. One organisation has further (non-FAB) cross-border rationalisation activities ongoing. FABEC's and Baltic FAB's activities show that no further rationalisation would be of benefit<sup>6</sup>. The justification behind that result mainly is due to the fact that the current standard requires to have ADS-B complementary to an independent surveillance source in medium and high density airspace for the reason of its availability. Further rationalisation enroute and in terminal areas is therefore difficult as long as there is no evidence that ADS-B can serve as single surveillance for separation purpose delivering the same safety and capacity.

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<sup>2</sup> This is in line with the Eurocontrol information that approximately 20% of the IFR flights are with ADS-B equipped aircraft.

<sup>3</sup> EASA Survey “Datasharing” Question Q-4.6.1

<sup>4</sup> Question asked to CANSO in March 2017

<sup>5</sup> Functional Airspace Block

<sup>6</sup> See Appendix 16.8.





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### 4.2. Problem area “lack of sustainability of spectrum (with a special focus on 1030/1090MHz)”

Note: The difficulty to assess this problem required to have an assessment made with different supports/methodologies to ensure that all points of views can be represented. EASA started to review the SESAR 15.01.6 “1030/1090 Final Evaluation Report (2013)” focussing on the spectrum congestion for Frankfurt area<sup>7</sup>, then complemented by a survey to all stakeholders sent by EASA in July 2016. The outcome was to launch a study end of 2016 carried out by Eurocontrol/Network Manager to reassess the SESAR report with another model and to extend the modelling to other areas than Frankfurt, i.e. Croatia, Spain and Sweden.

#### 1030/1090 MHz spectrum congestion problem

Based on the study conducted by Eurocontrol for the RMT.0679

- Potentially high significant spectrum congestion problem for Frankfurt-Brussels-Paris-London area after 2025 – 2030, where ACAS is a significant contributor.
- Potentially significant spectrum congestion problem in the Croatian area after 2035.
- No problem identified to for other areas like Sweden, Spain in the EASA sample.
- Some measurements made at different places in Europe show that transponders transmit higher reply rates than minimum performance specified in transponder MOPS.

For affected areas, there is the risk that traffic should be limited from 2025 to continue to ensure safety.

Based on survey answers:

The reported problems are regional and limited.

However the vast majority of ANSPs do not measure nor monitor the usage of this frequency. Only 3 Member States have developed various models to assess this frequency usage.

Some losses of detection reported by different stakeholders may be due to spectrum congestion. Several answers refer to the same loss of detection case in June 2014 in Central Europe which was based on spectrum congestion (see Appendix 16.1).

#### Assessment, modelling and monitoring

A minority of ANSPs (30%) and National Bodies (25%) assess the usage of 1030/1090MHz. 35% of the airspace users declare to assess this usage<sup>8</sup>. From this 1/3 of respondents again only 1/3 are able to model the use of this frequency usage (no airspace user models this usage). Each respondent uses a different model/tool. Only one of the few who models this frequency usage has installed a monitoring of the interrogation rates, the reply rates and the channel occupancy.

The current safety occurrences<sup>9</sup> identified with this frequency usage are “none” for a vast majority of the respondents (90% ANSPs and 65% of the National Bodies). There are problems for 50% of the airspace user, however these occurrences are rare and without severity consequences except cases as reported in June 2014.

Regarding the future evolution, 40% of the respondents forecast an increase of this frequency usage, while 30% don't know and 25% believe that there will be no change. Only one respondent forecasts a saturation of this frequency and 2 respondents forecast the opposite, i.e. a decrease. However, a majority of respondents consider that there will be no significant impact on ground system interrogation.

#### Conclusion

- The great majority of States and ANSPs except 3 are neither managing nor monitoring the usage of 1030/1090MHz frequencies. Only a small number of respondents model the 1030/1090MHz frequency usage;

<sup>7</sup> SESAR 15.1.6 modelling activity has shown that Mode A/C systems should no longer achieve the right level of performance within the core area of Europe.

<sup>8</sup> However, the means to assess is unclear and therefore for such an assessment the answer from airspace user is questionable as our questionnaire may not have been precised enough.

<sup>9</sup> The outcomes of this safety issue are loss of detection, false track/target, reduction of quality for surveillance information





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- Only regional issues which seem limited to Central Europe and Germany have been reported. However a few other cases have been reported over the last decade (CDG, north Italy, NL, Greece, UK, Latvia). All these cases were due to an unexpected system transmitting on 1030 MHz.
  - For Frankfurt-Paris-London area, the issue is due to the high density traffic and its continuous increase
  - For other cases, one main contributor is the lack of appropriate radar configuration: this results in an over interrogations of the aircraft transponders.

### ACAS

The vast majority of ANSPs have not encountered problems with ACAS however a large number of operators (33%) report unexplained losses of symbols on their airborne TCAS display.

ACAS contribution in the usage of the frequency 1030/1090MHz: only 2 respondents provided a value. It ranges from 30% to 50%. One respondent refers to SESAR WP.15.1.6 D3. One respondent is waiting for an EUROCONTROL report. All the other respondents have no available information.

### Conclusion

- currently no reported safety issues, only few cases of losses of symbols on TCAS display are reported;
- ACAS contribution to frequency 1030/1090MHz is reported high in 2 answers.

### Ground system interrogation

- There is always an organisation at national level to approve the transmission on frequencies 1030/1090MHz.,
- The most common criteria to give an approval refer to radio communication, however specific ATC criteria seem missing in most of the answers (e.g. maximum number of BDS extracted, interrogation sequence (MIP), range, ...)
- There was no need for a vast majority of respondents to increase the interrogation rate in order to ensure surveillance performance<sup>10</sup>.
- No significant changes expected in the future.

### Conclusion

- no specific issues reported

### Downloaded Aircraft Parameters (DAPs/BDS)

*Note: this item is not clearly indicated in the problem tree, however it is potentially a contributor to spectrum congestion if the download aircraft parameters are not used efficiently by the surveillance system.*

From the data reported, it could be seen that BDS extracted correspond to an EHS or ADS-B capable transponder. In one case the most use BDSs refer to an ELS specific BDS – ‘Identification’. Not all the parameters extracted are made available to the ATCO and are used as part of the ATCO procedure. This contributes to increase the spectrum congestion without any benefits.

### Harmful interference

A majority of respondents did not experience problems with harmful interferences. However 30% of ANSPs respondents and 40% of National Bodies respondents have experienced problems. These problems seem to have occurred only once and then are solved. They are linked to several aspects: IC conflict, SSR mode S, PSR. The 2014 case was several times mentioned. Causes of the issues mentioned are: low cost video cameras, manufacturer or private company trials, suspected MIL activity, wind turbines, misconfigured civil and MIL radar, overlapping surveillance coverage.

### Conclusion

Apart the few cases mentioned, procedural mitigations are in place to avoid escalating to safety related occurrences and they have no negative significant operational impacts.

### Link between “data sharing between ANSPs” and “spectrum congestion”

There does not seem to be an issue with data sharing. There are enough answers showing that data are shared to be confident that this practice is real. However, the survey did not ask specifically how far the shared data are used

<sup>10</sup> For Mode A/C the number of interrogations can be increased by changing the PRF. Mode S are automatically increasing the number of selective interrogations to maintain their performance.





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operationally: therefore it cannot be concluded that the implementation of data sharing is fully efficient from a spectrum congestion point of view. As a side effect, there is potential for further ground surveillance rationalisation with benefits in terms of avoided surveillance costs.

The number of ANSP not sharing data is a very small minority. It happens in only 2 countries: Estonia (2 CNS providers) and United Kingdom (6 our 14 respondents do not share surveillance data). However it could be that these ANSPs do not need to share data. At international level between ANSPs, there are 4 cross-border areas in Central Europe and one cross-border area between France and UK where there is no data sharing.

### 4.3. Problem area “lack of surveillance performance and functionality targets”

#### Overall

There are no significant issues which have been reported to support the statement that there is a lack of surveillance performance and functionality targets.

A common policy is to have cooperative surveillance mandated in controlled airspace. Some ANSPs extend this policy to all airspace classes (1/3). Regarding non-cooperative surveillance, the use of PSR is predominant for TMAs with a certain level of traffic (3 ANSPs use it also for en-route).

Regarding the technical ground system, while there is a trend to install ADS-B, there are currently a mix of different techniques (WAM, Mode S, Mode A/C). The lack of coordinated implementation plans between ANSPs at ground level could be the major source of the perceived lack of surveillance performance and functionality targets. No issues with the current performance as well as no additional needs for future performance were identified, however rather a lack of coordination of technology implementation. The ground surveillance system is mainly relying on Mode S radars. However, there are still Mode A/C radars in operation. There is currently a transition where the remaining Mode A/C radars are being decommissioned. However it has to be noted that some military ANSPs plan to continue the operation of a high number of Mode A/C radars beyond 2030 Multilateration has been deployed in some areas while ADS-B stations are being installed but not yet used operationally. The results of the survey show that the majority of ANSPs have a plan to move to a mix of Mode S /WAM/ADS-B systems. As a result the airspace users do not see yet the benefit of the future system which is gradually implemented on the ground.

#### Conclusion

It is proposed that optimisation of ground infrastructure as well as identifying a harmonised minimum required performance criteria for various surveillance applications should be one of the main objectives when developing options in order that the airspace user knows which types of transponder will be supported by the surveillance system in the future.

#### Additional information:

- ANSPs are implementing in majority Eurocontrol standards on a voluntary basis (they are not formally recognised means of compliance in the SPI IR).
- There is only a limited number of geographical areas which have been reported where surveillance could be improved. Most of the answers refer to non-controlled airspace classes. ANSPs answers may be sufficient to support this statement, however there are not sufficient answers from airspace users to ensure the validity of this statement. Eurocontrol provided a list of 51 aerodromes with surveillance operational needs, list provided in cooperation with IATA in 2007: after the feedback from the ANSPs<sup>11</sup>, it can be concluded that very few of these aerodromes are missing surveillance capability. The analysis of some case studies did not bring the evidence that adding providing surveillance based on ADS-B technology is the key contributing factor to make small airports attractive to expand aviation business.

### 4.4. Problem area “lack of interoperability between surveillance equipment”

The majority of the responses do not indicate an interoperability problem. Stakeholders are pointing to lack of means of compliance and lack of clarity on the availability of means of compliance. However this lack of means of compliance does not mean that there is in the end a lack of interoperability.

Ground to Ground and Air to Ground interoperability:

<sup>11</sup> March 2017



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- Ground to ground works with the support of ASTERIX format exchange (conclusion from **data sharing** related answers)
- Air to Ground: the responses are not showing a lack of interoperability. Note that the need of interoperability at aircraft level with FAA has been also expressed as a must by some respondents (manufacturers and European airlines operating in US).

Note: a list of anomalies has been provided by Eurocontrol, this does not change the statement (see 16.4).

There is a significant number of the answers referring to issues which are not linked to interoperability as such, e.g.:

- Cost of equipment
- Implementation issues
- Airspace structure / Class G issue regarding traffic information capability
- Certification process issue (time, ...)

### Conclusion

The majority of the responses does not indicate an interoperability problem.

### **4.5. Problem area “lack of security of transmitted surveillance data”**

Majority of stakeholders do not assess security vulnerabilities of their surveillance systems. From the stakeholders who responded, only 27% of the stakeholders have assessed security vulnerabilities.

Majority of stakeholders give lack of emphasis to security aspects of surveillance systems or are not so concerned about the widespread availability of surveillance data.

It is also clear that stakeholders generally lack knowledge and awareness in security aspects and have different views on who owns security risks.

Using non-cooperative surveillance and using multiple layers of surveillance techniques is used as mitigation to security vulnerabilities by a small number of ANSPs.

In terms of mitigation measures to be developed and regulatory measures to minimise security threats, most stakeholders do not have the knowledge to answer or there are very limited measures taken.

### Conclusion

It is commonly supported that this is a problem, however the significance of the problem cannot be defined. The problem is addressed outside this RMT.0679 SPI IR: indeed this aspect is already tackled by other initiatives of EASA such as cybersecurity RMT.0648<sup>12</sup>.

Potential action: to assess the need to protect the identification of specific categories of flights (EBAA & MIL positions)

### **4.6. Interface with state aircraft and military surveillance**

The remaining NON-transport type state aircraft flying GAT<sup>13</sup> represents a low proportion of the total GAT flights (1.65%) the significance of the problem for the ATM system is currently very low.

On ground military surveillance side, the issue is different: the Mode A/C radars are still representing a large share of the military surveillance with adverse effect on the spectrum congestion. Despite there is a trend showing the replacement of these radars by Mode S radars (based on partial data), it is not clear to know when the Mode A/C radars will be fully replaced by Mode S radars. The military ground surveillance infrastructure has a medium significance for areas which are subject to spectrum congestion issues (like Frankfurt).

More details:

<sup>12</sup> <http://www.easa.europa.eu/system/files/dfu/ToR%20RMT.0648%20Issue%201.pdf>

<sup>13</sup> General Air Traffic: all movements of civil aircraft, as well as all movements of State aircraft (including military, customs and police aircraft) when these movements are carried out in conformity with the procedures of the ICAO ([https://ext.eurocontrol.int/lexicon/index.php/General\\_Air\\_Traffic](https://ext.eurocontrol.int/lexicon/index.php/General_Air_Traffic))





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Within the survey it was possible to get not complete, but reasonable and sufficient feedback on the military surveillance ground infrastructure in order to conclude on possibilities and consequences in terms of e.g. surveillance infrastructure rationalisation.

In relation to the airborne side unfortunately it was not possible to get sufficient information on state aircraft fleets in terms of types and numbers of different airframes. As well it was not feasible to assess possible cost for additional technology integration such as e.g. ADS-B out integration into combat aircraft.

However a general analysis on the situation in relation to state aircraft and their influence on the overall ATM-system could be conducted.

This analysis is based primarily on the EUROCONTROL “Military statistics brochure” 2014 edition. This document builds on 2013 figures derived from EUROCONTROL’s Central Route Charges Office (CRCO) for the GAT IFR data and information from EUROCONTROL Members States for OAT and military fleets.

In summary based on 2013 figures the main facts derived are listed hereby. On top it can be assumed that today the figures in terms of airframes and flights conducted actual numbers are even lower!

- In ECAC region military organisations operate 9.437 state aircraft
- 949 of those air frames are transport type state aircraft
- Remaining 8.488 airframes are of NON transport type such as fighters, trainers, helicopters etc.
- In total in ECAC airspace 9.428.670 flights under GAT rules were conducted
- 155.268 of those GAT flights were conducted by state aircraft which represents 1.65 % of all GAT flights
- The percentage of GAT flights conducted by state aircraft within EUROCONTROL member nations is pending on national rules and varies from 0 % up to 26 %

Complementing the facts above it has to be stated that the vast majority of GAT flights conducted by state aircraft are executed with transport type state aircraft. These airframes already today are mandated by the (EU) 1207/2011 and its amendments to be equipped with Mode S EHS and ADS-B OUT by 7 June 2020.

### Conclusion

The remaining NON-transport type state aircraft in fact carry out only a very residual number of GAT flights. In consequence it has to be considered if these flights cause an impact on the overall ATM-system which would justify the retrofit of close to 8.500 airframes at cost which definitely would be much higher than for any civil airframes.

The significance of this problem for the ATM system is currently very low.

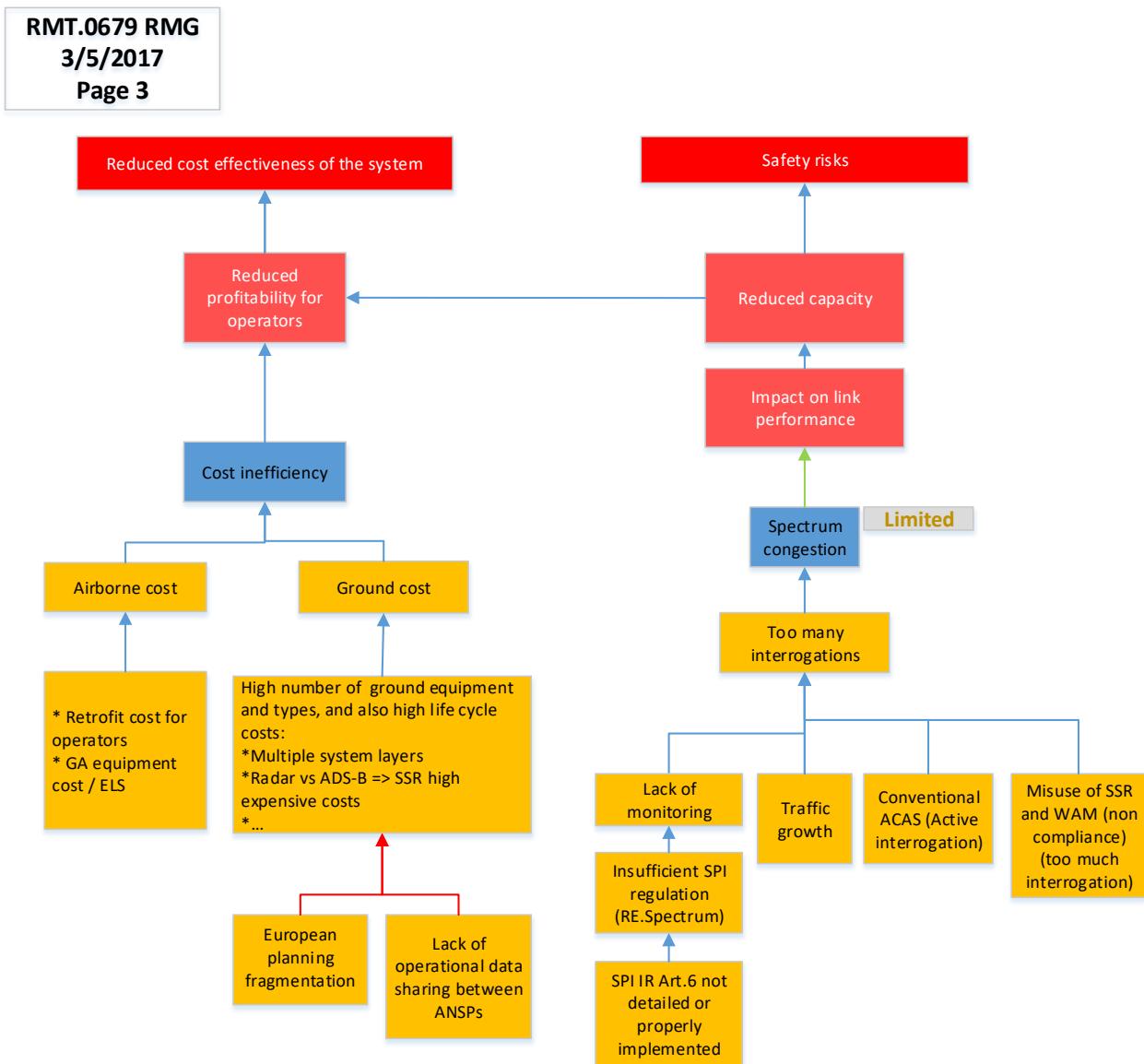




# **Baseline Analysis Report – RMT.0679 Revision of SPI**

#### **4.7. Update of the problem tree**

Based on the above conclusions, the problem tree has been simplified with the significant issues to consider.





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## 5. Baseline scenario

Without a review of the current SPI IR:

- the IFR aircraft category > 5.7 Tonnes and with a speed > 250 knots will need to be equipped with Mode S EHS and ADS-B out at an estimated cost approximately from 300 million to 1 billion € in 2020.
- the ground infrastructure will not be able to decode the ADS-B signal all over the EASA MS area
- the ADS-B ground infrastructure will continue to be implemented without an harmonised plan, preventing
  - to ensure an ADS-B service all over EASA MS, i.e. IFR airspace users will support the ADS-B costs without benefits
  - to contribute to the rationalisation of the surveillance infrastructure
- the spectrum congestion issue may become critical in some high density areas from 2025 (at least Frankfurt-Brussels-London area which has the highest density for aviation traffic activity in EASA MS), with the potential to prevent annually several billion of Euro of traffic revenues for the airlines. The same problem could happen in the Croatian area in 2035.
- Overall the surveillance evolution in EASA MS is not efficient.

## 6. Future needs expressed by respondents

The survey asks the respondents to express future needs regarding the potential problem with lack of performance and functionality targets. A variety of perspectives for all stakeholders has been collected:

General **ANSPs** views are that the current performance is good to support the surveillance applications currently and suitable for future. From an ANSP perspective the future performance requirements must not be different from today's and should not result in cost increase by giving due regard to the existing infrastructure. A clear wish exists with regards to common performance values dependent on the need. There is a need for a common evaluation tool and method for the SUR chain. A review of the current standards is recommended. One proposed a pan-European approach on frequency management.

From an **airspace user (AU)** perspective the future performance criteria differ between GA and CAT. However cost shall not be all supported by the AUs. CAT AUs are expecting lower route charges with ground infrastructure rationalisation thanks to ADS-B and lower certification costs. For GA users, most of them would like to get traffic situational awareness services outside controlled airspace, including also drones. Some proposed that similar services to the one provided by FAA (TIS, FIS) should be implemented.

**Manufacturers** would like to have surveillance mandate tailored to the airspace classes / use and to have further harmonisation.

**International CAT operators** would be also in favour of harmonisation with other ICAO regions, especially ADS-B Out. The current SPI IR requirements shall remain the baseline for future regulations.

**Authorities** are in favour of a common European approach: radar siting in particular for core European area, data sharing, performance requirements, include GA and drones in the approach, equipage according to use per airspace class, improve tools to monitor ground surveillance performance.

**Military stakeholders** did not answer in a representative majority. However the answers received indicate that the current situation would be acceptable, in particular with regard to Article 8 of the current SPI IR that sets the requirements for State Aircraft.





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## 7. Surveys: scope and answers overview

### 7.1. General information on the sources used for this report

Surveys were conducted to assess the scale of the problems from all stakeholders' points of view (see Appendix 16.1 for survey template).

When relevant, other sources of information were used or few additional short questions were sent to stakeholders on a case by case basis. They are indicated in the text.

The most important input out of the surveys was the Eurocontrol study on spectrum congestion carried out for this RMT. It complemented the survey on that issue.

#### Who was contacted?

- EASA Advisory Bodies ;
- In the case of the military stakeholders, the Eurocontrol Civil Military ATM Coordination Division was the contact point on behalf of the European Defence Agency (EDA).

#### What was the content and the structure of the surveys?

The surveys consisted in 5 different parts:

- one part with questions for all types of civil and military stakeholders for the different problem areas: spectrum, performance, interoperability, security;
- one part related to the state aircraft and civil large / business aviation aircraft fleet surveillance capabilities to assess the status of the SPI IR implementation and its related cost impact;
- one part related to VFR GA fleet to assess the current situation in terms of surveillance equipage (unit cost were gathered directly from GAMA);<sup>14</sup>
- one part related to the military and civil ground surveillance infrastructure to assess the current situation in terms of sensors, the incoming planned or potential changes with an horizon at 5 to 10 years, and their related costs. In order to overcome a lack of detailed military answers, a shorter survey was sent in December 2016 to military ANSPs.

Note: the original surveillance infrastructure data were provided by Eurocontrol and EASA asked each Member State to amend them when necessary. EASA added a unit cost questionnaire to this data collection.

- one part related only to the datasharing of surveillance data between ANSPs. Note that datasharing is not a problem area, but a potential cause for problem like interoperability, cost inefficiency and spectrum congestion. Due to the complexity of this subject, a survey was dedicated only to this subject to support the assessment of the significance of this cause to several problems.

#### What was the survey period?

- between 22 July 2016 and 31 January 2017

#### What else?

- Almost all questions from the surveys have been used in this report. However, and this was few cases, when answers were difficult to understand or to summarise due to the lack of clarity for some questions, these questions may not be mentioned in this report.

<sup>14</sup> the GA part of the SPISGA survey received too few answers, therefore the questions were redrafted in a new survey "fleet survey for GA" sent on 23 November 2016 with the deadline by 15 January 2017.





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## 7.2. Overview of the answers

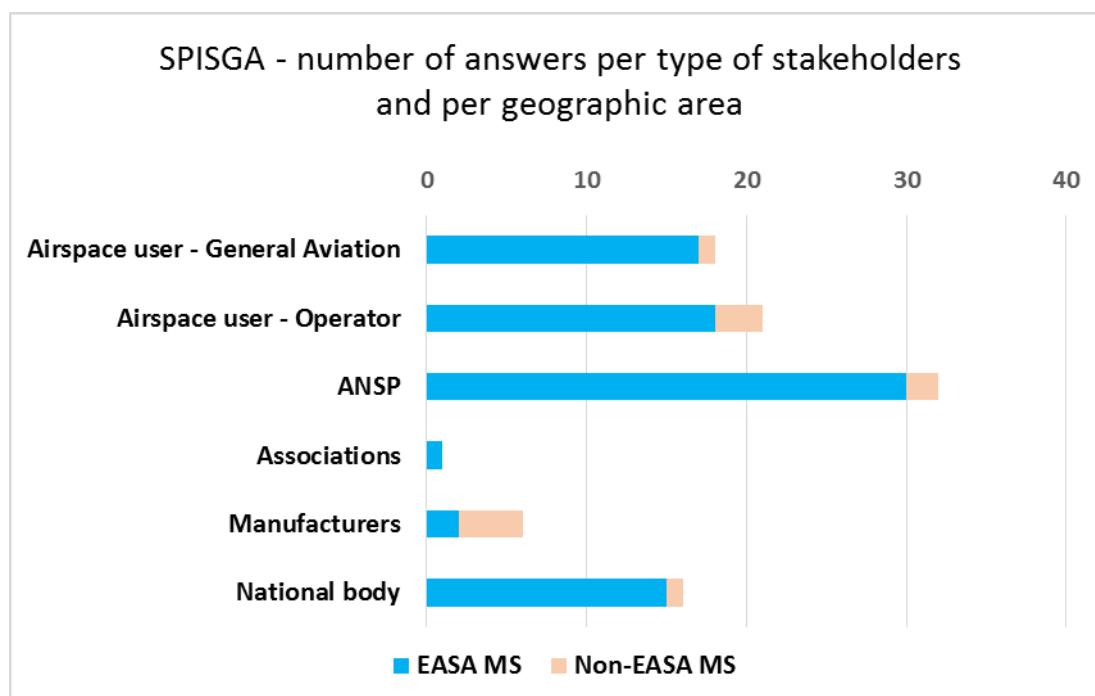
At the date of 15 June 2017

Surveys	Number of answers	Stakeholder scope
<i>SPISGA - Spectrum, Performance, Interoperability, Security Datassharing Fleet survey:</i>	93	ANSPs, Airspace users, National Bodies, Manufacturers, Military
	39	Civil and Military ANSPs
<i>State aircraft and civil large / business aviation aircraft fleet survey</i>	41	Airlines, Business Aviation, State Aircraft (including Military), Manufacturers
<i>VFR Fleet survey – GA</i>	375	GA airspace users
<i>Surveillance infrastructure survey:</i>		
<i>Ground survey - full</i>	29	Civil ANSPs
<i>Ground survey – limited questions</i>	19	Military ANSPs

## 7.3. SPISGA survey

SPISGA stands for “spectrum, performance, interoperability, security, General Aviation”.

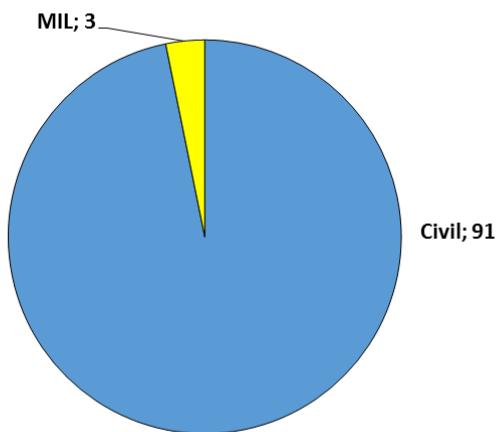
Total number of answers: 94 of which one answer was discarded (the answer from the responding association is to be discarded as it indicated that the association cannot answer to the survey).





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SPISGA - Number of civil and military answers



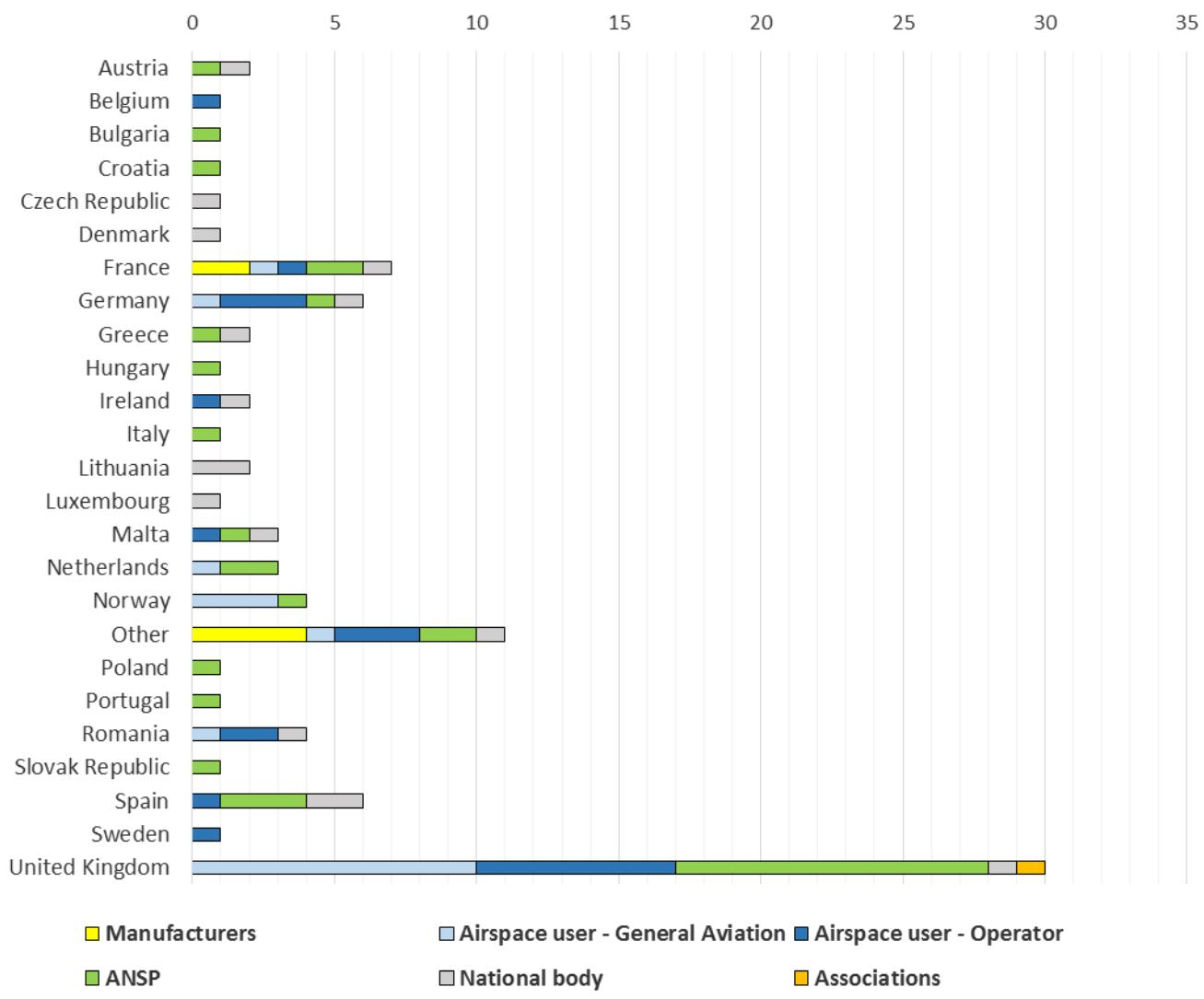
TYPE OF STAKEHOLDER	EASA MS	NON-EASA MS	GRAND TOTAL
AIRSPACE USERS - GENERAL AVIATION	17	1	<b>18</b>
AIRSPACE USERS - OPERATOR	18	3	<b>21</b>
ANSPs	30	2	<b>32</b>
CIVIL ANSPs	27	2	<b>29</b>
MILITARY ANSPs	3	0	<b>3</b>
ASSOCIATIONS	1	0	<b>1</b>
MANUFACTURERS	2	4	<b>6</b>
NATIONAL BODIES	15	1	<b>16</b>
<b>GRAND TOTAL</b>	<b>83</b>	<b>11</b>	<b>94</b>





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SPISGA - Number of answers per country and type of stakeholders





#### 7.4. Surveillance data sharing survey

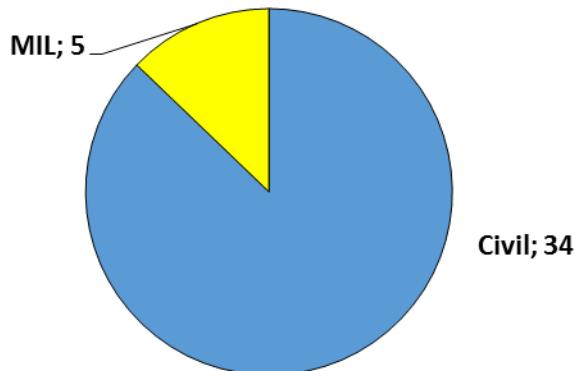
Total answers: 44, of which:

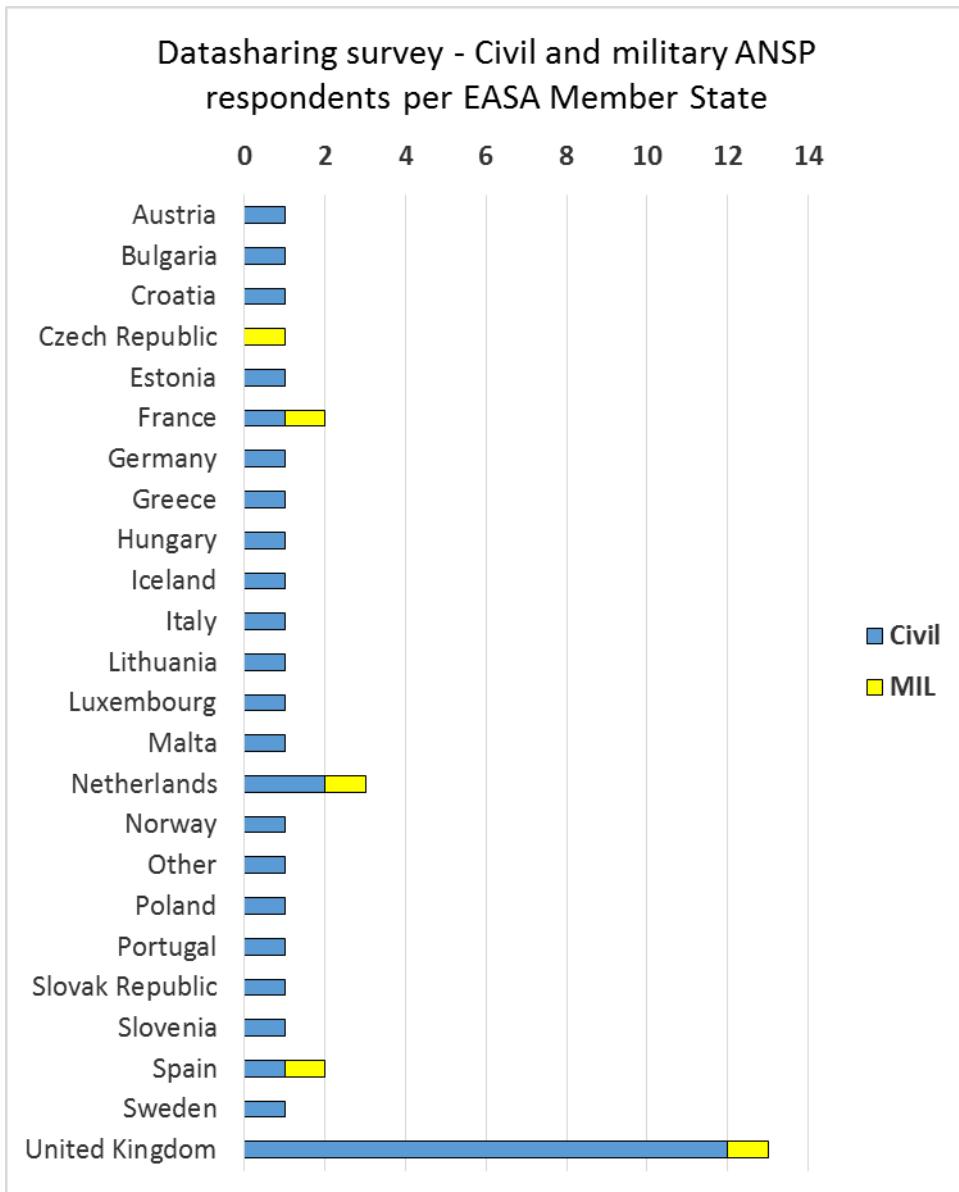
- 1 non relevant (Helicopter Operator)
- 2 ANS providers were always referring to the main ANSP in their country
- 1 NSA answer disregarded once the ANSP answered was received
- 1 ANS provider not belonging to EASA Member States: this is unsufficient to be considered in the analysis (it could have been interesting to analyse the surveillance data sharing situation between EASA and non-EASA Member State).

These answers were not considered in order to focus on the surveillance data sharing between EASA Member States.

Total relevant answers: 39 for the EASA Member States.

Datasharing survey in EASA Member States :  
civil and military ANSP respondents



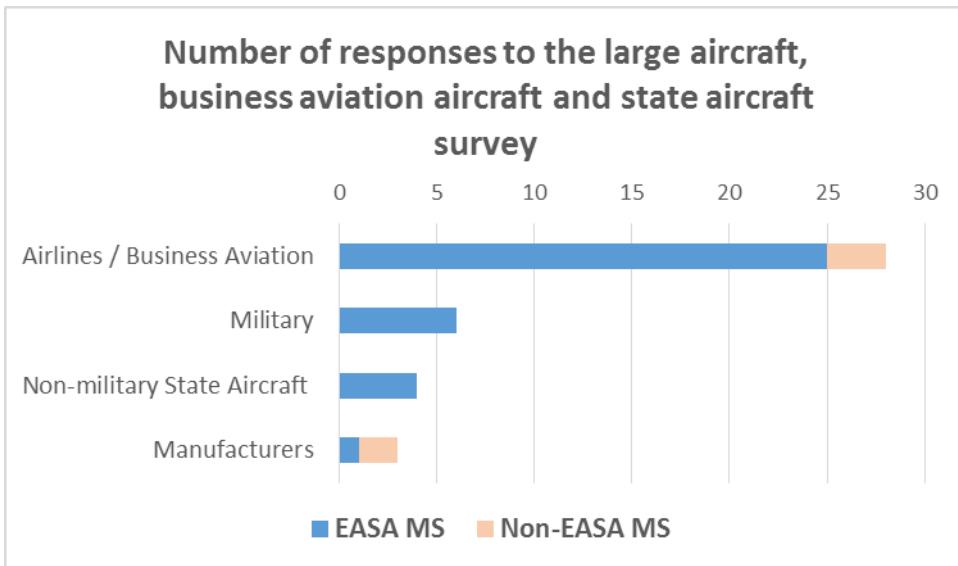


Note: EUROCONTROL MAASTRICHT UAC is indicated as having its activity in the Netherlands in that figure.

## 7.5. State aircraft, large aircraft and business aviation fleet survey

41 answers were received.





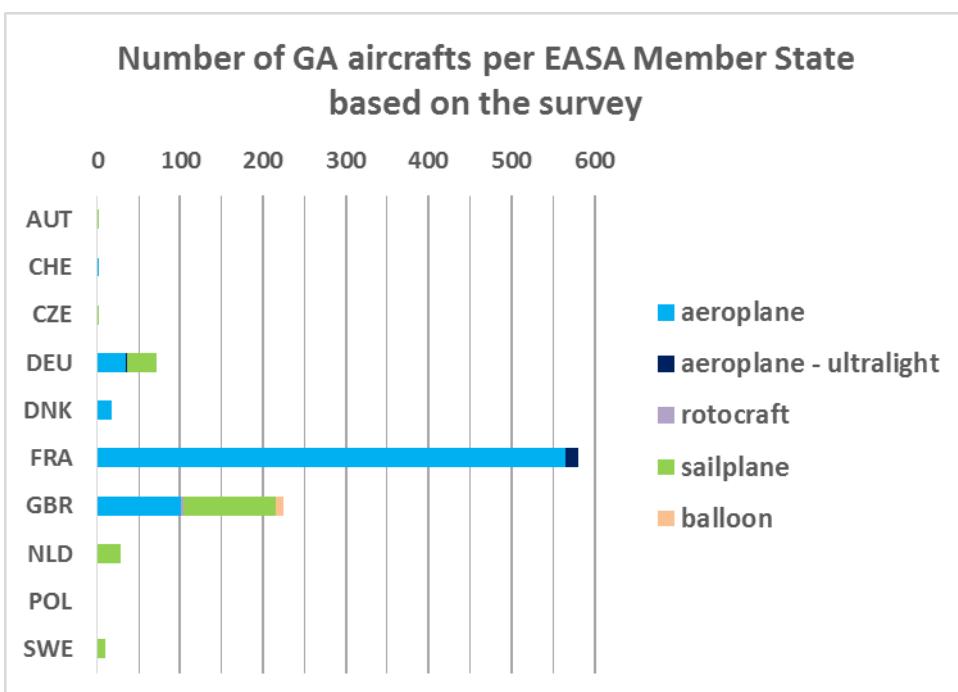
Note: the 4 answers for non-military aircraft are from the same Member State.

Except for airlines/business aviation and manufacturers, it was proposed to assess the relevant number of state aircraft (including military) in terms of number of IFR flights.

## 7.6. VFR GA fleet survey

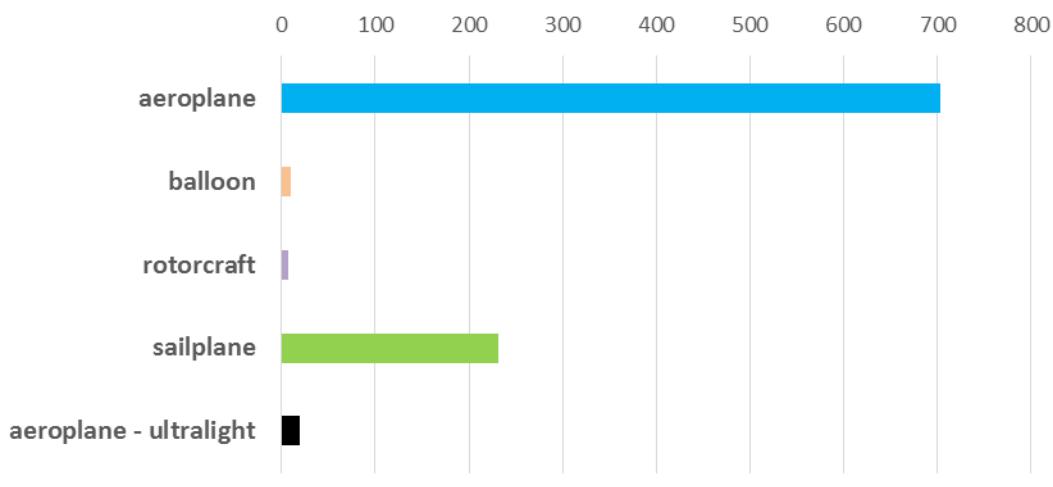
Note: GA questions were addressed in the SPISGA survey, however due to the very low GA answer rate, a more focussed survey was decided and launched from November 2016 to January 2017. This survey was decided after having studied the IOPA survey sent few years ago where transponder equipage was part of the questions. The EASA survey intended to update the transponder equipage status for the GA fleet.

375 responses were sent to EASA, covering 974 aircraft.





Number of GA aircrafts covered by the respondents

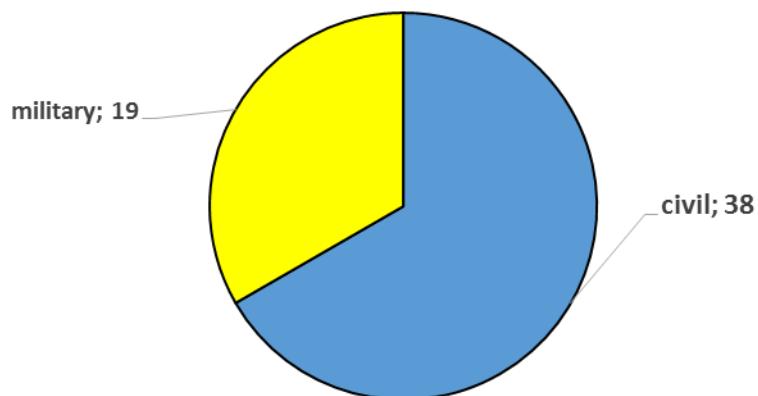


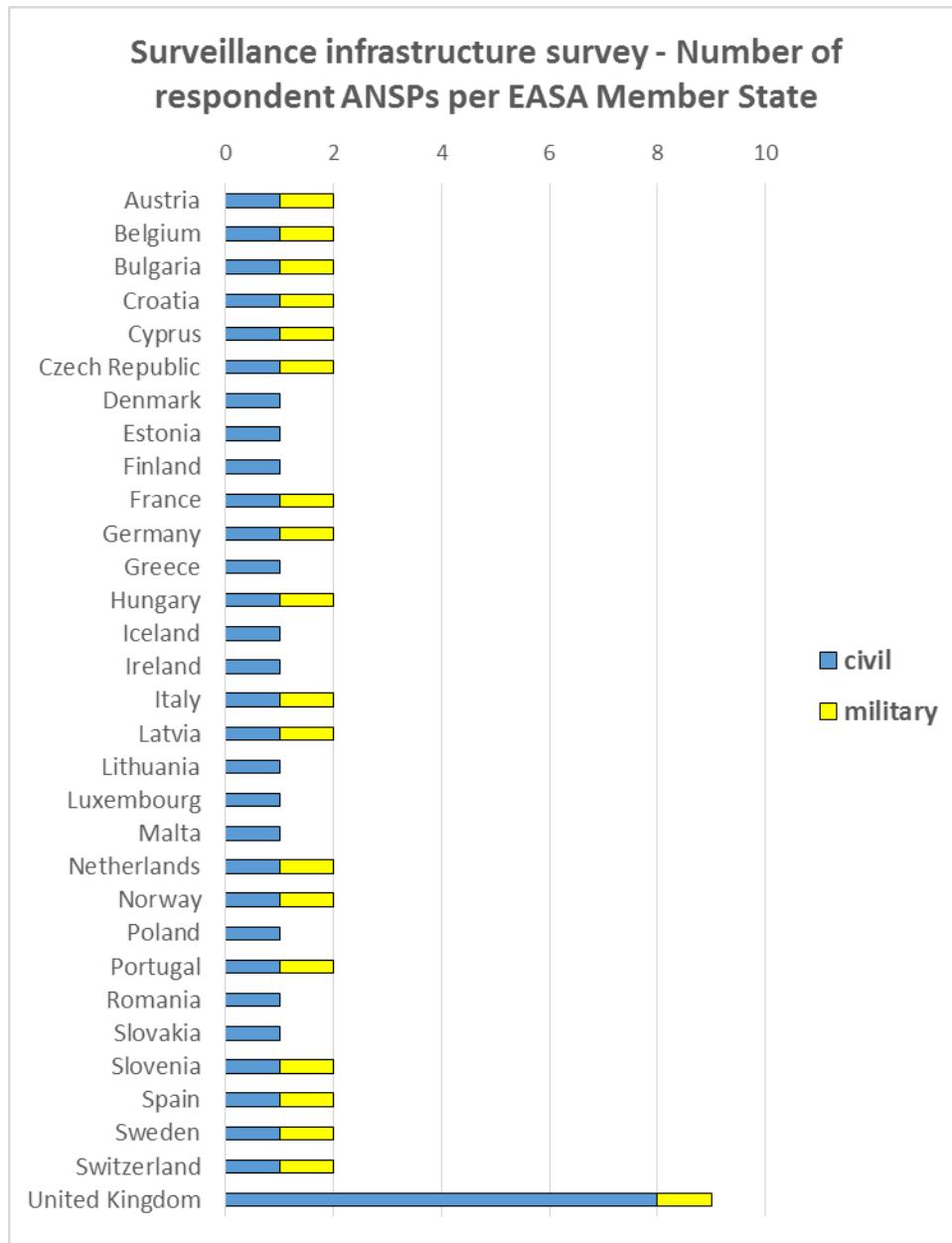
## 7.7. Surveillance infrastructure survey

The survey covers 57 civil and military ANSPs.

Note : the source of the information is from Eurocontrol for the following 5 civil ANSPs :  
Belgium, Greece, Iceland, Ireland, Latvia, Luxembourg

Surveillance infrastructure survey for EASA Member States- Number of respondent ANSPs





## 7.8. Overview of the military responses

As explained in section 7.1, some original surveys have been modified for the military aviation stakeholders in order to increase the answer rate.

The respondents cover 20 countries (19 EASA Member States, 1 non-EASA MS)

- 3 full responses
- 17 partial responses
- 1 respondent not belonging to EASA Member States: this is unsufficient to be considered in the analysis.





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Member State	Data Sharing survey	SPISGA survey	Aircraft survey	Surveillance infrastructure survey
AT	Partial answer			Partial answer
BE	Partial answer		Full answer	Partial answer
BG	Partial answer			Partial answer
CH	Partial answer			Partial answer
CY	Partial answer			Partial answer
CZ	Full answer		Full answer (different format)	Partial answer
ES	Full answer	Full answer	Full answer	Full answer
FR	Full answer	Full answer	Full answer	Partial answer
GE	Partial answer		Full answer (different format)	Full answer
HR	Partial answer			Partial answer
HU	Partial answer			Partial answer
IT	Partial answer			Partial answer
LV	Partial answer			Partial answer
NL	Full answer			Partial answer
NO	Partial answer			Partial answer
PT	Partial answer			Partial answer
SE	Partial answer			Partial answer
SLO	Partial answer			Partial answer
UK	Full answer	Full answer	Full answer (different format)	Full answer
<b>Total answers</b>	<b>19</b>	<b>3</b>	<b>6</b>	<b>19</b>
Full answers	5	3	6	3
Partial answers	14	Not applicable	Not applicable	16





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## 7.9. Representativeness of the answers

Surveys	Stakeholders	Total number of answers	Number of answers for EASA MS	Representativeness	Indicator
<b>SPISGA</b> (Spectrum, Performance, Interoperability, Security)	ANSP	29	27	67%	IFR flights in EASA MS
	National bodies	16	15	58%	IFR flights in EASA MS
	CAT airspace users	18	17	25%	Flights per year in EASA MS
	GA airspace users	21	18	0.02%	GA fleet
	Manufacturers	6	2	Good	Major manufacturers at EASA and worldwide level
	Military stakeholders	3	3	Poor	
<b>Datasharing</b>	Civil ANSPs	34	34	79%	IFR flights in EASA MS
	Military ANSPs	5	5	very low	
<b>Fleet survey</b>					
State aircraft and civil large / business aviation aircraft fleet survey	Airlines	28	25	23%	EASA MS operator large aircraft fleet
	Military	6	6	very low	
	Non military	4	4	None	
	State Aircraft				
VFR GA Fleet survey	Manufacturers	3	1	Good	Major manufacturers at EASA and worldwide level
	GA airspace users	375	375	1%	GA fleet in EASA MS
<b>Ground survey</b>					
Full survey	Civil ANSPs	38	38	100%	IFR flights in EASA MS
Limited survey	Military ANSPs	19	19	61%	EASA MS





## 8. Lack of cost-efficiency for surveillance

### 8.1. Main outcomes

The cost problem is highly significant with the current SPI IR:

- 300 million to 1 billion € investment by 2020 to get civil EASA MS fleet >5.7 tonnes MTOW compliant with the current SPI IR in terms of ADS-B equipage (no maintenance and operational costs)
- In addition, there is an industrial capacity issue to meet the 2020 deadline:
  - Only 14% of the current fleet was estimated to be SPI IR compliant regarding ADS-B requirements at the end of 2016<sup>15</sup>
  - approximately 150 aircraft per month to be retrofit with ADS-B before June 2020 : there is a strong concern that industry capacity are not sufficient
- Surveillance datasharing status: while most of the ANSP share data (see below), the purpose for sharing data though is mainly to enhance quality of these data rather than to rationalise radar stations. There are liability issues on data quality and availability between ANSPs which prevent to make a significant ground sensor rationalisation. When the respondents answer to their future expectations<sup>16</sup>, several indicate that data sharing should be improved to be more cost-efficient.
- No significant benefits identified with the current SPI IR (no ground rationalisation, ADS-B applications development are only at an early stage, ...)
- ADS-B stations are not homogeneous deployed in EASA Member States. The WAM deployment contributes to a higher coverage of the reception of the ADS-B signal transmitted by aircraft, however the full coverage of reception of ADS-B signal by the surveillance infrastructure is not complete (at least x MS without such capabilities currently).

In addition, a survey made for the GA fleet estimates that:

- 100% of the IFR aeroplanes are equipped with transponder: 80% with Mode S, 20 % with Mode A/C
- 90% of the VFR aeroplanes are equipped with transponder (VFR flights are not subject to the current SPI IR): 40% with Mode S, 60 % with Mode A/C
- 25% of the sailplane are equipped with transponder (in that case nearly all are Mode S)
- The transponder estimates for the other types of aircraft cannot be provided due to too few answers.
- in terms of Traffic Warning System, very few aeroplanes are equipped in comparison with sailplanes where FLARM is commonly installed in 90% of the sailplanes.
- 40% of the aeroplanes are equipped with GPS, compared to 85% for the sailplanes.

#### Feedback from some FAB activities in terms of infrastructure rationalisation<sup>17</sup>

Blue MED FAB<sup>18</sup> has ongoing harmonisation plans with a technical analysis expected by 2018. One organisation has further (non-FAB) cross-border rationalisation activities ongoing. FABEC's and Baltic FAB's activities show that no further rationalisation would be of benefit. The justification behind that result mainly is due to the fact that the current standard requires to have ADS-B complementary to an independent surveillance source in medium and high density airspace for the reason of its availability. Further rationalisation enroute and in terminal areas is therefore difficult as long as there is no evidence that ADS-B can serve as single surveillance for separation purpose delivering the same safety and capacity.

#### Is data sharing between ANSPs a root cause for the lack of cost efficiency?

For those that admit that no data sharing is in place, the number of overlaps could be reduced and investments could as well be reduced accordingly if they would share data. While the number of ANSP not sharing data is a small minority (2 countries at national level and 5 international cross-borders inside EASA MS based on the survey), the purpose for sharing data though is mainly to enhance quality of these data rather than to rationalise radar stations.

<sup>15</sup> This is in line with the Eurocontrol information that approximately 20% of the IFR flights are with ADS-B equipped aircraft.

<sup>16</sup> EASA Survey "Datasharing" Question Q-4.6.1

<sup>17</sup> Question asked to CANSO in March 2017

<sup>18</sup> Functional Airspace Block



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## 8.2. General aspects

Initial statement: a potential problem has been identified with the lack of cost efficiency in surveillance, due to

- high airborne avionics costs induced by the current SPI IR
- lack of benefit from potential ground rationalisation
- lack of data sharing.

## 8.3. Aircraft avionics

### 8.3.1. Transponder capabilities for the fleet > 5700 kg MTOW under SPI IR

Table 1 - EASA MS Commercial Fleet > 5 700 kg MTOW compliant with SPI IR based on the survey in 2016

Commercial fleet status from EASA Survey				Grand Total	
Current configuration	Current compliance with SPI IR				
	No	Yes	No information		
ADS-B	104	10		114 <sup>(x)</sup>	
ADS-B, EHS, ELS	360	205		565	
ADS-B, ELS		13		13	
EHS, ELS	433	280	154	867	
ELS	7	74		81	
ELS, ADS-B		18		18	
ELS, Mode A/C		11		11	
Mode A/C		4		4	
No information			3	3	
<b>Grand Total</b>	<b>922</b>	<b>597</b>	<b>157</b>	<b>1 676</b>	
Fleet equipped with ADS-B and SPI IR compliant				228	
				14%	
Fleet estimates at EASA MS level					
<b>Total EASA MS fleet in 2017 (Commercial operators)</b>				<b>7313</b>	
Estimated total current fleet with ADS-B and SPI IR compliant (based on 14%)				995	
Estimated new fleet in 2018 & 2019 before SPI IR deadline (2020)*				1 002	
<b>Estimated fleet for ADS-B retrofit</b>				<b>5 316</b>	
Number of months before SPI IR deadline				35	
<b>Estimated number of retrofit aircraft per month</b>				<b>152</b>	

<sup>(x)</sup>This information is partial, an aircraft cannot be currently operated only with ADS-B. It shall be complemented by another transponder.

\* replacement: 296+292 a/c phased out in 2018+2019 and replaced by new ones

\* new a/c due to business growth: + 2.7% increase in fleet per year: (211+203)

There is a an industrial capacity issue to ensure that this fleet will be compliant with the SPI IR by 2020.

### 8.3.2. Compliance costs with SPI IR

The unit costs were provided by IATA in March 2017, after a review of the average unit costs received from the EASA Survey.





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**Table 2 - ADS-B transponder unit cost for large aircraft and business aviation fleet in the scope of SPI IR**

	SPI IR / estimated cost in <b>USD</b> for	
	"new aircraft", i.e. delivered after year 2000, (e.g. CRJ700/900, E170/190, A320fam, 737NG, 787, newer A330, B777-300ER, 747-8, A380, ...)	"old aircraft", i.e. delivered before year 2000 (e.g. 737-300, B767, 747-400, MD11, early A320fam without MMR, 777, A340, ...)
Transponder (2 units) software and/or hardware upgrade	\$25.000	\$25.000
or	or	or
Transponder (2 units) replacement (if existing one is not upgradeable to DOC 260B)	\$70.000	\$70.000
Installation of GNSS (install MMR)	\$0 (GPS already installed)	0 - \$250.000 (\$0 if GPS already installed)
or	or	or
Installation of GPSSU (STC)		\$0 - \$100.000 (\$0 if GPS already installed)
ADS-B fail indication (into TCAS control panel)	\$30.000	\$30.000
or	or	or
ADS-B fail indication (into EFIS)	\$10.000 - \$40.000	\$10.000 - \$80.000
a/c without wiring (e.g. GPS source to transponder (need to install the wire))	\$10.000	\$10.000
Airframer Service Bulletin for ADS-B out (SPI IR) certification package	\$5.000 - \$10.000	\$50.000 - \$100.000
<b>Total estimated unit costs in USD</b>	<b>\$50.000 - \$130.000</b>	<b>\$85.000 - \$500.000</b>
<b>Total estimated unit costs in EUR</b>	<b>€45 500 - €118 300</b>	<b>€77.350 - €455.000</b>

**Important Remarks**

# All transport aircraft delivered from 2017 are compliant already from production (0€ to be accounted for the SPI IR mandate)

# Nearly all European long range aircraft will be compliant by Jan. 1st, 2020 due to the FAA NextGen mandate, which requires a SPI IR compliant configuration (0€ to be accounted for the SPI IR mandate)

These unit cost have been applied to the large aircraft and business aviation in the scope of the SPI IR (CS25 category). The source for the fleet data is the ASCEND data base.





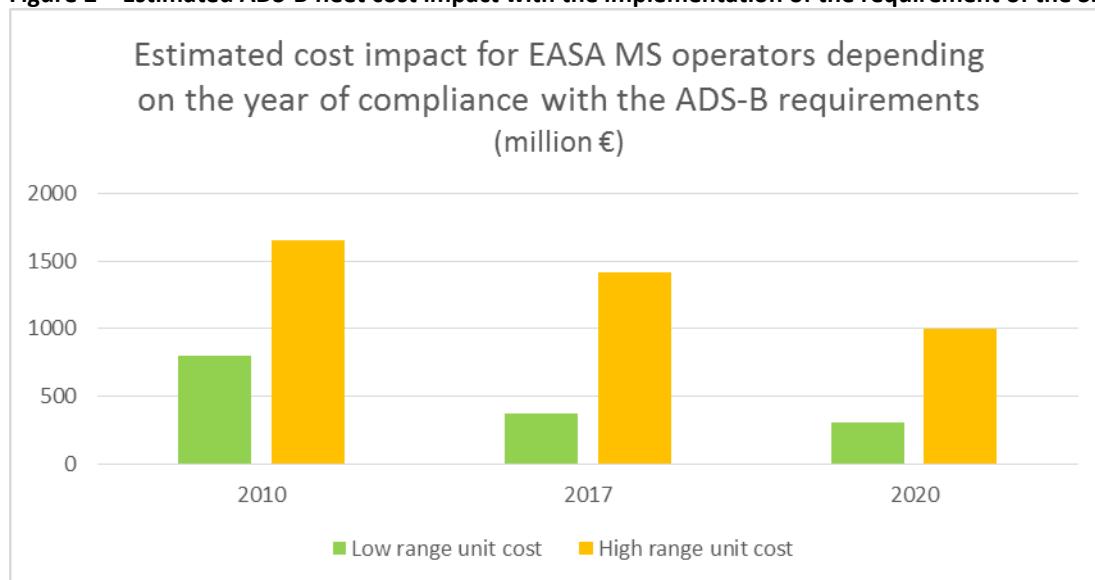
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**Table 3 - Estimated CS-25 fleet cost impact for EASA MS Operators with ADS-B requirements from SPI IR**

Indicator	Year group	Low / high range	2010	2017	2020
<b>Total EASA MS Operator fleet</b>			<b>6 038</b>	<b>7 313</b>	<b>7 933</b>
New aircraft fleet from 2017			n.ap	366	1 542
Existing fleet from 2000 to 2017 and remaining at least operational up to 2024			3 308	5 187	5 187
Fleet before 2000			2 730	1 760	838
<i>Share of the total fleet impacted by the FAA mandate: 20% of the European operators fleet</i>		20%	1 208	1 463	1 587
<b>Total fleet cost (Million €)</b>		<b>low</b>	<b>800</b>	<b>372</b>	<b>301</b>
		<b>high</b>	<b>1 653</b>	<b>1 414</b>	<b>995</b>
New aircraft fleet from 2017			0	0	0
Existing fleet from 2000 to 2017		low	124	236	236
		high	323	614	614
Fleet before 2000		low	676	136	65
		high	1 331	801	381
<i>Fleet costs impacted by the FAA mandate: 20% of the European operators fleet</i>		<i>low</i>	160	74	60
		<i>high</i>	331	283	199

The cost impact varies significantly across the years due to the significant retirement over the years of aircraft build before 2000. If the SPI IR would have required the EASA MS operator fleet to be equipped in 2010, the cost impact would have been from 0.8 to 1.6 billion Euro. It is estimated to be between 0.3 and 0.9 billion Euro in 2020.

Note that approximately 20% of the European fleet cost impacts is “already covered” by the compliance with the FAA mandate on ADS-B.

**Figure 2 – Estimated ADS-B fleet cost impact with the implementation of the requirement of the SPI IR.**



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## 8.3.3. General Aviation fleet

### 8.3.3.1 GA fleet based on EASA Survey 2016

EASA received 375 answers for the GA fleet survey sent end of 2016, representing a fleet of 1000 aircraft. It has been compared to a previous IAOPA survey where several similarities have been identified when the questions were comparable. However it is important to note that both surveys provide indications due to the low answer rate. These indications are considered being the best of what is currently available.

Figure 3 - GA fleet per type of aircraft and per Member State based on responses

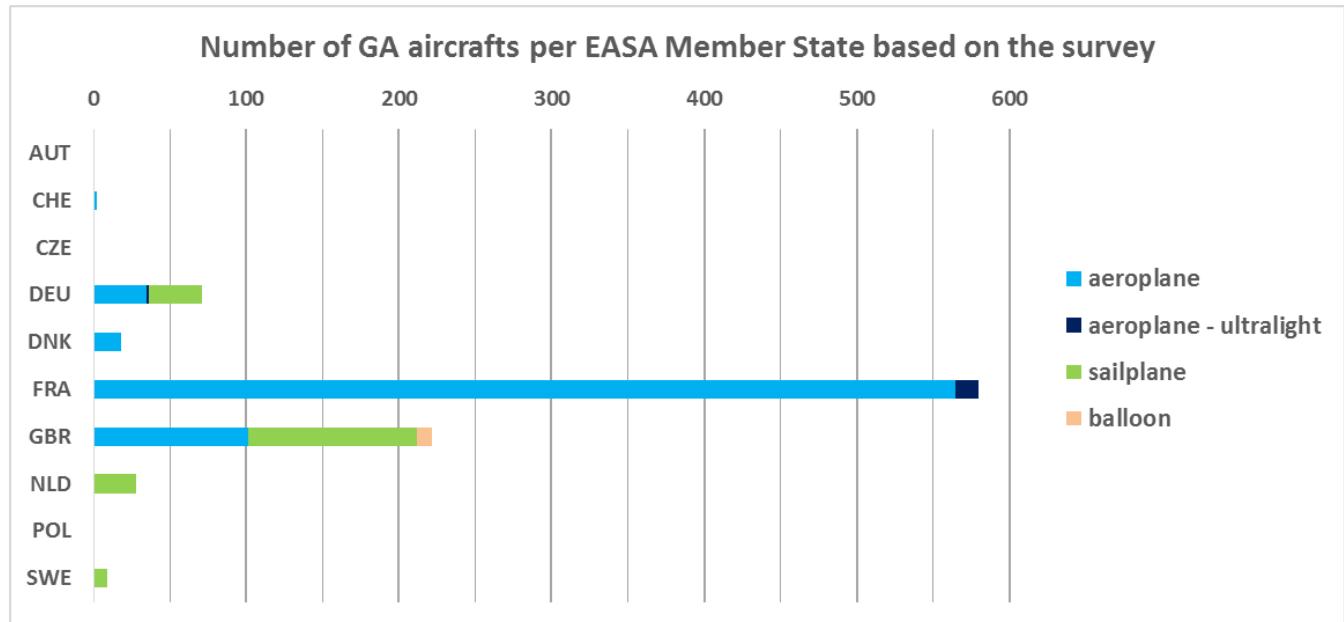
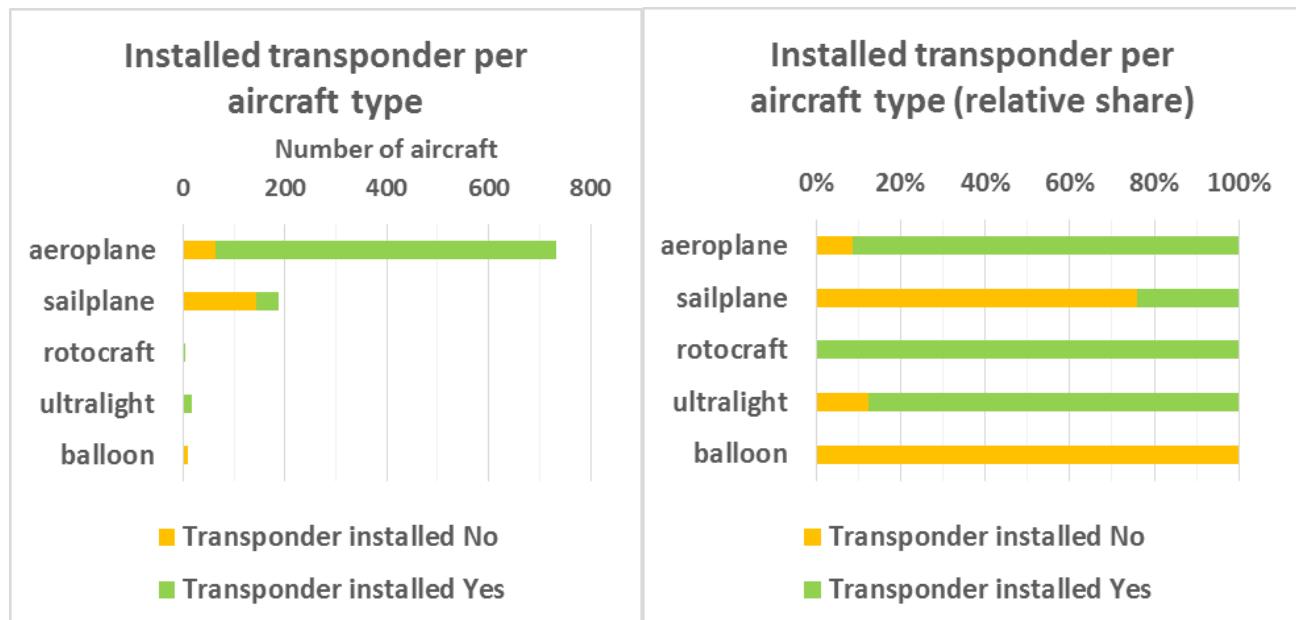


Figure 4 – Set of charts to give an overview of the GA answers.

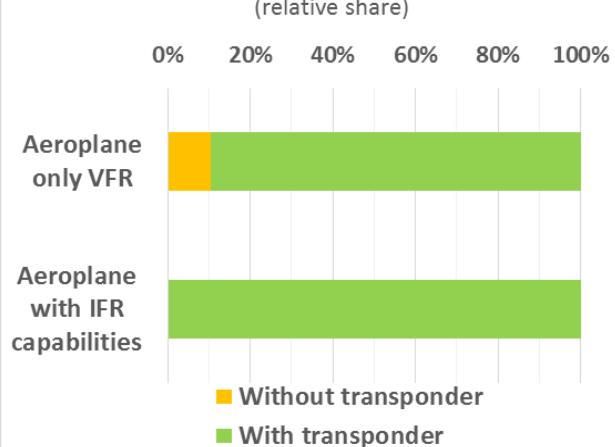




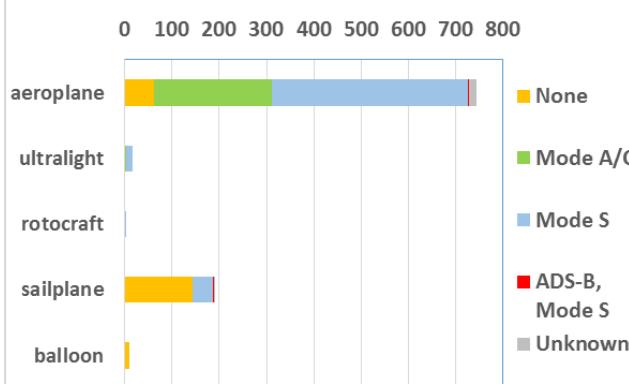
## Installed transponder on aeroplane and according IFR flight capabilities



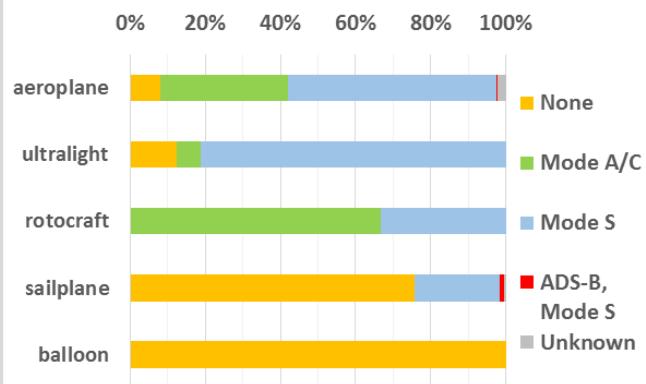
## Installed transponder on aeroplane and according IFR flight capabilities (relative share)



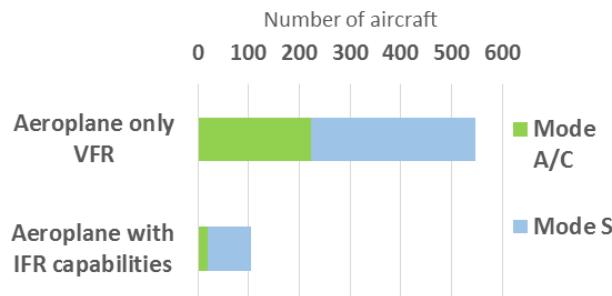
## Type of transponder per aircraft type



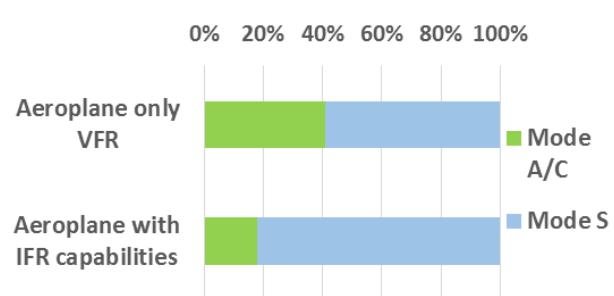
## Type of transponder per aircraft type



## Transponder type for aeroplane, flying VFR versus IFR

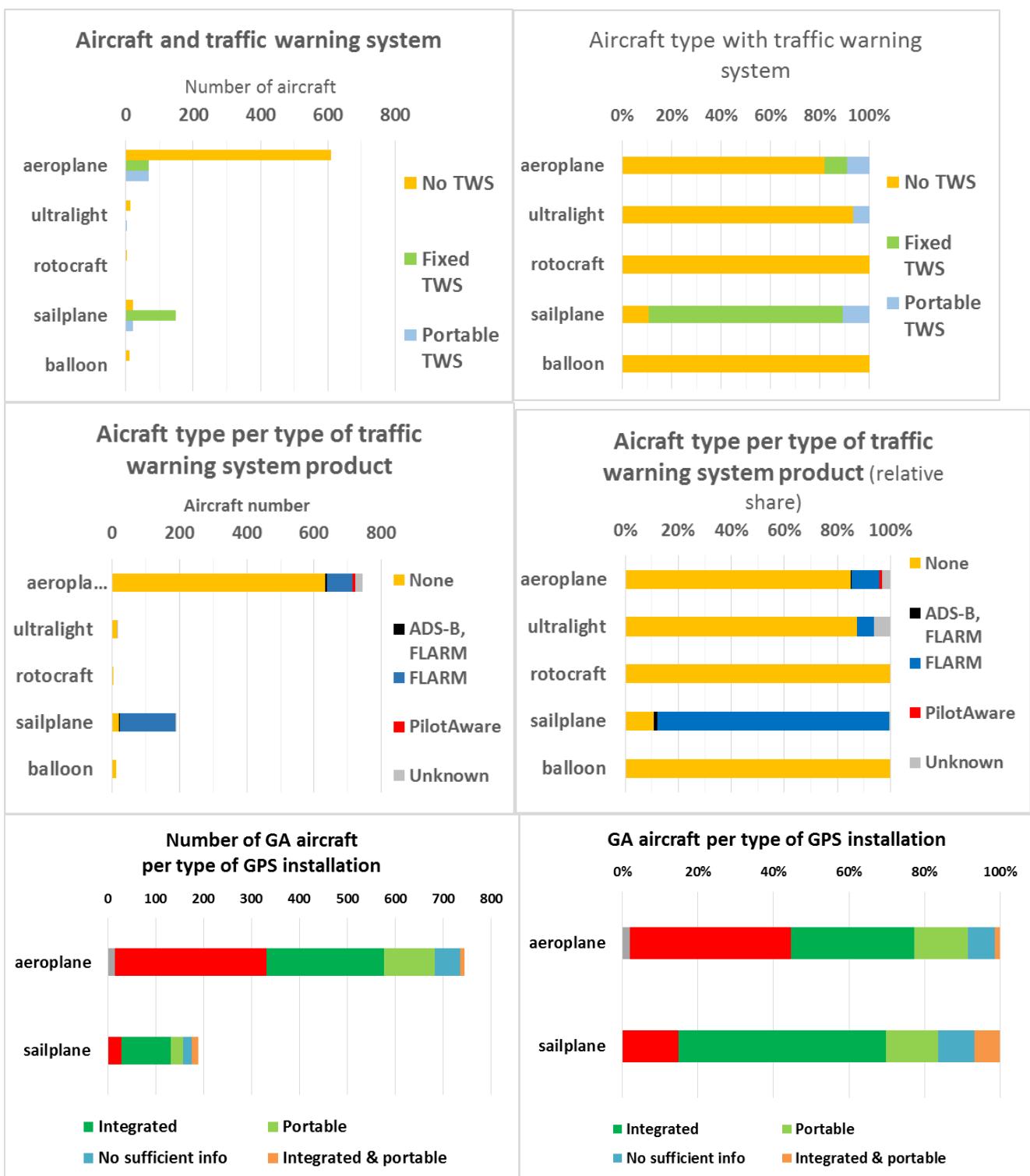


## Transponder type for aeroplane, flying VFR versus IFR (relative share)



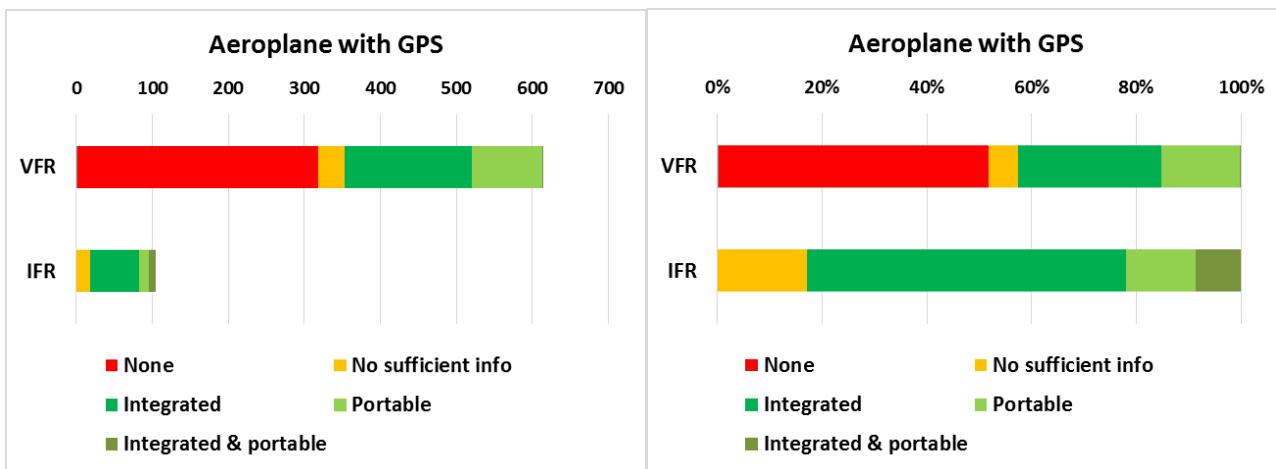


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Conclusion for the fleet equipage:

- 100% of the IFR aeroplanes are equipped with transponder: 80% with Mode S, 20 % with Mode A/C
- 90% of the VFR aeroplanes are equipped with transponder (VFR flights are not subject to the current SPI IR): 40% with Mode S, 60 % with Mode A/C
- 25% of the sailplane are equipped with transponder (in that case nearly all are Mode S)
- The transponder estimates for the other types of aircraft cannot be provided due to too few answers.
- in terms of Traffic Warning System, very few aeroplanes are equipped in comparison with sailplanes where FLARM is commonly installed in 90% of the sailplanes.
- 40% of the aeroplanes are equipped with GPS, compared to 85% for the sailplanes.

The ADS-B unit for GA aviation were estimated by GAMA. GAMA provided different types of cost configuration, however due to the lack of accuracy on the type of existing transponder and GPS configuration in EASA MS, it was decided to use the following averages for new and existing GA aircraft:

**Table 4 - ADS-B transponder + installation unit costs (€)**

	Total unit cost	Equipment	Installation
New aircraft	926	463	463
Retrofit aircraft	5 556	2 778	2 778

The estimated GA fleet was estimated from various sources. These values are providing an order of magnitude.

**Table 5 - GA fleet estimates in 2016**

A/C type	VFR fleet	IFR fleet	Total fleet
GA FW	27 000	18 000	40 000
GA Rotorcraft	4 200	2 800	5 000
Sailplanes	25 000	0	25 000
Microlight	20 000	0	20 000
Balloons	6 000	0	6 000
Gyroplanes	1 000	0	1 000
<b>Total fleet</b>	<b>83 200</b>	<b>20 800</b>	<b>104 000</b>

The following table estimates the total costs for the GA fleet flying in class E and above.





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### 8.4. Ground surveillance

#### 8.4.1. Ground surveillance assets

Note:

\*further details per ANSP and radar location in appendix 0.

\*Space-based ADS-B is not considered in the following information due to lack of information. However ENAV (Italy) indicated that there are additional studies in 2017 to take a decision on the choice between space-based ADS-B and ground ADS-B stations deployment.





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Table 6 – Civil and military ground surveillance systems per country in 2017 in EASA Member States (source: EASA survey)

EASA MS	PSR Stand alone			PSR with mode AC			PSR with mode S			Mode AC			Mode S			WAM civil	ADS-B civil	Grand Total		
	civil	mil	Total	civil	mil	Total	civil	mil	Total	civil	mil	Total	civil	mil	Total	civil	mil	Total		
AUT	10	10	20	2	2	4	18	18	35	5	5	10	3	19	22	68		78	47	125
BEL	1	1	2	4	2	6	3	1	4	6	2	8						15	6	21
BGR	1	9	10	3	8	11	3	11	14	4	9	13	3	23	26	33		47	60	107
CHE	2	2	7	7	7	7				7	7	7	7	7	7			9	21	30
CYP			1	2	3	1			1	1	2	3	3	3	3		3	9	4	13
CZE	3	14	17	4	4	8	1	2	3	5	5	10	3	2	5	28	3	38	27	65
DEU			11	11	22	10	35	45	15	11	26	15	35	50	34	1	86	92	178	
DNK			2		2	1			1	5	5	1	1	2	30	22	61	1	62	
ESP			4	4	8	3			3	13	4	17	17	17	8	1	46	8	54	
EST										2	2		4	4	4	24		26	4	30
FIN	4	4								11		11		18	18	131		146	18	164
FRA	7	7		54	54		3	3	6	1	54	55	29	3	32	88	14	142	114	256
GBR	8	25	33			20			20				43	17	60	16		87	42	129
GRC			7		7					13		13						20	0	20
HRV			1		1		5		5				4	5	9			5	10	15
HUN	23	23		2	2	4	3	7		3	3	3	4	3	7			8	34	42
IRL			3		3	1		1		4		4	6	6				14	0	14
ISL										6		6					8	14	0	14
ITA*			1	8	9	26	21	47	2	8	10	28	21	49		16	73	58	131	
LTU						3			3			3	2	5			6	2	8	
LUX						1		1		1		1	1	1			3	0	3	
LVA			1	1	2	2	3	5	1		1	1	3	3			7	4	11	
MLT			2		2				4		4	2		2			8	0	8	
NLD			2		2	1	5	6	1		1	2	5	7	55		59	12	71	
NOR	3	3	18	19	1	2	3	15	18	33	9	1	10	72	5	106	39	145		
POL			3		3	4		4	8		8	4	3	7	9		28	3	31	
PRT						1		1	7		7	3	3	3	82		89	4	93	
ROU						1		1	2		2	6	6	6	37		46	0	46	
SVK	2	2				1		1				4		4		1	8	0	8	
SVN			1		1	1	2	3	1		1	3	2	5			6	4	10	
SWE*	0		1	0	1	1	0	1	12	0	12	1	0	1	61		76	0	76	
<b>Total</b>	<b>31</b>	<b>81</b>	<b>112</b>	<b>45</b>	<b>122</b>	<b>167</b>	<b>93</b>	<b>120</b>	<b>213</b>	<b>137</b>	<b>122</b>	<b>259</b>	<b>210</b>	<b>169</b>	<b>379</b>	<b>776</b>	<b>58</b>	<b>1366</b>	<b>614</b>	<b>1980</b>





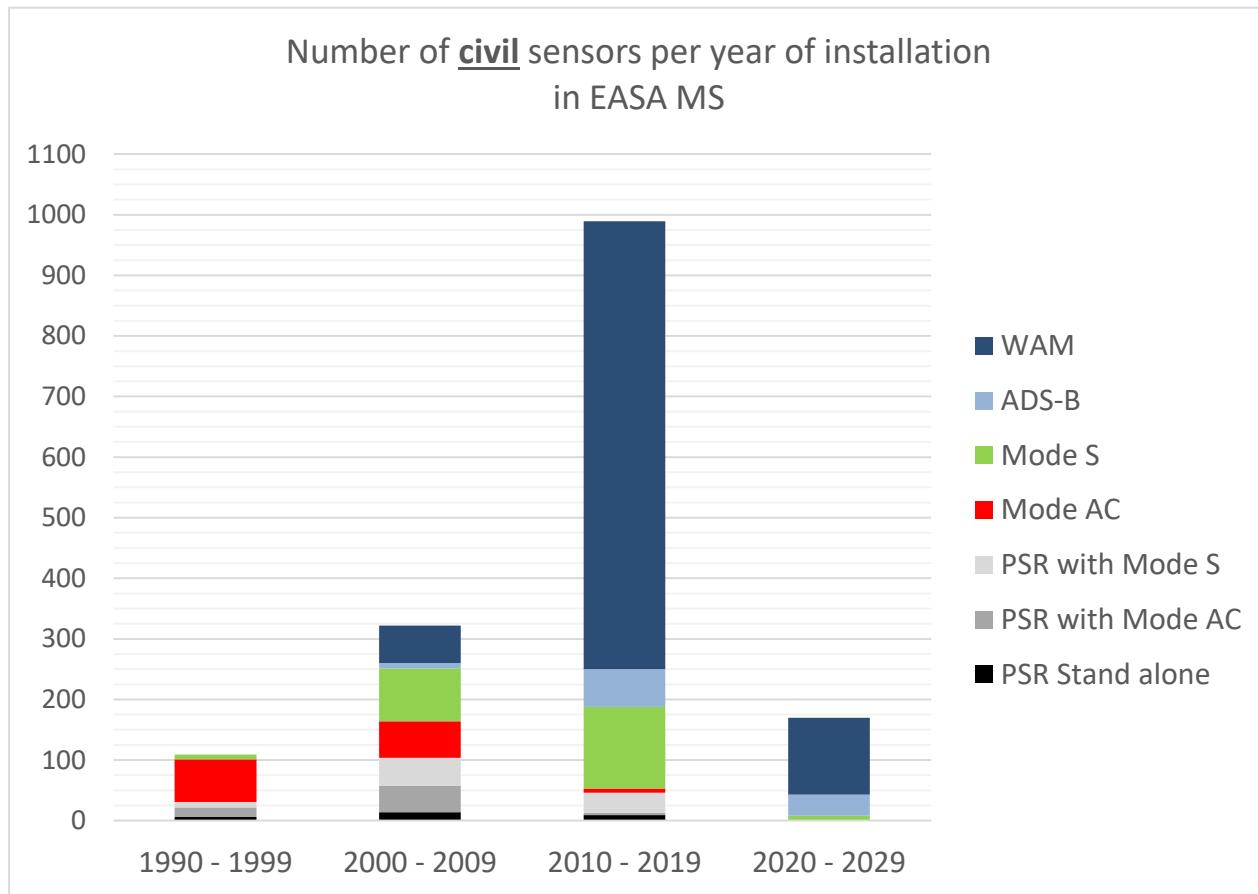
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**Note:**

\*Swedish Military uses the civil infrastructure.

\*Italy is implementing Space Based ADS-B (test in progress)

Figure 5 - Number of civil sensor per year of installation in EASA MS

**Conclusion**

There are approximately 2000 sensors in 2017 in EASA Member States, 2/3 are civil and 1/3 are military.

Regarding civil sensors:

- WAM sensors represent more than 50% of the civil sensors in 2017 and will continue to account for the main type of sensors to be installed in the next decade;
- ADS-B sensors are being installed, however this level of implementation is not sufficient for an independent surveillance layer;
- Mode A/C has been progressively replaced by Mode S, no more Mode A/C are installed in the next decade.

Regarding military sensors, confidentiality prevent to disclose more information.

## 8.4.2. Ground surveillance maps

Source: EASA, report prepared by ALG-ALPAC (2017)





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Figure 6 - Current sensors locations in 2017 in EASA MS



Yellow: Mode S Red: Mode A/C Blue: WAM Green: ADS-B

Stakeholder	Sensor type	Systems	Sensors
<input checked="" type="checkbox"/> Civil	<input type="checkbox"/> PSR	16	16
<input type="checkbox"/> Military	<input checked="" type="checkbox"/> SSR Mode A/C	84	84
Usage	<input checked="" type="checkbox"/> SSR Mode S	123	123
<input type="checkbox"/> APP	<input checked="" type="checkbox"/> ADS-B	69	69
<input checked="" type="checkbox"/> ENR	<input checked="" type="checkbox"/> WAM (Mountain)	73	657
<input checked="" type="checkbox"/> APP/ENR	<input type="checkbox"/> WAM (TMAs)	0	0
<b>Total</b>		<b>365</b>	<b>949</b>



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Figure 7 - ADS-B stations (Red) and WAM systems (green) planned by 2025 in EASA MS

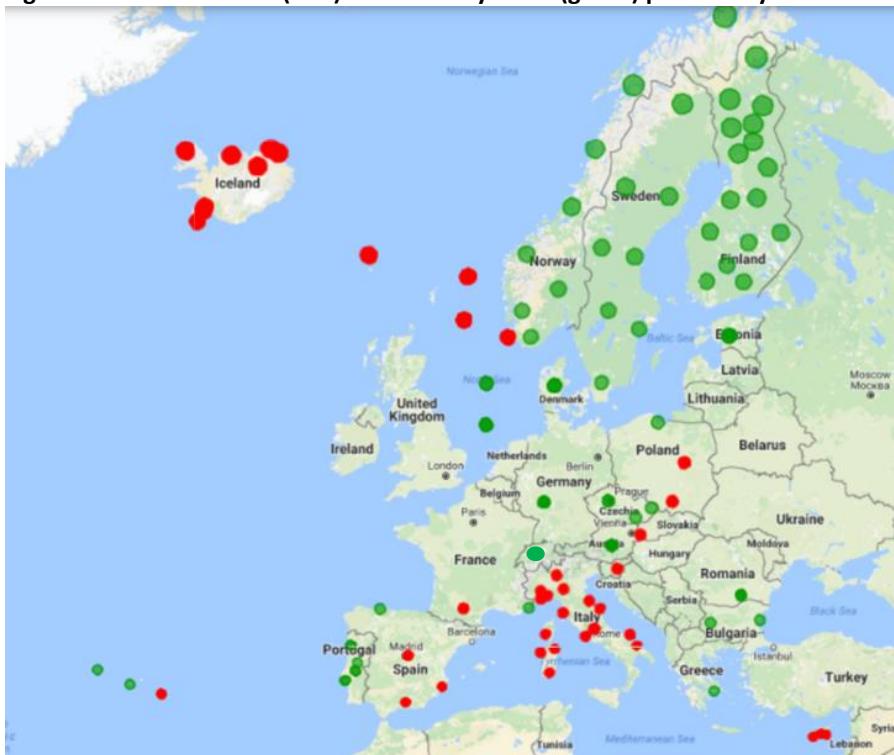
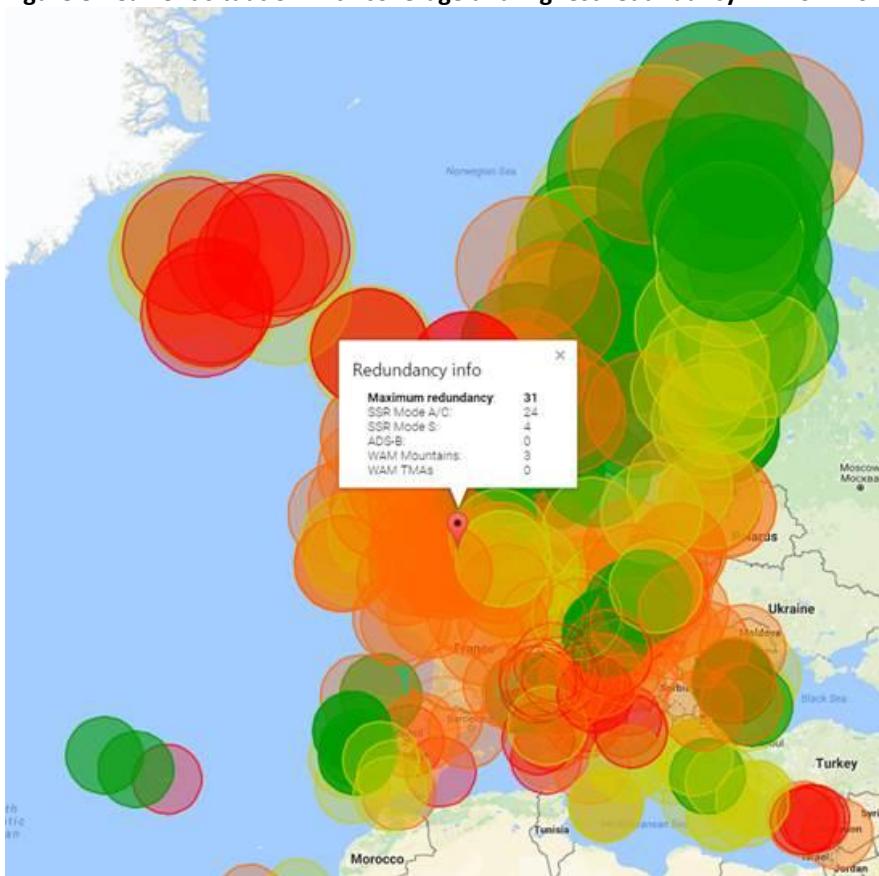


Figure 8 - Current situation with coverage and highest redundancy in EASA MS





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Figure 9 – Surveillance coverage (in green) at world level





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### 8.4.3. Civil ground surveillance costs (€)

Table 7 - Estimates for the total financial value of the civil ground surveillance infrastructure in EASA Member States - Situation in 2017 (Source: EASA survey)

Type of sensor	Number of sensors	One-off costs per sensor (€)	Total one-off costs (€)	Operational costs per sensor (€)	Lifetime	Total operational costs	Total life-cycle costs (LCC)	Global life cycle cost per year (€)	LCC per type of sensor and per year (€)
PSR	31	3 737 386	115 858 976	221 615	23	158 011 495	273 870 471	11 907 412	384 110
PSR with Mode A/C	45	2 681 307	120 658 808	221 615	21	209 426 175	330 084 983	15 718 333	349 296
PSR with Mode S	93	2 681 307	249 361 536	221 615	21	432 814 095	682 175 631	32 484 554	349 296
Mode AC	137	1 580 960	216 591 520	169 943	21	488 926 011	705 517 531	33 596 073	245 227
Mode S	210	1 868 693	392 425 564	178 965	20	751 653 000	1 144 078 564	57 203 928	272 400
ADS-B	74	75 500	5 587 000	40 562	15	45 023 820	50 610 820	3 374 055	45 595
WAM	776	119 853	93 005 928	15 731	15	183 108 840	276 114 768	18 407 651	23 721
<b>Total</b>	<b>1 366</b>		<b>1 193 489 332</b>			<b>2 268 963 436</b>	<b>3 462 452 768</b>	<b>172 692 005</b>	
Total related to PSR			485 879 320			800 251 765	1 286 131 085		
Total related to Mode A/C and Mode S			609 017 084			1 240 579 011	1 849 596 095		
Total related to ADS-B & WAM			98 592 928			228 132 660	326 725 588		
<b>Relative share</b>									
PSR			41%			35%	37%		
Mode A/C + Mode S			51%			55%	53%		
ADS-B & WAM			8%			10%	9%		

Note:

\*one-off costs for PSR with Mode A/C or Mode S are based on 4 500 000€ for the complete package PSR+Mode S minus Mode S radar cost;

\*cost related to Space-Based ADS-B is not estimated due to lack of information.





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### 8.4.4. Surveillance in the en-route charges and airspace user expectations

According to the Performance Review Board<sup>19</sup> (PRB) information, it is estimated that surveillance equipment account for 5% of the en-route charges, approximately forecast 405M€ in 2017<sup>20</sup>.

Scope: EASA MS	Million Euro
ANSPs global revenues	8019
ANSPs surveillance costs	405
Relative share	5%

Source: see footnote

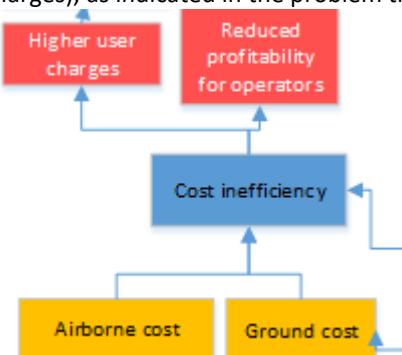
Reminder from the previous section:

- The annual life cycle costs estimated for surveillance infrastructure are approximately 170 M€, half of the surveillance costs from PRB information ;
- About 50% of these 170M€ are related to Secondary Surveillance Radars (SSR) equipment.

The PRB surveillance costs may consider other items than the ones in the scope of the EASA survey. At this stage of the analysis, it was not possible to get further details.

#### Conclusion on airspace user expectation regarding en-route charges

Airspace users consider that the ground cost inefficiency in the current situation results in higher user charges (e.g. enroute charges), as indicated in the problem tree:



Airspace users expect that surveillance rationalisation through the implementation of ADS-B and the partial removal of SSR (problem tree analysis) will decrease the route charges. Even in the case that further SSR rationalisation with ADS-B could decrease the share of SSR in the total surveillance costs, it would take a long time before to get a significant reduction of the related route charges. However, from the data above, enroute charges are in fact slightly impacted by surveillance equipment costs (5% overall).

As a consequence airspace users may have too high expectations regarding future route charges decrease based on SSR rationalisation.

#### Consequence for the problem tree:

The link between cost inefficiency and "higher user charges" should be removed because it is not significant.

<sup>19</sup> [https://webgate.ec.europa.eu/eusinglesky/content/welcome\\_en](https://webgate.ec.europa.eu/eusinglesky/content/welcome_en)

<sup>20</sup> Forecast for 2017 based on information from the Enlarged Committee for Route Charges report from 2015 (CER-105-2015-3552, ITEM 2, 10.12.15)





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## 9. Surveillance datasharing between ANSPs

Source: online survey part A: <https://ec.europa.eu/eusurvey/runner/SPI-ANSP-Datasharing>

### 9.1. Main outcomes

#### 9.1.1. Conclusions for the problem definition

Basis: 41 respondents (see section above 7.4).

The current overlap of cooperative SUR sensors serves to enhance data quality, continuity and/or availability while the overlap of non-cooperative SUR sensors mainly serves to detect non-equipped aircraft or help detecting and mitigating transponder failures.

Data sharing is currently done, mostly for reasons of cost saving, interest and to enhance quality. Within a country it is done based on commercial transactions, with neighbours and MIL rather not. However concerns exist with regard to data quality and availability.

##### Size of the problem:

- Datasharing is in place between civil ANSPs
  - Transaction cost within ANSPs of the same country
  - no transaction cost between countriesNote: no transaction cost with MIL ANSPs
- Issue with availability of data: data are shared but there is not enough confidence in their availability → issue is the level of usage of these data
- there are benefits, albeit their size in terms of EUR is hardly provided
- the potential to rationalise infrastructure due to higher use of shared data in the given environment is however not visible

**The answers did not provide evidence that more enforcement would provide additional benefits. Their contribution to the problem of “cost inefficiency” is low. However existing deficiencies should be eliminated, which mainly lie within the quality of the data and legal constraints with regard to MIL.**

**Data sharing problems do not contribute to the problem “lack of interoperability”.**

The following table indicates how significantly are the data sharing issues linked to the identified problem areas :

**Table 8- Surveillance data sharing conclusions for the problem definition**

Problem area	Conclusions
lack of surveillance performance and functionality targets	Data sharing is not a contributor for this problem
lack of sustainability of spectrum congestion	Limited, it depends if the data could be really operationally used or only used in case of back-up solutions
lack of cost efficiency with the surveillance equipment	Limited, however there seems to be a potential if the shared data would be more operationally used
lack of interoperability between surveillance system	Data sharing is not a contributor for this problem
lack of security of data transmitted	Few respondents mentioned security problem

#### 9.1.2. Global analysis to support the conclusions

##### 9.1.2.1 Conclusion on scale of data sharing problem between civil and MIL

- A strong majority of the respondents share data between civil and MIL ANSPs (reminder, only 5 Mil ANSP answers, most of them are civil ANSPs answers):
  - 50% of the civil respondents indicate they “only” provide surveillance data



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- 50% of the civil respondents indicate they provide **and** received surveillance data
- Due to the lack of Military ANSPs answers, Military ANSPs were asked to answer to a simplified question in another survey: 13 out of 19 Military ANSPs indicated that they share data with their civil ANSP.
- They seemingly make use of them for a number of technical reasons:
  - lack of coverage
  - an ANSP is interested by these data
  - to ensure redundancy
  - enhance data quality for controllers
- ASTERIX is commonly used by all these respondents.
- However, a majority of civil respondents have also identified constraints to receive data from MIL:
  - legal/confidentiality issues
  - lack of confidence in the data quality and availability.
- A limited number of civil ANSPs do not share data with MIL ANSPs because of legal/confidentiality issues or lack of confidence in the data quality and availability.

### 9.1.2.2 Conclusion on scale of data sharing problem between civil ANSPs (same country)

- This question is not applicable to 43% of civil ANSPs responses because there is only one civil ANSP in a country. In addition, in some cases other service providers like AFIS do not require surveillance data.
- For the rest of the respondents, half of them do not share data. Those who share data do it basically to comply with EUROCONTROL standards.
- ASTERIX is commonly used by all these respondents.
- Sharing data is based on commercial agreements with a range of cost from approximately 100 000 € to 300 000 € per year. It avoids the ANSPs investing in the corresponding surveillance infrastructure and its maintenance.
- Half of the respondents sharing data have identified constraints as follow:
  - lack of control on equipment downtime
  - lack of possibility to use data with anyone due to confidentiality constraints
  - For limited instances (e.g. case of a country with several ANSPs):
    - lack of data quality when the supplier is in a monopoly situation
    - cost of the service when the supplier is in a monopoly situation
- For the respondents who do not share data, the main reason is that the own coverage is sufficient.

### 9.1.2.3 Conclusion on scale of data sharing problem between ANSPs at European level

- All the civil respondents share data with other countries.
- From the 5 MIL responses in the data sharing survey, 2 MIL ANSPs are also sharing data with foreign civil ANSPs, while 2 MIL ANSPs are not sharing data at an European level and one MIL ANSP indicated sharing data however without providing details.
- However, few ANSPs share data with only **some** of their neighbouring countries. This is apparently mainly the case in central Eastern Europe.
- ASTERIX is commonly used by all these respondents.
- The main reasons for data sharing are:
  - “Another ANSP is interested in our data”
  - “Our own coverage is insufficient”
  - Followed by:
    - ensure redundancy
    - ensure multi radar tracking or enhancing data from several sources
- The agreement to share data is mainly based on providing and receiving data for free.
- When a commercial agreement is in place, the average price seems to be 50 k€ per year and per radar.
- Data sharing may avoid the need for significant investment: from 1 to 4M€ per radar.
- 31% of the respondents identified constraints with data sharing. The main reason not to share data is because the own coverage is sufficient (which is not a constraint). The second main reason is the cost to share data (in that case i.e. to receive data).





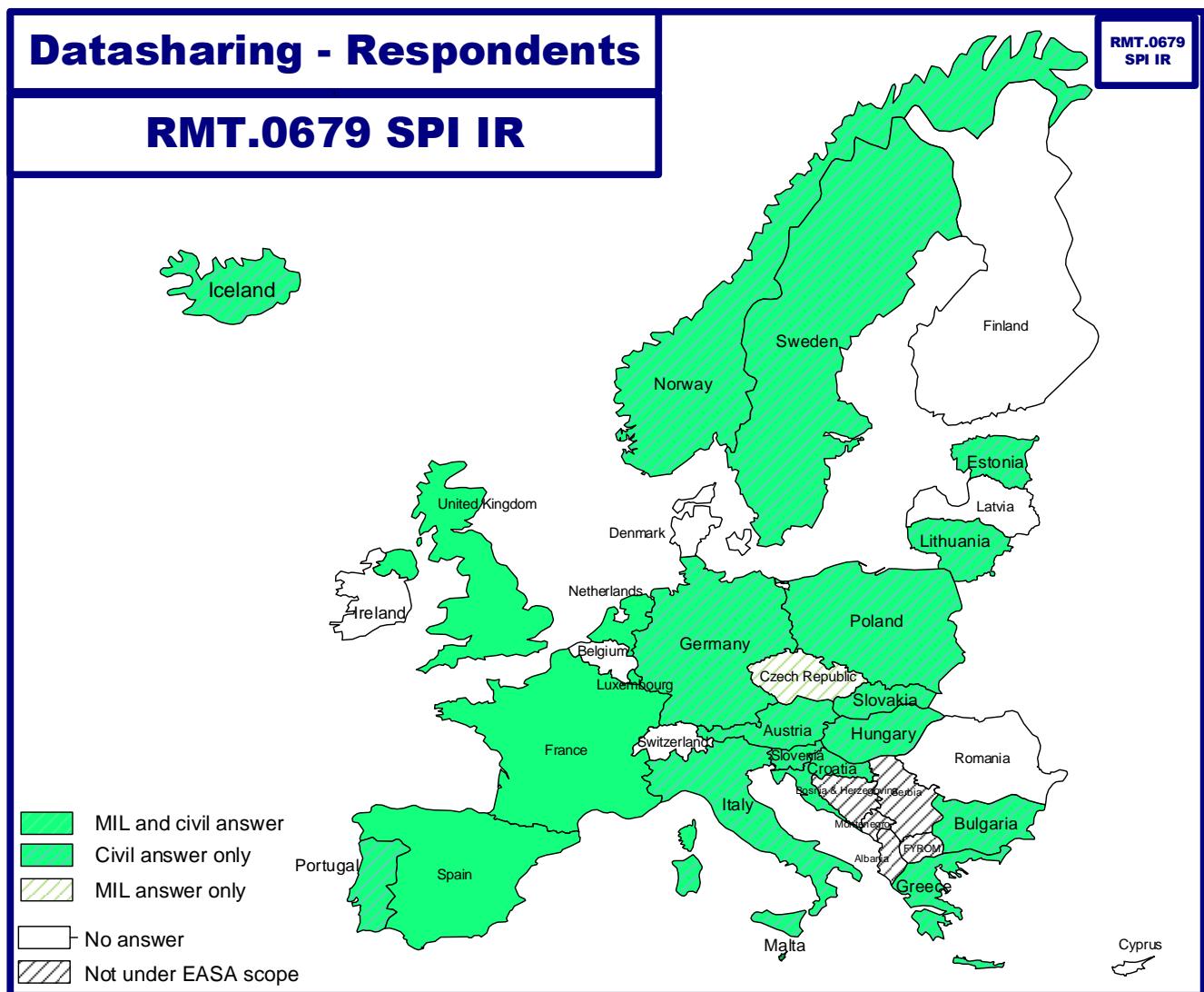
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## 9.1.2.4 Conclusion on scale of data sharing problem with other entities than ANSPs

Approximately half of the respondents indicated that they share data with entities other than ANSPs. These are airports in the vast majority of the cases. A few answers mention the sharing of data to support noise level assessment.

The details are in the following sub-sections.

## 9.2. Overview on received answers





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## 9.3. Surveillance layers that overlap in coverage within your ANSP area of responsibility

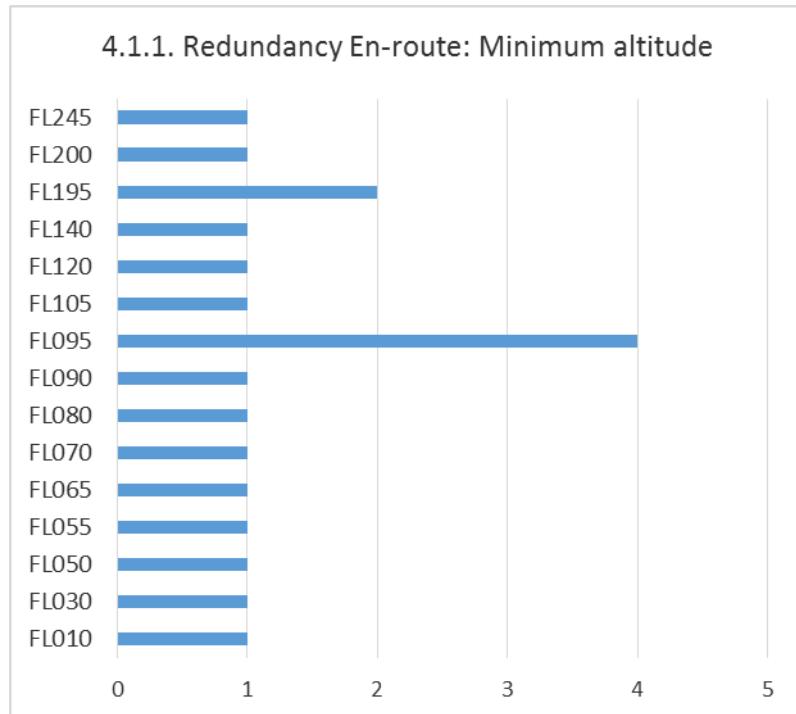
### 9.3.1. Summary per question

#### Q-4.1.1 What is your current surveillance redundancy by airspace (including buffer zones)?

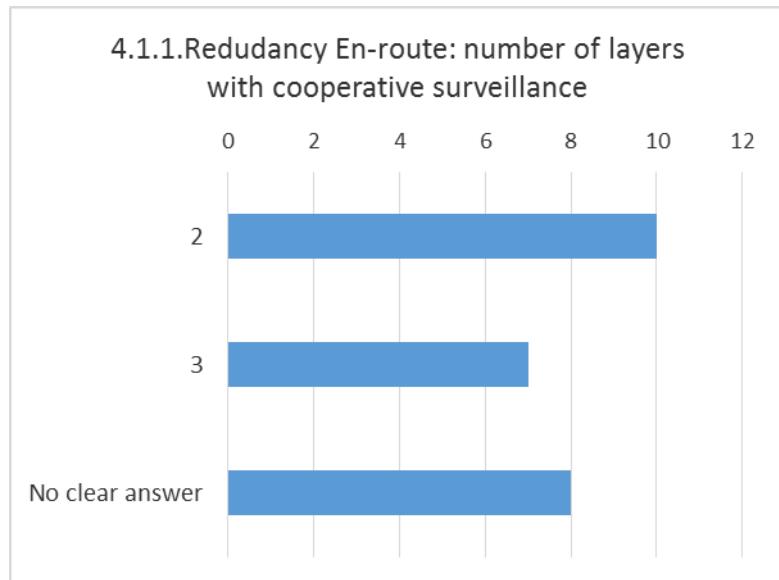
It was very difficult to assess the responses due to the question 4.1.1. being not enough clear and understood. Therefore it was only possible to create 2 graphs: one on the minimum altitude for en-route redundancy and one on the number of cooperative surveillance layers during en-route.

The following graphs show the number of answers:

Basis: 23 answers



Basis: 25 answers

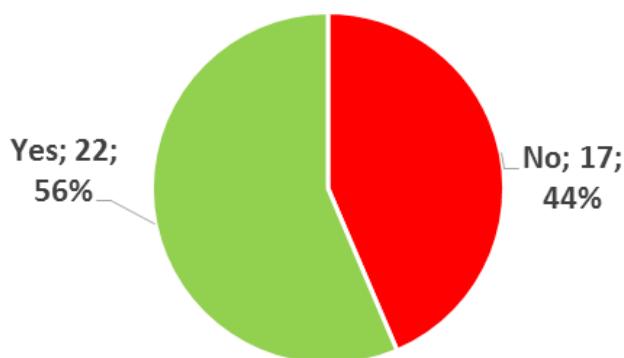


**Q-4.1.2 & Q-4.1.3**

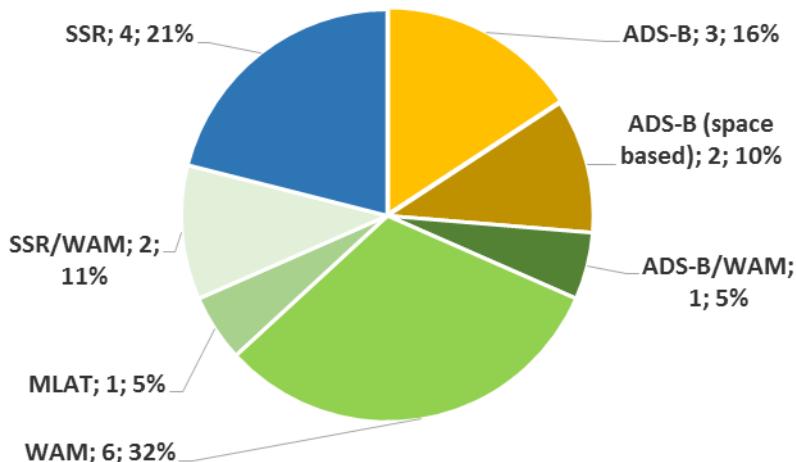
Summary not possible due to question not enough clear and understood.

**Q-4.1.4 Do you plan any changes to the current number of surveillance layers, type of ground surveillance systems and applications?**

4.1.4. Any plans to change the current surveillance infrastructure?  
(Based on number of answers)

**Q-4.1.5. Foreseen surveillance infrastructure changes (SSR related / Other)**

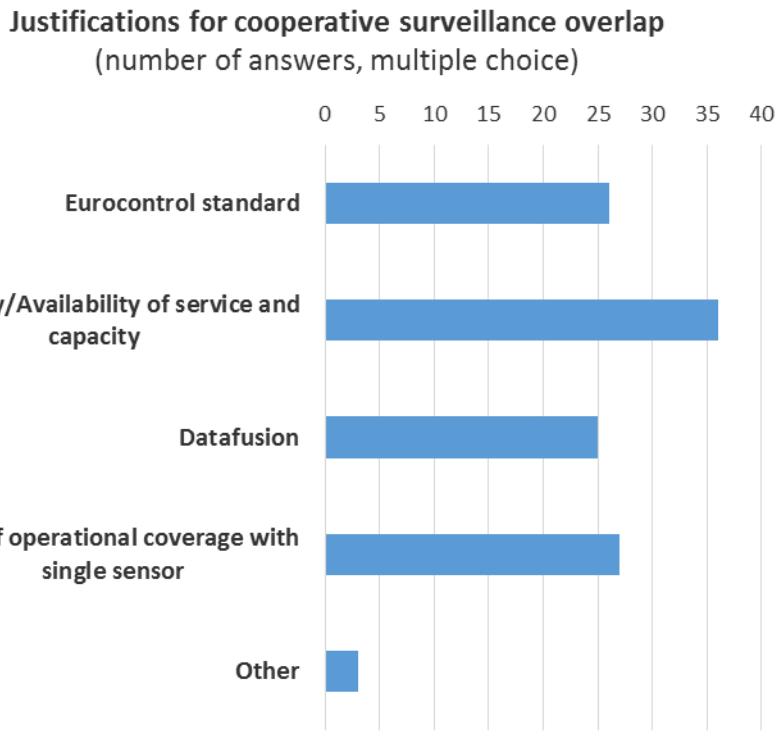
Type of future changes  
(based on number of answers)



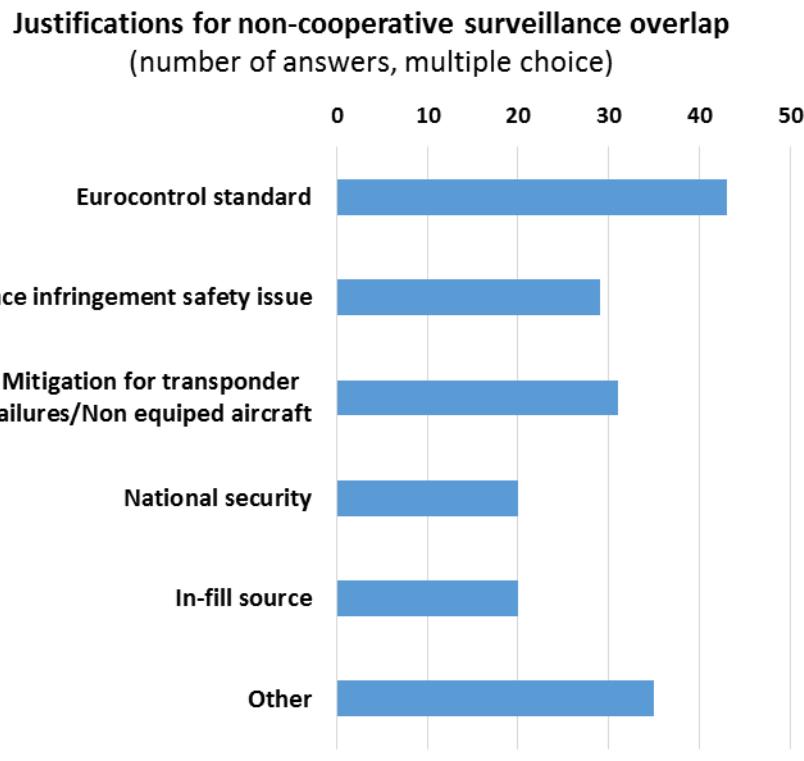


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### Q-4.1.6 What are the reasons and the purpose of having cooperative surveillance overlap?



### Q-4.1.8 What are the reasons and the purpose of having non-cooperative surveillance overlap?





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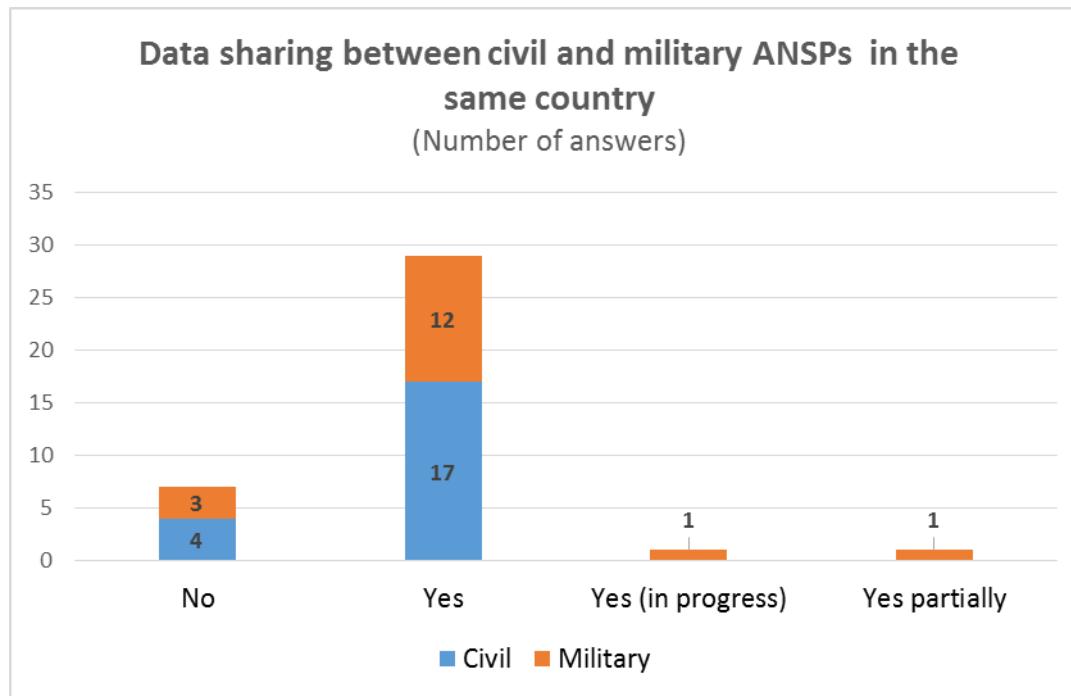
### 9.4. Current situation - Surveillance data sharing within your country between civil ANSPs and the military

#### 9.4.1. Summary per question

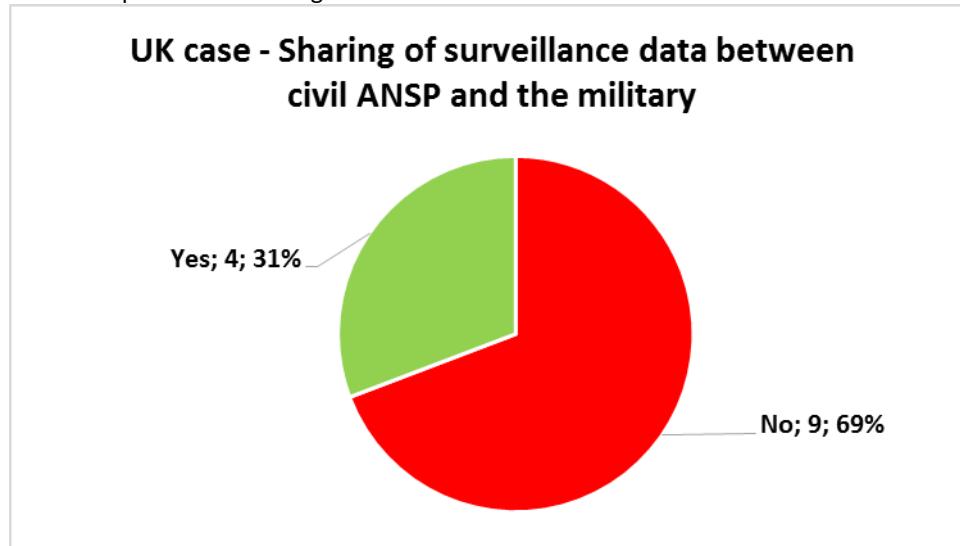
##### Q-4.2.1 Does your civil ANSP and the military share surveillance data?

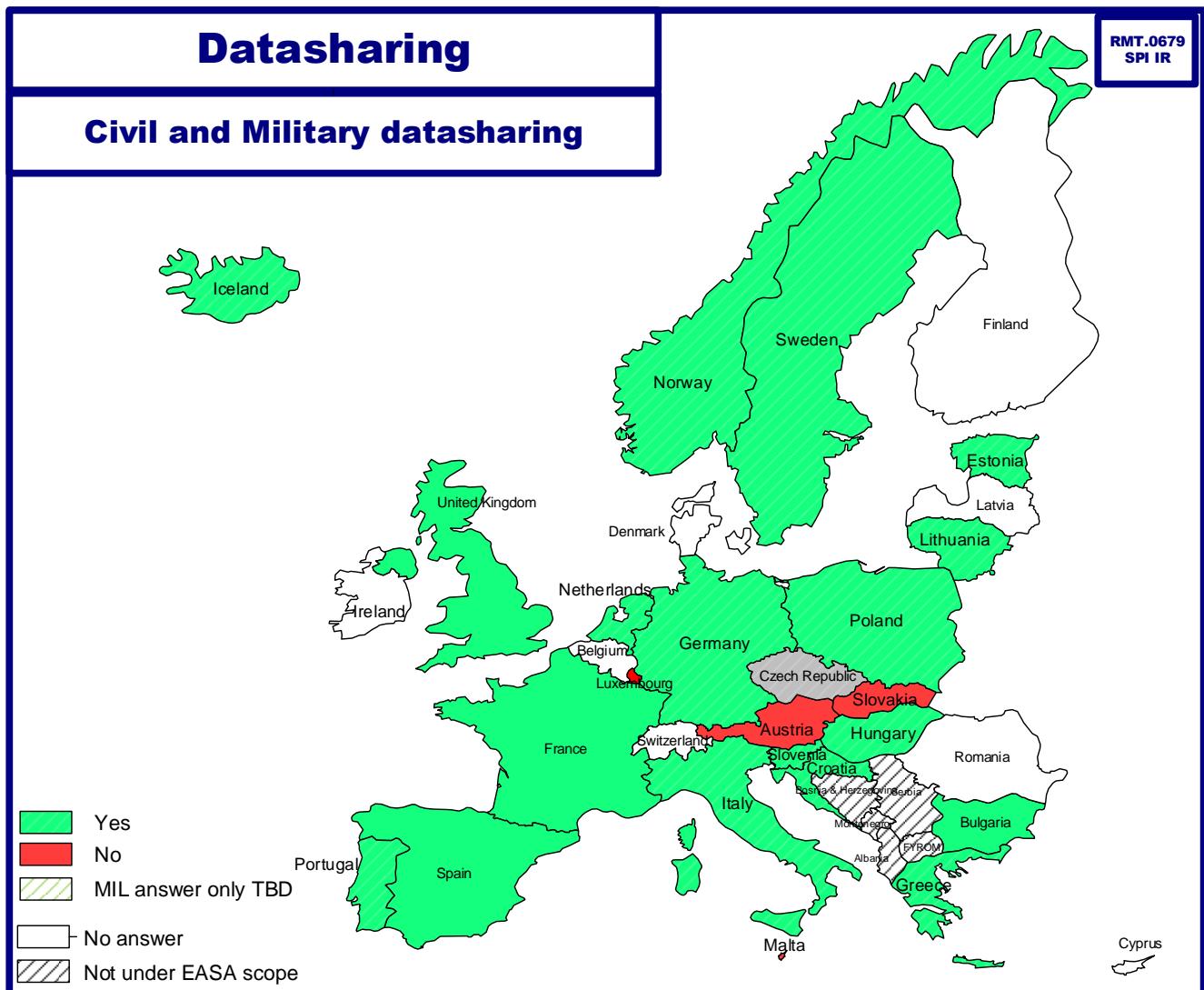
Note:

- Due the specific case of the high number of ANSPs in UK, they are not included in the following figure.
- Due to the low number of answer to the data sharing survey, the question Q-4.2.1 was again addressed in another survey: this enabled to get 14 additional answers.
- The following figure includes the 5 military answers from the data sharing survey and these 14 additional answers.



UK case is provided in this figure.





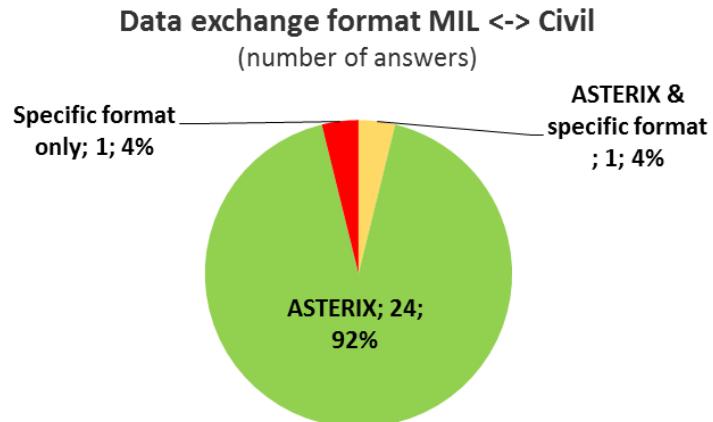
There are 26 respondents who indicated that civil and military ANSPs share data. This is the basis for the analysis of the following questions.



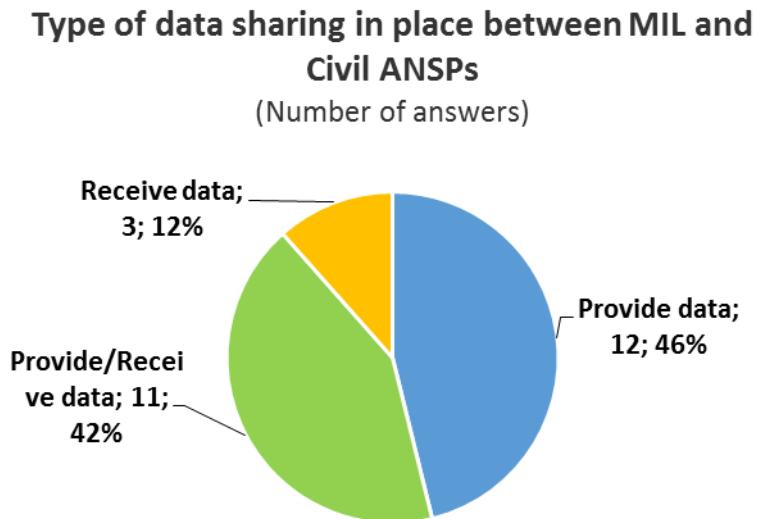


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### Q-4.2.2 What format do you use for data exchange? (e.g. ASTERIX)

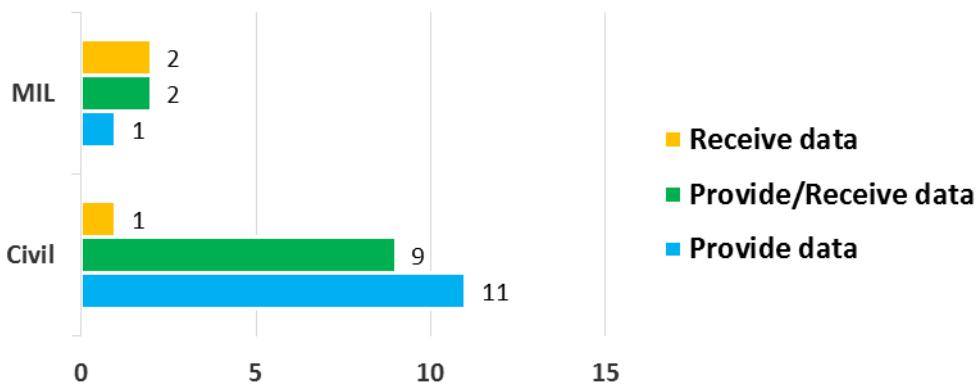


### Q-4.2.3 What is the type of sharing in place?



### Type of datasharing per type of ANSP (civil or military)

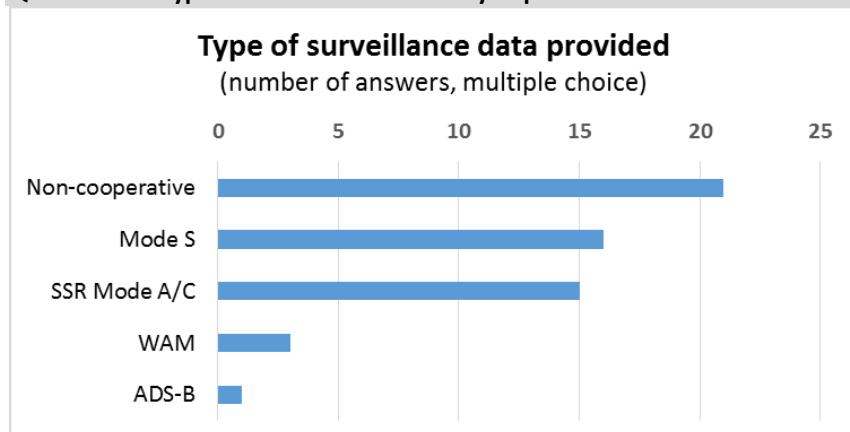
(Number of answers)



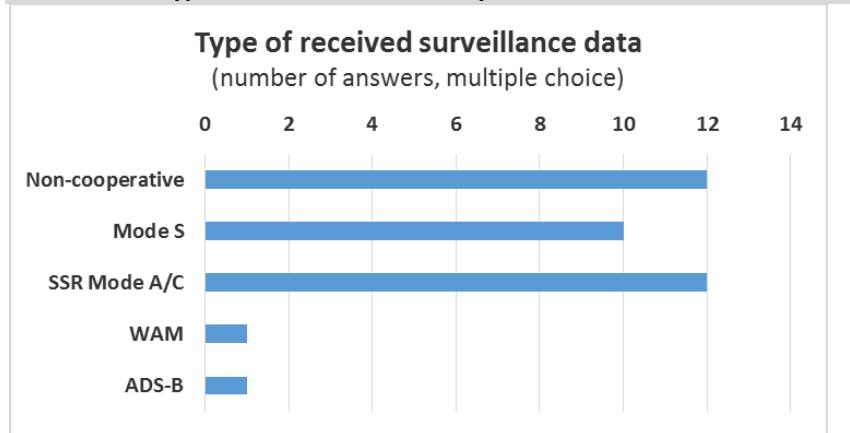


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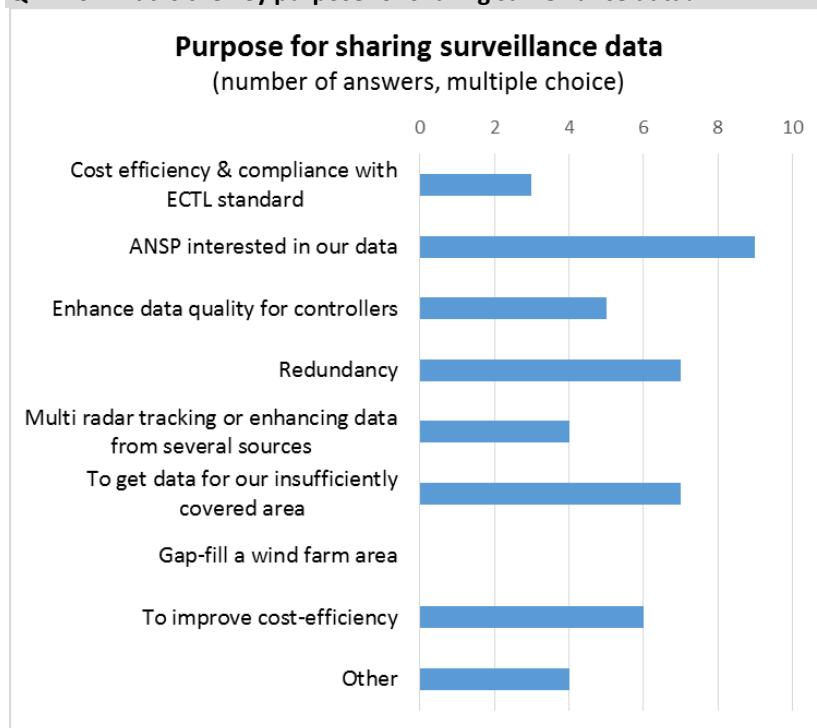
### Q-4.2.4 What type of surveillance data do you provide?



### Q-4.2.5 What type of surveillance data do you receive?



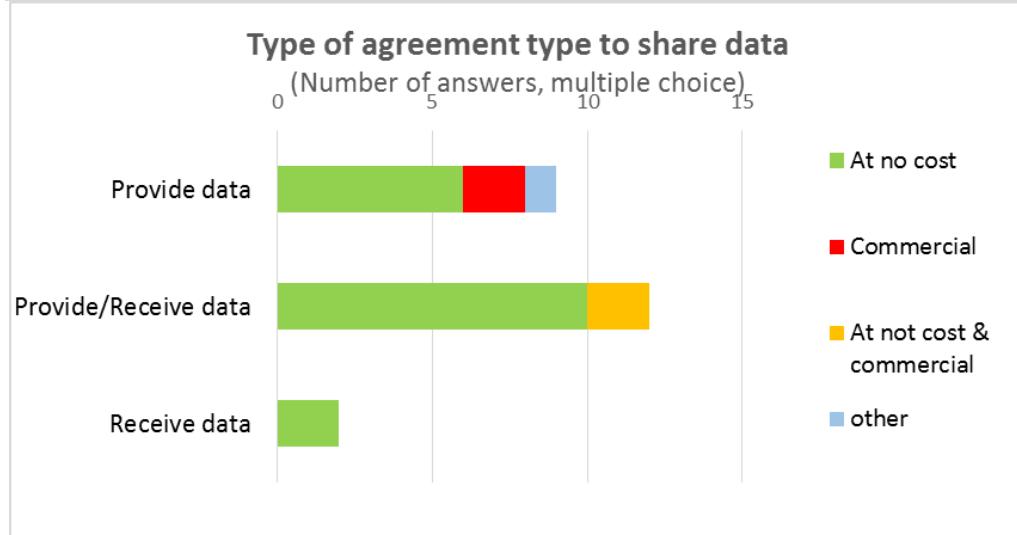
### Q-4.2.6 What is the key purpose for sharing surveillance data?





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### Q-4.2.8 What kind of agreement do you have in order to share data?



The graph is limited only to the ANSPs who have answered that they share data. Obviously if ANSPs are providing information based on a commercial agreement, we should have a corresponding number of ANSPs stating that they are receiving information based on commercial agreement. This is not the case because we do not get an answer from all ANSPs.

### Q-4.2.10 If your ANSP provides data to another ANSP: at which price do you sell this service?

Q-4.2.10.Price to provide data	Total
£65K per year	2
100 euro per month	1
Confidential	2

### Q-4.2.11 if your ANSP receives data from another ANSP: what is the cost for this service?

Lack of answers to the survey.

### Q-4.2.12 if your ANSP receives data from another ANSP: what is the avoided cost by receiving these data?

Q-4.2.12.Avoided cost by receiving data	Total
1000 euro per month	1
Avoid radar deployment (no cost data)	3
Avoid radar deployment (see cost data)	1

#### Details

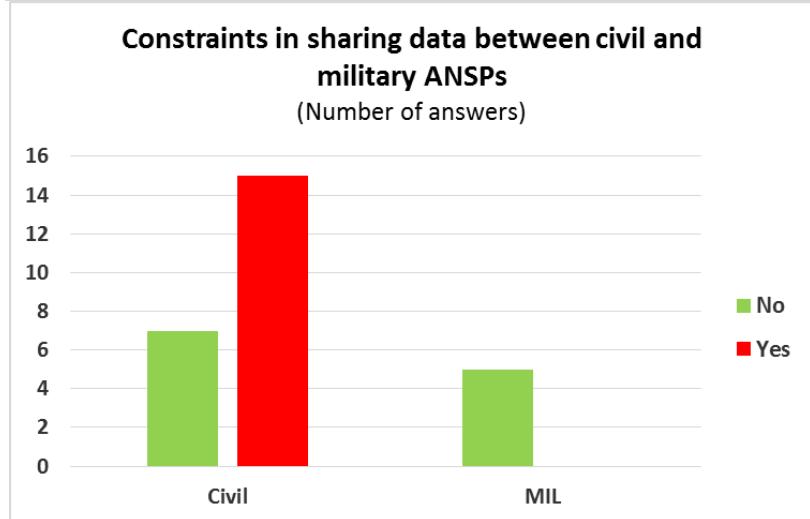
Investments for Radomes can be saved by 5 Mio EUR each (i.e. 14 stations = 70 Mio EUR) plus maintenance cost 250TEUR p.a. per Radome. So in case of e.g. bad weather conditions, the SUR data from MIL providers will be used for contingency.



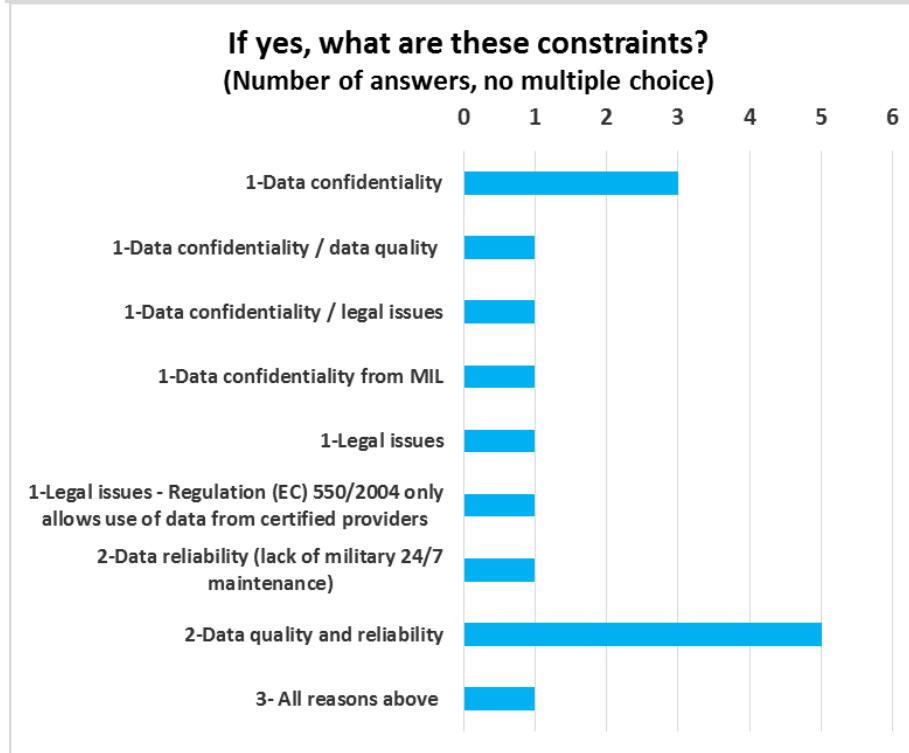


## Baseline Analysis Report – RMT.0679 Revision of SPI

Q-4.2.13 Did you identify constraints in sharing data between civil ANSPs and the military?<sup>21</sup>



Q-4.2.14 if yes, please specify:



<sup>21</sup> The question could have been further detailed by asking how shared data are operationally used. This is missing in the survey



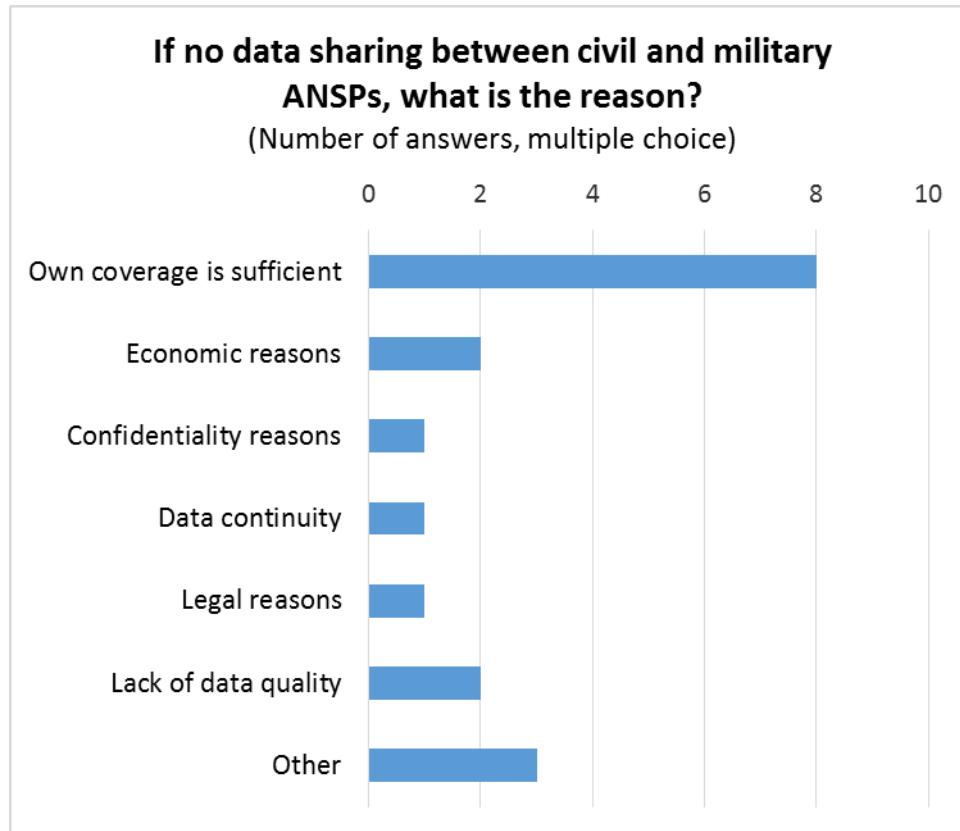


# Baseline Analysis Report – RMT.0679 Revision of SPI

Following Q.4.2.1 ➔ "IF NO DATA SHARING", the consequential question is:

Q-4.2.15 If there is overlapping coverage by a sensor not operated by you, what is the key reason for not sharing data?

Reminder: 13 respondents indicated that there is no data sharing between civil and military ANSPs.



## 9.4.2. Intermediate conclusion on scale of data sharing problem between civil and MIL

- A strong majority of the respondents share data between civil and MIL ANSPs (reminder, only 5 Mil ANSP answers, most of them are civil ANSPs answers):
  - 50% of the civil respondents indicate they "only" provide surveillance data
  - 50% of the civil respondents indicate they provide and received surveillance data
- Due to the lack of Military ANSPs answers, Military ANSPs were asked to answer to a simplified question in another survey: 13 out of 19 Military ANSPs indicated that they share data with their civil ANSP.
- They seemingly make use of them for a number of technical reasons:
  - lack of coverage
  - an ANSP is interested by these data
  - to ensure redundancy
  - improve data quality for ATCO
- ASTERIX is commonly used by all these respondents.
- However, a majority of respondents have also identified constraints to share data:
  - legal/confidentiality issues
  - lack of confidence in the data quality and availability.
- A limited number of civil ANSPs do not share data with MIL ANSPs because of legal/confidentiality issues or lack of confidence in the data quality and availability.





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## 9.5. Current situation - Surveillance data sharing within your country between civil ANSPs

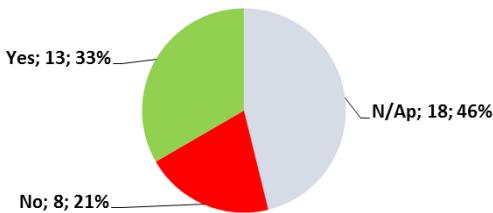
### 9.5.1. Summary per question

#### Q-4.3.1 Do your other civil ANSPs share surveillance data?

Number of answers: 39

##### Situation for all respondents

Within your country, do your other civil ANSPs share surveillance data?  
(Based on number of answers)



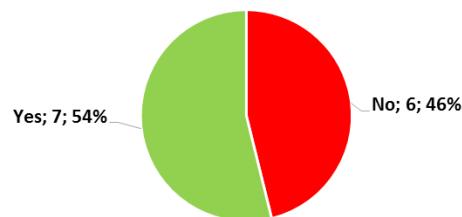
##### Situation for all respondents (except ANSPs from UK)

EASA MS (except UK case): do your other civil ANSPs share surveillance data?  
(Based on number of answers)



##### Situation in UK

UK case: do your other civil ANSPs share surveillance data?  
(Based on number of answers)



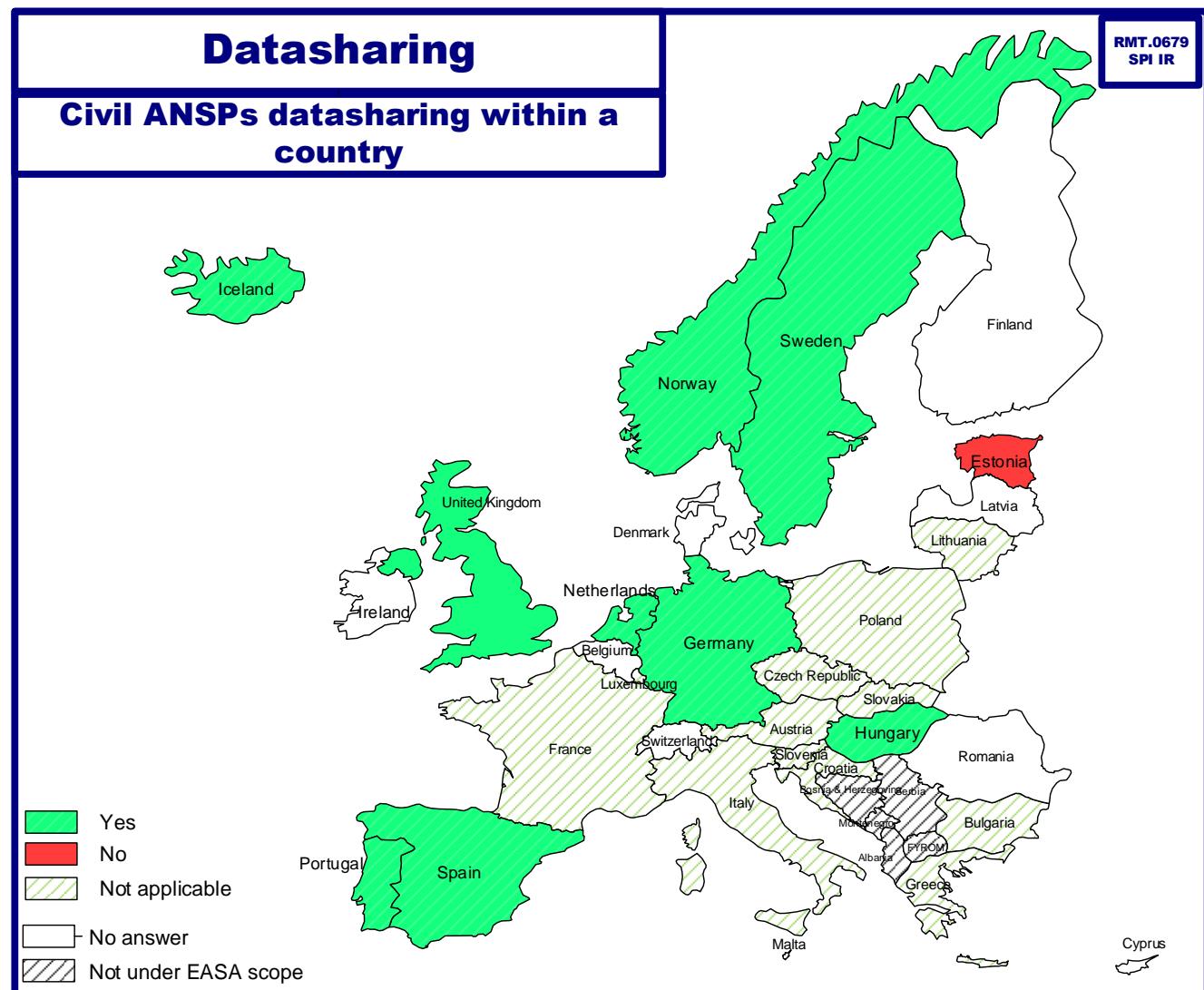
##### Explanations for

- the “N/Ap” answers, the reasons are:
  - there is only one ANSP in this country
  - or, other ANSPs provide only flight information service, no need for surveillance data.
- the “no” answers: ANSPs do not necessarily share their data with other ANSPs in the same countries. It happens in 2 countries: Estonia (2 CNS providers) and United Kingdom (7 out 13 respondents do not share surveillance data)

**As a consequence, there are 14 number of answers considered for the following questions: 7 UK answers and 6 non-UK answers.**

Note: after having read the answers, it is acknowledged that the question was not enough explicit. It should have been: do you share data with other civil ANSPs in your country?

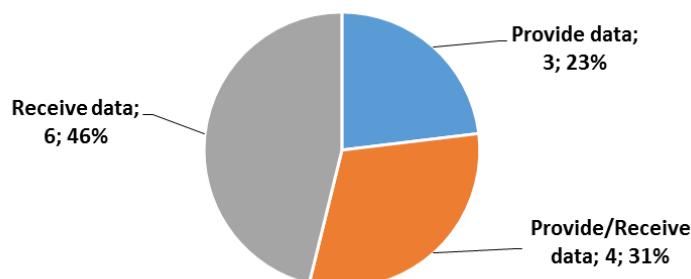


**Q-4.3.3 What format do you use for data exchange? (e.g. ASTERIX)**

All civil ANSPs exchanging data are using ASTERIX.

**Q-4.3.4 What is the type of sharing in place?**

4.3.4.Type of sharing in place  
(Based on number of answers)

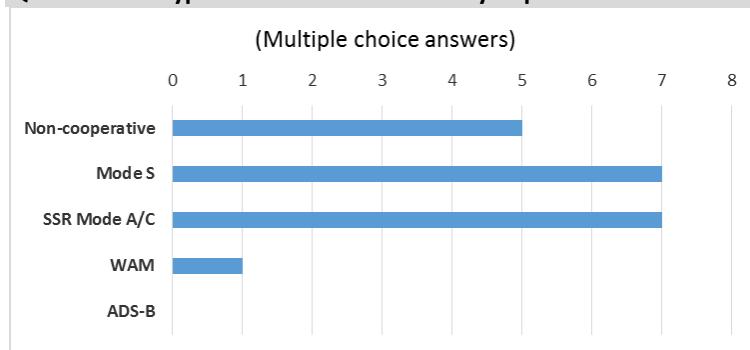




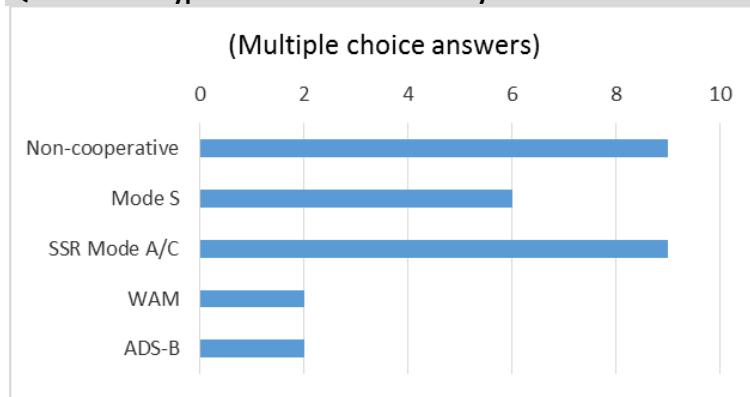
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Note that one provider may provide data to several ANSPs within a country. This may explain why there are more “receivers” of data than data providers.

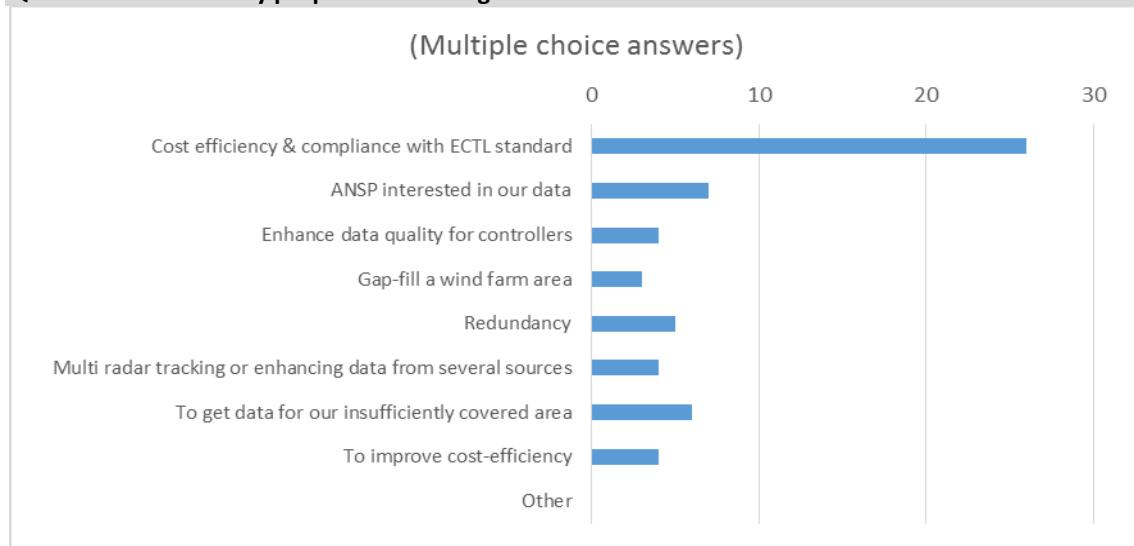
## Q-4.3.5 What type of surveillance data do you provide?



## Q-4.3.6 What type of surveillance data do you receive?



## Q-4.3.7 What is the key purpose for sharing surveillance data?



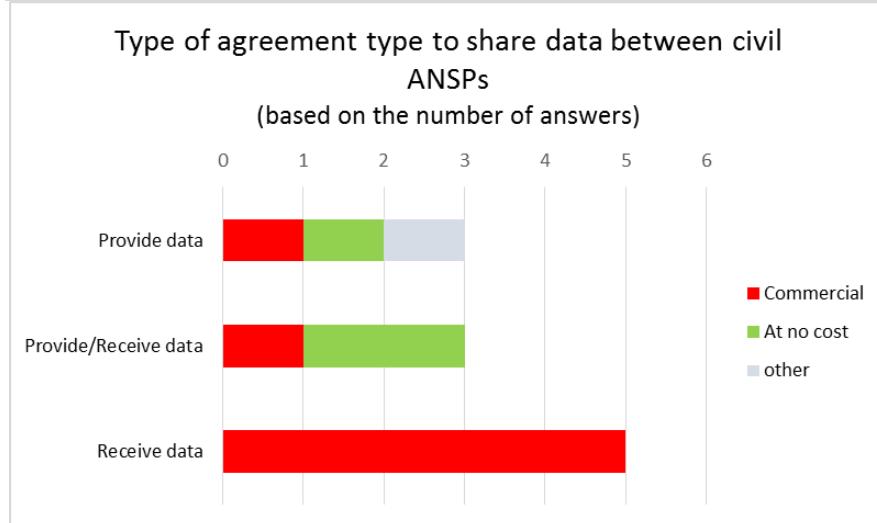
Data sharing purpose is mainly due to cost efficiency and compliance with ECTL standards.





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### Q-4.3.9 What kind of agreement do you have in order to share data?



Note:

- “other” agreement to provide data: Agreement is in place through Airport Manager (AENA) which is the entity setting a contract with the ATS provider and with the CNS provider (ENAIKE)

### Q-4.3.11 If your ANSP provides data to another ANSP: at which price do you sell this service?

The civil ANSPs providing data to another civil ANSPs in the same country did not answer to this question or indicated “confidential”.

### Q-4.3.12 if your ANSP receives data from another ANSP: what is the cost for this service?

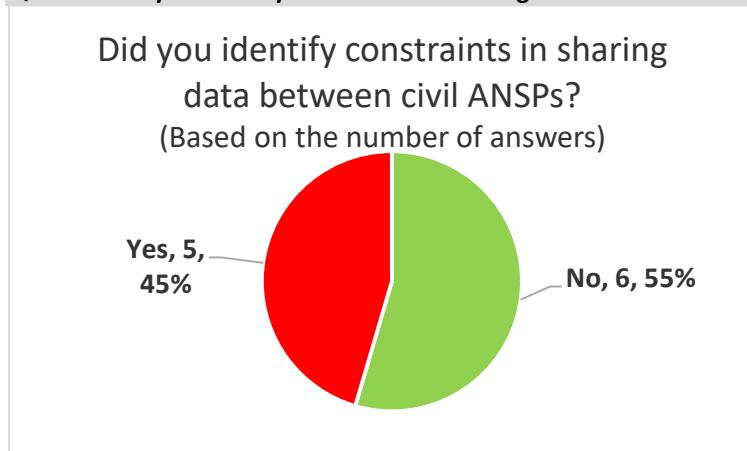
There were 5 UK answers. One indicated “confidential”, the other answers (only from UK) can be summarised with a range of 62 to 220 thousands £ per year (approximately 70 000 € to 250 000 €).

### Q-4.3.13 if your ANSP receives data from another ANSP: what is the avoided cost by receiving these data?

There were 3 answers:

- Avoid radar deployment (no cost data)
- There is no avoided cost however it allows us to have data of transponding aircraft in our airfield radar overhead.
- Confidential

### Q-4.3.14 Did you identify constraints in sharing data between civil ANSPs?





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**Q-4.3.15 if yes, please specify:****4.3.15.If yes, comments:**

Interoperability and lack of control of the radar supplier's asset

Limitations of lowest useable levels and operational range established for NATS ORRD

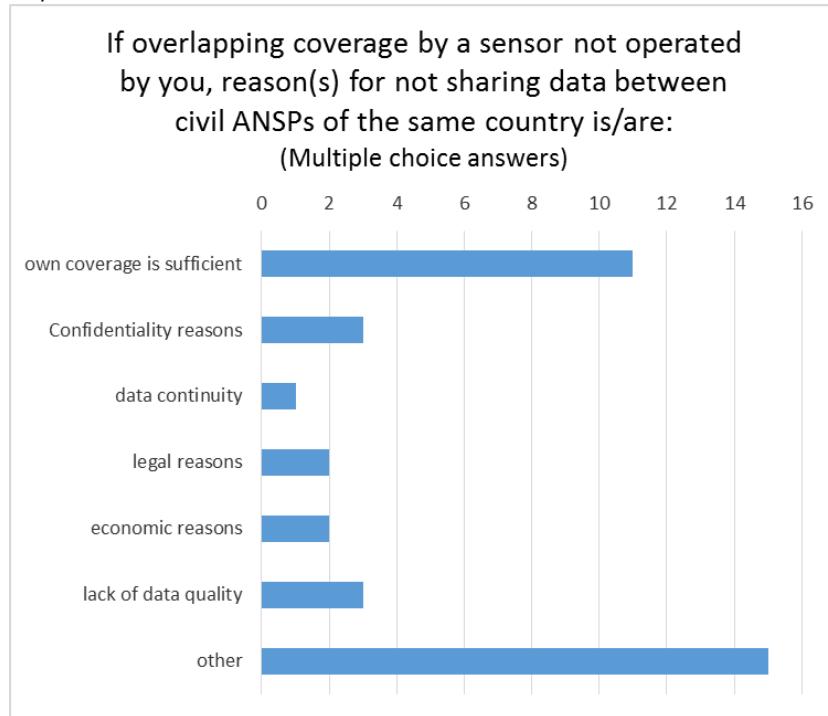
No control of equipment downtime.

The only issue is with data confidentiality in that I cannot provide the data to anyone else without permission. This can impact on investigations which require the use of the data provided by NATS. The quality and reliability are very good.

We have had a few issues with services not meeting our required performance specifications.

**Following Q.4.3.1 ➔ "IF NO DATA SHARING", the consequential question is:****Q-4.3.16 If there is overlapping coverage by a sensor not operated by you, what is the key reason for not sharing data?**

Reminder: 8 respondents indicated that they do not share data with another civil ANSP in the same country (6 are from UK).



Note: "other" answers need to be reviewed because several are providing an explanations which is already in the above categories or there is only one ANSP in the country. In total, only 3 "other" answers are relevant, see below.

**Q-4.3.17 in any case, please specify:**

(legal reasons may be: no standard available to agree upon (according to Implementing Rule (EU) 1207/2011 Article 5), national laws are more restrictive, Implementing Rule (EU) 1207/2011 requires certification of providers; ...)

**Comments:**

In the past, negotiations with adjacent ANSP's have failed, because of inadequate quality of SUR-data, or legal processes being to complicated.

Other ANSP provide only flight information service. No need for surveillance data.

political reasons





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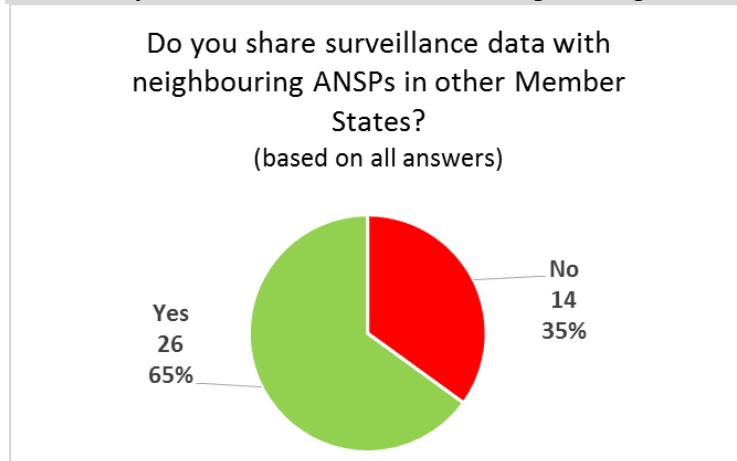
### 9.5.2. Intermediate conclusion on scale of data sharing problem between civil ANSPs (same country)

- This question is not applicable to approximately 70% of civil ANSPs responses because there is only one civil ANSP in a country. In addition, in some cases other service providers like AFIS do not require surveillance data.
- For the rest of the respondents, a majority share data<sup>22</sup>. Those who share data do it basically to comply with EUROCONTROL standards.
- ASTERIX is commonly used by all these respondents.
- Sharing data is based on commercial agreements with a range of cost from approximately 70 000 € to 250 000 € per year. It avoids the ANSPs investing in the corresponding surveillance infrastructure and its maintenance.
- Half of the respondents sharing data have identified constraints as follow:
  - lack of control on equipment downtime
  - lack of possibility to use data with anyone due to confidentiality constraints
  - For limited instances (e.g. case of a country with several ANSPs):
    - lack of data quality when the supplier is in a monopoly situation
    - cost of the service when the supplier is in a monopoly situation
- For the respondents who do not share data, the main reason is that the own coverage is sufficient.

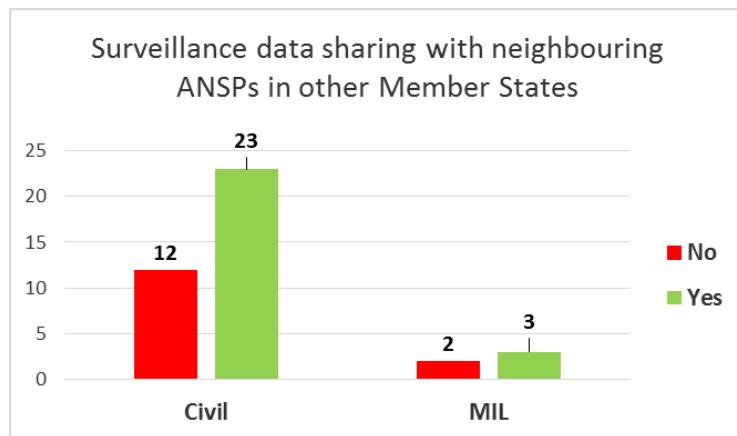
### 9.6. Current situation - Surveillance data sharing between countries

#### 9.6.1. Summary per question

##### Q-4.4.1 Do you share surveillance data with neighbouring ANSPs in other Member States?

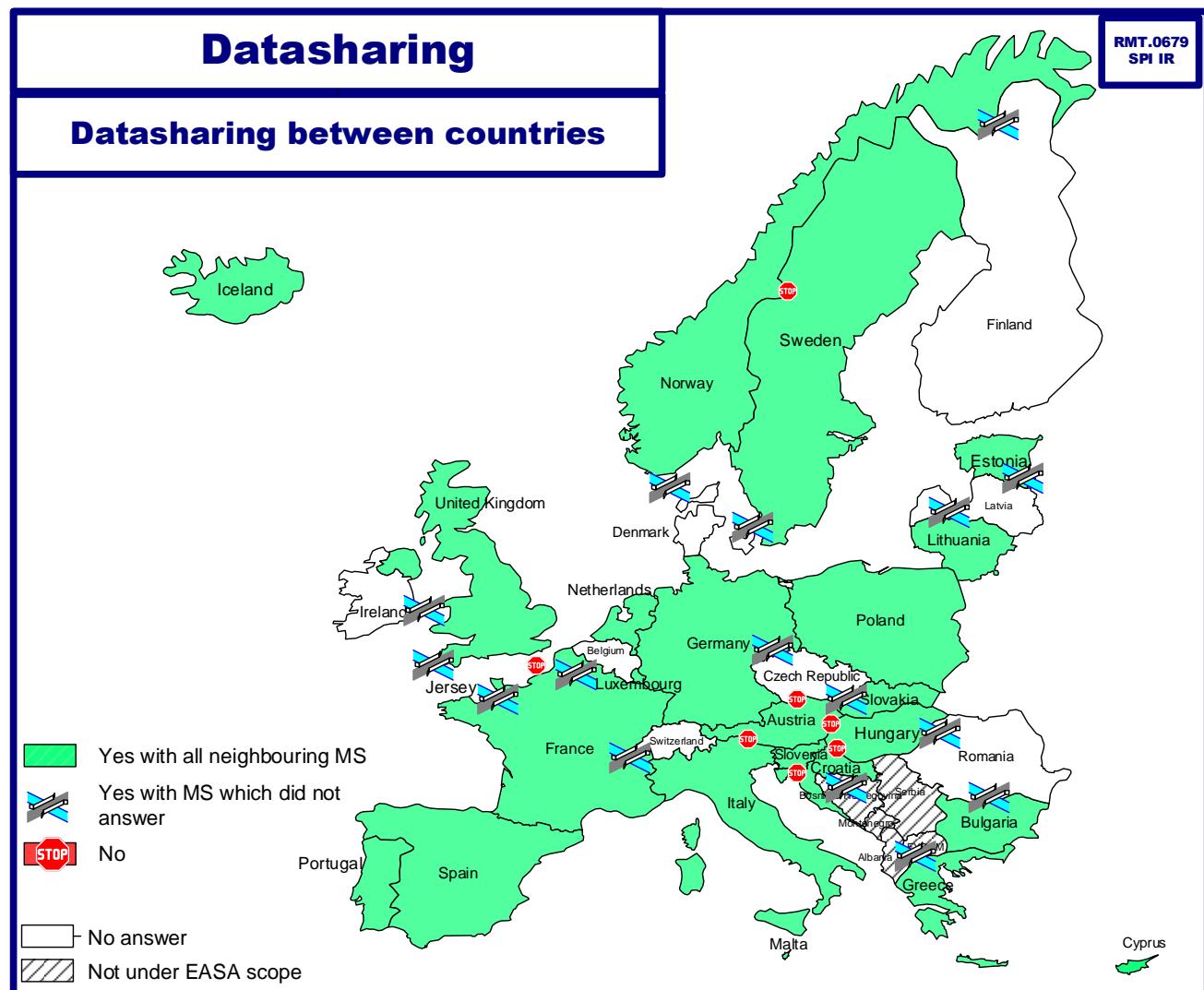


However all main ANSPs in a Member State share surveillance data with at least one other Member State. The “no” answer is coming mainly from local ANSPs (e.g. in Spain and UK).



<sup>22</sup> See question Q-4.3.1 : 13 “yes” versus 8 “no”





Q-4.4.2 A “yes” does not imply that you share with all existing neighbouring ANSPs. Please indicate with which ANSPs you share surveillance data:

Member States	4.4.2.A With which ANSPs you share surveillance data:
Civil ANSPs	
Austria	DFS, Germany LPS, Slovak Republic SLOVENIACONTROL, Republic of Slovenia
Bulgaria	ROMATSA SMATSA M-NAV HCAA
Croatia	Bosnia and Herzegovina (not EU Member state, but ECAC and EUROCONTROL Member)



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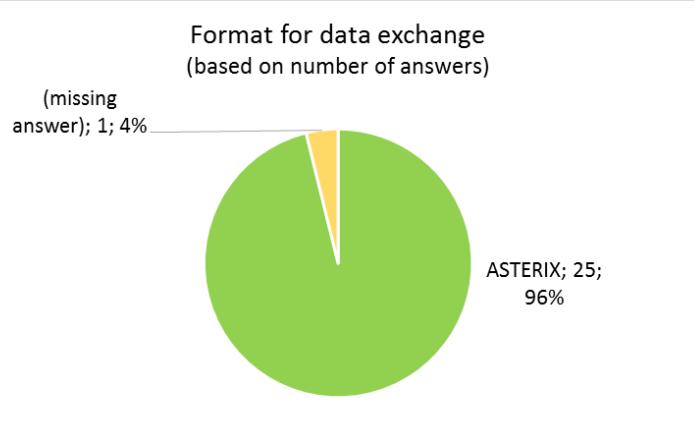
Member States	4.4.2.A With which ANSPs you share surveillance data:
Estonia	Finavia - we send Tallinn SSR feed and receive Helsinki SSR feed. LGS - we send Martna SSR feed and receive Ergli SSR Mode S feed.
France	Belgocontrol, LVNL, MUAC, DFS, Skyguide, ENAV, ENAIRE, IAA, Jersey
Germany	with all existing neighbouring ANSPs and some additional interested ones: DK, PL, CZ, A, F, LUX, NL, B, MUAC, UK, I, CH
Greece	CYPRUS (DCAC) MALTA (MATS) BULGARIA (BULATSA) ALBANIA FYROM
Hungary	ROMATSA LPS Sk Kosovo airspace
Iceland	NATS and NAVIAIR
Italy	To MATS, DSNA, Skyguide, , DFS
Lithuania	PANSA (Poland), LGS (Latvia)
Luxembourg	Data sent to RAPNET according to CoCoMu agreement
Malta	ENAV HCAA
Netherlands	Germany, Belgium, MUAC
Netherlands (MUAC)	Receiving: Germany, Belgium, Netherland, Luxembourg, Denmark, France, UK Sending ASP (tracked date): Germany, Netherlands, Belgium, Luxembourg, France
Norway	Finavia, Naviair
Poland	Oro Navigacija LPS SR DFS
Portugal	Spain (ENAIRE) and Morocco (ONDA)
Slovak Republic	Astro Control, Czech ANS (ŘLP ČR), HungaroControl, Polish ANSP (PANSA)
Slovenia	Austria, Italy (Astrocontrol, ENAV)
Spain	France and Portugal
Sweden	Naviair and Finavia.
United Kingdom	EUROCONTROL IAA Jersey Netherlands
Military ANSPs	
France	Skyguide and Maastricht.
United Kingdom	(no detail)
Netherlands	DFS, Belgo and LVNL



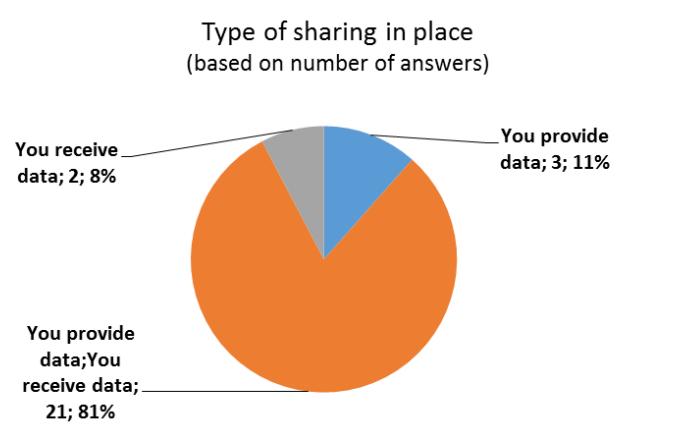


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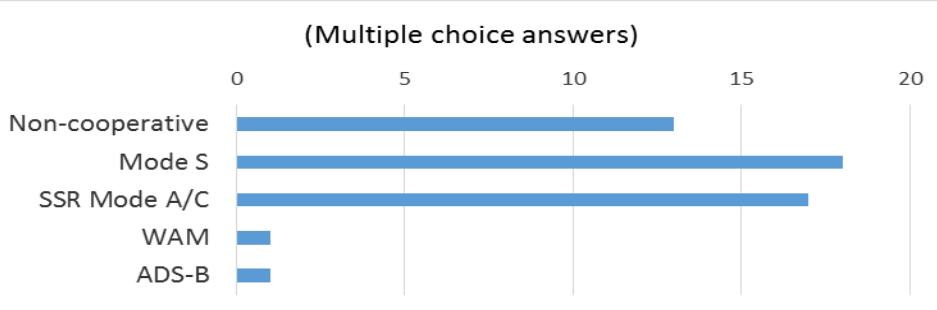
## Q-4.4.3 What format do you use for data exchange? (e.g. ASTERIX)



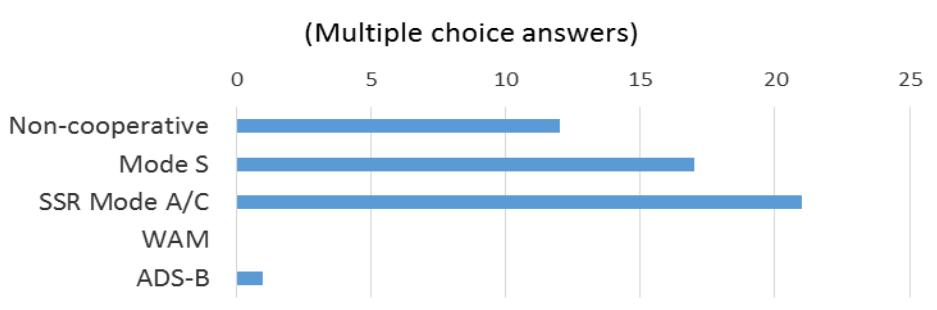
## Q-4.4.4 What is the type of sharing in place?



## Q-4.4.5 What type of surveillance data do you provide?



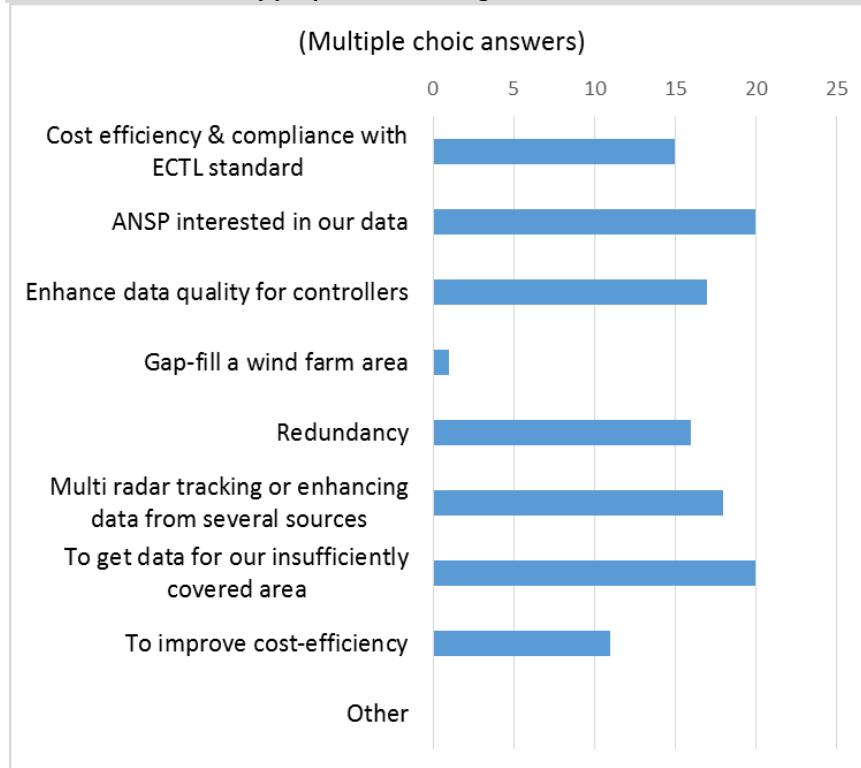
## Q-4.4.6 What type of surveillance data do you receive?





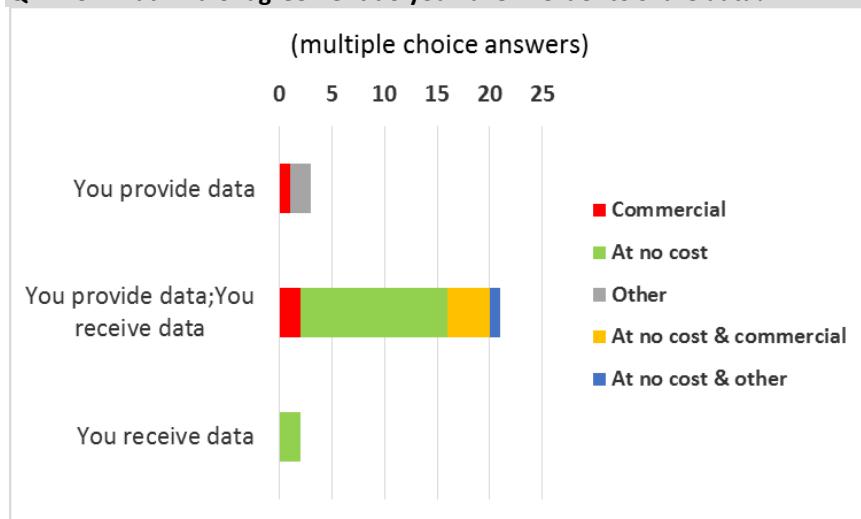
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### Q-4.4.7 What is the key purpose for sharing surveillance data?



Note: "cost efficiency" appears two times: one in the sense of cost-efficiency if EUROCONTROL standard is followed and once for a more general case

### Q-4.4.9 What kind of agreement do you have in order to share data?



### Q-4.4.11 If your ANSP provides data to another ANSP: at which price do you sell this service?

Answers:

27000 Euro/3months

50 000 Eur/year/radar

For the moment no cost, future cost TBD.

Generic Price 15% (Sensor-)OPEX per Year and Sensorshare

Confidential





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**Q-4.4.12 if your ANSP receives data from another ANSP: what is the cost for this service?**

Answers:

50 000 Eur/year/radar

90k€ per year for one radar, two sensors radar data are free of charge.

For the moment no cost, future cost TBD.

Generic Price 15% (Sensor-)OPEX per Year and Sensor share

N/Av

Confidential

**Q-4.4.13 if your ANSP receives data from another ANSP: what is the avoided cost by receiving these data?**

Answers:

1M€

At least 5 additional radar stations would be required at the investment cost of minimum 4 Mio EUR each (maintenance and personnel not included).

Avoid a radar deployment

Avoided cost are calculated as:

- Adjacent sensors coverage serves for 3% of total flight-time = representing 3% route charges

- Adjacent sensors increase flight planning efficiency by 1% = representing 1% route charges

- Adjacent sensors bridge mainte

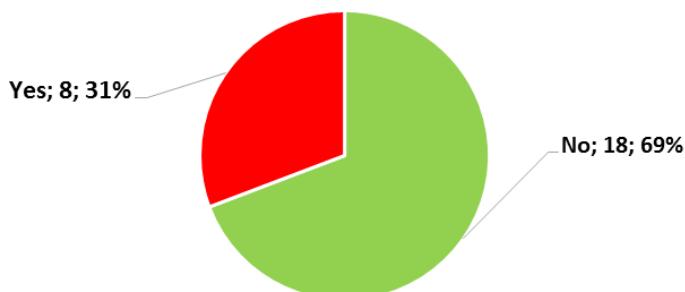
Confidential

20 - 30 M € because of savings on own radar investments

Hard to estimate

**Q-4.4.14 Did you identify constraints in sharing data between civil ANSPs?**

Constraints in sharing data between civil ANSPs  
and the military?  
(Based on number of answers)



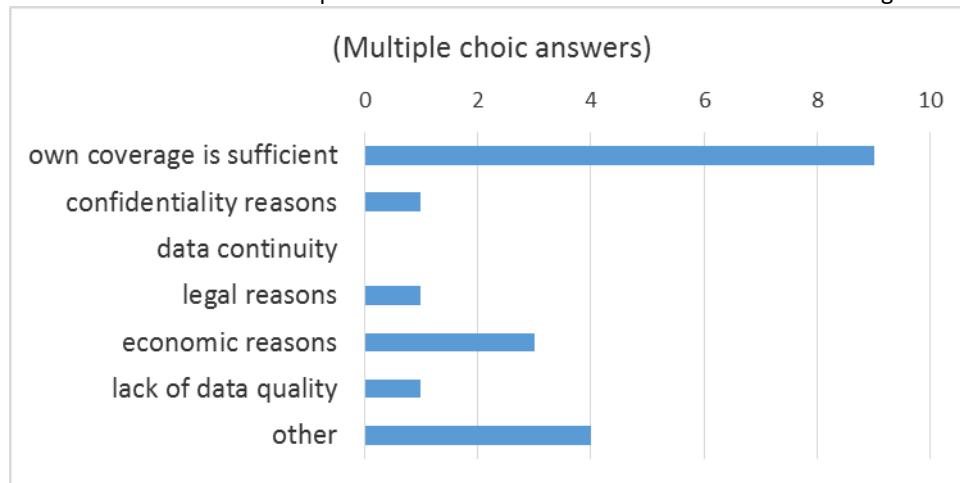


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Following Q.4.3.1 ➔ "IF NO DATA SHARING", the consequential question is:

Q-4.4.16 If there is overlapping coverage by a sensor not operated by you, what is the key reason for not sharing data?

Reminder: there were 14 respondents who indicated that there is no data sharing with other countries.



### 9.6.2. Intermediate conclusion on scale of data sharing problem between ANSPs at European level

- All the civil ANSP respondents share data with other countries.
- From the 5 MIL responses in the data sharing survey, 3 MIL ANSPs are also sharing data with foreign civil ANSPs, while 2 MIL ANSPs are not sharing data at an European level and one MIL ANSP indicated sharing data however without providing details.
- However, few civil ANSPs share data with only some of their neighbouring countries. This is apparently mainly the case in central Eastern Europe.
- ASTERIX is commonly used by all these respondents.
- The main reasons for data sharing are:
  - "Another ANSP is interested in our data"
  - "Our own coverage is insufficient"
  - Followed by:
    - ensure redundancy
    - ensure multi radar tracking or enhancing data from several sources
- The agreement to share data is mainly based on providing and receiving data for free.
- When a commercial agreement is in place, the average price seems to be 50 k€ per year and per radar.
- Data sharing may avoid the need for significant investment: from 1 to 4M€ per radar. One respondent indicated that it avoids the installation of 5 radars.
- 31% of the respondents identified constraints with data sharing. The main reason not to share data is because the own coverage is sufficient (which is not a constraint). The second main reason is the cost to share data (in that case i.e. to receive data).



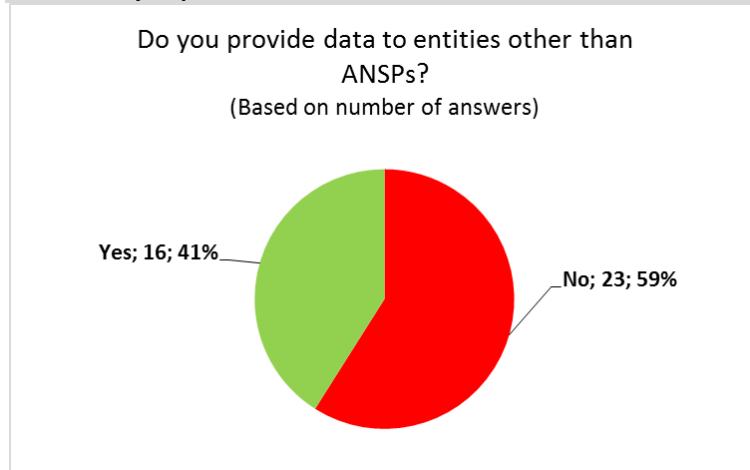


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## 9.7. Surveillance data sharing with other entities than ANSPs

### 9.7.1. Summary per question

#### Q-4.5.1 Do you provide data to entities other than ANSPs?



“No” Answers:

- 11 answers are from UK ANSPs, out of a total of 13 answers in UK for this survey.
- 8 are civil ANSPs from other countries
- 4 are MIL ANSPs

#### Q-4.5.2 if yes, please specify:

Member State	Status	Answers
Austria	Civil	- Small (FIS-only) airfields - Local communities for noise impact assessment
Bulgaria	Civil	Border police ASOC - Air Sovereignty Operational Center Airport operators at Sofia, Varna and Burgas Airports EUROCONTROL NM
Croatia	Civil	Military, Airport
France	Civil	Airport
Germany	Civil	Aerodromes, which require so, are provided with available SUR data.
Italy	Civil	Italian Air force
Lithuania	Civil	To the Lithuanian airport authorities for the purpose of monitoring of the noise pollution
Poland	Civil	Warsaw Airport
Slovak Republic	Civil	Airport operator - noise level measurement
Spain	Civil	Airport manager (AENA), operators for testing
United Kingdom	Civil	Various commercial companies
Netherlands	Civil	Network manager
Estonia	Civil	To airport.
Sweden	Civil	Industry, airports.
Greece	Civil	To LGAV (Athens Airport) for the noise monitoring system and for enhancing their operational activities (Airport Safety and Operational Center).





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### 9.7.2. Intermediate conclusion on scale of data sharing problem with other entities than ANSPs

Approximately 40% of the respondents indicated that they share data with other entities than ANSPs. These are airports in the vast majority of the cases. Few answers mention the sharing of data to support noise level assessment.

## 9.8. Future developments

### 9.8.1. Summary per question

#### Q-4.6.1 What would be the benefits if data sharing would be improved?

(answers directly taken from the EASA survey)

Cost efficiency
-enhance safety by improving surveillance functions -overcome the gaps in the coverage of the existing surveillance systems, especially in South-East and North West areas -maintain capacity during the maintenance activities
Better coverage of En-route route areas, especially near national borders. Improved cost-efficiency, shared cost to maintain the radar.
Small benefits possible at low level altitudes
Further cost reduction could be achieved if the use of MIL SUR data would be possible, supposed that data are provided in sufficient quality and continuity. However the FABEC surveillance rationalisation study WP2 (2013) already indicates that further rationalisation of infrastructure through better use of data sharing is limited and only possible with the integration of MIL SUR sensors and data.
Receive Surveillance data from Military
For cost reduction and more efficient use of airspace. Improve the quality of data and fail-safe option in ATS. Data sharing within the BLUE MED is already consolidated. Deployment of a MATS ADS-B station on a Greek island (at an HCAA site) is being discussed with HCAA. Data sharing with other (non-European) ANSP is more difficult. Norwegian airspace is very little overlapping with other ANSPs surveillance systems. Due to long coastline and rugged terrain. Some benefits may be feasible in WAM design along the border, or offshore.
Cost effectiveness
- Better coordination. - Better data managing. - Less HW to be maintain. - Less SW to be implemented. - Less ATSEP workload. - Less malfunctioning probability.
Better cost efficiency
Reduced capital and revenue costs
Resilience, cost efficiency, potential improvements to coverage, reduction in clutter (i.e. from wind farms) If data was a centralised resource and could be accessed by everyone to provide a 'known' data standard and identical coverage, this would be advantageous as safety would be and efficiency and effectiveness could be improved. The main issue would be the cost of the data provision including the equipment standard required to accept the data feeds.
Enhanced resilience.
Increased coverage and redundancy.
Possible reduction of the impact of wind farm developments





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Benefits could be of many forms. Benefits could be technical or financial or other. However if the number of overlapping surveillance layers covering the same piece of airspace exist above and beyond the required number of layers to provide sufficient redundancy and performance, it would help for the spectrum environment to avoid overlaps as much as possible. However several layers may exist in order to provide redundancy in the event of failure of the main system or for example to enhance the performance of the data or to track either co-operative or non-cooperative targets in a mixed traffic environment.

Sharing data can only provide benefit if the performance of the sources that provide the data meets the required performance of the application for which the data will be used for, where this is commercially viable and cost effective to the ANSPs who receive data.

More efficient use of sensor resource (shared costs)

Better options for redundancy / backup

Possible new revenue streams

Possibility of centralised Tower and Approach facilities

Cost reduction/sharing.

Huge..... Maybe not so much in lowering costs for ANSP:s, but in improving service and coverage.

Not applicable, our ANSP is completely happy

Increase surveillance coverage and data availability to the maximum possible extend.

Working already fine at the moment.

### Q-4.6.2 Please identify your concerns and expectations with regard to data sharing

(answers directly taken from the EASA survey)

- Signature of bilateral Agreements/SLA's is complicated and takes long time
- Conformity work requires many resources
- Safety case work requires many resources

Today, only Radar and ADS-B data sharing (regarding sensors) feasible.

WAM system data sharing is not so convenient because positional error increases outside bundle of WAM sensors (which are located under national boundaries). WAM sensors data sharing is not possible because there is no common standard on this kind of data.

Usually, low altitudes could not be covered by radars from neighbouring ANSPs (bad radar visibility) and those areas are mostly identified to be covered better. Also, radar data quality on low elevation is poor because negative impact of the ground on signal propagation (multipath and reflection).

As long as aircraft are not uniformly equipped, the ground infrastructure needs to serve all possible technologies used on board. In addition, equipment malfunction onboard aircraft require mitigation measures that does implicitly raise ground infrastructure costs.

Reduced security of data, increased hidden costs and lack of control in availability.

Data sharing should entail a centralized body for planned maintenance and outages co-ordination due to complexity.

Data sharing communications infrastructure is to be renovated due to technological development

Data sharing IP communication specifications or regulations may not be available or are still under review (in terms of Quality of Service and Security)

Data sharing is an important consideration for future deployment, especially if neighboring ANSP manage to co-own/co-manage a surveillance sensor.

Low level FAB technical working groups/cells consisting of surveillance experts may manage to promote and expedite data sharing when given opportunity.

Technical and Commercial complexity.



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- requirements for radar data exchange with countries out of SES are to general and not fully clear
The contracts on provision of radar data as service with foreign ANSPs have been established in the past. Although principles of data quality management were set up by these contracts some questions on payment duties occasionally raise from other stakeholders. Clear common position, mainly from legal point of view, on this issue would improve level of cooperation.
Data sharing in general is good idea however one has to bear in mind that ANSP's when placing sensors in operation first take care of their own requirement and also fine tune sensor to their purposes. So the receiving party can only get what there is and usually doesn't have influence on technical requirements for particular sensor.
Coordination with other CNS service providers. Sharing data or knowledge about it would be the main problem. How to share data and technics without competency issues problems.
Performance levels
Security constraints.
No control of equipment downtime
Lack of control of data, scheduled outages, optimisation not focused on individual airport requirements, transmission line reliability, loss of tactical control (such as weather filters), serviceability monitoring, data security/corruption
Potential monopoly and cost control
Surveillance requirements may not support the airport growth
We would need confidence that the data would be always available with sufficient resilience and redundancy in the provision (i.e. for a WAM or multi-laterated picture, an N-1 or greater would have to be employed).
Cost, complexity, having to potentially upgrade current surveillance data servers and radar data processors.
Reliability of sources not owned by GPA
Our concerns for data sharing are;
1) the complexities of sharing data between military and civil entities due to confidentiality, and because the law does not make it explicitly clear what is legally binding for such data sharing contracts and what applies to military.
2) Obtaining the required safety assurance evidence for the surveillance sensors that are used for the provision of surveillance data due to commercial complexities.
3) Reluctance of the data providing parties to guarantee a performance hence ANSPs having to assess the suitability of the received data for themselves, however not all ANSPs not having the required tools or knowledge to do this.
4) Data sharing between countries is not necessary unless the other country with overlapping coverage has a compelling reason to do so. But why would one country have surveillance over another country to monitor other state's traffic? If it is SSR the area of operation is limited when Interrogator Codes are assigned so that it remains within the ANSPs operational coverage area. If this is PSR, there may be overlapping coverage but whether another country is ready to accept such data from a 3rd country depends on many aspects such as sovereignty, cost, the performance of the feeds, and whether the necessary safety assurance data can be provided. This may involve commercial sensitivities and security concerns.
Reliability of access.
> Demarcation of maintenance responsibilities
> Who has overall control of the system
> Connectivity - Leased Line / BT Network costs and Service Levels
> Interoperability between units sharing same information i.e. RDP / tracker capability or performance
> My expectations are that ANSPs will move away from local sensors to Satellite based systems or that national infrastructure, i.e. MLAT/MSTATIC, is put in place.
Ensuring Service Level Agreements are met by other parties.
Concerns with regard to:
1. data quality
2. data security (corrupted or compromised data)
3. network/interface security (access, protection)
4. s/w security and safety, s/w assurance





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Concern is that commercialization of data exchange leads to decreased surveillance coverage, impacting quality and redundancy.
Competition regarding traffic between ANSP is a concern leading to unused S infrastructure that already is paid by EnRoute charges.
Getting information from NATO military surveillance system should be easier and the data received should be without delays so it could be used operationally.
We have had some issues with sensitive "state" flights being used by the general public via our external supply of data
Reliability of access
Security constraints
Today, only Radar and ADS-B data sharing (regarding seniors) feasible.
WAM system data sharing is not so convenient because positional error increases outside bundle of WAM sensors (which are located under national boundaries). WAM sensors data sharing is not possible because there is no common standard on this kind of data.
Usually, low altitudes could not be covered by radars from neighbouring ANSPs (bad radar visibility) and those areas are mostly identified to be covered better. Also, radar data quality on low elevation is poor because negative impact of the ground on signal propagation (multipath and reflection).

### Q. 5.1. Please provide any other comments that are not yet covered in the answers above:

Answers:
Given the commercial competitive environment within the UK compared to most other European States (62 ANSPs within the UK), agreement could be difficult to achieve between ANSPs as they might wish to retain a 'commercial advantage' by having a better surveillance picture. It would really require either the UK State or an independent entity to supply data for which a fee is paid based upon the number of movements at an airport.
What is required is to encourage data sharing where there is overlapping coverage and reasons to do so. But it is important to ensure that the provider of such data can provide the data to the required quality, be prepared to provide necessary safety assurance data to the user of that data, and standardisation of certain elements such as data format and the aspects of a service level agreement which the current IR address to a certain degree.
Also for Mode S interrogators where there are areas of overlap by a large number of sensors over a same coverage area it must be up to the interrogator code assignment entity to assess the reasons and the underlying requirement for the individual sensors and to avoid overlaps as much as possible to help manage the spectrum environment.
Mandating data sharing isn't as simple as there must be valid reasons to do this.

**Note: Some respondents indicated that few online questions were not set up properly. In that case the respondents indicated how to correct their answers.**

### 9.8.2. Intermediate conclusion on scale of data sharing problem for future developments

if surveillance data sharing could be improved, respondents indicate that there would be positive impacts on

- cost efficiency
- use of airspace/extension of the coverage
- quality of data
- more options for redundancy / backup
- development of centralised Tower and Approach facilities



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- resilience

However, constraints are:

- Security
- Signature of bilateral Agreements/SLA's: it is complicated and takes long time to agree on the level of performance and quality of the shared surveillance data
- Ressources issues to get the conformity assessment
- Ressources issues to get the safety case





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## 10. Lack of sustainability of spectrum (with a special focus on 1030/1090 MHz)

Source: online survey part B: <https://ec.europa.eu/eusurvey/runner/SPI-PerformanceInteropSecurityGA>

### 10.1. Main outcomes

Note: The difficulty to assess this problem required to have an assessment made with different supports/methodologies to ensure that all points of views can be represented. EASA started to review the SESAR 15.01.6 “1030/1090 Final Evaluation Report (2013)” focussing on the spectrum congestion for Frankfurt area<sup>23</sup>, then complemented by a survey to all stakeholders sent by EASA in July 2016. The outcome was to launch a study end of 2016 carried out by Eurocontrol/Network Manager to reassess the SESAR report with another model and to extend the modelling to other areas than Frankfurt, i.e. Croatia, Spain and Sweden.

#### 1030/1090 MHz spectrum congestion problem

Based on the study conducted by Eurocontrol for the RMT.0679

- Potentially high significant spectrum congestion problem for Frankfurt-Brussels-Paris-London area after 2025 – 2030, where ACAS is a significant contributor.
- Potentially significant spectrum congestion problem in the Croatian area after 2035.
- No problem identified to for other areas like Sweden, Spain in the EASA sample.
- Some measurements made at different places in Europe show that transponders transmit higher reply rates than minimum performance specified in transponder MOPS.

For affected areas, there is the risk that traffic should be limited from 2025 to continue to ensure safety.

Based on survey answers:

The reported problems are regional and limited.

However the vast majority of ANSPs do not measure nor monitor the usage of this frequency. Only 3 Member States have developed various models to assess this frequency usage.

Some losses of detection reported by different stakeholders may be due to spectrum congestion. Several answers refer to the same loss of detection case in June 2014 in Central Europe which was based on spectrum congestion (see Appendix 16.1).

#### Assessment, modelling and monitoring

A minority of ANSPs (30%) and National Bodies (25%) assess the usage of 1030/1090MHz. 35% of the airspace users declare to assess this usage<sup>24</sup>. From this 1/3 of respondents again only 1/3 are able to model the use of this frequency usage (no airspace user models this usage). Each respondent uses a different model/tool. Only one of the few who models this frequency usage has installed a monitoring of the interrogation rates, the reply rates and the channel occupancy.

The current safety occurrences<sup>25</sup> identified with this frequency usage are “none” for a vast majority of the respondents (90% ANSPs and 65% of the National Bodies). There are problems for 50% of the airspace user, however these occurrences are rare and without severity consequences except cases as reported in June 2014.

Regarding the future evolution, 40% of the respondents forecast an increase of this frequency usage, while 30% don't know and 25% believe that there will be no change. Only one respondent forecasts a saturation of this frequency and 2 respondents forecast the opposite, i.e. a decrease. However, a majority of respondents consider that there will be no significant impact on ground system interrogation.

<sup>23</sup> SESAR 15.1.6 modelling activity has shown that Mode A/C systems should no longer achieve the right level of performance within the core area of Europe.

<sup>24</sup> However, the means to assess is unclear and therefore for such an assessment the answer from airspace user is questionable as our questionnaire may not have been precised enough.

<sup>25</sup> The outcomes of this safety issue are loss of detection, false track/target, reduction of quality for surveillance information





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## Conclusion

- The great majority of States and ANSPs except 3 are neither managing nor monitoring the usage of 1030/1090MHz frequencies. Only a small number of respondents model the 1030/1090MHz frequency usage;
- Only regional issues which seem limited to Central Europe and Germany have been reported. However a few other cases have been reported over the last decade (CDG, north Italy, NL, Greece, UK, Latvia). All these cases were due to an unexpected system transmitting on 1030 MHz.
  - For Frankfurt-Paris-London area, the issue is due to the high density traffic and its continuous increase
  - For other cases, one main contributor is the lack of appropriate radar configuration: this results in an over interrogations of the aircraft transponders.

## **ACAS**

The vast majority of ANSPs have not encountered problems with ACAS however a large number of operators (33%) report unexplained losses of symbols on their airborne TCAS display.

ACAS contribution in the usage of the frequency 1030/1090MHz: only 2 respondents provided a value. It ranges from 30% to 50%. One respondent refers to SESAR WP.15.1.6 D3. One respondent is waiting for an EUROCONTROL report. All the other respondents have no available information.

## Conclusion

- currently no reported safety issues, only few cases of losses of symbols on TCAS display are reported;
- ACAS contribution to frequency 1030/1090MHz is reported high in 2 answers.

## **Ground system interrogation**

- There is always an organisation at national level to approve the transmission on frequencies 1030/1090MHz,.
- The most common criteria to give an approval refer to radio communication, however specific ATC criteria seem missing in most of the answers (e.g. maximum number of BDS extracted, interrogation sequence (MIP), range, ...)
- There was no need for a vast majority of respondents to increase the interrogation rate in order to ensure surveillance performance<sup>26</sup>.
- No significant changes expected in the future.

## Conclusion

- no specific issues reported

## **Downloaded Aircraft Parameters (DAPs/BDS)**

*Note: this item is not clearly indicated in the problem tree, however it is potentially a contributor to spectrum congestion if the download aircraft parameters are not used efficiently by the surveillance system.*

From the data reported, it could be seen that BDS extracted correspond to an EHS or ADS-B capable transponder. In one case the most use BDSs refer to an ELS specific BDS – ‘Identification’. Not all the parameters extracted are made available to the ATCO and are used as part of the ATCO procedure. This contributes to increase the spectrum congestion without any benefits.

## **Harmful interference**

A majority of respondents did not experience problems with harmful interferences. However 30% of ANSPs respondents and 40% of National Bodies respondents have experienced problems. These problems seem to have occurred only once and then are solved. They are linked to several aspects: IC conflict, SSR mode S, PSR. The 2014 case was several times mentioned. Causes of the issues mentioned are: low cost video cameras, manufacturer or private company trials, suspected MIL activity, wind turbines, misconfigured civil and MIL radar, overlapping surveillance coverage.

## Conclusion

<sup>26</sup> For Mode A/C the number of interrogations can be increased by changing the PRF. Mode S are automatically increasing the number of selective interrogations to maintain their performance.





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Apart the few cases mentioned, procedural mitigations are in place to avoid escalating to safety related occurrences and they have no negative significant operational impacts.

### Link between "data sharing between ANSPs" and "spectrum congestion"

There does not seem to be an issue with data sharing. There are enough answers showing that data are shared to be confident that this practice is real. However, the survey did not ask specifically how far the shared data are used operationally: therefore it cannot be concluded that the implementation of data sharing is fully efficient from a spectrum congestion point of view. As a side effect, there is potential for further ground surveillance rationalisation with benefits in terms of avoided surveillance costs.

The number of ANSP not sharing data is a very small minority. It happens in only 2 countries: Estonia (2 CNS providers) and United Kingdom (6 our 14 respondents do not share surveillance data). However it could be that these ANSPs do not need to share data. At international level between ANSPs, there are 4 cross-border areas in Central Europe and one cross-border area between France and UK where there is no data sharing.

The following table indicates how significantly are the spectrum issues linked to the identified problem areas :

**Table 9- Conclusions for the problem definition on the link between the sustainability of the spectrum and ...:**

Problem area	Conclusions
lack of surveillance performance and functionality targets	No evidence
lack of cost efficiency with the surveillance equipment	Evidences only for Frankfurt-Brussels-Paris-London impacted <u>from 2030</u> (Eurocontrol report): if no solution addresses the problem, there will be high negative consequences : reduction of capacity and/or safety risk increase
lack of interoperability between surveillance equipment	No evidence
lack of security of data transmitted	No evidence

### 10.2. Approaches to assess the problem

Initial statement: a potential problem has been identified with the spectrum congestion in particular with 1030/1090MHz frequencies.

The lack of sustainability of spectrum has been assessed with 2 different approaches. One was based on the online survey with a list of questions covering the 1030/1090MHz as well as any kind of harmful interferences due to surveillance (see sections 10.3 to 10.7). Based on the answers, it was confirmed that there is currently a lack of monitoring and modelling of the spectrum congestion issue.

Therefore a complementary approach was decided end of 2016 when the RMG decided to ask EUROCONTROL to provide an analysis of monitoring of the spectrum congestion issue for 1030/1090MHz in a sample EASA MS geographical areas: see section 10.8).



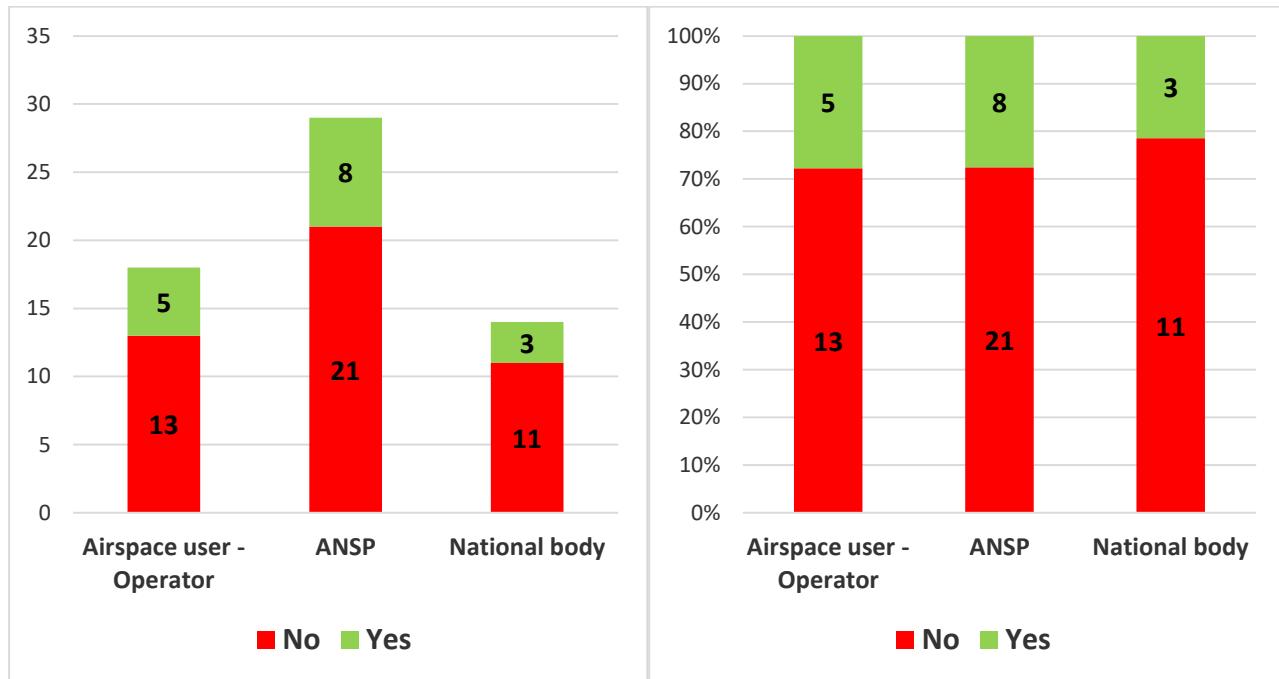


### 10.3. Responses from the online survey

(For ANSP, airspace users, NAA, NSA and national bodies)

#### 10.3.1. Summary per question

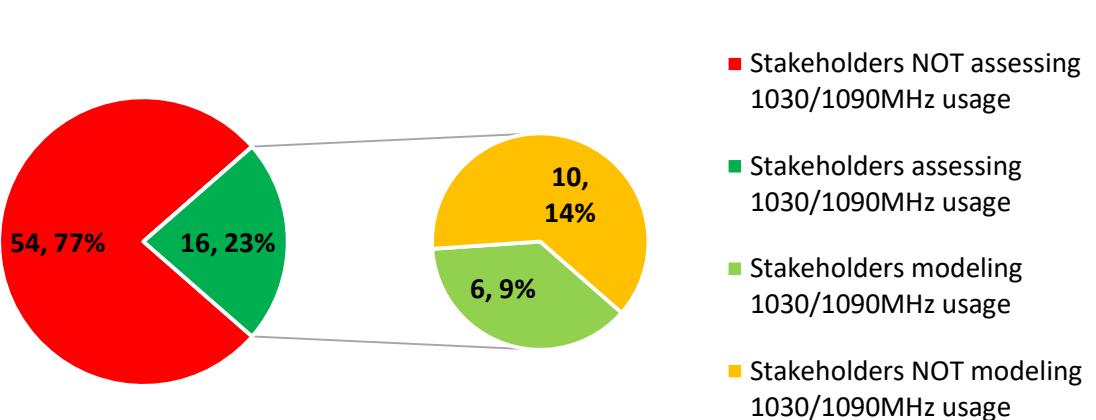
##### Q.4.1.1 Do you assess 1030/1090MHz usage?



The fact that the question was not enough accurate made some airspace users answering positively to it. In fact only ANSPs and some dedicated national organisations may the potential to really assess the 1030/1090MHz usage.

##### Q.4.1.2 Do you model 1030/1090MHz spectrum use, e.g. in terms of interrogation rates, reply rates and channel occupancy?

###### Assessing and modeling 1030/1090 usage



Based on the answers, there are only a minority of the ANSPs and National Bodies (6/48) who perform a modelling of the 1030/1090MHz usage.





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### Q.4.1.3 if yes, which tools and model are you using:

Type of stakeholder	4.1.3.Tools and model for 1030/1090MHz usage	Total
ANSP	Radio Field Monitor No specific tools Joint Civil/MOD National IFF/SSR Committee (NISC) which contracts modelling through Qinetiq Calculations	1 1 1 1
ANSP Total		4
National body	"Method 1 - Theoretical calculation according "EUROCONTROL Guidelines for the means of compliance to SPI IR Article 6, edition 2.0, date 24.10.2014". UK's SSR/IFF Environment Model (SIEM2)	1 1
National body Total		2
Grand Total		6

2 ANSPs answers should be discarded at this stage: "no specific tools" and "calculations" should be too vague to be taken into account.

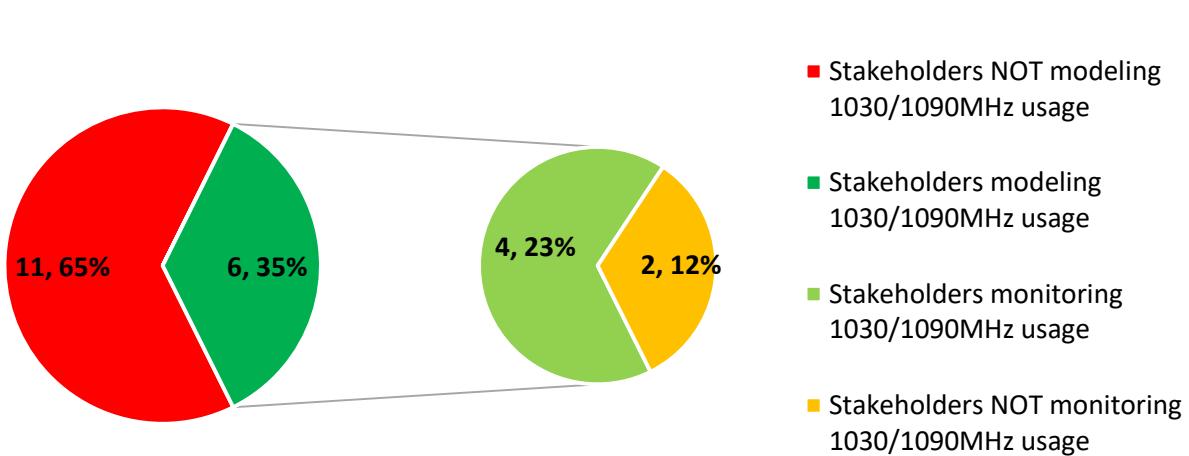
There are 2 answers referring to the same tool:

- UK's SSR/IFF Environment Model (SIEM2)
- Joint Civil/MOD National IFF/SSR Committee (NISC) which contracts modelling through Qinetiq

Overall, 3 answers are suitable for this question.

### Q.4.1.4 Do you monitor 1030/1090MHz spectrum use, e.g. in terms of interrogation rates, reply rates and channel occupancy?

#### Modeling and monitoring 1030/1090 usage





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### Q.4.1.5 Which processes and infrastructure are you using?

For the respondents who answered "yes" to the question 4.1.2:

Type of stakeholder	4.1.5.Processes and infrastructure to monitor 1030/1090Mhz usage	Total
ANSP	Assessment of anomalies from reporting system Monitoring according Raytheon manufacturer specifications No continuous monitoring - Done with Eurocontrol support SISSIM model with inputs from 8 stations (first operational station in 2017)	1 1 1 1
ANSP Total		4
National body	ROMATSA does not own a system to monitor continuously the transponder occupancy. In spite of this, during oversight activities (audits and inspections) conducted at ROMATSA (the only ANSP in Romania) by Romanian NSA, the performance of periodical determination of the transponder occupancy using theoretical calculations of the number of radars interrogations and the number of replies of aircraft transponders is verified.	1
National body Total		1
Grand Total		5

### Q.4.1.6 Do you monitor the contribution to frequency occupation of the different sources of RF transmissions (Mode A/C, Mode S, ADS-B, WAM, ACAS, Military IFF modes)?

For the respondents who answered "yes" to the question 4.1.2:

Type of stakeholder	4.1.6.Monitor of the contribution to frequency occupation of the different sources of RF transmissions	Total
ANSP	Not available No continuous monitoring - Done with Eurocontrol support Yes to a certain extent	2 1 1
ANSP Total		4
National body	Only Mode A/C and Mode S are assessed	1
National body Total		1
Grand Total		5

### Q.4.1.7 What technical performance criteria are applied?

There was only 2 answers:

- According ICAO SARP
- Probability of target detection, probability of reply decoding, ...

### Q.4.1.8 What operational performance criteria are applied?

There was only 2 answers:

- Achievement of horizontal and vertical separation requirements
- probability of target detection





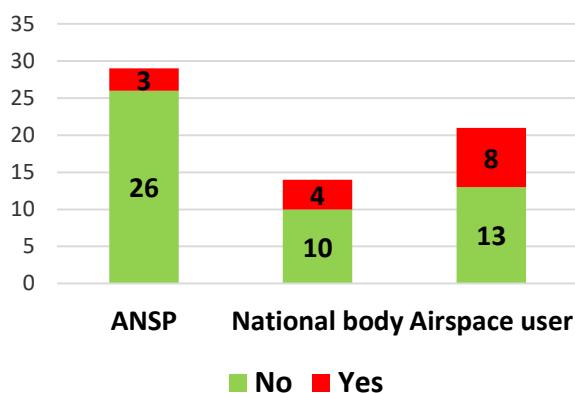
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**Q.4.1.9 (For ANSP, NAA, NSA, national bodies) Have you identified any problems with 1030/1090 MHz frequency use, within your airspace area of responsibility?**

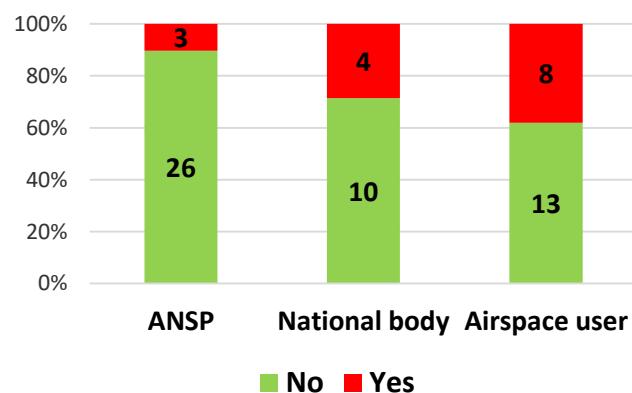
combined with

**Q.4.1.16 (for airspace users): Do you have any evidence of transponder stop replying to interrogations?**

Any problems identified with 1030/1090 MHz frequency use / transponder use?



Any problems identified with 1030/1090 MHz frequency use / transponder use?



**Q.4.1.10 if yes, please specify:**

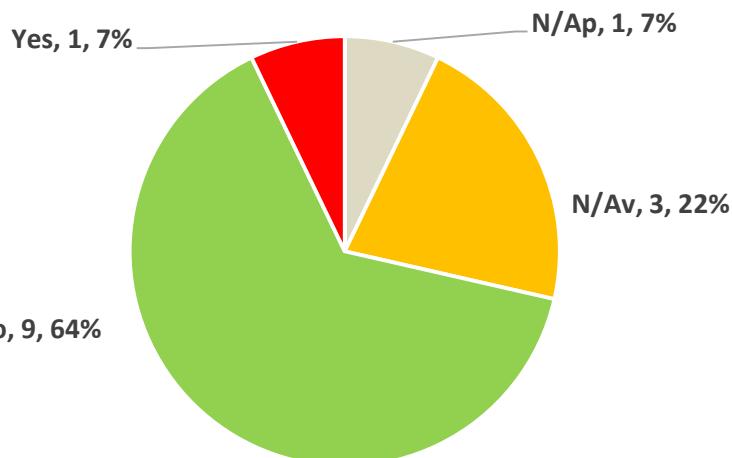
to

**Q.4.1.15 (ANSP, national bodies) What are the outcomes of the problems?**

Too limited number of answers to provide a meaningful summary. Please refer to the section 0 for an executive overview of the safety analysis for surveillance in EASA Member States.

**Q.4.1.17 (for NAA, NSA, national bodies) In relation with Regulation 1207/2011 Article 6 (1), have you experienced problems in ensuring that transponders are not over-interrogated?**

National Bodies answers

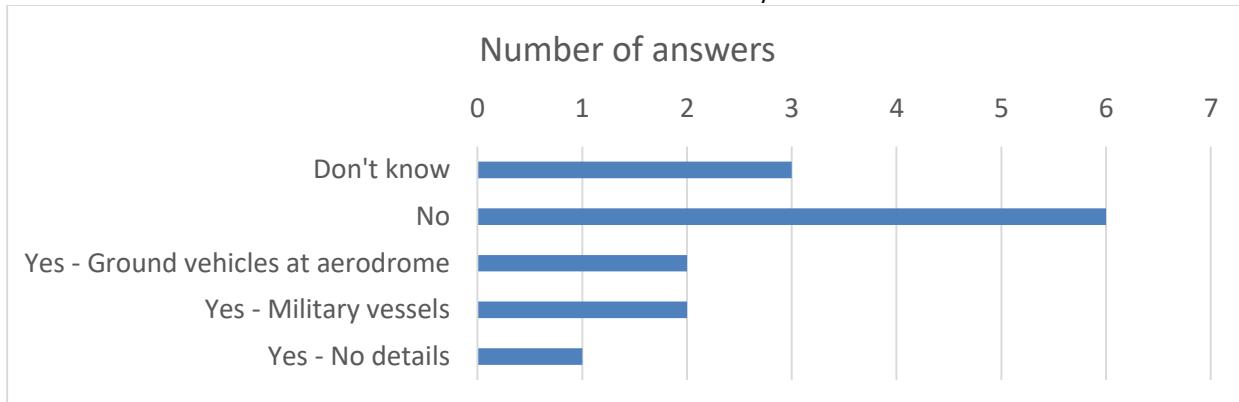




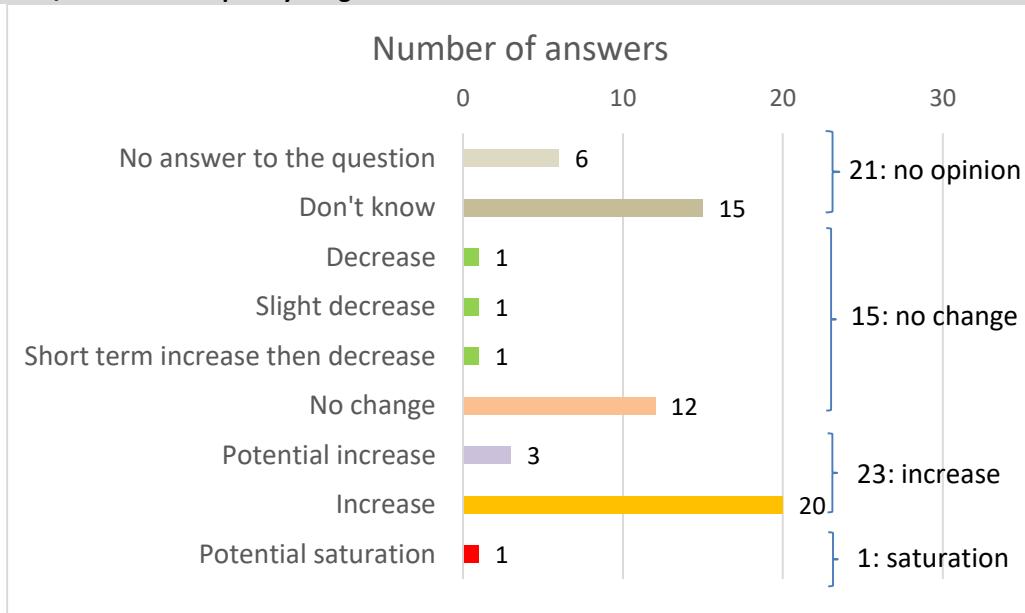
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**Q.4.1.18 (for NAA, NSA, national bodies) Are the 1030/1090 MHz frequencies used by other transport modes? (e.g. Military vessels, ...)**

14 answers out of 15 total national bodies who answered to the survey.

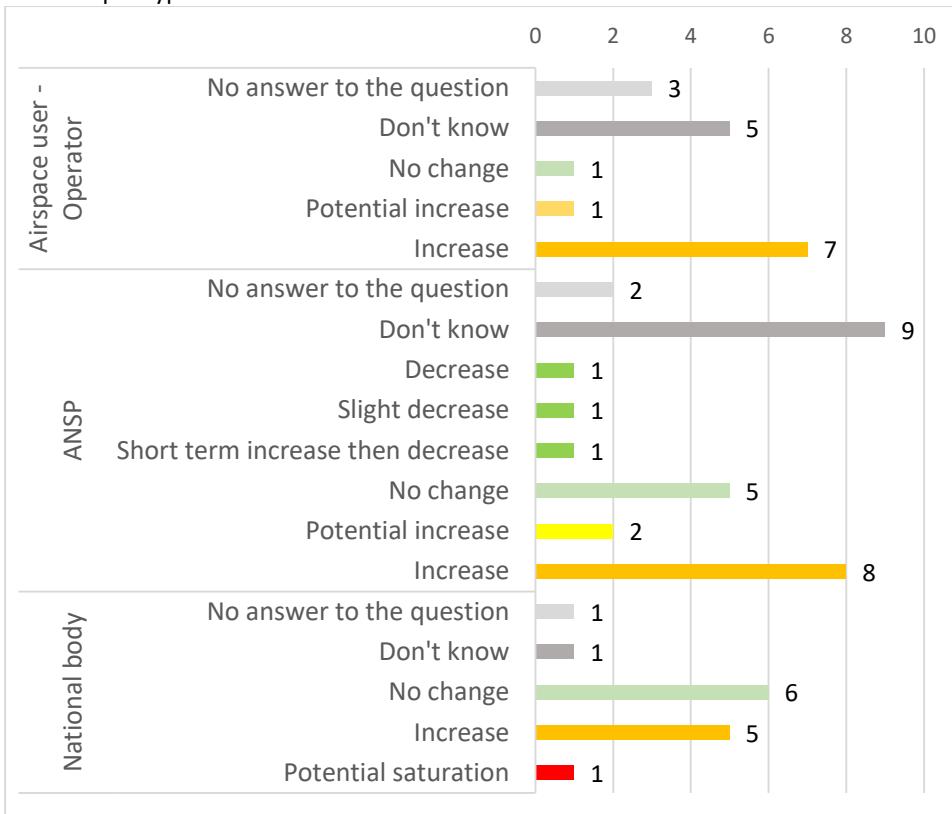


**Q.4.1.19 With the current equipment and considering the future traffic increase, how do you expect that the 1030/1090 MHz frequency usage will evolve?**





Answers per type of stakeholders



The airspace users have more a tendency to consider that there will be an increase in the usage of the 1030/1090Mhz spectrum, compared to the ANSPs and National Bodies who have a more balanced view. There is a significant number of answers from ANSPs and National Bodies stating no change or even a decrease in this spectrum congestion. However the number of answers reflecting a lack of awareness of the situation is also significant, specially from the ANSPs side. This mirrors the previous summary of answers to the questions Q.4.1.1 and Q.4.1.9. where a majority of ANSPs or National Bodies do not assess this spectrum congestion and do not report spectrum issues.

### 10.3.2. Intermediate conclusions

#### Assessment, modelling and monitoring

A minority of ANSPs (28%) and National Bodies (22%) assess the usage of 1030/1090MHz. 28% of the airspace users declare to assess this usage<sup>27</sup>. From this 1/3 of respondents again only 1/3 are able to model the use of this frequency usage (no airspace user model this usage). Each respondent uses a different model/tool. The majority of the few who model this frequency usage have installed a monitoring of the interrogation rates, the reply rates and the channel occupancy.

90% ANSPs and 65% of the National Bodies did not identify problems with the 1030/1090 MHz frequency usage. There are problems for 40% of the airspace user operators, with the caveats that the number of answers from airspace users is extremely low.

Regarding the future evolution, a 40% of the respondents foreseen an increase of this frequency usage, while 35% don't know or did not answer and 25% believe that there will be no change or even a decrease. Only one foresees a saturation of this frequency and 2 foresees at the opposite a decrease (Q.4.1.19). However, a majority of respondents consider that there will no significant impact on ground system interrogation (further question Q.4.3.7).

<sup>27</sup> This could be through reports received from ANSP? or pilot reports, the source of this information was not asked in the survey





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Conclusion:

- Only a small number of respondents model the 1030/1090MHz frequency usage.
- the significance of the spectrum congestion issue is difficult to assess, the perception being different amongst stakeholders

**Due to the lack of modelling of the spectrum congestion issue as identified above, Eurocontrol was tasked for the RMT.0679 Revision of SPI IR to develop an in-depth analysis: see Appendix 3.**

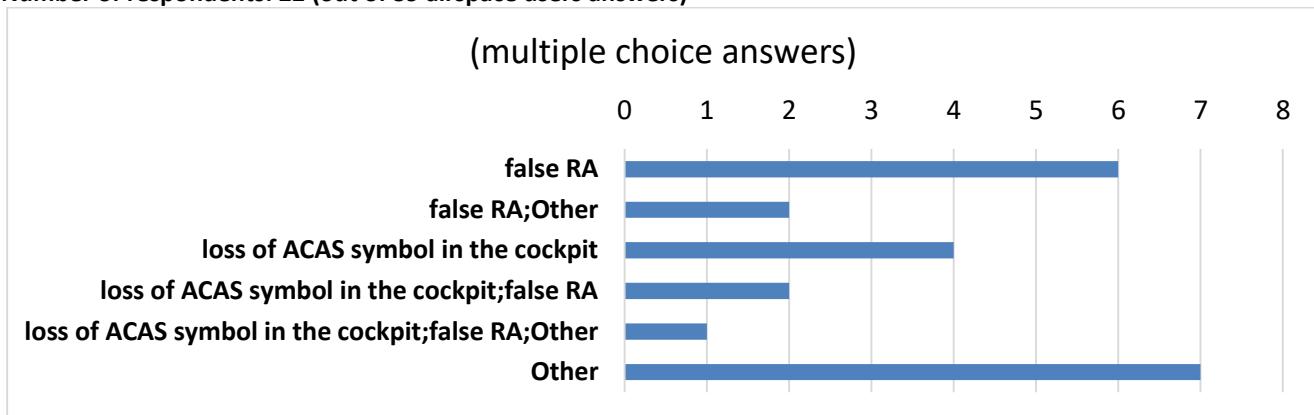
## 10.4. ACAS contribution to spectrum usage

Further the general questions above, ACAS has been specifically identified as a large contributor to spectrum usage and transponder occupancy.

### 10.4.1. Summary per question

**Q.4.2.1 (For airspace users) What type of problems have you encountered with ACAS functionality?**

**Number of respondents: 22 (out of 39 airspace users answers)**



**Q.4.2.2 If other, please specify:**

**Number of respondents: 8**

If other, please specify:

- Some rare cases reported of TA symbols freezing on one ND.
- One case of loss of ACAS symbol, solved with the replacement of the TCAS equipment type.
- Some false RA, with root cause identified as an avionic workshop performing tests on transponder.

Conflicts with GA & military aircraft not equipped with ACAS

Hardware failures

LRU failure( computer failure)

Occasional false RA from hybrid surveillance. Otherwise, very few. NB all BA aircraft are equipped with TCAS v 7.1

We have no ACAS onboard

Nil, ACAS functionality is much improved with TCAS II. No reports of spurious RAs and TAs - all generated by actual aircraft closure.

Have not experienced problems.

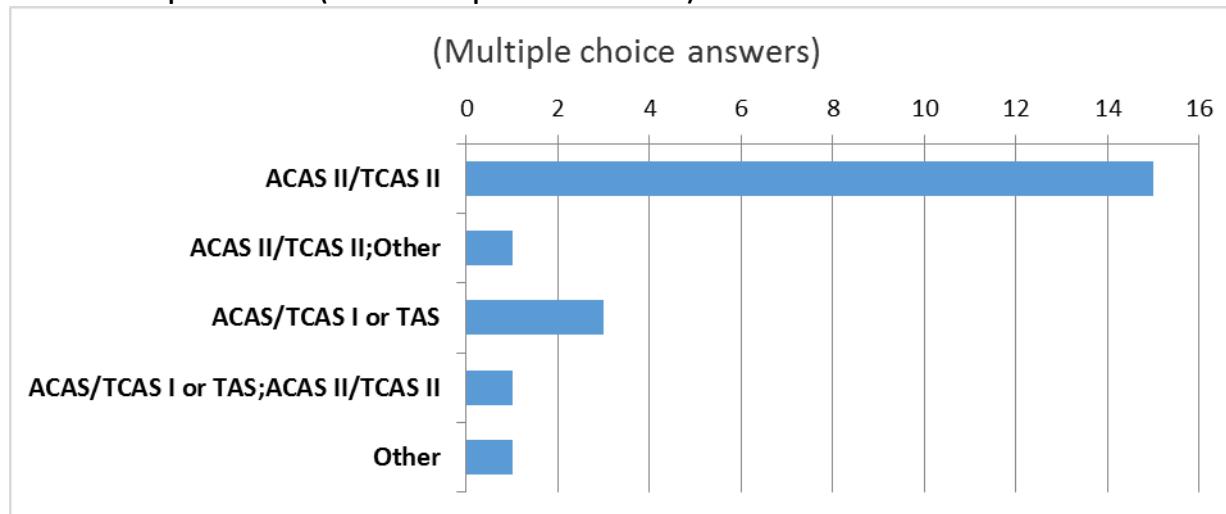




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### Q.4.2.3 (For airspace users) What type of collision avoidance system do you use?

Number of respondents: 22 (out of 39 airspace users answers)

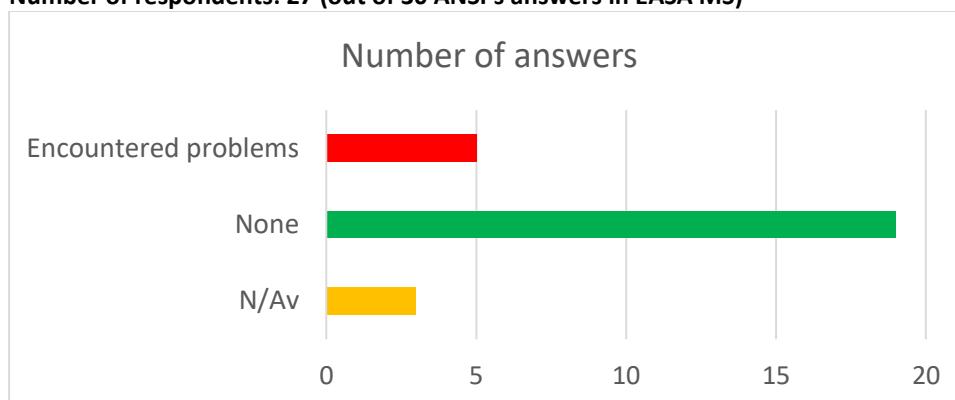


### Q.4.2.4 If other, please specify:

Only one answer out of 2 indicating "other" above: FLARM.

### Q.4.2.5 (For ANSP) What type of problems have you encountered with ACAS within your ANSP area of responsibility?

Number of respondents: 27 (out of 30 ANSPs answers in EASA MS)



For the ANSPs who indicated to have encountered problems with ACAS:

We did not identify any problem related to transponder occupancy by ACAS system, except some false ACAS alarms caused by Hybrid ACAS failures.

Sometimes only one of the two planes involved in a TCAS RA correctly report BDS 3,0

When it first entered service the rate of climb of military ac was to fast for ACAS. A maximum of 8000' per minute ROC was put in place, within controlled airspace.

We have not really seen issues with the exception of a number of well documented Airbus issues.

Loss of detection;False track/target;Reduction of quality of surveillance information

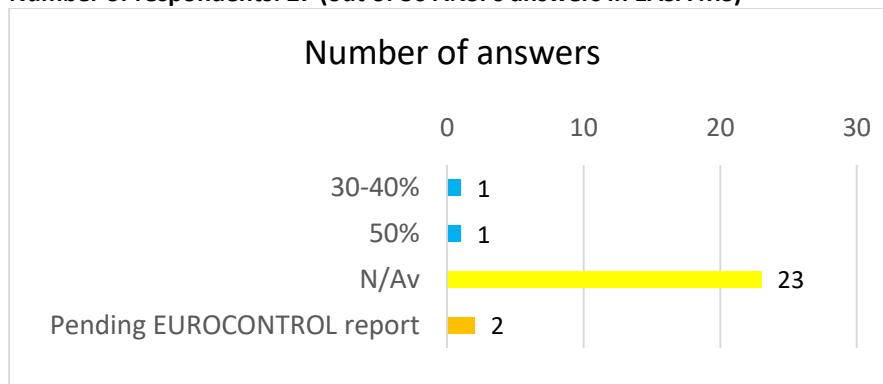




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**Q.4.2.6 (For ANSP) Please provide an estimate of the occupancy of the 1030/1090MHz frequencies that can be attributed to ACAS within your ANSP area of responsibility:**

Number of respondents: 27 (out of 30 ANSPs answers in EASA MS)



### 10.4.2. Intermediate conclusions

#### ACAS

The vast majority of ANSPs have not encountered problems with ACAS.

ACAS contribution from 30% to 50% in the usage of the frequency 1030/1090MHz, based only 2 respondents.

#### Conclusion

- no reported safety issues
- ACAS contribution to frequency 1030/1090MHz to be confirmed by Eurocontrol? There are only 2 evidences: is it representative for EASA MS area?

**Due to the assessment of the ACAS contribution to the 1030/1090MHz frequency, Eurocontrol was tasked for the RMT.0679 Revision of SPI IR to develop an in-depth analysis: see Appendix xxx.**

## 10.5. Ground system interrogations

These questions cover Mode A/C, Mode S, LAM (M-LAT) and WAM ground surveillance.  
(For ANSP, NSA, NAA and national bodies)

### 10.5.1. Summary per question

**Q.4.3.1 Is there a process to provide an approval to transmit on 1030/1090MHz?**

20 EASA Member States answered to this question.

All respondents confirmed that there is an approval to transmit on 1030/1090MHz.

**Q.4.3.2 Who grants this approval?**

EASA MS	Q.4.3.2. Who grants this approval?
Austria	National Supervising Authority and National Telecom Authority, both headed by the Federal Ministry of Transport and Innovation. Approval is needed for start of Operations. NSA
Bulgaria	Bulgarian CAA Communications Regulation Commission (CRC) of Bulgaria
Croatia	HAKOM - Croatian Regulatory Authority for Network Industries
Czech Republic	The Czech Telecommunication Office issues the general permission for transmission on 1030/1090 MHz frequency band.





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	NSA CZ (the national coordinator) coordinates/reduces/stops the actual transmission on 1030/1090 MHz as appropriate.
Denmark	Details about the technical installation of the actual radar equipment is being notified to the CAA in accordance with EU 1035/2011 - the notification shall on completion of the installation be accompanied by a technical file iaw. 552/2004. As for the frequency to be used, an approval for use has to be aquired through the CAA
France	ARCEP after DSNA recommendation In France, the Military entity CNGF (commission nationale de gestion des fréquences) is in charge of approval for new broadcasting equipment.
Germany	BNetzA (federal authority for Networks) (in coordination with BAF (NSA)) Federal Network agency (Bundesnetzagentur - BNetzA) in coordination with BAF.
Greece	Regulatory division D4. HANSA (CNS section) is in cooperation with D4 for spectrum issues.
Hungary	NSA with cooperation of the National Media and Infocommunications Authority
Ireland	The NSA. 'Approval' to introduce new radar sensors is formally conducted via the NSA safety-related change review/acceptance process as mandated by EU 1034/2011 (The NSA requires that each new sensor is formally accepted under this process). The acceptanc
Italy	For internal approval, ANSP. For formal approval, NAA.
Lithuania	The Communications Regulatory Authority of the Republic of Lithuania
Malta	Malta Communications Authority Malta Communications Authority following a coordination process with the Civil Aviation Directorate.
Norway	NKOM (national communication authorities)
Poland	Office of Electronic Communication
Portugal	The National Comunications Autorithy (ANACOM) provides licinging of all ground transmiting equipment and for "aeronautical" frequencies the NFM must be consulted.
Romania	National Authority for Administration and Regulation in Communications (ANCOM).
Slovak Republic	Telecommunication Authority
Spain	The "Secretaría de Estado de Telecomunicaciones y para la Sociedad de la Información" (SETSI), Secretary of State for Telecommunications and Information Society), dependant of the "Ministerio de Industria, Energía y Turismo" (Ministry of Industry, Energy a
United Kingdom	UK National IFF SSR Committee (NISC) - This is a joint civil and military Committee charged by statute to process Interrogator approvals and for dealing with issues concerning 1030/1090MHz environment to ensure a balanced and equitable use of this scarce resource

## Q.4.3.3 Which criteria are used? (power, PRF, ...)

42 answers

The responses indicate there are common criteria mainly in the field of radio communication like:

- Power
- PRF
- location
- Frequency
- Range
- Class of emission

However it was observed that criteria more specific to ATC were missing in most of the answers, e.g.:

- Maximum number of BDS extracted
- interrogation sequence (MIP)
- Range

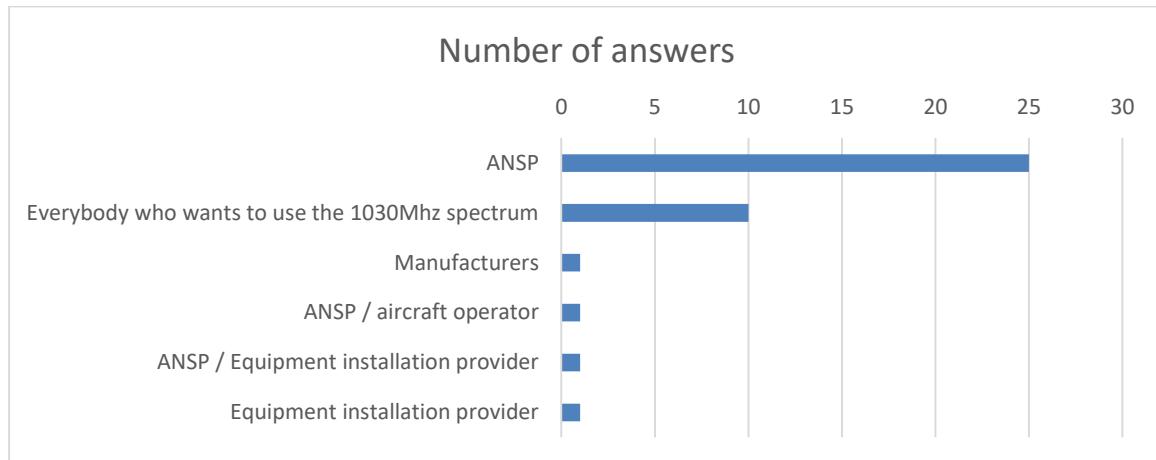




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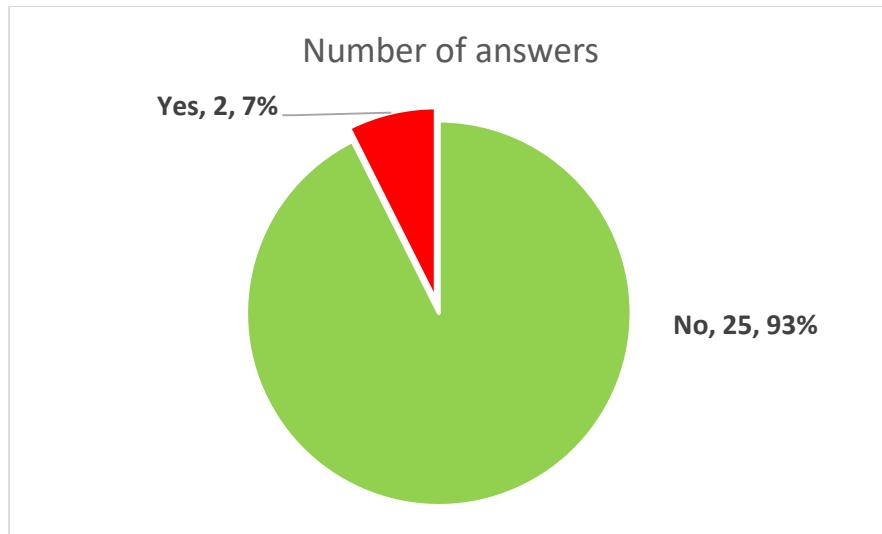
### Q.4.3.4 Who is supposed to ask for this approval? (manufacturers, ANSPs, ...)

44 answers



### Q.4.3.5 Do you encounter problems of surveillance performance requiring an increase of interrogations rate within your ANSP area of responsibility?

27 answers



### Q.4.3.6 If yes, please specify:

*(answers directly taken from the survey)*

- radar performance issue in Strasbourg TMA ==> new Mode S radar needed
- masking of Nice Mode S radar ==> WAM to mitigate
- change of evolution period to mitigate multi radar tracker issues

Monopulse systems may be used with lower interrogation rates, however due to the interferences in their environment in certain areas, higher interrogation rates are necessary.

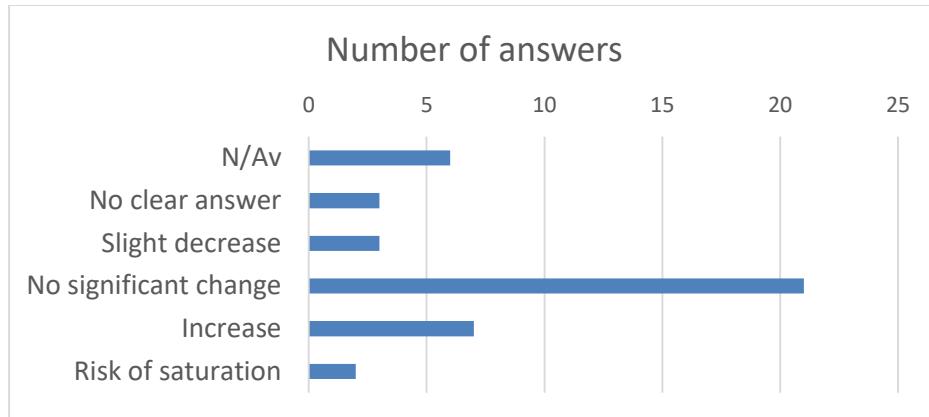




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**Q.4.3.7 With the current equipment and considering the future traffic increase, how do you expect that the ground surveillance system spectrum use will be affected within your ANSP area of responsibility?**

42 answers from ANSPs and National Bodies



**Q.4.3.8 If you expect more issues, what are the developments to prevent these issues?**

12 answers (directly taken from the survey)

Best practices follow-up
Clustering of Mode-S stations, reduction of coverage to the operationally necessary range, etc. For more see SESAR WP15.1.6. D15 and D16 and WP15-4-1 D10.
Frequency monitoring and transmission rate optimisation
Likely to be utilising more Mode S capability to reduce unwanted traffic and improve information
Need for developing a simulator and monitoring by european entity. Due to cross-border surveillance overlap, this task should be done at european level .
Proactive action - spectrum monitoring by ANS, trend analysis, early warning, cooperation / sharing information with neighboring states, keeping of the rules oversight.
The harmonized way to monitor the 1030/1090 channel occupancy should be defined. This could be done by defining common simulation models and approved measurement set to be used. We are following EUROCONTROL SGEG group to be up to date with different solutions. One of them is certainly Centralised Service CS7-2: Network Infrastructure Performance monitoring and analysis Service/Performance of 1030/1090 RF bands (NIPS/SUR-RF)
DAPs will have to be reduced and/or their request sectorized to comply with Annex 10 3.1.1.7.9 Reply rate and 3.1.2.10.3.6 Reply rate limiting. Cluster may become mandatory. Implement ADS-B and other passive acquisitions methods on surveillance systems and enable cluster operation.
As regards interference, as the necessity to share spectrum with other non-aviation applications are identified, or where there is potential for interference by technologies that use adjacent bands, the necessary supporting evidence will be collected to establish the scale of the issue, the tolerability of any residual risk or otherwise, and to identify potential solutions where necessary. This may include, for instance, not allowing other equipment to operate within a certain distance from an aviation platform, or carrying out modifications to surveillance systems etc. UK takes continuous effort to enhance the spectrum planning criteria by developing methods and tools to model the environment and identify the impact. Although there is no immediate need or concern at present there is pressure on spectrum and in future to potentially share the spectrum.
ADS-B
ModeS airspace mandate in busy air traffic volumes!





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## 10.5.2. Intermediate conclusions

### Ground system interrogation

Although there is always an organisation at national level to approve the transmission on 1030MHz frequency, there is a lack of common harmonised criteria (e.g. number of DAPs extraction, number of all call replies, ...) to regulate the utilisation of the frequency.

ANSPs are supposed to ask for this approval in the vast majority.

There was no need for a vast majority of respondents to increase the interrogation rate in order to ensure surveillance performance.

A majority of ANSPs do not envisaged significant changes regarding the use of the frequency in the future. 9 ANSPs are expecting an increase of the 1030/1090 utilisation (even 2 ANSPs envisage a possible saturation).

## 10.6. Downlinked Aircraft Parameters (DAPs)

\* Extracted BDS Registers (see doc 9871 edition 2) by your system and associated extraction rates

\* DAPs currently operationally used (i.e. one or more information elements contained in the BDS are used either by the ATM-system, ATCO or for other purposes)

### 10.6.1. Summary per question

#### Q.4.4.1 BDS and DAPs

##### General facts on the type of BDS and the type of transponder

The first 5 BDSs extracted as reported in the summary below (BDS4.0, BDS 6.0, BDS 5.0, BDS 2.0, BDS 1.0) are the same regardless if Mode S radars or WAMs are extracting them.

The parameters in the BDS 4.0 (MCP/FCU SELECTED ALTITUDE, FMS SELECTED ALTITUDE, BAROMETRIC PRESSURE SETTING) require and EHS capable transponder generally or ADS-B.

The parameters in the BDS 6.0 ( MAGNETIC HEADING, INDICATED AIRSPEED, MACH, BAROMETRIC ALTITUDE RATE, INERTIAL VERTICAL VELOCITY) require EHS capable transponder.

The parameters in the BDS 5.0 (ROLL ANGLE, TRUE TRACK ANGLE, GROUND SPEED, TRACK ANGLE RATE, TRUE AIRSPEED) require EHS capable transponder.

The parameters in the BDS 2.0 require a ELS or ADS-B out capable transponder.

##### Main outcomes:

- BDS 1,0; BDS 2,0 and BDS3,0 (ACAS RA) are used by system supporting ELS.
- First 4 BDSs (4,0 6,0 5,0 2,0?)are extracted by Mode S radars or WAM systems. However, the extraction of the registers via Mode S radars is used by 2-3 times more than the WAM technology (as reported).
- The extraction rate (per second, or antenna rotation) for Mode S and WAM are in a similar range for many parameters.
- There is quite a range of extraction rate values (e.g. aircraft identification from 5s to 263 seconds). The reason for these different rates is not understood. The results are more focussed in regards to the 'selected vertical intention' BDS. The extraction rate is generally one per scan (5-10 s). Focused results have also been reported for the track and turn BDS (4 and 17s). Analysis should be done for each of the BDSs for both Mode S and WAM (how is this relevant?)
- Aircraft Identification (BDS 2.0) is a ELS specific parameters (ADS-B squitter also provides the same information through squittering BDS 0,8).There are 5 respondents which did not extract the aircraft ID therefore not yet ready to support the use of aircraft identification as the primary means of identification. (are the respondents still using mode A/C radars?). 3 of theme are indicating that they are evaluating its use while 2 reported no plan for using ACID.
- Many parameters from the extracted BDSs are made available to the ATCOs, however approx. 70% of them are used as part of a procedure while half the DAPs made available are used in automation tools.
- Even if a complete BDS register is extracted, not all the parameters from that BDS register are used at the same rate.





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- Among other parameters, there is an interest on 'FMS selected altitude' (being under consideration by some respondents). This requires EHS capable transponder or ADS-B and correct information be sent by the FMS to the transponder.
- Less than half of the respondents are benefiting from the ACAS RAs, and a little more than half of those ones are using this as part of their automation tools to support real time operation (low respondent rate really may deem the responses not representatives).
- The parameters are also used for technical evaluations/post processing.

This is a complex subject which may need in the future additional investigations.





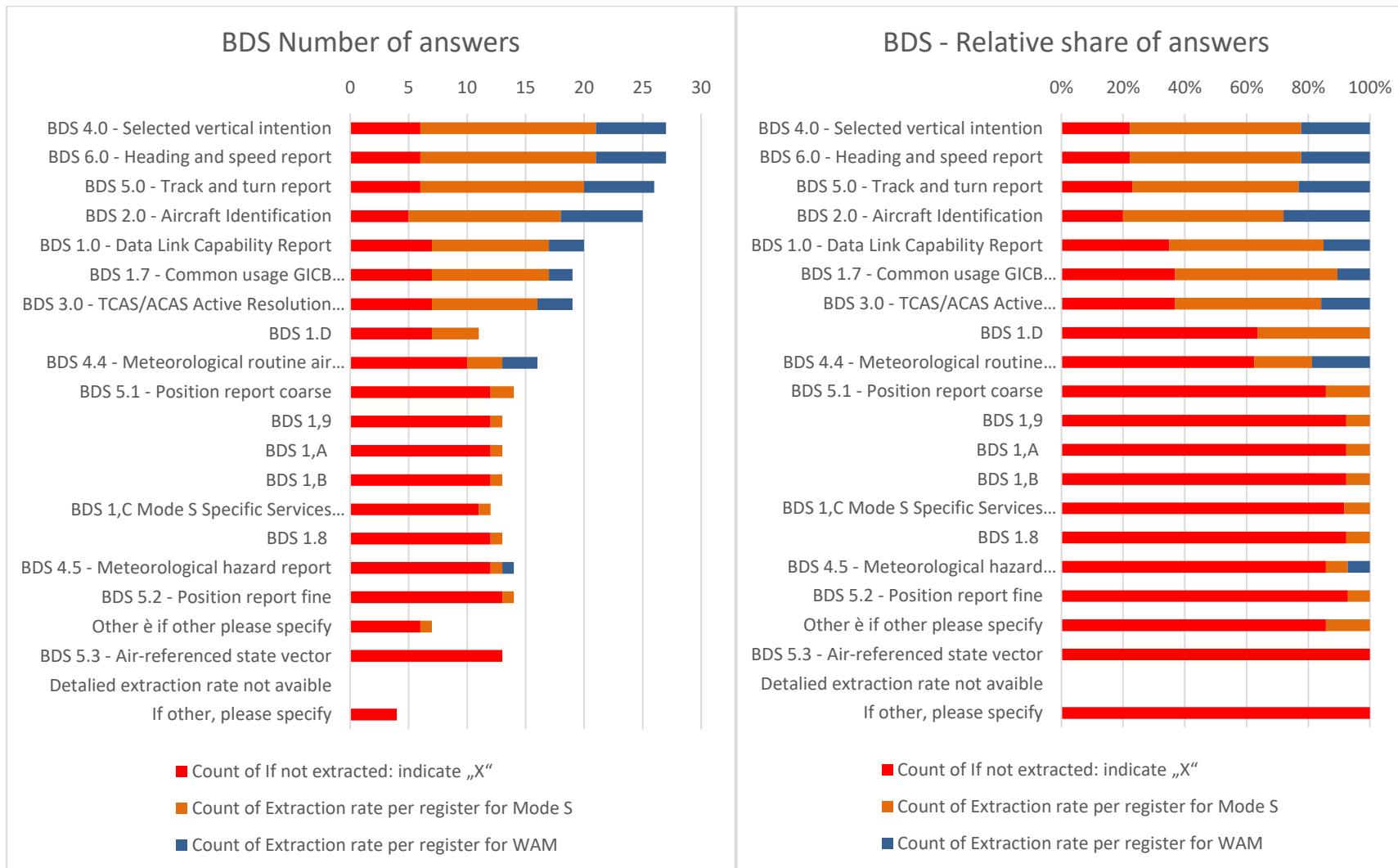
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Row Labels	Count of If not extracted: indicate „X“	Count of Extraction rate per register for Mode S	Count of Extraction rate per register for WAM
BDS 4.0 - Selected vertical intention	6	15	6
BDS 6.0 - Heading and speed report	6	15	6
BDS 5.0 - Track and turn report	6	14	6
BDS 2.0 - Aircraft Identification	5	13	7
BDS 1.0 - Data Link Capability Report	7	10	3
BDS 1.7 - Common usage GICB Capability Report	7	10	2
BDS 3.0 - TCAS/ACAS Active Resolution Advisory (on RA indication)	7	9	3
BDS 1.D	7	4	
BDS 4.4 - Meteorological routine air report	10	3	3
BDS 5.1 - Position report coarse	12	2	
BDS 1,9	12	1	
BDS 1,A	12	1	
BDS 1,B	12	1	
BDS 1,C Mode S Specific Services Capability	11	1	
BDS 1.8	12	1	
BDS 4.5 - Meteorological hazard report	12	1	1
BDS 5.2 - Position report fine	13	1	
Other è if other please specify	6	1	
BDS 5.3 - Air-referenced state vector	13		
Detailed extraction rate not available			
If other, please specify	4		





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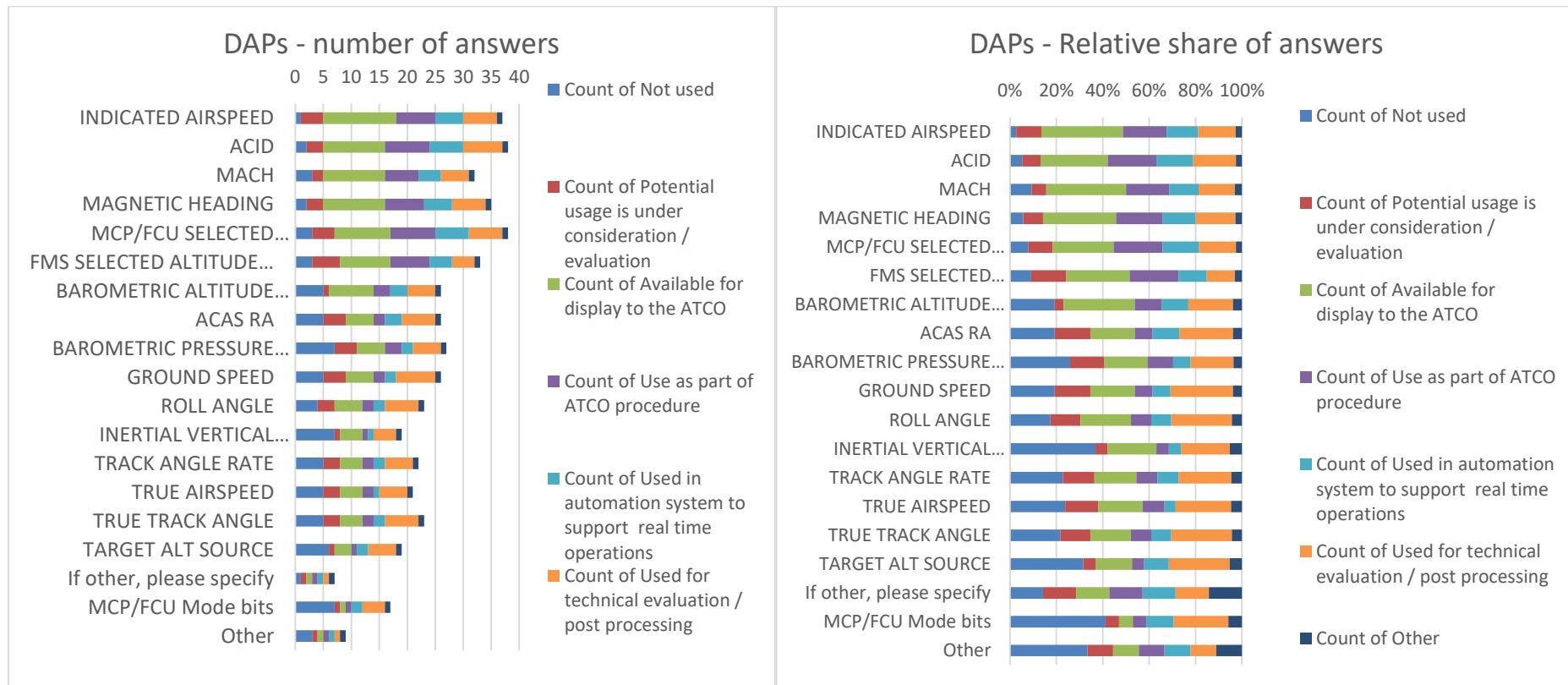
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DAPS	DAPs	Count of Not used	Count of Potential usage is under consideration / evaluation	Count of Available for display to the ATCO	Count of Use as part of ATCO procedure	Count of Used in automation system to support real time operations	Count of Used for technical evaluation / post processing	Count of Other
INDICATED AIRSPEED		1	4	13	7	5	6	1
ACID		2	3	11	8	6	7	1
MACH		3	2	11	6	4	5	1
MAGNETIC HEADING		2	3	11	7	5	6	1
MCP/FCU SELECTED ALTITUDE		3	4	10	8	6	6	1
FMS SELECTED ALTITUDE...		3	5	9	7	4	4	1
BAROMETRIC ALTITUDE RATE		5	1	8	3	3	5	1
ACAS RA		5	4	5	2	3	6	1
BAROMETRIC PRESSURE SETTING		7	4	5	3	2	5	1
GROUND SPEED		5	4	5	2	2	7	1
ROLL ANGLE		4	3	5	2	2	6	1
INERTIAL VERTICAL VELOCITY		7	1	4	1	1	4	1
TRACK ANGLE RATE		5	3	4	2	2	5	1
TRUE AIRSPEED		5	3	4	2	1	5	1
TRUE TRACK ANGLE		5	3	4	2	2	6	1
TARGET ALT SOURCE		6	1	3	1	2	5	1
If other, please specify		1	1	1	1	1	1	1
MCP/FCU Mode bits		7	1	1	1	2	4	1
Other		3	1	1	1	1	1	1
Grand Total		84	53	118	69	57	100	20





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**Q.4.4.2 In addition to this file above, please identify other data items you would need and explain for which purpose:**

**19 answers**

4.4.2.Any other data items needed	Total
1-None	13
1-None, currently a combination of the given 17 is required for the time being due to BDS aircraft configuration /Future:could support even a reduction to only 6 parameters.	
To identify causes of malfunction and trace necessary actions registers E1 to E6	1
2-BDS 4.4 is under evaluation to improve Time Based Arrival procedures.	1
2-BDS not used. SSR Mode S retrofit program in progress.	1
2-BDS use under consideration	1
2-No DAPs are used / Future: heading, speed and antenna position	1
Individual ANSPs decide what BDS registers to extract based on their requirements. In UK AIP section GEN 1.5 section 5.3 specifies the SSR transponder carriage requirements in the UK and also specifies the areas of airspace where Mode S Elementary surveillance	1

Most of the answers provided state that no additional information is needed, however information such as the transponder and TCAS version installed could be of a significant support for the monitoring and resolution of issues met with Airborne installations. Also the extraction of meteorological registers is being investigated by few ANSPs (3 answers).

## 10.6.2. Intermediate conclusions

According to the results of the survey:

- All EHS parameters are reported used for operation by at least one ANSP,
- FMS selected altitude is reported extracted and presented to ATCO however it is known that this piece of information is not readily available. The interpretation is that there was a confusion between MCP/FCU selected altitude and FMS selected altitude,
- Barometric altitude rate is reported as displayed to ATCO and used in 3 procedures although known as noisy.

There is a set of parameters (INDICATED AIRSPEED, ACID, MACH, MAGNETIC HEADING, MCP/FCU SELECTED ALTITUDE, FMS SELECTED ALTITUDE, BAROMETRIC ALTITUDE RATE) that are used by a majority of ANSPs. The barometric pressure setting is also reported as being used or under evaluation for use however airborne installations needs to be corrected before it could be operationally used.

There is another set of parameters (GROUND SPEED, ROLL ANGLE, INERTIAL VERTICAL VELOCITY, TRACK ANGLE RATE, TRUE AIRSPEED, TRUE TRACK ANGLE...) that are only used by a limited number of users.

A number of parameters are reported as operationally used although they are available on a limited/very limited number of platforms (e.g. MCP/FCU Mode bits, Target Altitude source). The use of these parameters should be checked with ANSPs that have reported their use.





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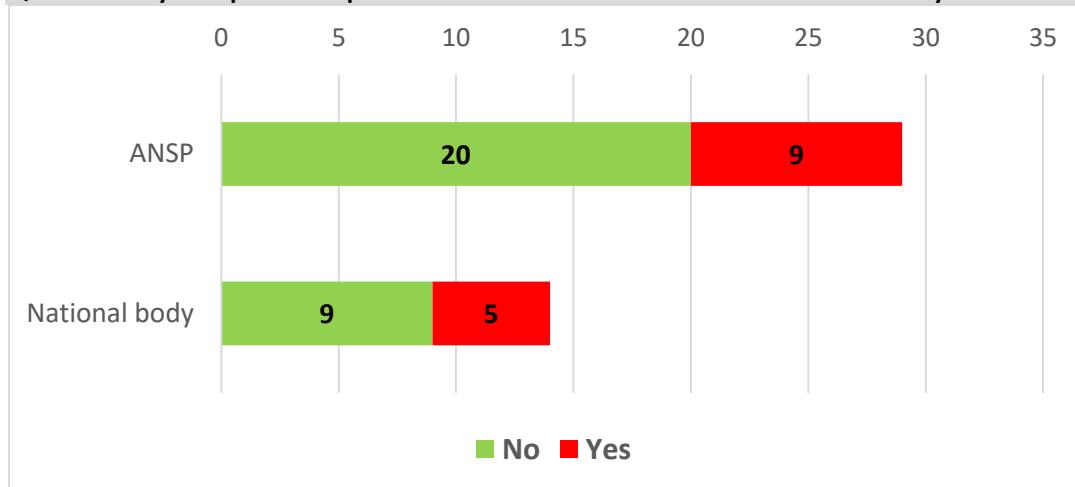
## 10.7. Harmful interferences on other surveillance systems

(For ANSP, NAA, NSA and national bodies)

In reference to Implementing Rule (EU) 1207/2011 Article 6 (3)

### 10.7.1. Summary per question

#### Q.4.5.1 Have you experienced problems with harmful interference on surveillance systems?



Note that there were 6 contradictory answers in Austria, France, Germany, Netherlands, Spain, UK: the ANSP responded "no" and the NSA responded "Yes".

#### Q.4.5.2 If yes, please specify:

15 answers

4.5.2.Details for harmful interferences	Number of answers
Not recently	1
Few IC (Interrogator Code) conflict, but with no operative effects.	1
Interference detected on SSR/mode S radars	1
Interference detected on SSR/mode S radars (same answer as R049)	1
interference on PSR	1
Interference on S Band Radar	1
Once in 2012: aircraft detection lost during 10mn due to interference in near vicinity of the radar causing receiver saturation and processing overload.	1
PSR affected by wind farm and Wimax interference effects	1
radar data processing saturation due to 1090 MHz jamming	1
Interference on the SSR & PSR system	1
Wimax/LTE deployment. LTE base stations, operating very close to the 2.6 of our non-cooperative terminal approach radar.	1
See Report to the European Commission Detection losses in Central Europe on the 5th and 10th of June 2014	4





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### Q.4.5.3 Have you identified the cause of interference effects ?

14 answers

4.5.3.Harmful interferences causes	Number of answers
No	1
- low cost Video camera	1
- manufacturer trials	
MIL radars and wind turbines	1
Private company doing tests on 1030MHz	2
Suspected Military Activity.	1
Yes (no details)	1
Mode S interrogator code conflict event due to a misconfigured UK radar locking out some targets from acquisition by a single Irish sensor (the problem had no operational impact as the locked out area was covered by overlapping surveillance coverage from	1
Imported CCT cameras operating on or near the SSR frequencies, Armature radio and TV interference on the PSR systems,	1
Faulty TV antenna booster amplifier	
Wimax/LTE deployment. LTE base stations, operating very close to the 2.6 of our non-cooperative terminal approach radar.	1
See Report to the European Commission Detection losses in Central Europe on the 5th and 10th of June 2014	4

### Q.4.5.4 Which mitigation measures did you implement?

14 answers

- identification of the owner and mandate to stop the use of the camera
- ad-hoc procedure for manufacturer trials
"Mixed Mode" usage, so no effect on CTO working position
1.MOD contacts 2.in-fill radars / small areas of blanking, enhanced processing
Agreements with the Telecom providers.
Contact MOD
None because quality of the SUR service was kept (Interference has no effect on other, redundant surveillance sensors)
Overlapping surveillance coverage with other sensors
Procedural mitigations are in place (technical solutions to be developed?)
Procedures for detection of interferences at national level
The interference sources were removed via government agencies
See Report to the European Commission Detection losses in Central Europe on the 5th and 10th of June 2014

### 10.7.2. Intermediate conclusions

#### Harmful interferences

A majority of respondents did not experience problems with harmful interferences. However 30% of ANSPs respondents and 40% of National Bodies respondents have experienced problems. These problems seem to have occurred only once and then are solved. They are linked to several aspects: IC conflict, SSR mode S, PSR. The 2014 case was several times mentioned. Causes of the issues are: low cost video cameras, manufacturer or private company trials, MIL radars, MIL activity, wind turbines, misconfigured radar, overlapping surveillance coverage.

However there was no accidents mentioned as a consequence. Apart the few cases mentioned, procedural mitigations are in place to avoid accidents and they have no negative significant operational impacts.





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### 10.8. Eurocontrol report on “1030/1090MHz usage and forecast for some geographical areas”

See report in Section 16.3

#### Extract from the executive summary:

“This study using an RF model has looked at the evolution of 1090 MHz frequency for different future scenarios (2025 and 2035) based on a busy 2016 week day. Although these scenarios do not necessarily correspond exactly to the final regulatory approach under development their simulations give some indications on the 1090MHz RF expected evolution at different places in Europe.

Ground scenarios are based on EUROCONTROL Mode S implementation data and data reported by stakeholders through the RMT.0679 EASA survey. The aircraft scenario is based on the surveillance data recordings received from MUAC, Sweden, Croatia and Spain for Friday 09/09/2016 that was a peak day in Europe with 35,594 flights.

#### The study shows that, without further measures put in place:

- the occupation of 1090 MHz RF band would become “unsustainable” in some areas;
- the occupation of 1090 MHz RF band would remain “acceptable” outside core area.

The study shows, and it is further confirmed by recordings, that transponders are often interrogated in such a way that in order to reply to these interrogations they should exceed the maximum Mode S reply rate specified in ICAO Annex 10 Vol IV. Although some transponders are able to sustain such high rates some will not; the behaviour of such transponders under these conditions may generate surveillance gaps. Such gaps were already observed in June 2014 where several tens of aircraft were no longer detected by cooperative surveillance systems (see EASA report<sup>28</sup>).

The 4 main contributors to the occupancy of the 1090 MHz RF band in 2035 would be:

- Mode S TCAS replies;
- Long Mode S Roll-Call replies;
- Mode S All-Call replies;
- ADS-B Extended Squitters.

<sup>28</sup> Report to the European Commission Detection losses in Central Europe on the 5th and 10th of June 2014 In response to letter DG MOVE E2/OW/nd A(2014) sent by the European Commission to the Agency on the 25th of July 2014, Report-ED0.1-2014-ed04.00





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## 11. Lack of performance and functionality targets

Initial feedback from stakeholders is that there might be a lack of performance and functionality targets due to European planning fragmentation, lack of a common vision and lack of support to implementation of the surveillance regulations.

### 11.1. Main outcomes

#### Overall

There are no significant issues which have been reported to support the statement that there is a lack of surveillance performance and functionality targets.

A common policy is to have cooperative surveillance mandated in controlled airspace. Some ANSPs extend this policy to all airspace classes (1/3). Regarding non-cooperative surveillance, the use of PSR is predominant for TMAs with a certain level of traffic (3 ANSPs use it also for en-route).

Regarding the technical ground system, while there is a trend to install ADS-B, there are currently a mix of different techniques (WAM, Mode S, Mode A/C). The lack of coordinated implementation plans between ANSPs at ground level could be the major source of the perceived lack of surveillance performance and functionality targets. No issues with the current performance as well as no additional needs for future performance were identified, however rather a lack of coordination of technology implementation. The ground surveillance system is mainly relying on Mode S radars. However, there are still Mode A/C radars in operation. There is currently a transition where the remaining Mode A/C radars are being decommissioned. However it has to be noted that some military ANSPs plan to continue the operation of a high number of Mode A/C radars beyond 2030. Multilateration has been deployed in some areas while ADS-B stations are being installed but not yet used operationally. The results of the survey show that the majority of ANSPs have a plan to move to a mix of Mode S /WAM/ADS-B systems. As a result the airspace users do not see yet the benefit of the future system which is gradually implemented on the ground.

#### Conclusion

It is proposed that optimisation of ground infrastructure as well as identifying a harmonised minimum required performance criteria for various surveillance applications should be one of the main objectives when developing options in order that the airspace user knows which types of transponder will be supported by the surveillance system in the future.

#### Additional information:

- ANSPs are implementing in majority Eurocontrol standards on a voluntary basis (they are not formally recognised means of compliance in the SPI IR).
- There is only a limited number of geographical areas which have been reported where surveillance could be improved. Most of the answers refer to non-controlled airspace classes. ANSPs answers may be sufficient to support this statement, however there are not sufficient answers from airspace users to ensure the validity of this statement. Eurocontrol provided a list of 51 aerodromes with surveillance operational needs, list provided in cooperation with IATA in 2007: after the feedback from the ANSPs<sup>29</sup>, it can be concluded that very few of these aerodromes are missing surveillance capability. The analysis of some case studies did not bring the evidence that adding providing surveillance based on ADS-B technology is the key contributing factor to make small airports attractive to expand aviation business.

The following table indicates how significantly are the performance issues linked to the other identified problem areas.

**Table 10- Conclusions for the problem definition on the link between the lack of performance/functionality targets and ...:**

Problem area	Conclusions
lack of surveillance performance and functionality targets	No evidence
lack of continuity of 1030/1090 MHz frequency	No evidence
lack of cost efficiency with the surveillance equipment	No evidence
lack of interoperability between surveillance equipment	No evidence

<sup>29</sup> March 2017



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lack of security of data transmitted	No evidence
--------------------------------------	-------------

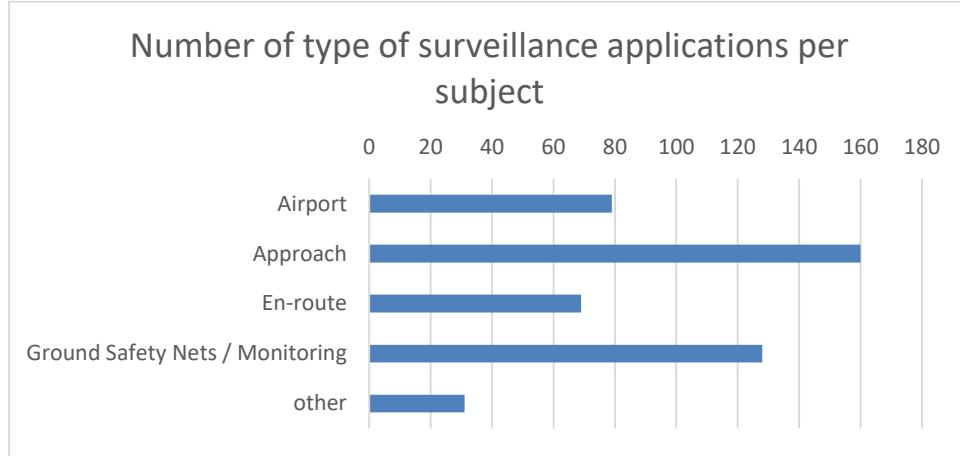
### 11.2. General information on surveillance applications

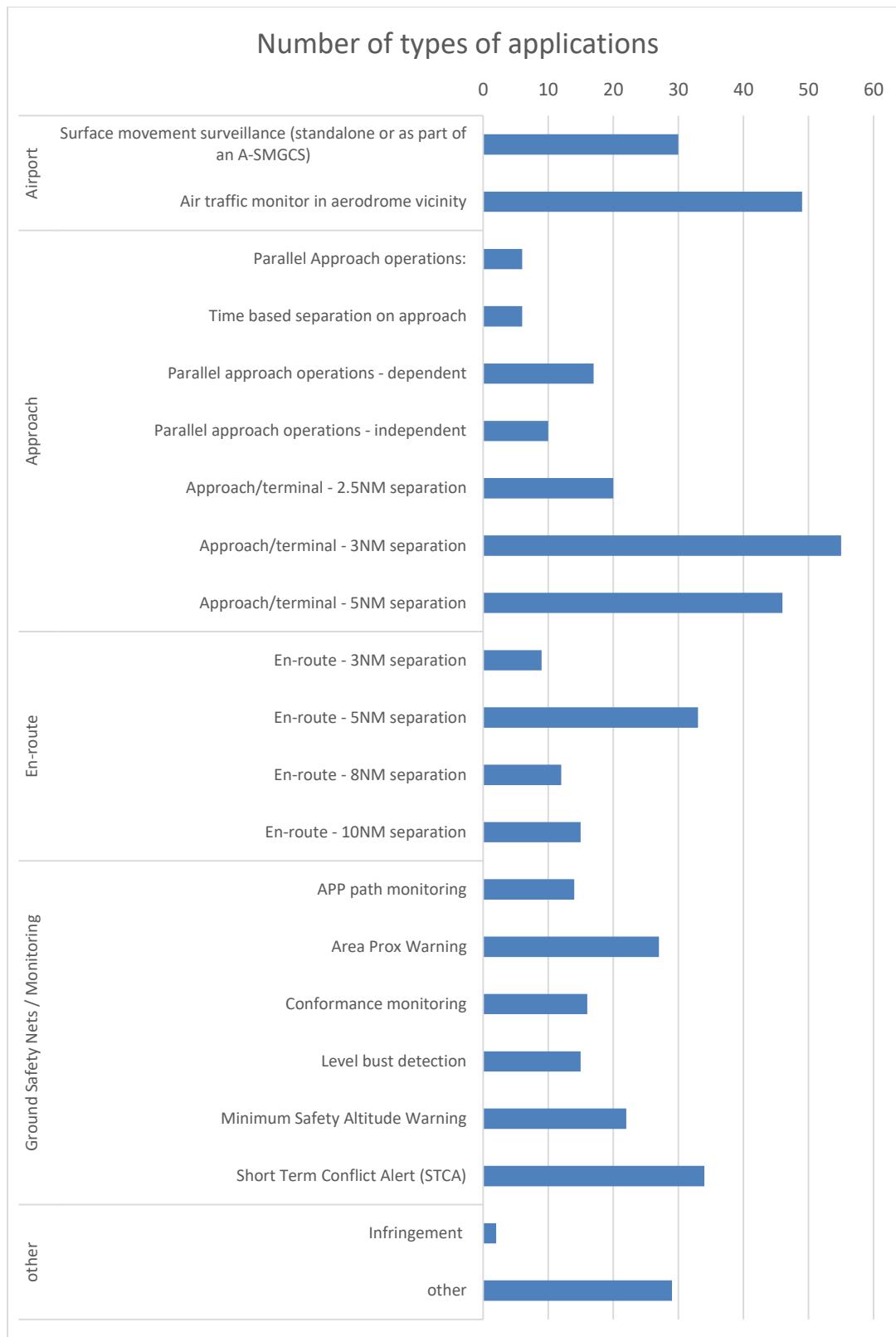
Identify the surveillance applications you are currently using regarding the type of surveillance:

#### 11.2.1. Summary per question

Q.5.1.1 (ANSPs) Air/Ground Applications

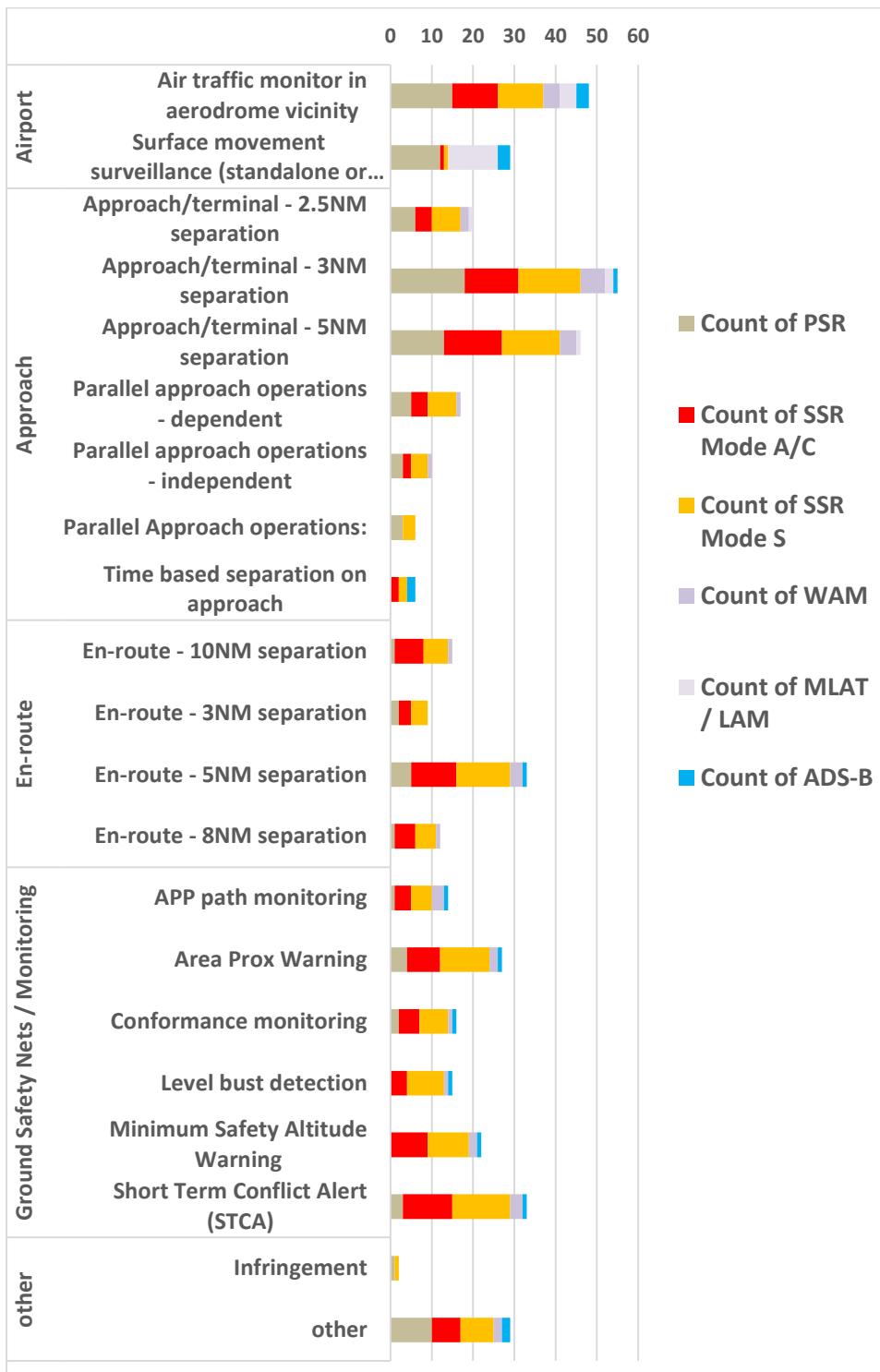
24 respondents





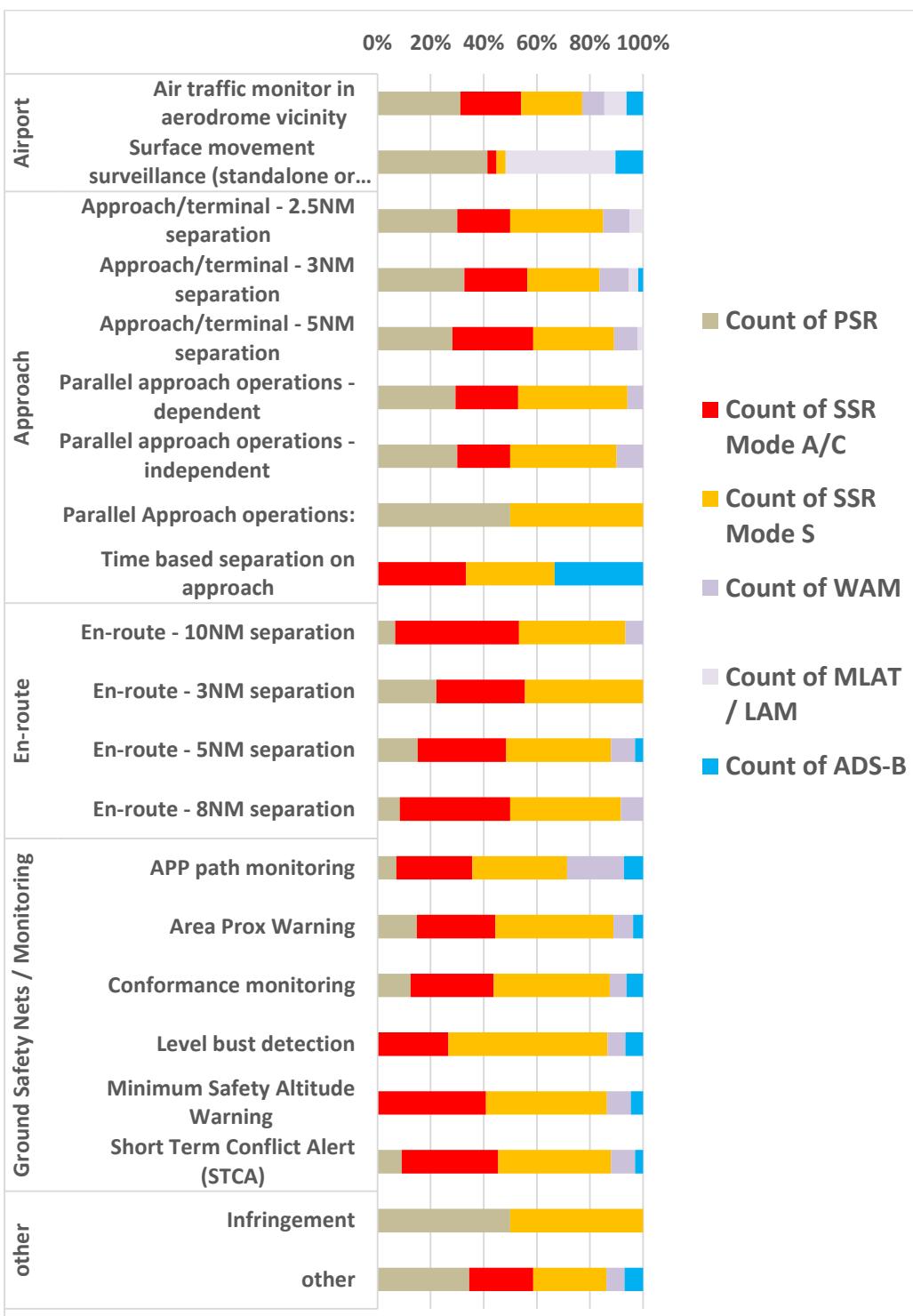


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- The airport/aerodrome application mostly used is air traffic monitor. Surface movement surveillance comes in second. Overall airport/aerodrome specific applications rely still on PSR, while mode A/C is still reported as being used by the same number of respondents using the Mode S. MLAT technology is used even more than Mode S. Additionally, A-SMGCS relies mostly on primary radar and MLAT.
- For approach the application mostly used is 3nm, however 5NM and 2.5NM are also used depending on local needs. For the approach phase, applications are mostly using Mode S, while primary radar is still widely used. Additionally, mode A/C radar is used less however not significantly less than Mode S radar. WAM is also used for some 3 and 5 NM separation applications.





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- For en-route 5NM is mostly used, 8/10 nm are also used and in limited number of places 3NM is used. For en-route, mode S is mostly used to support the applications, however Mode A/C is also used almost as much to support similar applications. Primary radar is still used for en-route, however almost 30% of the cases compared with usage for Mode S or Mode A/C.
- Surveillance data is supporting ground safety nets and tools.
- For ground-safety nets mode S is clearly in the lead, followed by mode A/C (80 % of mode S). It should be noted that primary radar is still used in 15-20% compared with the mode S.
- Overall, the applications are supported mostly by Mode S radars, followed by Mode A/C and primary radars.

### Q.5.1.2 (Air space users) Air/Air applications

Are you currently using any ADSB In application within your flight operation? If yes please list (eg. SURF, VSA, ITP...)

#### Outcome:

The feedback on ADSB in applications is very reduced. There are however few applications for ADS-B In however it appears that their use is extremely limited. The other option is that the question did not draw interest or was not properly understood or formulated.

Out 16 responses, 9 stated clearly it is not used. For the others, the question may not have been understood. It is not really used today, some are planning for the future.

### 11.2.2. Intermediate conclusions

In general there are common surveillance applications for approach (3NM), en-route (5NM) with some differences depending on local needs.

There is uniformity in the applications used in Europe. The different ground surveillance means are sufficient to support an uniform use of applications.

For surface surveillance is derived from primary radars and MLAT. Overall airport/aerodrome vicinity specific applications rely still on a mix of PSR, mode A/C and Mode S radars.

For approach the applications are supported by 32% Mode S, 25% mode A/C, 30% PSR, 10% MLAT, 2% ADB-B. Primary radar is often used, and we see also MLAT and ADS-B. For the approach phase, applications are mostly using Mode S, while primary radar is still widely used. Additionally, mode A/C radar is used less however not significantly less than Mode S radar. WAM is also used for some 3 and 5 NM separation applications.

For enroute, the application is supported by cooperative surveillance system provided by mode S (55%) and by mode A/C. Primary radar is still used for enroute, however almost 15%. ADS-B is not really used. There are still a lot of mode A/C radars.

For ground-safety nets mode S is clearly in the lead, followed by mode A/C (80 % of mode S). It should be noted that primary radar is still used in 15-20% compared with the mode S.

Overall, the applications are supported mostly by Mode S radars, followed by Mode A/C and primary radars. Non cooperative ground surveillance is still reported as largely used.





### 11.3. Cooperative and non-cooperative surveillance policies (of ANSPs)

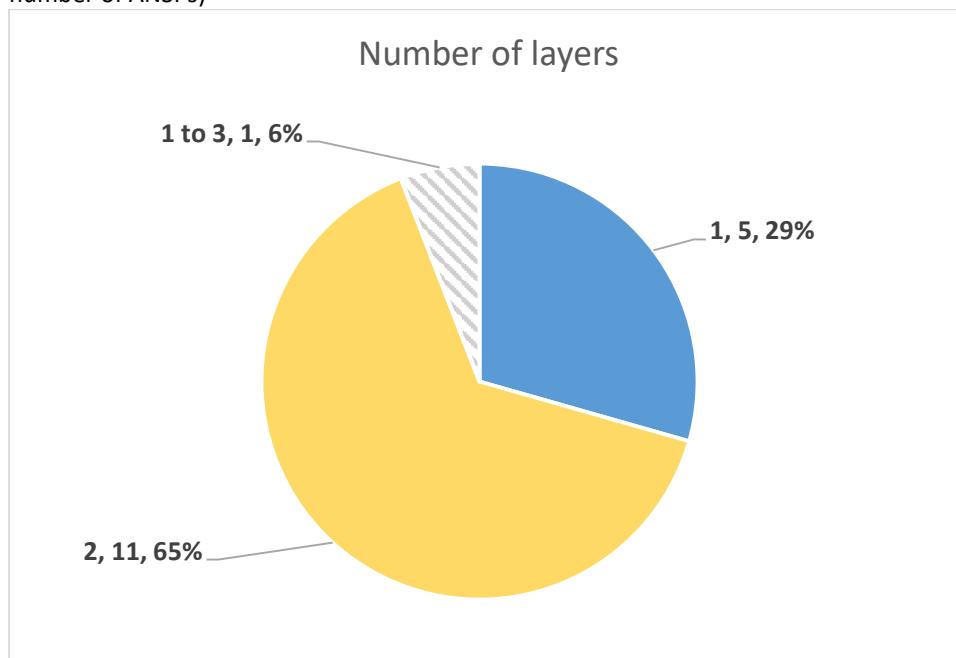
For the following questions:

Please explain in terms of need, purpose and applications. Take into consideration also the number of layers, the need for buffer zones, developments with regard to service provision and operation of systems (e.g. availability, maintenance, supervision of functions).

#### 11.3.1. Summary per question

##### Q.5.2.1 What is the national policy in your state with regards to co-operative surveillance?

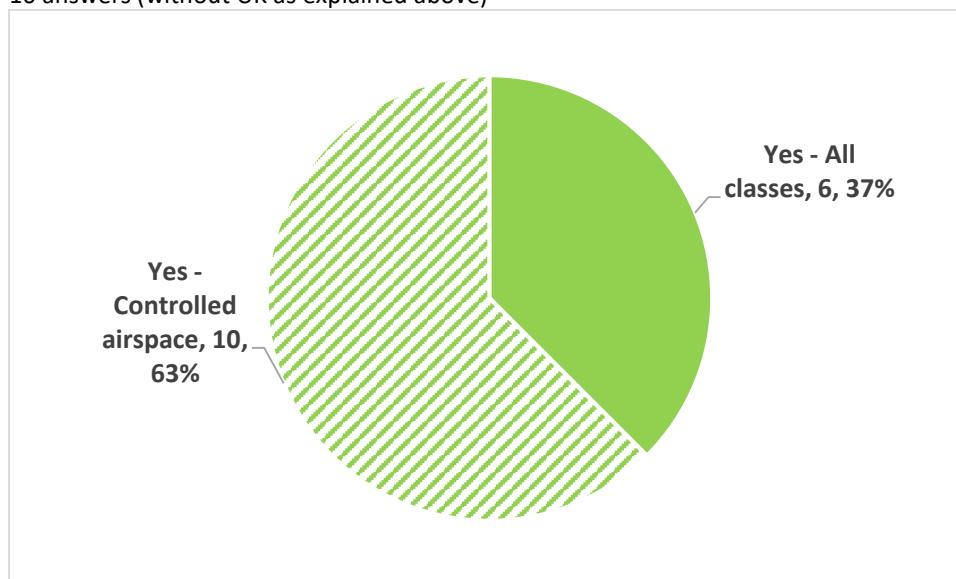
Scope: 17 relevant answers for EASA MS (without UK as it was not possible to draw a reasonable statement due to the high number of ANSPs)



Conclusion: A majority of the respondents (63%) have at minimum 2 layers for cooperative surveillance. 29% have only one layer of cooperative surveillance. One EASA Member State has from one to 3 layers depending the area.

##### Q.5.2.2 Is co-operative surveillance mandated in any part of the airspace?

16 answers (without UK as explained above)





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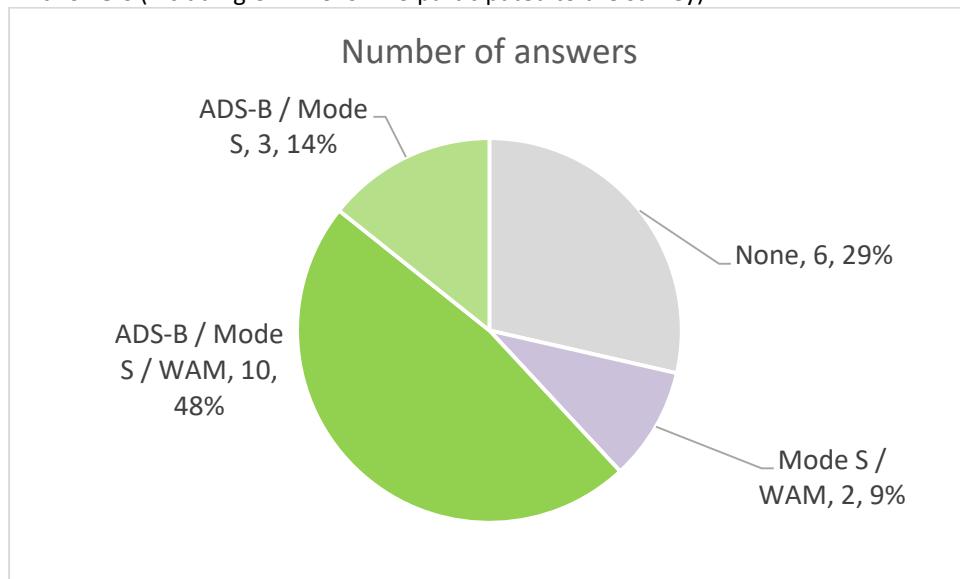
Cooperative is mandated in all the EASA Member States who answered to the survey. However the areas under cooperative surveillance are different from one country to another.

There are 2 main categories of respondents: the ones where cooperative surveillance is mandated for all airspace classes and the ones where it is mandated only in controlled airspace. Some respondents take also into account Flight Levels.

Note: The limits of airspace classes in terms of FL for one country to another can be significantly different.

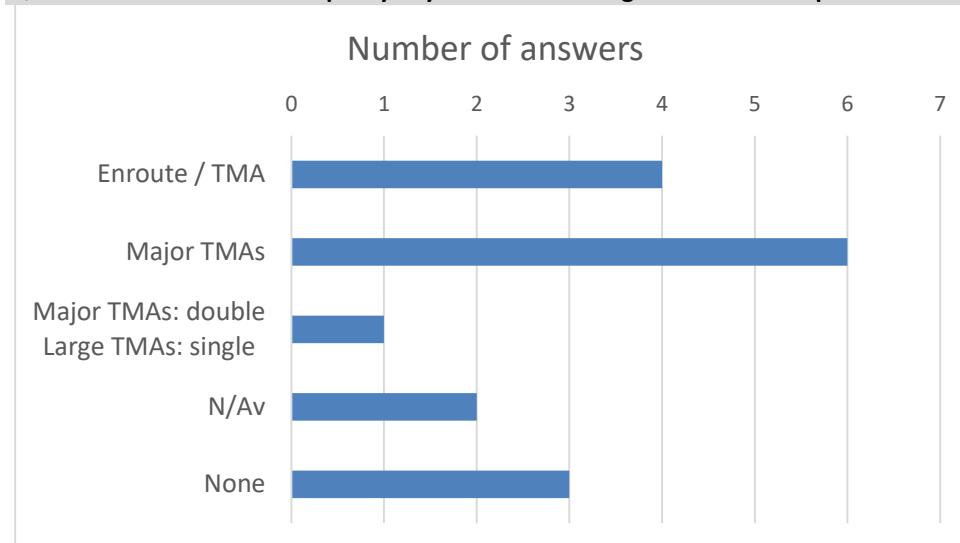
### Q.5.2.3 What are your implementation plans for co-operative surveillance if any?

21 answers (including UK ANSPs who participated to the survey)



29% of the respondents indicate that their plans consider maintaining their current surveillance infrastructure. For a majority of the answers (62%)<sup>30</sup>, they are planning to include one ADS-B layer. 2 answers refers also to implement Mode S and WAM without referring to ADS-B. No ANSP is planning implementing new mode A/C.

### Q.5.2.4 What is the national policy in your state with regards to non co-operative surveillance?



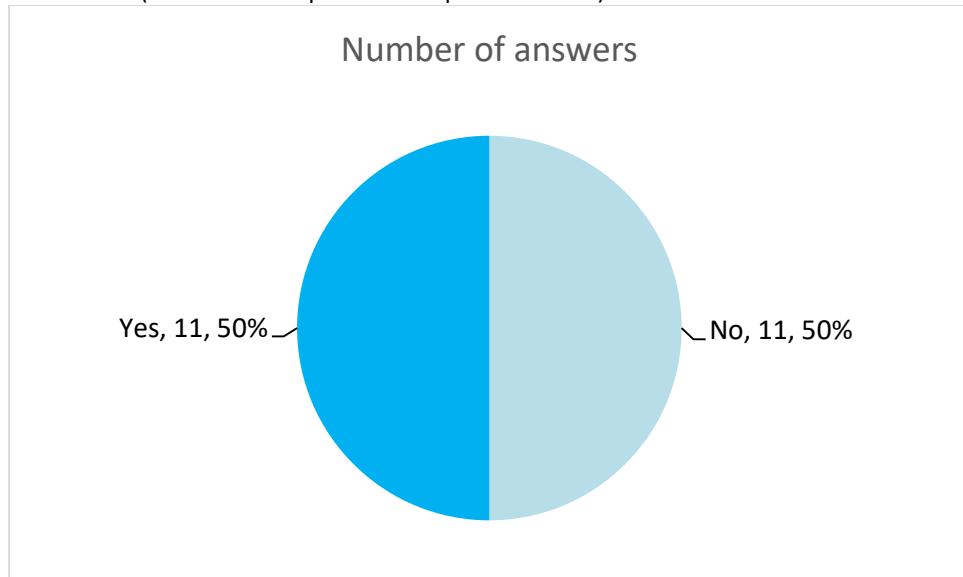
The use of PSR is predominant for TMAs with a certain level of traffic. 4 ANSPs use it also for en-route. 3 ANSPs indicated that they do not use PSR.

<sup>30</sup> =14%+48%



**Q.5.2.5 Is non co-operative surveillance mandated in any part of the airspace?**

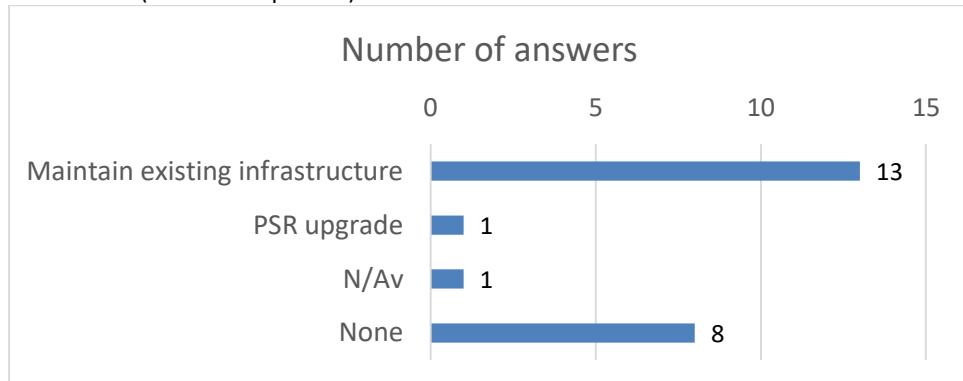
22 answers (without UK responses as explained above)



Half of the countries mandate non-cooperative surveillance layer in some parts of their airspace, predominantly in major TMAs.

**Q.5.2.6 What are your implementation plans for non co-operative surveillance if any?**

23 answers (with UK responses)



A majority of the responses indicate a plan to maintain non-cooperative surveillance.





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## 11.4. Performance requirements - SPI IR Article 4

Implementing Rule (EU) 1207/2011, Article 4 (1) requires:

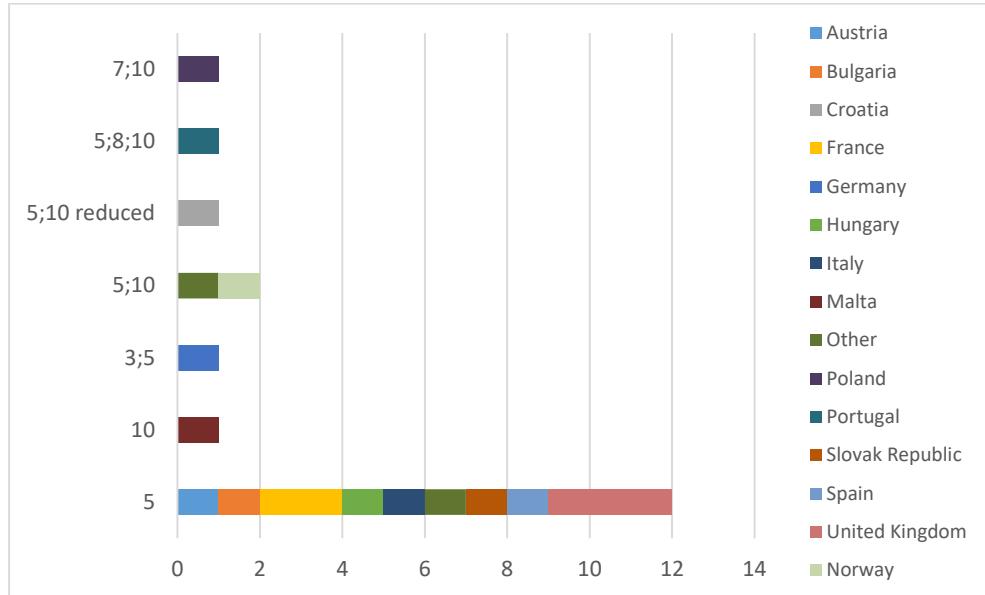
Air navigation service providers shall ensure seamless operations within the airspace under their responsibility and at the boundary with adjacent airspaces by applying appropriate minimum requirements for the separation of aircraft.

### 11.4.1. Summary per question

#### Q.5.3.1 Situation within your airspace under your responsibility: what separation values are applied?

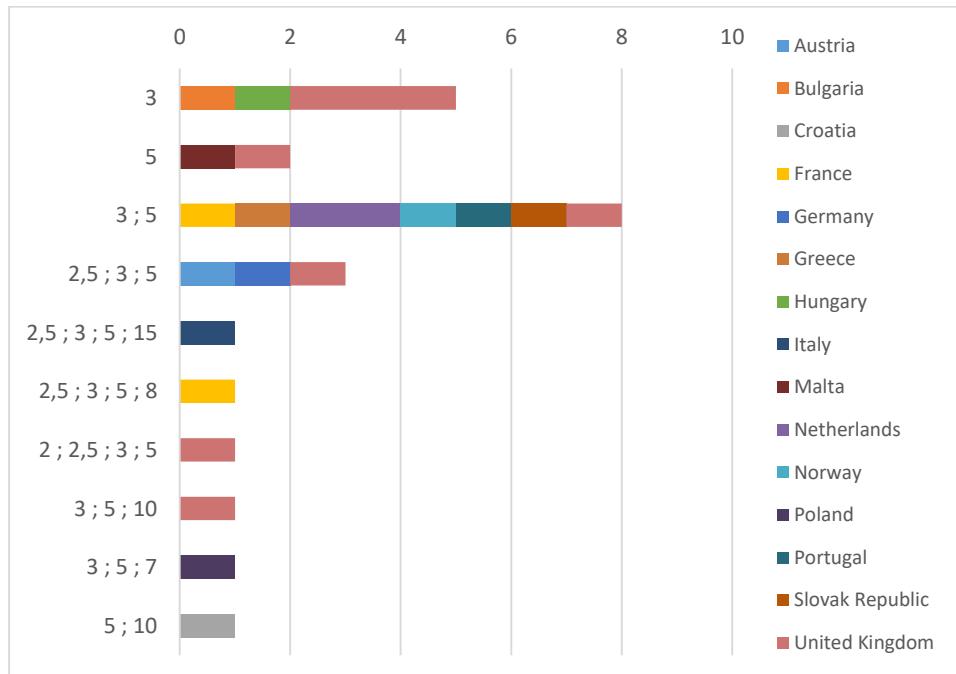
En-route

23 answers



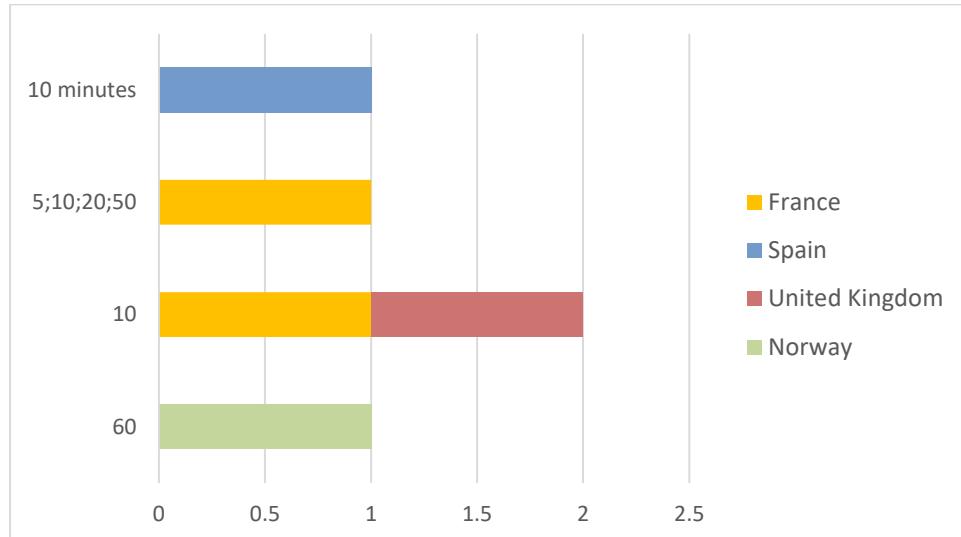
TMA

24 answers





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**Oceanic****4 answers**

Note: not under the scope of the regulation SPI IR.

## 11.4.2. Intermediate conclusions

5NM is supported in general for En-route. There are higher values some adjacent control centers however nothing is indicating that this is due to surveillance performance.

For TMA, 3NM is the normal value. There are other values depending local needs.

There are no specific problems with seamless operations as required by SPI IR Article 4.





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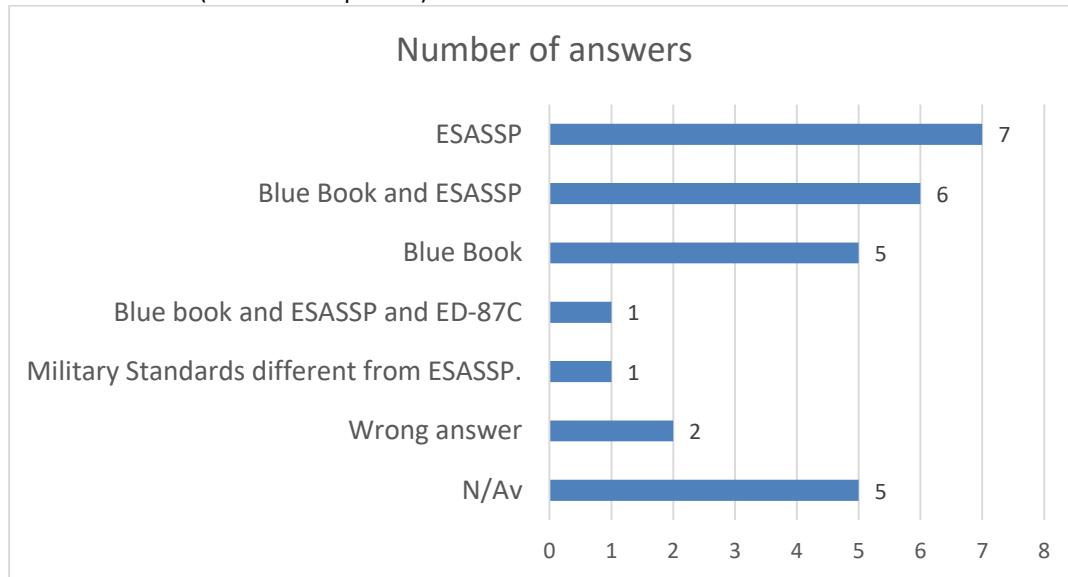
## 11.5. Performance requirements - SPI IR Annex I section 2

### 11.5.1. Summary per question

Indicate which of the following performance requirements are defined (please indicate the values), detail whether these are applied to the surveillance chain or a single system within the chain in terms of:

#### Q.5.4.1 data accuracy

22 valid answers (out of 27 responses)



ESSASP and/or the Blue Book are used by the majority of the respondents. These standards are used by ANSPs to comply with SPI IR Annex I section 2. They contain target values for data accuracy.

Military standards were also used (different from the ESSASP).

Performance Requirements for 3 NM/5 NM Separation Application:

- SUR 02.47 Surveillance Performance criteria have been developed by EUROCONTROL for 3 NM and 5 NM applications for both co-operative and non-co-operative surveillance techniques.
- SUR02.48 The values in the following specification may be used as guidance by ANSPs. This document will be updated as new standards are developed by ICAO or European bodies such as EASA or Eurocontrol.
- SUR02.49 The ATM Surveillance System Performance Specification is available at: [www.eurocontrol.int/documents/eurocontrol-specification-atm-surveillance-system-performance](http://www.eurocontrol.int/documents/eurocontrol-specification-atm-surveillance-system-performance)

Note for CAP670:

CAP 670 SUR02 does make reference to ESASSP as follows just for 3NM and 5NM separation applications. But as you can see it's not mandatory. It is as guidance. The ANSP has to justify to us the performance criteria they have applies and give evidence as to what performance the system meets. Complying with CAP 670 does not mean the system is compliant with Blue book or the ESASSP standard unless otherwise the ANSP declares their system is compliant with them in their safety case for the surveillance system concerned.

**Example of detailed expected answers:**

Answer from UK:

- Meets Eurocontrol (3N\_N-R4)

Answer from UK:

- PSR Range Accuracy <120m
- PSR Azimuth Accuracy <0.15 degrees

Spain:





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- On single system within the chain, calculated for MSSR:  
systematic errors:  
slant range bias < 100m  
azimuth bias < 0,1°  
slant range gain error < 1 m/NM  
timestamp error < 100 ms  
random errors:  
slant range < 70m  
azimuth < 0,08°
- For the full surveillance chain, ENAIRE guarantees that the parameters of EUROCONTROL Specification for ATM Surveillance System Performance (ESSASP) R3, R4, R7, R14, R16, R17 are met.

Norway: ESASSP R4

Malta: 500m surveillance chain

France:

The assessment is done at the controller display level. This means that all the data processing and the implied delays of the surveillance chain are taken into account. The requirements are compliant with ESASSP.

Horizontal position RMS error: see 5.4.6

Horizontal position errors: Less or equal to 0.1 % of target reports with errors larger than 0.5 NM (3 NM), 0.8 NM (5 NM), 1.3 NM (8 NM), 1.6 NM (10 NM)

Horizontal position errors: Less or equal to 0.9 NM (3 NM), 1.13 NM (5 NM), 1.8 NM (8 NM), 2.3 NM (10 NM) for 100% of the flights, any flight above shall be investigated

Ratio of target reports involved in sets of 3 consecutive correlated horizontal position errors larger than 0.3 NM (3 NM), 0.5 NM (5 NM), 0.8 NM (8 NM), 1 NM (10 NM): 0.03 % (recommendation)

Track velocity RMS error for straight line: Less than or equal to 8 kt (3 or 5 NM), 12 kt (8 or 10 NM) (recommendation)

Track velocity RMS error for turn: Less than or equal to 16 kt (3 or 5 NM), 24 kt (8 or 10 NM) (recommendation)

Track velocity angle RMS error for straight line: Less than or equal to 10° (3 or 5 NM), 16° (8 or 10 NM) (recommendation)

Track velocity angle RMS error for turn: Less than or equal to 25° (3 or 5 NM), 40° (8 or 10 NM) (recommendation)

Pressure altitude unsigned error: Less than or equal to 200 ft in 99.9 % of the cases for stable flights

Pressure altitude unsigned error: Less than or equal to 300 ft in 98.5 % of the cases for climbing/descending flights

Pressure altitude unsigned error: Less than or equal to 500 ft for 100 % flights (recommendation)

Rate of climb/descent RMS error: Less than or equal to 250 ft/mn for stable flights (recommendation)

Rate of climb/descent RMS error: Less than or equal to 500 ft/mn for climbing/descending flights (recommendation)

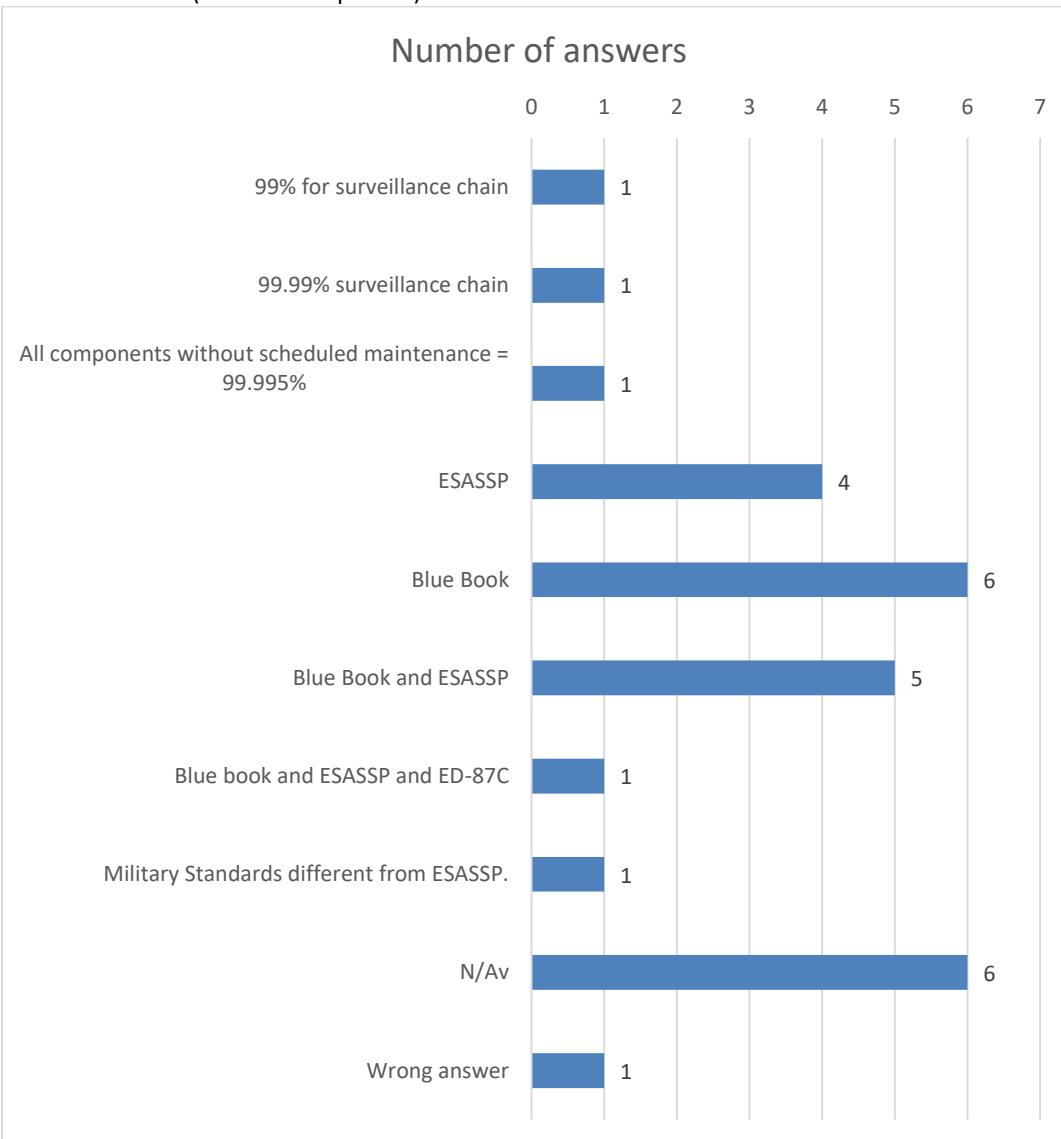




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## Q.5.4.2 data availability

20 valid answers (out of 27 responses)



Blue book and/or ESSASP are provided as answers by the majority of the respondents.

Some have provided the information in value 99% or 99.99%(for the surveillance chain). Military standards were also used (different from the ESSASP). Question is not really answered except in 3 cases.

While few ANSPs answered the data availability to be at a minimum of 99% , the others referred to ESASSP or Bluebook values.

Example of detailed expected answers:

- ESASSP R1,R2, R7, R14
- 99.99% surveillance chain
- For separate radar data - Blue book values are used  
For end user data availability - availability chart is defined based on 5NM/10NM separation service
- All components without scheduled maintenance = 99.995%  
All components with scheduled maintenance = 99.999%
- SC Pt 2 pg 81
- Display System - 99.9975% Availability SC Pt2 Pg 110





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- availability > 99,9%

For the full surveillance chain, ENAIRE guarantees that the parameters of EUROCONTROL Specification for ATM Surveillance System Performance (ESSASP) R2, R14 are met.

Measurement interval for probability of update assessments: Less than or equal to 5 seconds (3 NM), 8 seconds (5 NM), 10 seconds (8 or 10NM)

Relative time of applicability of horizontal position for aircraft in close proximity (less than 2x separation minima): Less than or equal to 0.3 second (3 NM), 0.5 second (5 NM), 0.8 second (8 NM), 1 second (10 NM) RMS for relative data age

Probability of update of horizontal position: Greater than or equal to 97% for 100% of the flights, any flight below 97% shall be investigated

Probability of update of horizontal position: Greater than 99 % (global) (recommendation)

Probability of update of pressure altitude with correct value: Greater than or equal to 96 % global

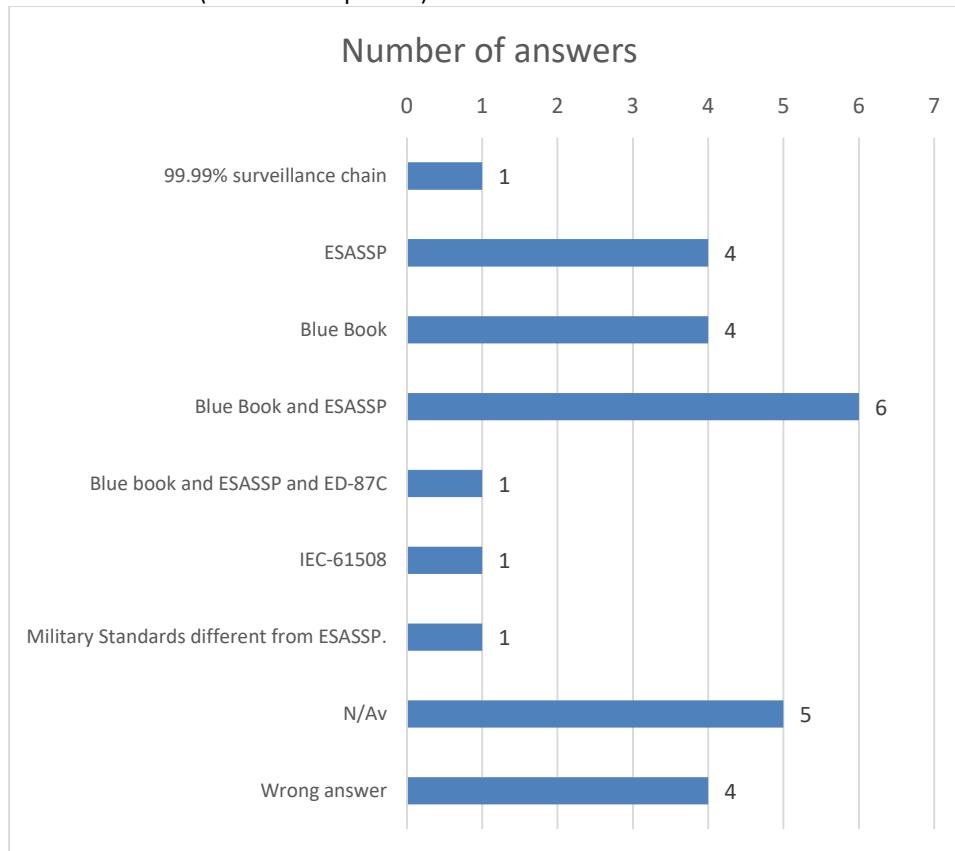
Probability of update of aircraft identity with correct value: Greater than or equal to 98 % global

## Conclusion

- Respondents had difficulties to understand the questions on availability & continuity mixing availability of system and data availability.
- In ESASSP there is no system availability defined. It is left for local decision driven by local business consideration. A value for instance like 99.999% is the type of expected value as an answer.

### Q.5.4.3 data integrity

19 valid answers (out of 27 responses)



ESSASP and/or the Blue Book are referenced as standards providing the data integrity value. Military or IEC standards were also used (different from the ESSASP).

Examples of expected answered:



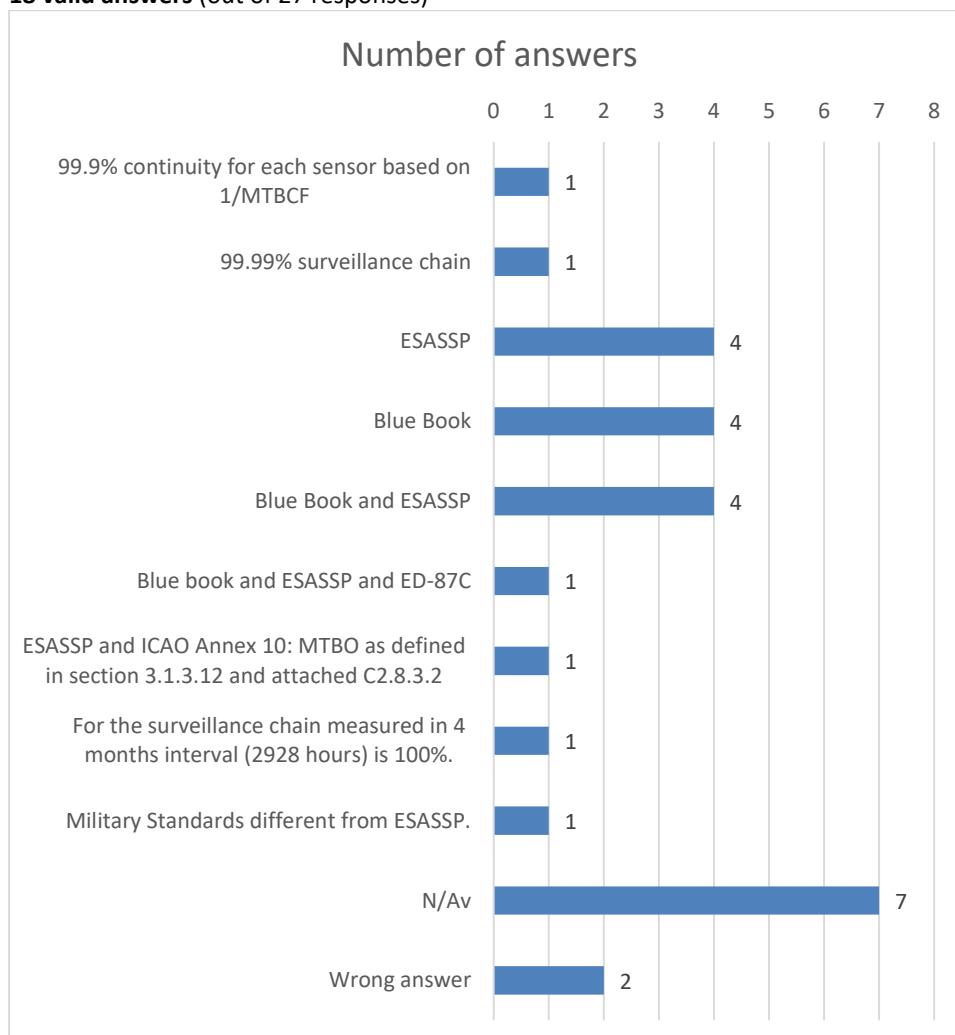


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- Ratio of incorrect aircraft identity: Less than or equal to 0.1 %  
Density of uncorrelated false target reports: Less than 2 false target reports per area of 100 NM<sup>2</sup> and over a duration of 720 applicable measurement intervals (3 NM), 10 false target reports per area of 900 NM<sup>2</sup> and over a duration of 450 applicable measurement intervals (5, 8 or 10 NM) (recommendation)  
Number per hour of falsely confirmed track close to true tracks: Less than or equal to 1 non-coincident falsely confirmed tracks per hour that are closer than 9 NM from true tracks (3 NM), 2 non-coincident falsely confirmed tracks per hour that are closer than 7 NM from true tracks (5, 8 or 10 NM) (recommendation)  
All are applied to the complete surveillance chain
- false code information:  
overall false codes ratio < 0,2%  
validated false mode a codes < 0,1%  
validated false mode c codes < 0,1%  
For the full surveillance chain, ENAIRE guarantees that the parameters of EUROCONTROL Specification for ATM Surveillance System Performance (ESSASP) R10, R15 are met.
- Software to Safety Integrity Level 1 (SIL1) as defined in IEC-61508 with hazard defined at <10-5 per operational hour. Transmission via ASTERIX with associated check sums to validate data integrity
- ESASSP R5, R19, R20
- 99.99% surveillance chain

## Q.5.4.4 data continuity

18 valid answers (out of 27 responses)



The answers are not very specific to continuity. They are more referring to availability. There are no answers pointing to system continuity. Respondents are using the available standards to define their level of performance for data continuity.





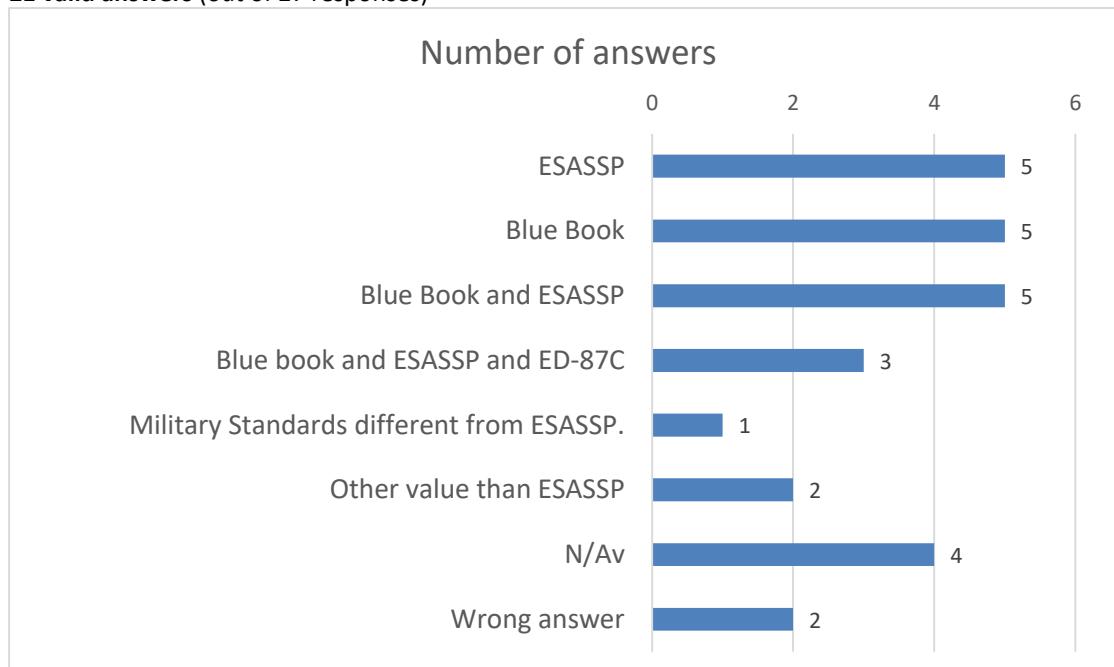
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Examples of expected answered:

- Ratio of missed 3D position involved in long gaps (larger than 16.5 s =  $3 \times 5 \text{ s} + 10\%$ ): Less than or equal to 0.5 %  
All are applied to the complete surveillance chain
- For the full surveillance chain, ENAIRE guarantees that the parameter of EUROCONTROL Specification for ATM Surveillance System Performance (ESSASP) R3 is met.
- 99.9% continuity for each sensor based on 1/MTBCF
- ESASSP R3
- 99.99% surveillance chain

## Q.5.4.5 timeliness of surveillance data

21 valid answers (out of 27 responses)



ESSASP and/or the Blue Book are referenced as standards providing the timeliness of surveillance value. Few answers with measured data rather than requirements.

- Examples of expected answered:
  - Forwarded (last measured) pressure altitude maximum data age: 16 seconds (3 or 5 NM), 20 seconds (8 or 10 NM) (recommendation)  
Delay of change in aircraft identity: Less than or equal to 15 seconds (3 NM), 24 seconds (5 NM), 30 seconds (8 or 10 NM) for 100% of the cases  
Delay of change in emergency indicator/SPI report: Less than or equal to 7.5 s (3 NM), 12 s (5 NM), 15 s (8 or 10 NM) for 100% of the cases  
All are applied to the complete surveillance chain
  - Data timeliness is within ESASSP required limits for a surveillance chain (requirements 5N\_C-R8 and 3N\_C-R8).  
delay < 1 sec when leaving radar station, < 2 sec when arriving at radar data processing system  
For the full surveillance chain, ENAIRE guarantees that the parameters of EUROCONTROL Specification for ATM Surveillance System Performance (ESSASP) R6, R8, R9, R12, R13 are met.
  - ESASSP R8, R9, R12





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### Q.5.4.6 Required maximum horizontal position RMS error

#### 5.4.6.Required maximum horizontal position RMS error Approach/terminal surveillance (separation 2.5 NM)

There were only 3 valid responses. The RMS error values reported were 0.25NM, 210 meters and values according to ESASSP.

#### 5.4.6 Required maximum horizontal position RMS error Approach/terminal surveillance (separation 3 NM)

Required maximum horizontal position RMS error is not estimated for 3NM separation.

Where RMS error values were provided, values were varying from as small as 14.5m up to 300 meters.

#### 5.4.6. Required maximum horizontal position RMS error Approach/terminal surveillance (separation 5 NM)

There were only 11 credible answers. Other answers were not relevant or not meaningful.

However it is clear all answers were according to ESASSP values. One answer was 0.5NM which was greater than ESASSP value.

#### 5.4.6.Required maximum horizontal position RMS error En-route surveillance (en-route separation 5 NM)

There were only 11 credible answers.

Most values seemed to be equivalent to the values in ESASSP. However there were values such as 70m, 62m which seemed rather good values for an RMS error for 5NM which is typically not achieved.

#### 5.4.6.Required maximum horizontal position RMS error En-route surveillance (en-route separation 8 NM)

There were only 2 credible responses. 500 meters and 800 meters were reported.

#### 5.4.6.Required maximum horizontal position RMS error En-route surveillance (en-route separation 10 NM)

There were only 4 credible responses. Values reported were 500m, 300m, 465 m and 1000m.

### Q.5.4.7 If other, please specify:

There was one additional remark which suggested that where radar trackers are used, greater accuracy can be achieved. But when individual sensors are used accuracy varies on how good each sensor is in terms of accurately calculating the target position.

### 11.5.2. Intermediate conclusions

ESSASP and/or the Blue Book are used by the majority of the respondents. These standards are used by ANSPs to comply with SPI IR Annex I section 2.

The general Required maximum horizontal position RMS values for 3NM and 5NM separation applications are in line with ESASSP.

The general Required maximum horizontal position RMS values quoted conform to those required to support the associated separation applications.

There are no standards for 2.5NM, 8NM and 10NM.

The respondents have not reported that the current situation impact negatively performance.

Clear lack of responses for the 2.5NM, 8NM and 10 NM separation applications suggest that these separation applications are not commonly in use.

There is still a lack of the level of responses to represent a sufficient number of European ANSPs.

It seems that some ANSPs are not in compliance with the current SPI IR Annex I requirements.

However for 3NM and 5NM separation applications, ESASSP values seem to be typically applied.

However looking at all performace metrics, thre doesn't appear to be a commonly agreed harmonised performance criteria for various surveillance applications.





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### 11.6. Performance requirements for the future surveillance system

#### 11.6.1. Summary per question

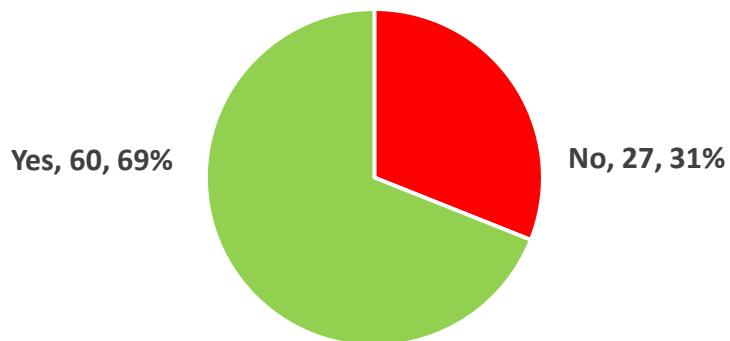
For the next question, the respondents were asked the following:

*Please elaborate on your views and suggestions with regard to the performance requirements necessary for the future surveillance system and the means to ensure that performance. Please indicate to which airspace users you are referring to.*

#### Q.5.5.1 (For all) Your views on future performance requirements

87 answers

Proposals for future performance requirements  
(based on number of respondents)



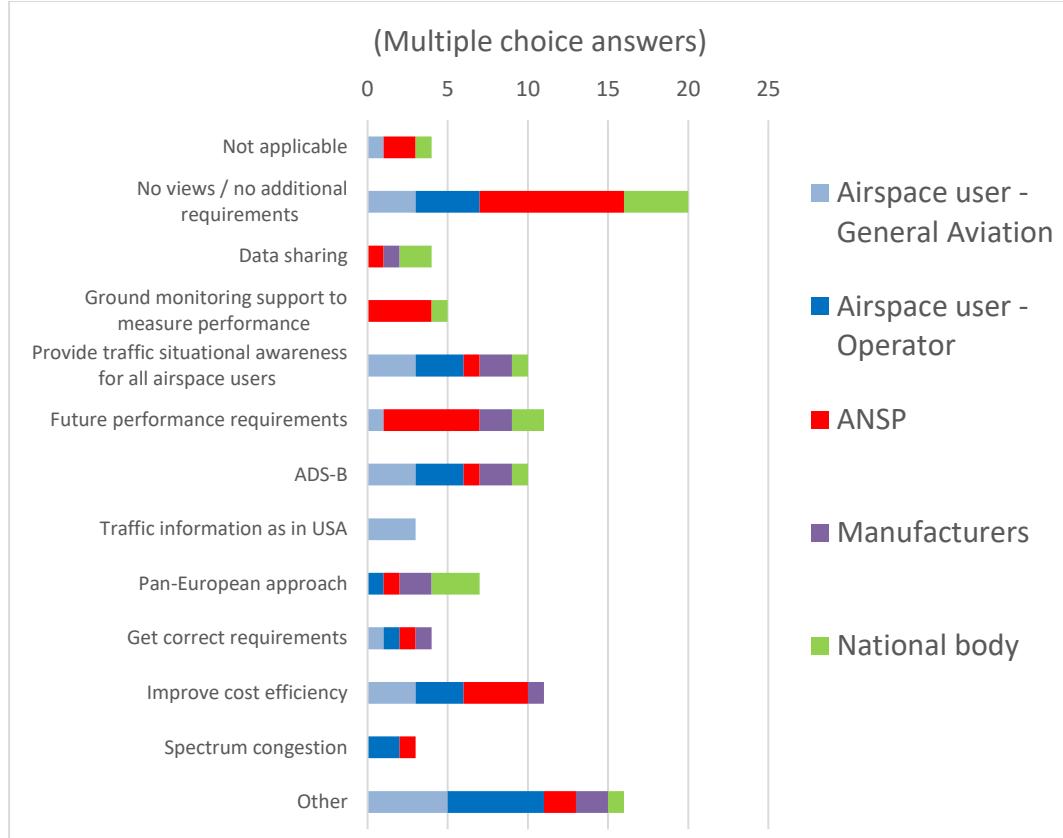
69% of the respondents proposed an answer for the future surveillance requirements.



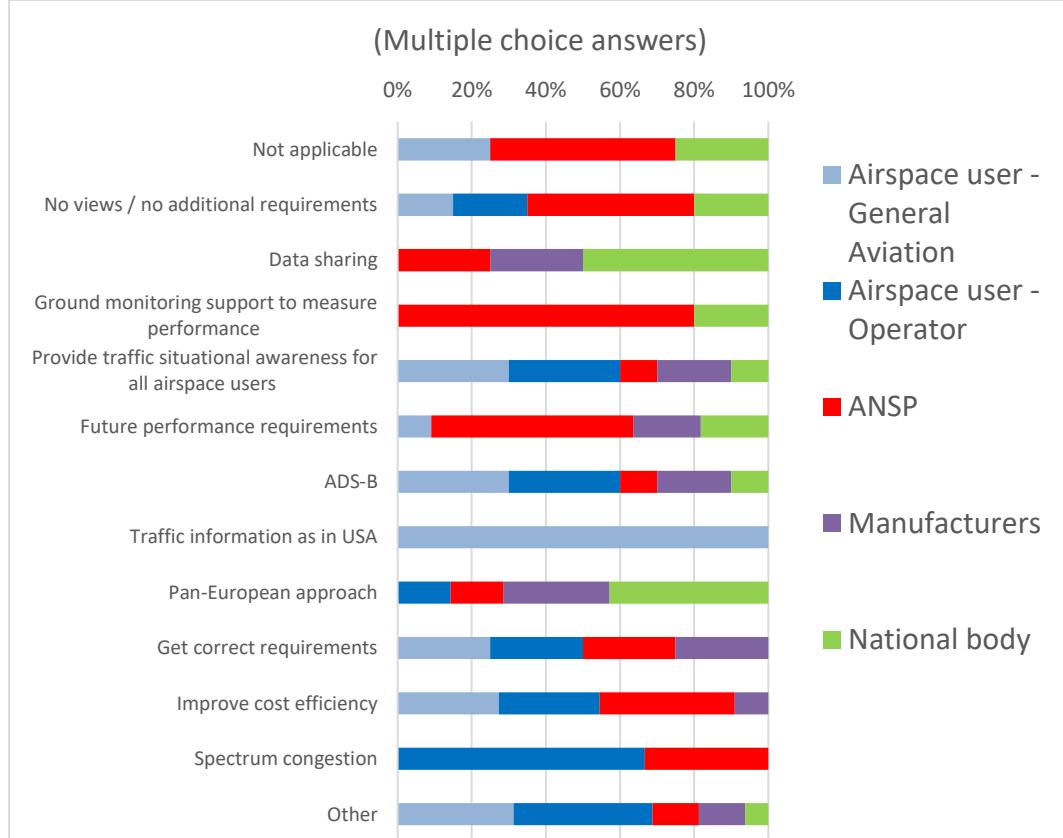


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## Answers on future performance requirements and needs per category and per stakeholder type



## Relative share of answers on future performance requirements and needs per category and per stakeholder type





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Answers taken directly from the survey, grouped per type of subject:

## No views / no additional requirements

A significant investment has been done in the core area of Europe in Mode S coverage. Mode S radars are the backbone of the surveillance coverage and still will be in the near future. ADS-B and WAM will progressively take their place but it is essential not to force change through a regulatory environment which fosters them.

N/Av

None

None - FIR traffic in our region is times lower than in core Europe

None - Operations below radar coverage

## Data sharing

Data sharing: Improve data sharing with neighbouring states

Data sharing: Require total surveillance shared between ANSPs and/or airspace users paid for though en-route charges

Improve Data sharing

## Ground monitoring support to measure performance

Focus on monitoring tools to assess the surveillance system.

Harmonised tools to verify the parameters and to compare the results.

Improve monitoring - Refine the tool (SASS-C) for ADS-B and ground surveillance performance analysis

Measurement methods

## Provide traffic situational awareness for all airspace users

An EU vision for surveillance shall be developed taking into account all airspace users (including RPAS), but also already performed investments (ie 1090MHz DO-260B ADS-B Out for commercial aircraft, deployment of ADS-B Out ground stations ...), while guaranteeing a world-wide interoperability (ie Trans-Atlantic flights). All flight phases shall be considered.

Data sharing: Require total surveillance shared between ANSPs and/or airspace users paid for though en-route charges

For the GA use it would also be beneficial to have a common strategy for safe handle of GA traffic and minimum surveillance capability to address any safety risks arising by having no means of surveillance, including risk of infringements, GA-GA mid air collision, risk to controlled airspace traffic if accidentally entered or due to being in a mixed traffic environment.

Future surveillance to cover all kind of traffics

Identification of conflicting traffic within the aircraft

Inside controlled airspace, ACAS II seems acceptable.

Outside controlled airspace, mid-air collision is our biggest risk. Our experience shows that we need to be in an environment where everybody is radiating their position in some mutually agreeable format that is compatible for all.

Introduce common situational awareness on-ground and in-air.

Radar coverage and number of controllers on duty to make it possible to have a worthwhile deconfliction service. Often controllers who agree to provide deconfliction service to pilots withdraw that service when workload is impossible to manage.

Rotorcraft operations are also to be considered for uncontrolled airspaces class G and F.

According to the increased risk of interference between type-certified aircraft and RPAS, there is a need for clarification of the integration of RPAS in the future surveillance system.

To electronically see ALL other airspace users around me and to be also electronically visible for all other airspace users.

## Future performance requirements





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Being technology independent, set up minimum required performances at ATCo display level. The requirements must depend upon the need for a given separation minima.
Common European minimum performance required for the different surveillance applications The minimum performance specifications for ground systems must be agreed for the key applications to be used whichever state the application is performed.
Equal to or better than current performance.
ESASSP to be improved.
Increasing accuracy to allow reduced separation. CAP670 as minimum requirements
Performance requirements according to the use of airspace (e.g.TMA, En-route) and the traffic density. The aircraft equipment has to be sufficient only to the specific use of airspace.
Precise performance requirements
Reduction of aircraft separation
Required Surveillance System Performance needs to: - be established unambiguously for each airspace class, - correlated with Required Communication Performance and Required Navigation Performance, and - formulated in such a way that traceability to rotorcraft airborne systems performance requirements is ensured.

<b>ADS-B</b>
ADS-B for GA
ADS-B in and out
ADS-B OUT is mandated for controlled airspace classes A, B, C and E.
Cost effective approval/certification systems for ADS-B out.
For airspace where ADS-B is used as means of surveillance, ALL (=100%) aircraft must be equipped.
i fly over 50 hrs in the usa each year using ADS-B this is the way forward for europe
Mandated ADS-B Performance at least capable to replace PSR and SSR (see FAA NextGen).
Optimisation of onboard systems (Mode S, ADS-B, ...).
SURF, ITP applications will grow. ADS-B in and out due to grow in the future.

<b>Exemption</b>
Exemptions must be available to the very small number of specialised aircraft which will remain in service fulfilling non CAT tasks.
MIL radars cannot meet ESASSP requirements
Too old aircraft to be equipped with a new equipment (no space, no excess electrical power)

<b>Pan-European approach</b>
Coordination implementation across all stakeholders.
coordination of surveillance in Mode-S are coordinated via MICA cell must be continued
European-wide frequency management is essential
Implementing Rule (EU) 1207/2011 for all stakeholders.
Pan-European approach into the siting of radars sensors.

<b>Traffic information as in USA</b>
Communication to advise unsafe conditions...weather
Ideally access to weather and other AIS-information (see USA).
System that will provide traffic information as in USA

<b>Improve cost efficiency</b>
Cost effective approach control for smaller general aviation airports to allow for GNSS instrument approaches.
Current performance at lower costs





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Data sharing: Require total surveillance shared between ANSPs and/or airspace users paid for though en-route charges
Decommissiong ground radars to adjust route charges in order to balance the costly new onboard equipment.
Ensure cost efficiency
Financial supports
Implement the VPF mechanism here: <a href="https://en.wikipedia.org/wiki/Virtual_Print_Fee">https://en.wikipedia.org/wiki/Virtual_Print_Fee</a>
increase capacity to commercial traffic.
Low cost
Reduction in cost. Remove need for PSR by enhanced aircraft equipage.

<b>Get correct requirements</b>
Acceptable standards
Get once the correct specifications for transponders (avoid Datalink problems).

<b>Spectrum congestion</b>
Improve spectrum congestion problem
Pressure on spectrum: Future performance will depend upon any changes to our airfield operations. Dependant upon further squeeze on the S-Band 3GHz frequency spectrum I can envisage that a replacement system could well be X-Band 9GHz.Mandatory
We believe that modifications such as hybrid surveillance for ACAS may be necessary to keep the spectrum viable.

<b>Other</b>
A FUSION type of environment is called for to provide integrity and operational robustness.
ANSP to provide a service to airspace users, not vice-versa
Communication to advise unsafe conditions...weather....equipment malfunction and similar
Concerns with the required TCAS RA Flag parameter, however not used by ATC in Europe: still rely on VHF call from pilot.
Education is better than regulation
e-Loran : other source for aircraft position source determination
Redundancy of surveillance system. No airspace access limitation for GA.
For the future it is necessary to focus on the key applications, and other requirements such as potential need to integrate UAS and VLJ(very light jets) in to the airspace and impact of evolving spectrum environement.
In order to increase performance without infringing on safety, it is in my viewpoint imperative that the weakest link is removed from the equation. With more powerful technology, automated and autonomous systems have to take over the identification and control over aircraft in highly dense traffic areas. Combined with an intra-aircraft communication (like Mode S, but multiple times more powerful), aircraft will be spaced horizontally and vertically at the most narrow margins and automated reporting (without human intervention) will operate as feedback and confirmation of the sequencing. NASA is experimenting heavily with "Terminal Sequencing and Spacing" able to coordinate speed and separation of hundreds of aircraft simultaneously, improving the flow of planes landing at airports. It goes beyond discussion that the position of all these aircraft needs to be "communicated", which will require in its turn a more developed technology.
Our future performance requirements will be based on our target level of safety
Provide safety
Rotorcraft operations are also to be considered for uncontrolled airspaces class G and F.
According to the increased risk of interference between type-certificated aircraft and RPAS, there is a need for clarification of the integration of RPAS in the future surveillance system.
Satcom is the future. CPDLC/FANS via Satcom will be key to future surveillance but it will not work as it is mandated today (LINK 2000 without multi-frequency equipment)
System more and more robuts makes Air Sport declining





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### 11.6.2. Intermediate conclusions

General ANSPs views are that the current performance is good to support the surveillance applications currently and suitable for future. From an ANSP perspective the future performance requirements must not be different from today's and should not result in cost increase by giving due regard to the existing infrastructure. A clear wish exists with regards to common performance values dependent on the need. There is a requirement for a common evaluation tool and method at the end of the SUR chain exists and a review of the current standards is recommended. One proposed a pan-European approach on frequency management.

From an airspace user perspective the future performance criteria differ between GA and CAT. However cost shall not be at the AU side: lower route charges, lower certification costs. For GA users, most of them would like to get traffic situational awareness services outside controlled airspace, including also drones. Some proposed that similar services to the one provided by FAA (TIS, FIS) should be implemented.

Manufacturers would like to have surveillance mandate tailored to the airspace classes / use. Harmonisation with other ICAO regions is a must for CAT operators, especially ADS-B Out. The current SPI IR requirements shall remain the baseline for future regulations.

Authorities are in favour of common European approach: radar siting in particular for core European area, data sharing, performance requirements, include GA and drones in the approach, equipage according to use per airspace class, improve tools to monitor ground surveillance performance.

Military stakeholders did not answer in a representative majority. However the answers received indicate that the current state would be acceptable; also with regard to Article 8.

### 11.7. Reporting of functional anomalies

Implementing Rule (EU) 1207/2011, Article 4 (4) requires:

If an air navigation service provider identifies an aircraft whose avionics exhibit a functional anomaly, he shall inform the operator of the flight of the deviation from the performance requirements. The operator shall investigate the matter before the next flight is initiated and any rectification necessary shall be introduced in line with normal maintenance and corrective procedures for the aircraft and its avionics.

#### 11.7.1. Summary per question

##### Q.5.6.1 (For ANSPs) By what mean does ANSP carry out monitoring?

Answers directly taken from the survey

Q.5.6.1.(For ANSPs) By what mean does ANSP carry out monitoring?
As part of anomalies monitoring procedures and reporting system.
ATC observation
ATC User reports.
ATCO monitoring of Mode A/C information and position.
ATCO reporting via internal fault reporting and MOR scheme as applicable
By functional use of the radar
Controller reports
Daily functional checks
Minor Occurrence Reporting - Internal
Assure - Company reporting system
Mandatory Occurrence Reporting - Eccairs
No case
No monitoring at present time.
Operational Monitoring undertaken at Aberdeen.
Operational observations.





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Reported by controllers, and other personell in AVINOR FS by reporting system IFS
SAERCO as TWR ATS service provider: Double checking aircraft call sign.
SASS C
The ATCO identifies anomalies. RFM tool also incorporates an application (CORMORAN) for technical conformance monitoring. However, currently neither national nor European process is defined to react on such issues and ensure an acceptable solution.
This monitoring is part of ATS procedures and in such cases the ATCO informs the pilot.
VERIF
WAM+ADS-B
We can not provide any mean, because our operative procedures consider these records only if ascribable to a Safety event.
Humberside monitors the SSR display for the aircraft that it controls. Where there is an error with the information, the aircrew is informed. Where it cannot be corrected, the equipment is turned off (the airspace that Humberside operates within does not require carriage of SSR).
In March 2014 FerroNATS elaborated and distributed among the staff (ATCOS) an operational circular regarding functional anomalies in avionics, in compliance with article 4 (4) of the implementing rule (EU) 1207/2011. In June 2014 this circular became part of the operating manual of all the ATS unit operated by FerroNATS.
By conducting analysis if anomaly is reported by controller. In case the avionics functional anomaly is confirmed, the operator is informed. Other means is, by using EUROCONTROL BDAMS tool and reporting the anomaly via online SAFPA tool (Surveillance Avionics Issues Centralised Database).
N/Av The identification of a transponder malfunction suspicion is made by triggering a technical analysis on the data recorded after an operation's room report. If the technical analysis confirms the suspicion, the result is sent to the national NSA (ANAC) and aeronautical incident's board (GPIA).
Once DTI receives a report from either Air Traffic Controllers, radar data (permanet recordings) is analysed with different tools. Specific Excel spreadsheet is updated and a mail is sent to the operator. The problem might also be written into the EUROCONTROL MANTIS database. Any subsequent event related to the same aircraft lead to update the tracking Excel file. In case no reply is received from the operator, then DSAC (French Surveillance Authority) is triggered.

Most of the means refer to reports provided by ANSP operational staff (ATCO, ...). Other respondents mention different tools like SASS-C or BDAMS. Systemic and continuous monitoring is not widespread, based on the answers above.

In most of the cases, these occurrences are considered as safety occurrences that need to be reported by the ATS operational staff and investigated afterwards. Some ANSPs confirm inclusion of specific procedures to deal with these situations in their respective operating manuals. On the other hand, some responses indicate that there are also cases in which no monitoring or no detection of these occurrences exists.

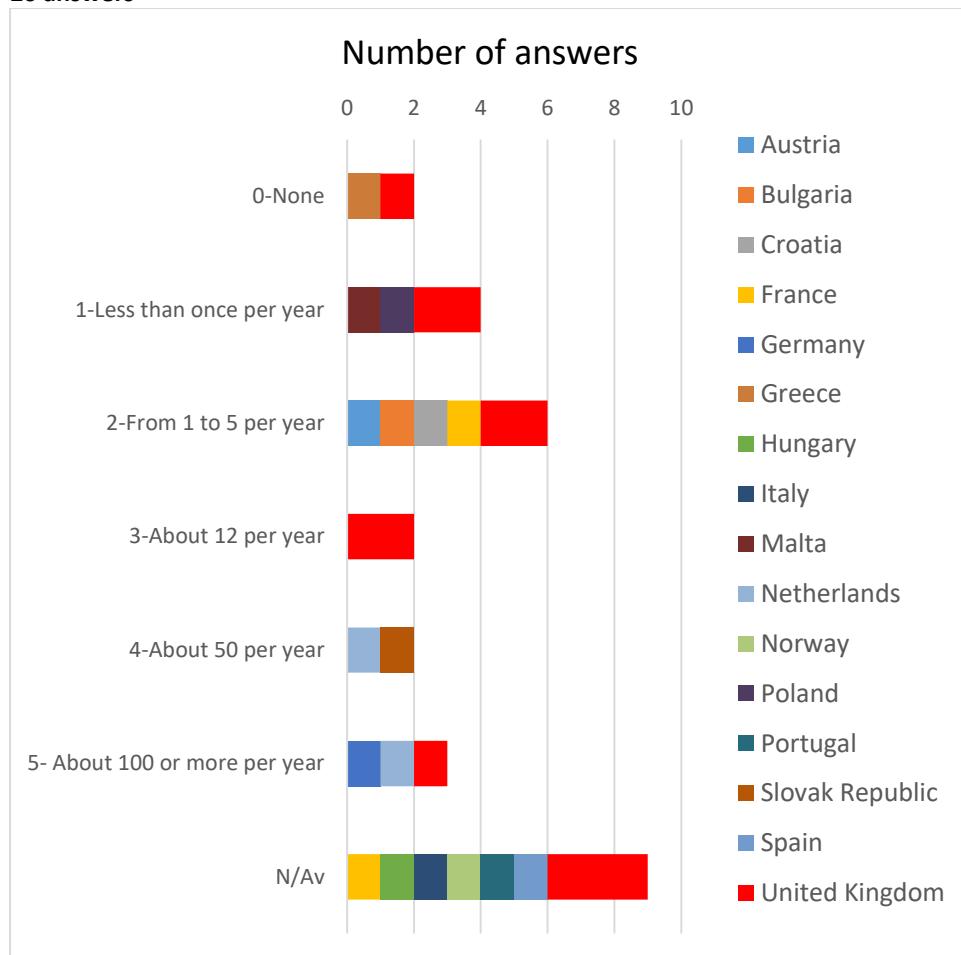




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Q.5.6.2 (For ANSPs) How many times and over what period did you identify and report about an aircraft whose avionics exhibit a functional anomaly?

26 answers



Note: possibility of 2 answers from the same country when there are civil and military ANSPs answers.

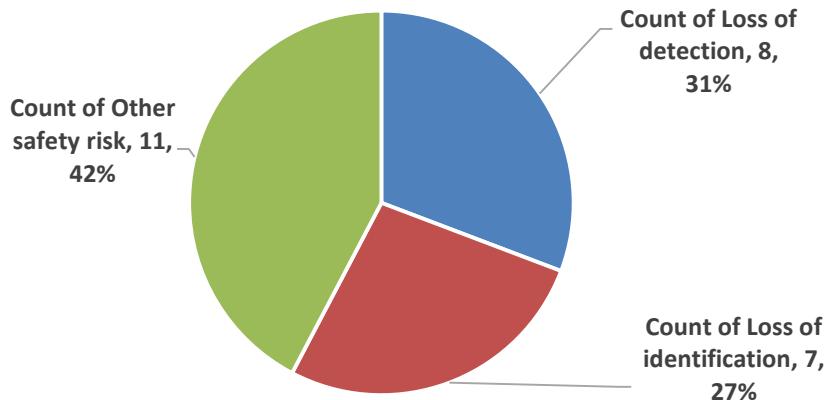




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## Q.5.6.3 (For ANSPs) What were the risks identified?

(Multiple choice answers)



Note: due to the low number of answers and the difficulty to provide details in the survey, please refer to the section on safety analysis.

### Other safety risk

- Airborne conflict
- Corrupted data
- False ACAS alarm=> no direct risk
- Ghost targets / Incorrect Mode C
- Increase in controller workload
- Lack of ATCO in Mode S
- Lack of correct Mode S information displayed.
- Lack of situational awareness
- Missing Safety Nets alerts / Wrong altitude information.
- Reduction of quality of surveillance information

Description of the occurrences seems to cause an increased ATC workload, mainly associated with the following SUR system failures:

- ✓ False targets
- ✓ False ACAS advisories
- ✓ Losses of identification/correlation of targets

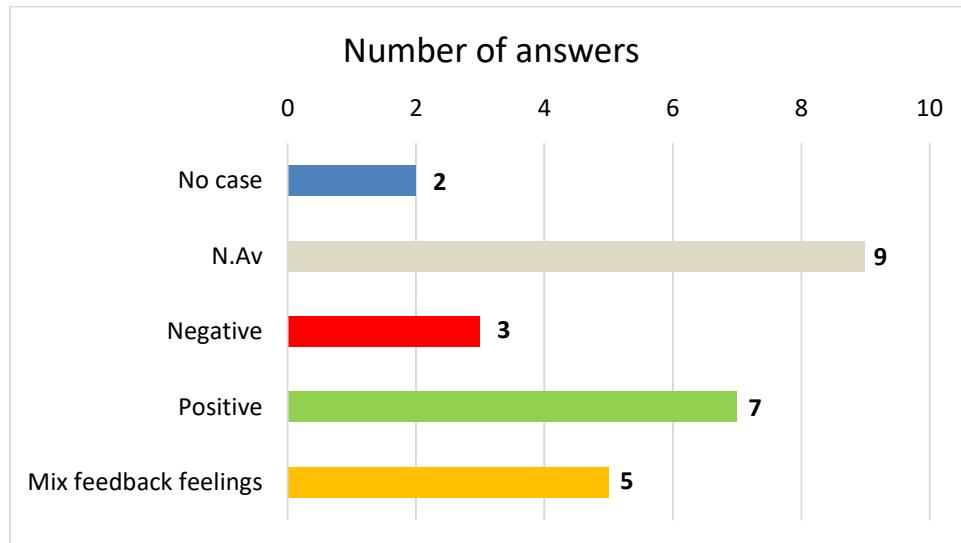




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## Q.5.6.4 (For ANSPs) What is your experience when reporting the anomaly to the airspace users?

26 answers



Details (13 valid answers out of 17 answers received from figure above)

Q.5.6.4.OVERALL FEEDBACK OF ANSP WHEN REPORTING THE ANOMALY TO THE AIRSPACE USERS	Q.5.6.4.(FOR ANSPS) YOUR EXPERIENCE WHEN REPORTING THE ANOMALY TO THE AIRSPACE USERS	TOTAL
NEGATIVE	Significant lack of feedback	2
POSITIVE	Good cooperation (CAT and private pilots), replies usually within a week Positive: Quick steps to solve the problem in most of the cases	1 1
	Rather positive, however it takes time	1
MIX FEEDBACK FEELINGS	The user rectified the fault 50% feedback received, however lack implementation of mitigation measures	4 1
	Do not always get a direct feedback from operator Good Initial acknowledgement over radio, but difficult to track/report to airline operator once outside our control	1 1
	Mix results. Likely feedback when operator is based at the airport	1
<b>GRAND TOTAL</b>		<b>13</b>

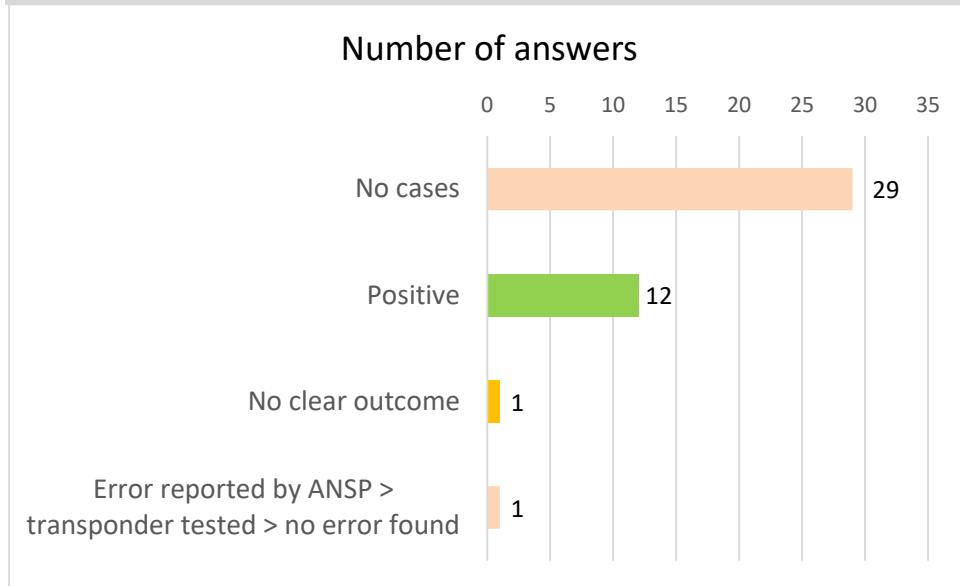
Collaboration rendered by aircraft operators is perceived as positive, however responses seem to indicate that feedback from the operator's investigation is not always provided. This suggests that coordination could be improved, especially in relation to those occurrences reported on the frequency.





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**Q.5.6.5 (For airspace users) If you have experienced such anomalies what was the outcome of your assessment of this situation?**



Details:

FEEDBACK	Q.5.6.5.TRANSPONDER ANOMALIES: DETAILED AIRSPACE USER FEEDBACK
NO CASES	In our company, daily flight test activities are performed with new installed surveillance equipment. No anomaly has been detected in any such installation. No occurrence reporting from our operators has been received on such topics. No cases
NO CLEAR OUTCOME	We occasionally receive reports from ATC of discrepancies between encoded altitude and indicated altitude, but always within tolerances. Not clear if the problem was the aircraft equipment or the ATC equipment.
POSITIVE	Call maintenance to replace cables with problems Controller informed me that my transponder altitude reporting was outside limits. I restricted the aircraft to operations where SSR was not required until the next routine maintenance was able to solve the problem. Encoder problem - fixed Occurrence reporting to CAA, fault identification , retrieving more information from service provider for further follow up rectified iaw MEL specifications reported anomalies are investigated and rectified accordingly
	We have had reports of some avionics not handling the EHS selected altitude parameter. Operators have been notified. There is no fix because the product is out of service. we have experienced a radio failure in one of our helicopters this was identified by the ATS & the pilot concerned the aircraft was repaired before further operation
	We've had the case with French ANSP reporting wrong Id on mode S. It was an issue with the transponder of B744. Problem has been solved by applying corrective modification. Also some cases of reported anomalies seen by the ground and solved by the replacement of transponder before the next flight.
	Reported anomalies are analyzed. Operational and safety impacts are assessed with Airworthiness Authorities and Services Providers, as necessary. Way-forwards are defined accordingly.

Operators are not informed of many anomalies related to their transponders. However, in those cases in which an occurrence is reported by the ATS unit, subsequent investigation often leads them to identify and fix the corresponding deficiency.





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### 11.7.2. Intermediate conclusions

Feedbacks provide positive statement that ANSPs and air space users are talking when there is an issue. However there is a high number of “not available” respondents from ANSPs .

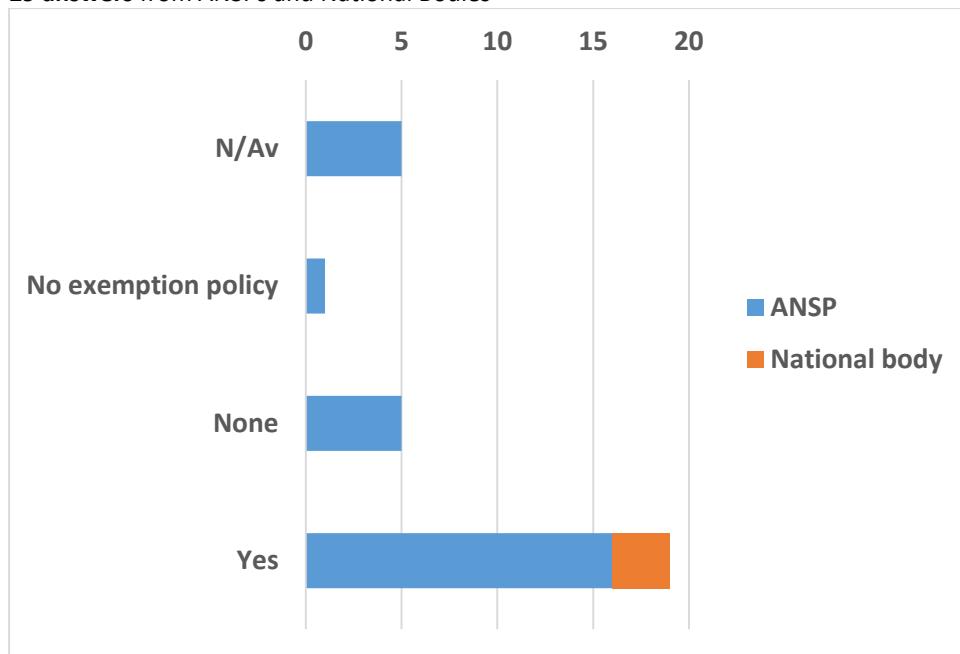
### 11.8. State aircraft accommodated by Air Traffic Service Providers

Implementing Rule (EU) 1207/2011 Article 8 (5) Air traffic service providers shall ensure that the State aircraft identified in paragraph 3 can be accommodated, provided that they can be safely handled within the capacity of the air traffic management system.

#### 11.8.1. Summary per question

##### Q.5.7.1 (For ANSPs) Do you have procedures to accomodate non-compliant state aircraft with SPI IR?

29 answers from ANSPs and National Bodies



Details:

Answer	5.7.1. Detailed answer - ANSPs/NBs procedures for non-compliant state aircraft with SPI IR
No	No additional procedures Procedures are defined in Air Traffic services Manual and all Local Operational Manuals, and are applicable for all aircraft which are not compliant with SPI IR. No specific procedures are defined for non-compliant state aircraft.
Yes	1. Mode-S Level 1 (ELS) transponder - standard ATS procedures 2. Mode A/C transponder - standard ATS procedures 3. Without transponder - procedures for ASM (airspace segregation) A non-Mode S aircraft is controlled with a mode A code, with no particular procedures for state aircraft. Accommodation is ensured by continuity of mode A/C service All airports have PSR as a means of detecting non-compliant aircraft. all state aircrafts have ModeA/C or special military mode. Exemption required Manual operations Military accomodate non mode S aircraft





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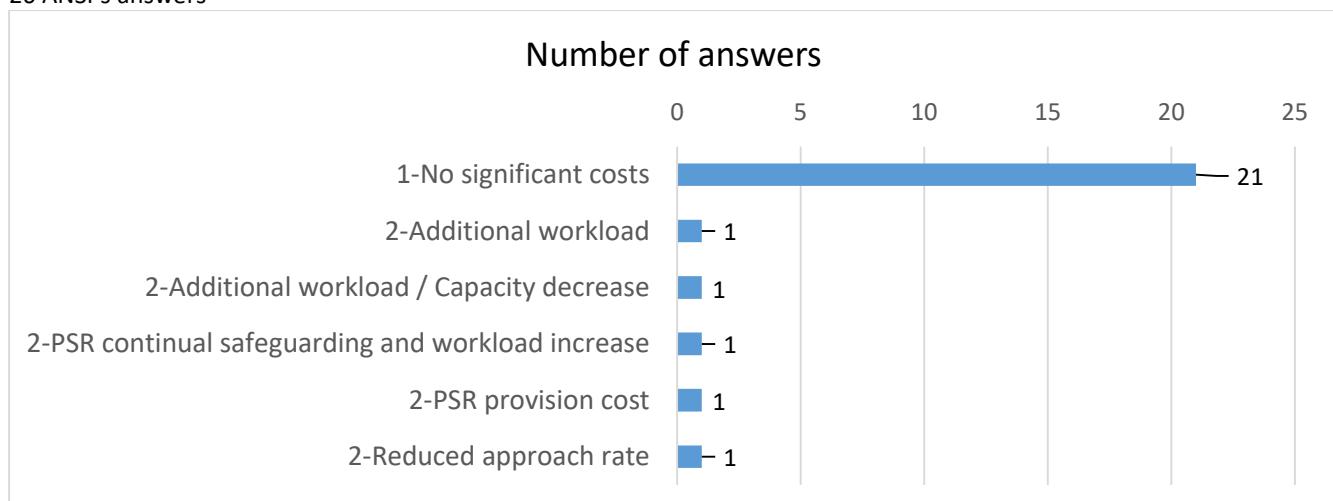
Present situation requires A/C which is mandatory for all Aircraft. After 2020 one layer of A/C interrogation will be maintained.  
Procedures are included in our ATS' Manual.  
Special permission applied by ANSP  
The policy of exceptions is still applied. The individual cases are published in AIP. The tendency is to minimize those exceptions.  
Use PSR  
Workload and Capacity based procedures - can a non responding aircraft be accommodated within the airspace volume?  
Civil ANSPs who have military traffic in their airspace of responsibility have procedures in place to handle such aircraft in a safe manner and these procedures are published in the relevant air traffic service unit's MATS(Manual of Air Traffic Services) part 2.  
The NERL Surveillance Sensors are configured to support the detection of aircraft equipped with classical Mode 3A/C transponders.

Additionally where Primary Surveillance Radar is available, aircraft with no transponder and a radar cross section of greater than 1m<sup>2</sup> can be detected by the NERL Surveillance Sensors.  
AIP, VDV: Without correct functioning transponder functionality, aircraft are not allowed to enter Dutch controlled airspace. If transponder is performing correctly, they will be handled by ATC". No exceptions!

N/Av	N/av - according to a.m. Article 8 state compliance required by 7 December 2017 National civil-military coordination is being developed. DFS grants about 80 exemptions per anno. 80% of these are for non-compliant state aircraft. They will be guided alike equipped aircraft, using a dedicated code. (blank) N/Av Same as for non state aircraft.
No exemption policy	(blank)

### Q.5.7.2 (For ANSPs) What is the cost of accommodating non-compliant state aircraft with SPI IR? (in terms of capacity, additional workload, ...)

26 ANSPs answers





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### 11.8.2. Intermediate conclusions

Today the handling of non-equipped state aircraft does not raise significant concerns.

Stakeholders see no significant cost caused by the handling of Non-equipped state aircraft.

Some stakeholders seem not to be aware of the legal obligation on them or, there is no need for additional procedures since stakeholders use the same which are in place for Non-compliant civil aircraft.

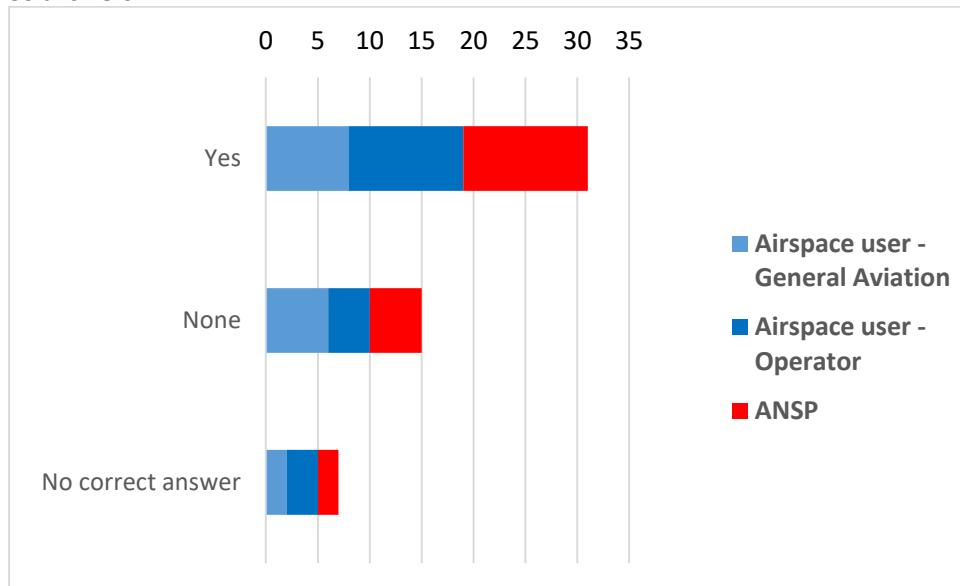
### 11.9. Surveillance needs - Airspace without or with limited ground based surveillance coverage

#### 11.9.1. Summary per question

(For ANSPs and airspace users)

**Q.5.8.1.What airspace, without ground based surveillance coverage (i.e. remote airspace/airports), would need surveillance to better answer the needs of airspace users?**

53 answers



**Q.5.8.1 Geographic area(s) / Location(s)<sup>31</sup>:**

Q.5.8.1.(details Provided for a “yes” answer) Identified areas with limited or without ground based surveillance coverage

Airspace user - General Aviation	Airspace user - Operator	ANSPI

An overwaters airspace from 13W to 15W in the DEMOS and VERAM sectors in the Lisbon FIR.

1

Blackpool airport used to have primary radar but closed and then reopened as a procedural unit. This has reduced the Blackpool ATCOs situational awareness as they no longer have radar to confirm an aircraft's true position and must rely on pilot reports.

1

Bodø Oceanic  
Dubrovnik area

1  
1

<sup>31</sup> Only answers with areas referring to Europe are mentioned in this table





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Q.5.8.1.(details Provided for a “yes” answer) Identified areas with limited or without ground based surveillance coverage	Airspace user - General Aviation	Airspace user - Operator	ANSPI
In the UK, class G needs better surveillance where radar is not available. Areas such as Cranfield (EGTC) do not have adequate radar coverage in the vicinity of the airport. Lower than FL120 over Albacete Bilbao Airport Approach (North of Spain) Granada Airport Approach (South of Spain) Reduce dependency on military surveillance radars			1
Bucarest / LRBB Mayotte for a complete coverage			1
Chambery and Ajaccio TMAs for an additional coverage Need to ensure that all European airspace is covered by ADS-B surveillance to ensure that the future mandate for 15 min aircraft tracking can be met. For example certain over water routes do have coverage issues (e.g. UK to Canary islands, etc)			1
Around Humberside there is plenty of surveillance provision provided through competing ANSPs (NATS, Doncaster, Waddington, Scampton, Coningsby, Cranwell, Linton-on-Ouse, Leeds, etc), including other military non-ATC systems - the problem is that this data is not shared. This airport has good coverage throughout the envelope with the exception of a small area of missing Primary Radar coverage below 2,000ft from the coast at Spurn Point on the Humber Estuary to 3NM inland.			1

In addition several GA airspace users have expressed the need to have ADS-B in Class G airspace. A lower ADS-B information integrity would be acceptable in such case.

### 11.9.2. Intermediate conclusions

Limited number of airspace user respondents which prevent to generalise the following statement.

Complains about lack of surveillance coverage in remote areas:

- Oceanic areas
- Secondary airports or airport operated by military

In addition several GA airspace users have expressed the need to have ADS-B in Class G airspace. A lower ADS-B information integrity would be acceptable in such case.

Due to the few precise answers, further information was gathered on potential areas / aerodromes lacking surveillance.

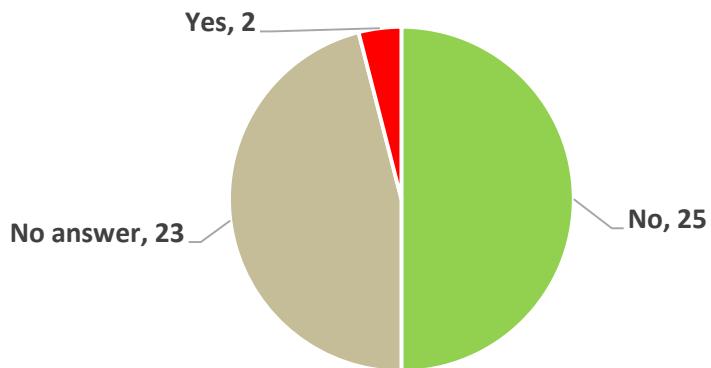
Based on a list of 50 aerodromes with potential additional surveillance needs<sup>32</sup>, respondents indicated that 25 aerodromes do not need additional surveillance needs, 2 aerodromes need additional surveillance and there was no answer for 23 aerodromes.

<sup>32</sup> Source: EASA Survey 2016, combined with a list from 2007 provided by EUROCONTROL and confirmed by IATA





Number of Airports with additional surveillance needs



For additional information: appendices 16.5 and 16.6.





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## 12. Lack of interoperability

Initial feedback from stakeholders is that there might be a problem of interoperability between ground surveillance systems and airborne systems. Please provide your comments.

### 12.1. Main conclusions

The majority of the responses do not indicate an interoperability problem. Stakeholders are pointing to lack of means of compliance and lack of clarity on the availability of means of compliance. However this lack of means of compliance does not mean that there is in the end a lack of interoperability.

Ground to Ground and Air to Ground interoperability:

- Ground to ground works with the support of ASTERIX format exchange (conclusion from **data sharing** related answers)
- Air to Ground: the responses are not showing a lack of interoperability. Note that the need of interoperability at aircraft level with FAA has been also expressed as a must by some respondents (manufacturers and European airlines operating in US).

Note: a list of anomalies has been provided by Eurocontrol, this does not change the statement (see 16.4).

There is a significant number of the answers referring to issues which are not linked to interoperability as such, e.g.:

- Cost of equipment
- Implementation issues
- Airspace structure / Class G issue regarding traffic information capability
- Certification process issue (time, ...)

#### Conclusion

The majority of the responses does not indicate an interoperability problem.

The following table indicates how significantly are the interoperability issues linked to the identified problem areas :

**Table 11- Conclusions for the problem definition on the link between the lack of interoperability and ...:**

<i>Problem area</i>	<i>Conclusions</i>
lack of surveillance performance and functionality targets	No evidence
lack of continuity of 1030/1090 MHz frequency	No evidence
lack of cost efficiency with the surveillance equipment	No evidence
lack of security of data transmitted	No evidence

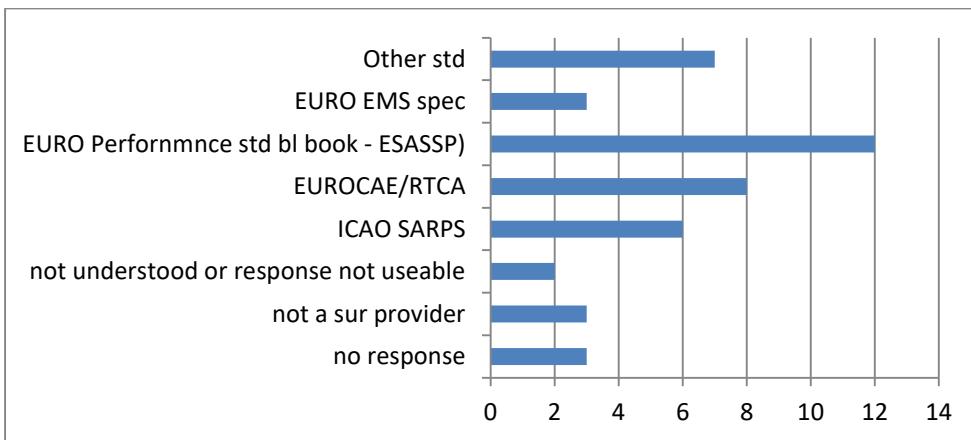
## 12.2. Summary per question

**Q.6.1 (For ANSPs) Please state the SARPs, EUROCAE, EUROCAE, RTCA, ETSI or STANAG or any other standards that you use for the ground surveillance systems along with the type of applications for which the systems is used for (e.g. 3 NM separation)?**





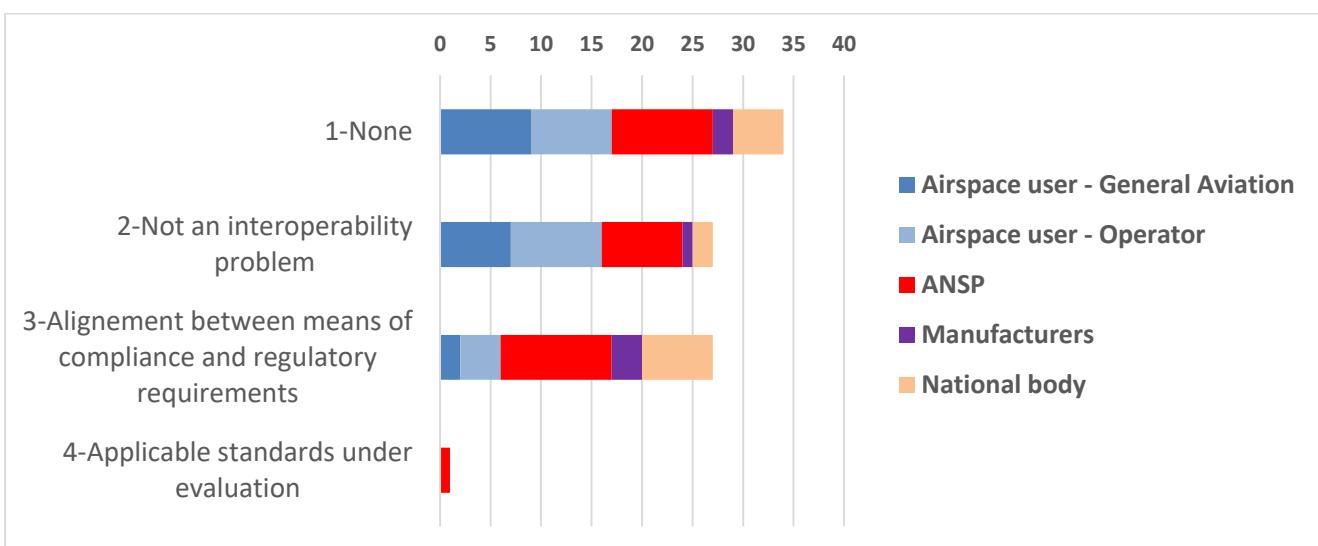
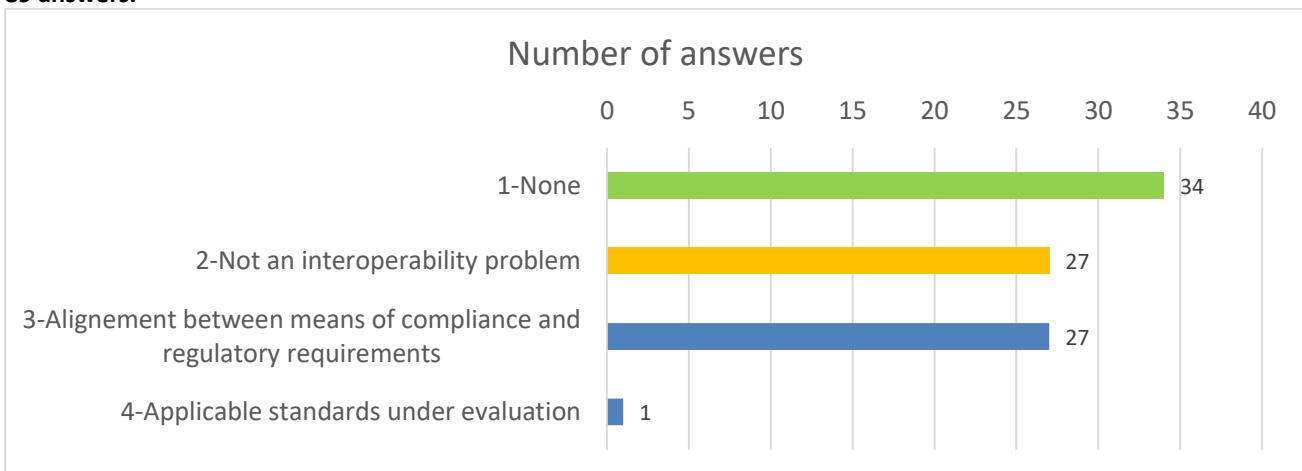
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**Q.6.2 (For all) What are the current problems with the surveillance requirements / standards?**

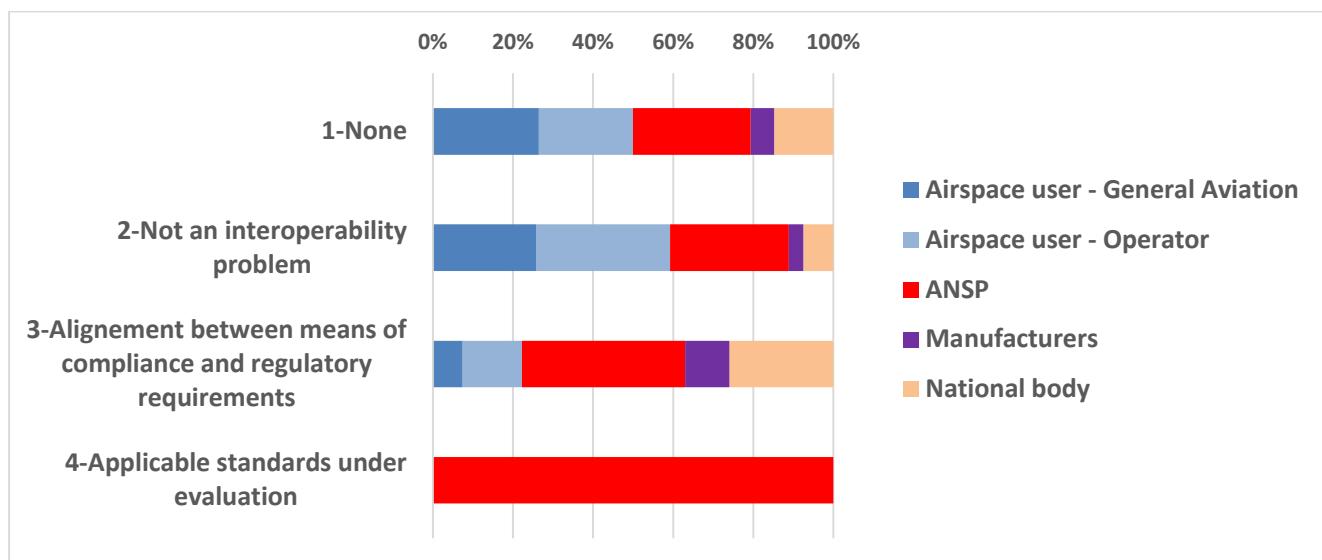
**Answer without details cannot be taken into account.**

**89 answers.**





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Row Labels	Count of Resp
<b>1-None</b>	
1-None	32
<b>2-Not an interoperability problem</b>	
2- solution, not an interoperability problem	1
2-Airspace structure	1
2-Airspace structure / Class G issue regarding traffic information capability	2
2-Airspace structure / GA vs CAT issues	1
2-Answer not understandable	4
2-Certification process issue (time, ...)	1
2-Cost effective certification process issue (time, ...)	1
2-Cost issue	4
2-Implementation problem	2
2-Not a SUR issue	3
2-Wrong equipment for a specific type of operation	1
<b>3-Alignment problem between means of compliance and regulatory requirements</b>	
3-Different solutions which are not compatible	4
3-Lack of balance between IR and Means of Compliance	1
3-Lack of balance between IR and Means of Compliance / Implementation issues	
3-Lack of means of compliance	1
3-Lack of means of compliance / Lack of recognition of means of compliance	5
3-Lack of means of compliance for ESASSP to ensure the performance of the entire surveillance chain	1
3-Lack of means of compliance	1
Lack of clarity	
3-Lack of precise requirements in binding regulation	2
3-Lack of traceability between means of compliance	1
3-Non harmonised FAA/EU requirements	2
3-Not up to date standards, inconsistencies between standards / Lack of means of compliances / No harmonised minimum performance standards	
3-Stability of standards	1
3-Standards not up to date	1
Standards not necessarily applied	
<b>4-Applicable standards under evaluation</b>	
4-Applicable standards under evaluation	1
<b>4-A-SMGCS: See with Bryan</b>	
4-A-SMGCS: See with Bryan	1
<b>Grand Total</b>	<b>77</b>

## 12.3. Intermediate conclusions

The majority of the responses does not indicate an interoperability problem. The main interoperability problem is reported by ANSPs and pointing to lack of means of compliance and lack of clarity, or lack of tools to verify performance.





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## 13. Lack of security

Initial feedback from stakeholders is that there might be a lack of security due to inappropriate surveillance requirements. Please provide your comments.

Note: you may consider the following items when answering to the following questions:

- a) Possibility of deliberate intruders with malicious intent entering your airspace if you were to operate in a co-operative only environment where transponders can be deliberately switched off.
- b) Non-cooperative surveillance system as a means to mitigate such risk.
- c) Potential security concerns with regards to increased RPAS operation in your airspace
- d) Policies or technical solutions to mitigate or reduce the security vulnerabilities of airborne or ground based surveillance systems (for example such as using multiple sources to verify the position data).
- e) Security concerns of surveillance data being easily accessible to the public.
- f) Regulatory measures taken by your state in order to minimise the security threats by the widespread availability of surveillance data by various less expensive technical devices.

For ANSPs and national bodies

### 13.1. Main conclusions

Majority of stakeholders do not assess security vulnerabilities of their surveillance systems. From the stakeholders who responded, only 27% of the stakeholders have assessed security vulnerabilities.

Majority of stakeholders give lack of emphasis to security aspects of surveillance systems or are not so concerned about the widespread availability of surveillance data.

It is also clear that stakeholders generally lack knowledge and awareness in security aspects and have different views on who owns security risks.

Using non-cooperative surveillance and using multiple layers of surveillance techniques is used as mitigation to security vulnerabilities by a small number of ANSPs.

In terms of mitigation measures to be developed and regulatory measures to minimise security threats, most stakeholders do not have the knowledge to answer or there are very limited measures taken.

#### Conclusion

it is commonly supported that this is a problem, however the significance of the problem cannot be defined. The problem is addressed outside this RMT.0679 SPI IR: indeed this aspect is already tackled by other initiatives of EASA such as cybersecurity RMT.0648<sup>33</sup>.

Potential action: to assess the need to protect the identification of specific categories of flights (EBAA & MIL positions)

#### Statement on the significance of the problem

It is commonly supported that this is a problem, however the significance of the problem cannot be defined. The problem is addressed outside this RMT.0679 SPI IR.

The following table indicates how significantly are the security issues linked to the identified problem areas :

**Table 12- Conclusions for the problem definition**

<i>Problem area</i>	<i>Conclusions</i>
lack of surveillance performance and functionality targets lack of continuity of 1030/1090 MHz frequency lack of cost efficiency with the surveillance equipment lack of interoperability between surveillance equipment lack of security of data transmitted	Cannot be defined within this RMT, the problem is addressed outside this RMT.0679 SPI IR

<sup>33</sup> [http://www.easa.europa.eu/system/files/dfu/ToR%20RMT\\_0648%20Issue%201.pdf](http://www.easa.europa.eu/system/files/dfu/ToR%20RMT_0648%20Issue%201.pdf)





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The problem tree is therefore updated with the following changes:

- Cannot be defined within this RMT. Outside the scope of this RMT

## 13.2. Overview on received answers

### 13.3. Summary per question

#### **Q.7.1 Have you assessed the level of security risks that the widespread availability of surveillance data and the vulnerabilities of surveillance systems can be used for malicious intent?**

Altogether there were 45 responses. 28 responses from ANSPs, one from associations (ECOGAS), 5 from manufacturers, 11 from national bodies.

Interestingly only 1 NSA answered “yes” to the question and all other NSAs replied as “No”. Out of the 5 manufacturers 3 of them replies as not being a relevant issue for manufacturers. Other 2 replied “yes”.

From the 28 ANSPs that responded to the question , only 7 responded that they have assessed the security risks and vulnerabilities of surveillance systems.

It is apparent from the survey responses that majority of them do not conduct security risk assessments or give particular emphasis in conducting an assessment of security vulnerabilities of the surveillance systems.

#### **7.2 Please summarise this risk assessment**

To summarise ANSP's concerns and comments;

- Surveillance data is already widespread and freely available on the internet.
- The widespread availability of surveillance data is a national security issue and not an issue that an individual unit can control.
- Confident on the surveillance data from the unit's own primary radars.
- However security risk of SSR data received from 3<sup>rd</sup> parties not assessed.
- Rely on primary radar coverage by national defence forces.
- Surveillance data is not publicly available. The Security missions are under Military responsibility. Civil-Military coordination is established in case the flight is not maintaining defined flight rules (plan).
- Multiple surveillance sources (sensors) are used to cover controlled airspace. Multiple distribution lines are used to increase overall surveillance data availability.
- Risk assessments undertaken by the supplier of the data.
- Surveillance and network security risk assessment still in progress.
- Following risks identified;
  - 1) identification of potential targets for ground-to-air attacks via MANPADS;
  - 2) guiding MANPADS or hostile RPAS attacks
  - 3) attempt of signal spoofing or denial of service
  - 4) perturbation of ATC/operations based on mode S in a multiple attack scenario
- Using non co-operative surveillance to mitigate the risk
- A global risk study has been recently carried out, including the vulnerabilities of surveillance systems.
- Some potential security threats include:
  - 1) Airborne Aircraft being targeted by some ground to air weapons
  - 2) ATC impersonator giving deliberately incorrect instructions to pilot(s) using ATC frequencies.

Manufacturer's expressed views as below;

Many Gulfstream operators are concerned that tracking movement of their aircraft provides a means to infer business relationships (mergers, acquisitions, partnerships) that are confidential. This information could have an impact to their business.

Military and state operators have similar concerns with inference from their aircraft operations.





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The possibility of spoofing traffic into a terminal environment could cause a large impact to overall traffic management and could cause individual aircraft to divert from their desired path to avoid traffic which is not actual, potentially into the path of other real aircraft.

Another manufacturer expressed concerns that a malicious actor can load an airplane with multiple ADS-B out systems outputting or spoofing false targets and overwhelming the system.

National Bodies views can be summarised as follows;

- Not directly involved with security concerns.
- No specific risk assessment has been carried out. NSA does require security concerns to be identified and addressed under each certificated ANSP's security management system.
- Risk is seen in the area of data communications infrastructure.
- No formal assessment carried out. However the use of primary radar in combination with secondary radar do offer some kind of verification on the secondary data.
- Risk assessment on ANSP IT-Network (e.g. according to requirements of Annex 1 (4) 1035/2011) done
- As identified by NATO and ECTRL through NEASCOG
- For Cyber Security, the requirement to be compliant with IT&C ISO Standard 27001/ISO 28000 is included also in National Security Program. Developed and implemented an IT&C Security Management System – ROMATSA IT&C Security Management Manual, which includes a Risk Assessment Procedure based on SECRAM methodology developed by EUROCONTROL.
- In 2014, the UK Department of Transport (DfT) conducted a series of workshops involving the CAA and developed a risk matrix on ATM Cyber Security consulting with various domain experts. This was compiled on behalf of the ICAO Threats and Risks Working Group as the UK DfT Plays a key role in that WG. A risk matrix was developed for all CNS domains identifying all potential vulnerabilities. The matrix identified threat scenarios, Likelihood, Impact, Consequences, Current mitigations, Vulnerability Factors and potential additional mitigation measures. It also identified potential future security vulnerabilities by increased use of RPAS systems. Also security vulnerabilities of GPS/GNSS systems that may be used for both Navigation and surveillance purposes. However the level of threat is not entirely predictable since a fair amount of national security intelligence has to be gathered on the likelihood of a malicious attack by persons/groups with malicious intent to disrupt systems, obtain information or cause harm to persons or properties. At least the vulnerabilities inherited in various technologies due to how they are currently designed to operate, can be analysed.

### Q.7.3 What are the mitigation measures in place?

As regards the mitigation measures in place several ANSPs responded that the use of Primary Radar as a security measure. Many responded that having double overlapping coverage or use of multiple surveillance layers as a mitigation measure. 2 ANSPs responded that there are no mitigations in place.

The various answers received can be summarised as follows;

- Primary radar can help identify the false targets.
- least double radar coverage overlapping. All radars are connected via circuit radar data network chain.
- Segregated services
- Short range (~60nm) non-cooperative surveillance cover is provided around the three major international in the State using primary radars. States regulations on gun control regulations on gun controlThreat of ATC impersonator giving deliberately incorrect instructions to pilot(s) using ATC frequencies is under the remit of Communications Regulator who aim to restrict and remove non legitimate radio transmissions.
- Data infrastructure architecture, Redundancy of data sources and Site protection - fencing of sites, regime of entrance, remote monitoring
- Risk Assessment undertaken by supplier.
- Austro Control will follow the national and EU-wide regulations on Cybersecurity. At the present, local security measures, to be applied as "state of the art" for critical infrastructure are in place.





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- IT mitigation measures (i.e. on cyber security) are already in place and will be adapted accordingly to upcoming new EU-regulations.
- use of traditional means of surveillance and application of available contingency planning and cooperation with Law Enforcement and the Appropriate Agency for Spectrum Surveillance for identification and interdiction of unlawful signal sources;
- No mitigations in place X 2
- Use of primary radar
- In most cases having multiple sources(or layers) of surveillance data enhances confidence in data in addition to enhancing the technical performance of the data used for surveillance services.
- Multiple radar heads/sensors are used to provide operational redundancy. The use of double/triple radar coverage.
- ICAO and ISO 27001 security requirements and tested them
- Also, a variety of IT&C conventional countermeasures (controls) supporting the application-specific security requirements are in place:
  - a. authentication to the network;
  - b. Authentication and filtering of network packets for getting expected information / actively filter data for sensitive data or for data integrity „no change to data in transit”;
  - c. Class of service: Network traffic divided into real-time and non real-time classes.
  - d. Operational network separation at logical level;
- Use of non-cooperative surveillance.Using multiple sources of independent co-operative and non-cooperative information.Using leased and secured communication lines.Non-public access to the surveillance data.Applying of security IT policies.
- close cooperation with military services (non-cooperative surveillance) and different technologies to be used

### Q.7.4 What are the mitigation measures to be developed?

As regards the mitigation measures, limited number of ANSPs responded which a number of them included encryption of data. The responses can be summarised as follows:

- Encryption and authentication
- The ANSP is planning to install a new primary radar that should enhance the surveillance of deliberate intruders with malicious intent.
- The State's security agencies and ANSP's proactively manage their risks (including security risks). The NSA is not currently aware of any new mitigation measures being developed exclusively in the context of ANSP operations.
- Service Level Agreement between stakeholders and directives for operation of the remote site
- Risk Assessment undertaken by supplier.
- According to future measures on Cybersecurity regulations.
- IT mitigation measures are already in place.
- CANSO ATM Security Working Group established an ad hoc team for ADS-B security and other spectrum security issues, which is developing a global initiative on the topic.
- NEASCOG (NATO Eurocontrol Security Coordination Group) is focusing its attention on a global cooperation with flight tracking providers (flightradar24 and others) in order to adopt countermeasures for specific flights (obscuring or delaying presentation on web for sensitive flights e.g. state and significant flag flights)
- Encryption of ADS-B data. Confidential records connecting ICAO code to aircraft registration number may be needed. Some addition of information to the ADS-B data to validate the reality of the aircraft?
- Potential encryption mechanisms for surveillance data is one solution being discussed with regards to potential future solution to minimise security risks.
- An action plan has still to be defined
- Development and improvement of ROMATSA Cyber Security Management System;Penetration tests for operational network (planned in 2017);Awareness actions and specialised training in cyber security domain for ATC / Technical Personnel.
- SOC (Security Operational Center) responsible for the cyber security of the surveillance and ATM systems.





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### Q.7.5 Are there any regulatory measures taken by your state in order to minimise the security threats by the widespread availability of surveillance data by various less expensive technical devices?

- cryptography implied to surveillance date limited availability of surveillance data
- cannot currently provide a relevant answer to this questions given the lack of knowledge in the matter.
- Irish law on interception of telecommunications messages is contained in section 98 of the postal and telecommunications services act 1983 which prohibits the interception and disclosure of telecommunications messages.
- According to the coordinated national future plans on Cybersecurity.
- Aviation Security strategy including all concerned stakeholder started and under further development.
- It is established, in the National Civil Aviation Security Program, that each Air Navigation Service Provider must include in its Security Management System a Cybersecurity risk assessment, and put in place cyber security measures.
- The Civil Aviation Security Authority has established a cyber working group with all the national relevant entities to develop cyber security measures and to put in place all de requirements established by the NIS directive.
- Nothing specific but only related to spectrum protection
- The FAA have a mechanism to block aircraft registration numbers from data coming from the Air Traffic Control system, but this does not individual ground-based receivers from gathering data and forwarding to an aggregator of that data.
- Not at present. Less expensive devices are not always illegitimate hence the receivers can be widespread and can be legitimately used by the public. Some flight data are available on Apps on mobile phones which has legal disclaimers of the intended use of that data and it is not clear how the security vulnerabilities that arise with the use of such devices can be prevented.
- However where there can be a direct safety issue to aircraft resulting from air traffic personnel using such less expensive technical devices (e.g. Flightradar24) at various airfields is a cause for concern and which the CAA can act upon.
- National Security Program, which contains IT&C security requirements, including the obligation to implement an IT&C Security Management System according to ISO 27001/28000 Standard. An established practice for BULATS is to procure equipment from proven and trusted providers only. The surveillance data is shared/transferred using encrypted private data communication channels.

### 13.4. Intermediate conclusions

Majority of stakeholders do not assess security vulnerabilities of their surveillance systems. From the stakeholders who responded , only 27% of the stakeholders have assessed security vulnerabilities.

Majority of stakeholders give lack of emphasis to security aspects of surveillance systems or are not so concerned about the widespread availability of surveillance data.

It is also clear that stakeholders generally lack knowledge and awareness in security aspects and have different views on who owns security risks.

Using non-cooperative surveillance and using multiple layers of surveillance techniques is used as mitigation to security vulnerabilities by a small number of ANSPs.

In terms of mitigation measures to be developed and regulatory measures to minimise security threats, most stakeholders do not have the knowledge to answer or there are very limited measures taken.





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### 14. Interface with military surveillance

The remaining NON-transport type state aircraft flying GAT represents a marginal share of the 1.65% share of the total GAT flights: the significance of the problem for the ATM system is currently very low.

On ground military surveillance side, the issue is different: the Mode A/C radars are still representing a large share of the military surveillance with adverse effect on the spectrum congestion. Despite there is a trend showing the replacement of these radars by Mode S radars (based on partial data), it is not clear to know when the Mode A/C radars will be fully replaced by Mode S radars. The military ground surveillance infrastructure has a medium significance for areas which are subject to spectrum congestion issues (like Frankfurt).

More details:

Within the survey it was possible to get not complete, but descent feedback on the military surveillance ground infrastructure in order to conclude on possibilities and consequences in terms of e.g. surveillance infrastructure rationalisation.

In relation to the airborne side unfortunately it was not possible to get sufficient information on state aircraft fleets in terms of types and numbers of different airframes. As well it was not feasible to assess possible cost for additional technology integration such as e.g. ADS-B out integration into combat aircraft.

However a general analysis on the situation in relation to state aircraft and their influence on the overall ATM-system could be conducted.

This analysis is based primarily on the EUROCONTROL "Military statistics brochure" 2014 edition. This document builds on 2013 figures derived from EUROCONTROL's Central Route Charges Office (CRCO) for the GAT IFR data and information from EUROCONTROL Members States for OAT and military fleets.

In summary based on 2013 figures the main facts derived are listed hereby. On top it can be assumed that today the figures in terms of airframes and flights conducted actual numbers are even lower!

- In ECAC region military organisations operate 9.437 state aircraft
- 949 of those air frames are transport type state aircraft
- Remaining 8.488 airframes are of NON transport type such as fighters, trainers, helicopters etc.
- In total in ECAC airspace 9.428.670 flights under GAT rules were conducted
- 155.268 of those GAT flights were conducted by state aircraft which represents 1.65 % of all GAT flights
- The percentage of GAT flights conducted by state aircraft within EUROCONTROL member nations is pending on national rules and varies from 0 % up to 26 %

Complementing the facts above it has to be stated that the vast majority of GAT flights conducted by state aircraft are executed with transport type state aircraft. These airframes already today are mandated by the (EU) 1207/2011 and its amendments to be equipped with Mode S EHS and ADS-B OUT by 7 June 2020.

The remaining NON-transport type state aircraft in fact carry out only a very residual number of GAT flights. In consequence it has to be considered if these flights cause an impact on the overall ATM-system which would justify the retrofit of close to 8.500 airframes at cost which definitely would be much higher than for any civil airframes.





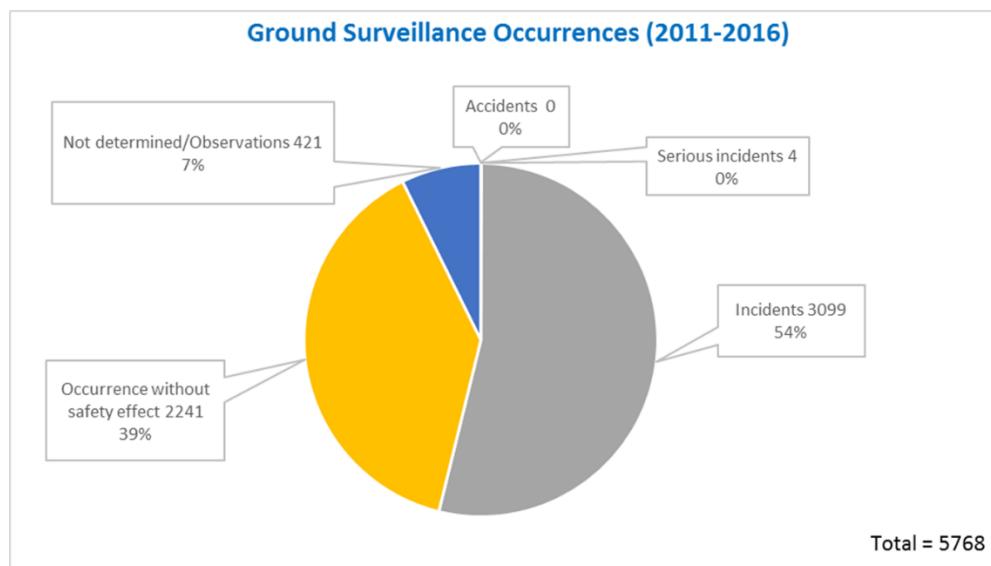
## 15. Safety analysis

This section provides an assessment of the current safety risks with surveillance. The top right part of the problem (section 3) is subject to this section.

### 15.1. Technical SUR occurrences

This section provides an assessment of the reported occurrences related to the safety risks associated to technical issues of surveillance system stored into the European Central Repository (ECR). The period covered from 2011 to 2016, included, and the geographical scope covering all EASA Member States. The search was limited to ATM-specific occurrences (i.e. technical failures) that covered occurrences related to the surveillance system. In other words, those occurrences that identified a technical issue related to the surveillance system as an event present in the report. These events can be traced to the elements “spectrum-congestion” and “technical failures” that are described in the problem tree of Section 3. It should be noted that the picture given by these occurrences in the ECR is not complete, as the level of reporting is highly variable in the EU. Some Members States record a high number of occurrences, while others do not record any, but this situation is more related to the existence of differences in reporting culture than any difference in safety levels of the surveillance system.

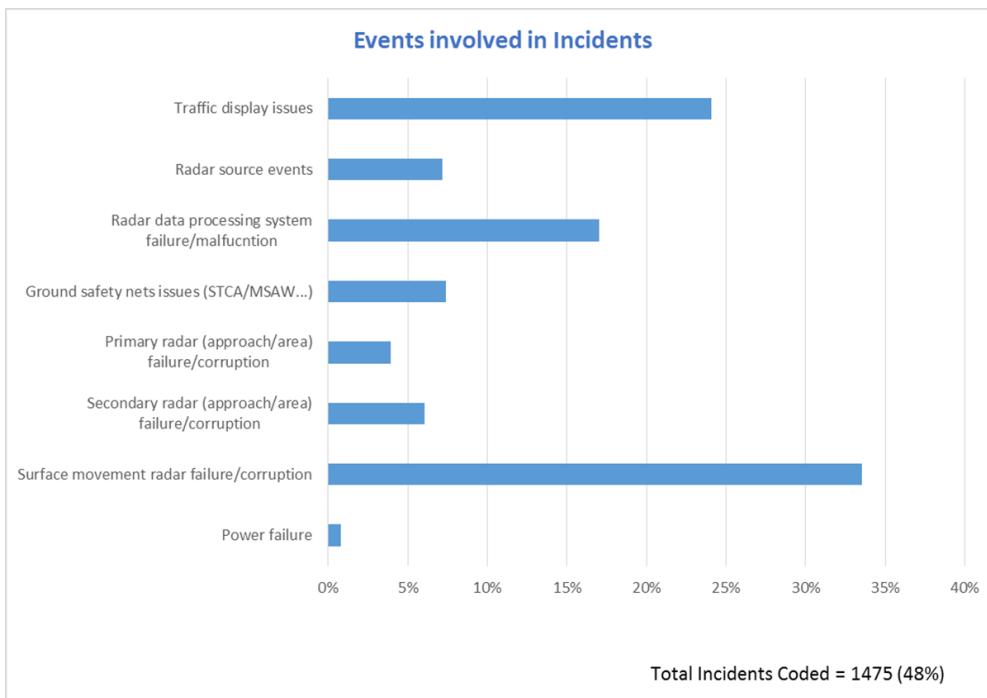
5768 occurrences were found with technical events related to the ATM surveillance system. It is worth noting that no technical occurrence related to the surveillance was found in any accident, and only four were found in investigated serious incidents by AIBs. 54% were recorded with some safety implication, and the rest did not have safety effects or no information was sufficient to classify the severity of the occurrence.



Among the occurrences coded as serious incidents and investigated by AIBs, the technical events were related to the radar system generating mirroring position of aircraft, power supply loss of a DVOR, blackout/frozen radar screens.

A look at the main type of technical occurrences coded in the incidents group of reports (based on 1475 occurrences) are shown in the figure below. The most frequent occurrence seems to be associated with surface radar failure and data corruption (495 occurrences), followed by secondary and primary radars with 109 and 58 occurrences, respectively. These are event that make the surveillance radar service to fail and may involve several causes. Among these sources of issues, traffic display (e.g. blackout of screens, frozen picture) are the most common, followed by technical problems in the Flight Data Processing System, and radar tracks originated at the source, which are manifested in the presence of echoes or ghost track, and loss of radar tracks. No technical reports were found linked to most of these events to identify the underlying causes of the technical problems, but the fact that a minimal fraction of the occurrences was classified as highly severity (only four events were classified as serious incidents and investigated by AIBs) and seems to imply that the current degraded modes of operations and fall back procedures in place at the ANSPs are effective to manage the associated risks.





Within the technical reports associated to loss of radar tracks, no occurrence was identified as serious incident but there was an event reported by Austria, also mentioned in the EASA survey, and investigated by EASA, already mentioned in Section 4.2 as evidence of lack of sustainability of spectrum. The event was related to the loss of radar tracks from the ATCO screens simultaneously in several States in Central Europe on the 5<sup>th</sup> and 10<sup>th</sup> of June. The EASA report (Report-ED0.1-2014-ed04.00 in response to the Commission letter to the Agency) identified that the occurrence was linked to excess interrogation of the transponders on the aircraft flying in the area by a surveillance system/equipment-kind ground-based and non-directional. Even though the source of the over interrogation was likely a test, there is currently a constant amount of interrogations in the area which approaches 80 % of the required transponders' capabilities. This indicates a potential problem of spectrum congestion, as already indicated in Section 4.3.

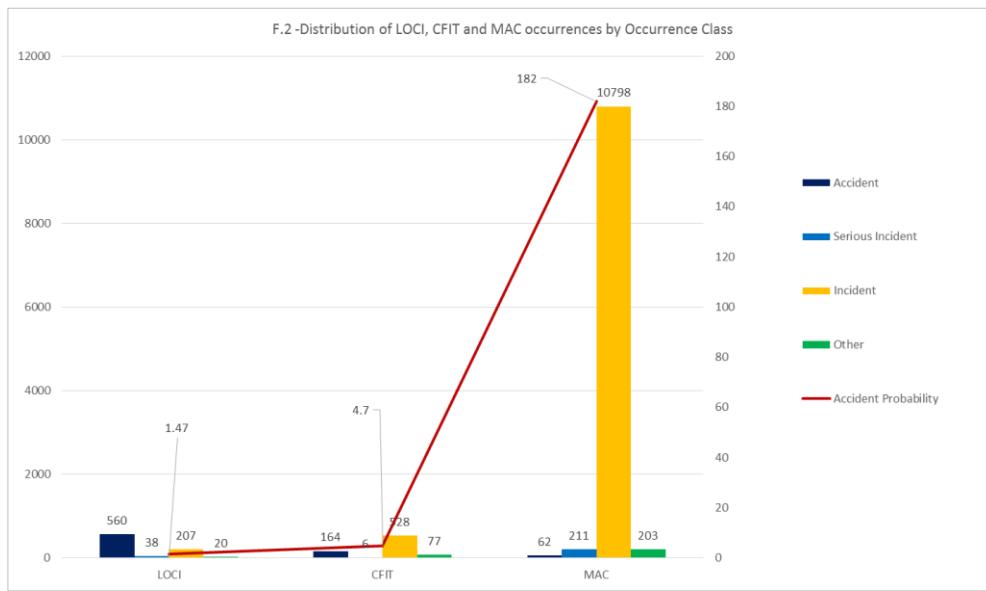
## 15.2. Operational occurrences related to MAC

A review of mid-air collisions accidents and incidents was relevant to this report, as indicated in the problem tree of the Section 4. In a recent EASA study on mid-air –collision, 11,291 occurrences collected through the NoA for the period 2012-2014 were reviewed. The vast majority of MAC/ Airprox occurrences were incidents rather than accidents or serious incidents. There were only 62 accidents compared with 211 serious incidents and 10,798 incidents. The graph below compares the number of accidents, serious incidents and incidents found in the ECR for MAC/ Airprox compared with LOC-I and CFIT. MAC/ Airprox accounted for the 2% of all fatalities, compared with 23% for LOC-I and 15% for CFIT, but the amount of incidents makes the risk of type of occurrences relevant.

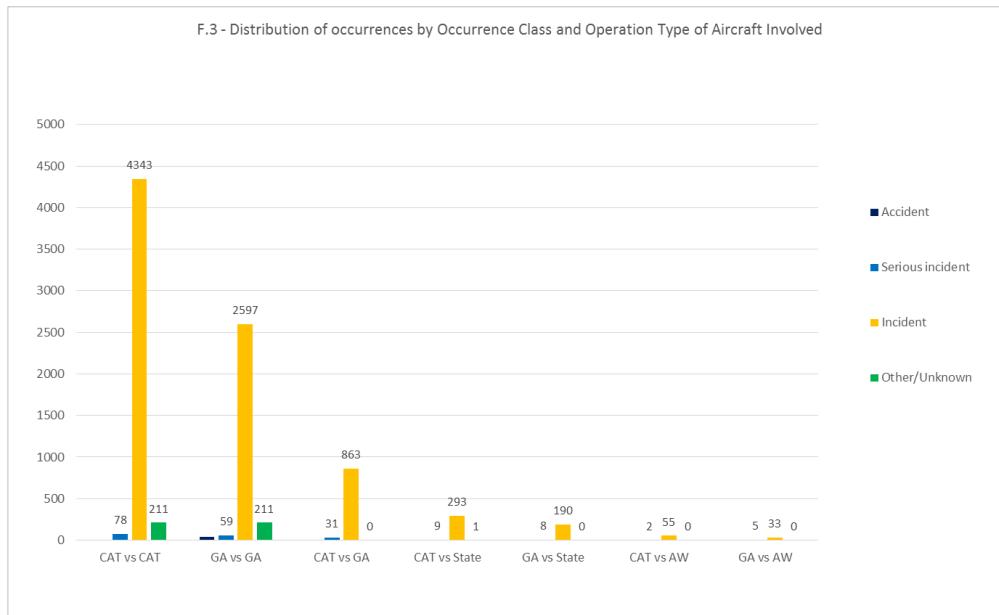




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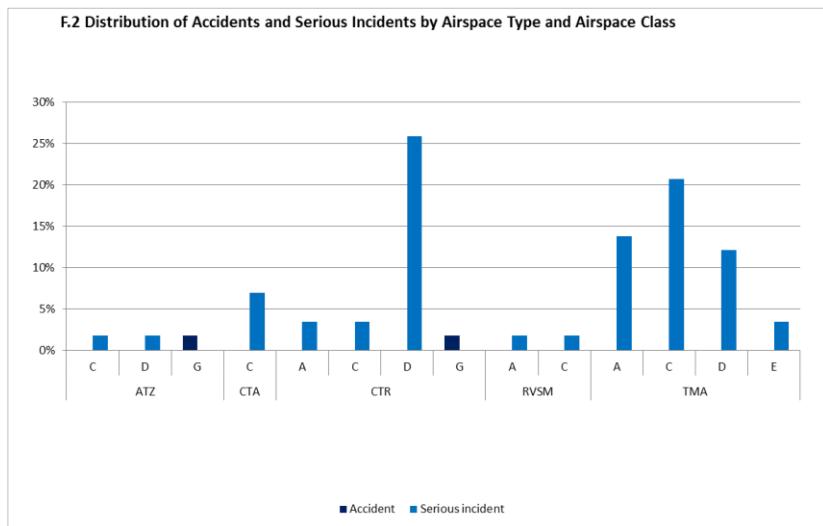


When looking at the type of MAC/near MAC type of aircraft operations involved, the study found that the most frequent incidents correspond to CAT-CAT encounters but with no accidents, so the barriers appear strong in these situations. CAT vs GA is the 3rd most frequent type of occurrence, also with no accidents but the higher proportion of Serious Incidents compared to CAT vs CAT suggest weaker barriers. Finally, GA-GA is 2nd most frequent in terms of occurrences but weaker systemic barriers and greater reliance on pilot see-and-avoidance, a weak barrier that translates in that most fatalities do occur in GA vs GA collisions.



The figure below, showing the type of airspace where the incidents and accidents occurred, show that accidents of GA were located in airspace class G, where the majority of GA activity takes place.





### 15.3. Conclusion

Therefore, one of the main conclusions of the study was that actions were needed to prevent mainly GA vs GA and CAT vs GA encounters. As a result, the safety promotion SPT089 was launched (see appendix in section 16.2) where the main actions proposed are the promotion of technical standards for electronic conspicuity devices to improve the resilience of the see-and-avoid barrier improving the cockpit traffic situation awareness, and the promotion of installation of affordable traffic display system and ADS-B transceiver for GA (from a non-certified GPS source). No additional actions related to the ATM surveillance system are proposed in the short term.





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## 16. Appendices

### 16.1. Appendix 1 – Final Report on radar losses in June 2014

See file: RMT0679 EC Report-BAR-Ax01 Radar losses June 2014.pdf

### 16.2. Appendix 2 – SPT.089 Safety Promotion on Mid-air collisions and airspace infringement

See file: RMT0679 EC Report-BAR-Ax02 SPT089.pdf

This Safety Promotion Task is being currently proposed for the next EPAS 2018-2022.

### 16.3. Appendix 3 – Eurocontrol study for RMT.0679 on spectrum congestion

See file: RMT0679 EC Report-BAR-Ax03 Spectrum.pdf

### 16.4. Appendix 4 - List of air-ground surveillance and ACAC anomalies

Source: EUROCONTROL, based on EUROCONTROL-EASA Working Group to solve air-ground surveillance and ACAC anomalies

The following list contains more than 100 air-ground interoperability issues that have been reported over the last 15 years and are being tracked up to their full resolution. These anomalies are listed depending on their operational impact.

#### 'A' list – safety related and major issues

- [A-1] partial or non-detection of aircraft on Mode S radars
- [A-2] total non-detection of aircraft type 1 on Mode S radars
- [A-8] wrong BDS 17 when using SI code > 16
- [A-9] total non-detection of aircraft by Mode S radars on SI
- [A-10] transponders report CA=0 where no TCAS is installed
- [A-11] total non-detection of military transponder in SI=II code area
- [A-12] loss of altitude information in Mode S
- [A-13] partial detection issue after transponder upgrade
- [A-14] complete and partial losses of transponders on aircraft type 2
- [A-15a] ghosting at the same position – aircraft type 2
- [A-15b] ghosting at the same position – aircraft type 3
- [A-16] intermittent invalid mode a 0607 in Mode S reply
- [A-17] track split issues with aircraft type 4 and Mode S radar

#### 'B' list – non-major issues

- [B-33] ACID : intermittent trailing U character
- [B-42] abnormal high number of broadcast of BDS1,0
- [B-43] ACID - alert not detected on transponder type 1
- [B-44] ACID - alert not detected on transponder type 2
- [B-45] ACID : loss of value upon power up
- [B-48] incorrect BDS1,0 header value set to 30
- [B-49] erroneous subnetwork version number
- [B-55] capability report register BDS 1,0 reset
- [B-57] high rate of spurious Mode A/C replies
- [B-58] high rate of replies radars operating SI code –aircraft type 4
- [B-59] ACID replaced by registration id – transponder type 3
- [B-60] ACID - alert not detected on transponder type 4
- [B-61] ACID replaced by arrival or departure airport



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## 'H' list – enhanced surveillance anomalies

- [H-1] selaltitude: intermittent validity on aircraft type 5
- [H-2] selaltitude: value not available – transponder type 4
- [H-3] selaltitude: incorrect due knob in motion issue
- [H-4] selaltitude: short intermittent failure of MCP/FCU
- [H-8] selaltitude: long intermittent failure of MCP/FCU
- [H-5] selaltitude: intermittent validity – CSDB format
- [H-6] selaltitude: bad ARINC 575 labels interpretation
- [H-7] selaltitude: incorrect value on MCP/FCU
- [H-15] BPS : previous value continues to be downlinked
- [H-18] invalid "mode bits" information in BDS 4,0
- [H-25] true track angle corrupted with selected airspeed
- [H-45] magnetic heading : true heading value downlinked
- [H-60] baro alt rate : transmission of erroneous value
- [H-65] inertial vertical velocity : erroneous value transmitted
- [H-66] baro alt rate : 0 value transmitted as a/c climbs or descend
- [H-67] loss of daps on aircraft type 6

## 'C' list – resolved anomalies

- [C-2] transponder type 2 revert to standby mode
- [C-6] intermittent transponder failure due to ARINC buses overload
- [C-8] non recognition of Mode A code change
- [C-9] ACID change erroneously on aircraft type 5
- [C-10] transponder type 7 revert to standby mode
- [C-11] ACID presented centrally justified
- [C-12a] detection problem transponder type 6a
- [C-12b] detection problem transponder type 6b and transponder type 6c
- [C-13] no EHS capability reported – transponder type 1
- [C-15a] ghosting between 0 and 5nm from actual return
- [C-15b] ghosting between 9 and 10 nm
- [C-15c] reflections and ghosting on Mode S track
- [C-17] ACID: character shift in middle of aircraft id – FMC
- [C-19] potential detection issue – transponder type 6
- [C-20] non detection issue – transponder type 10
- [C-22] ACID: 0000000 value downlinked prior to take-off
- [C-24] BDS swap caused by military aircraft
- [C-25] mode a : transmission of erroneous '7777' value
- [C-29] ACID: additional leading '0' in flight number
- [C-35] intermittent invalid mode a 0607 in Mode A/C reply
- [C-36] BDS swap caused by transponder malfunction

## 'D' list – ADS-B anomalies on certified installations

- [D-1a] jumps in ADS-B position reports – transponder type 5
- [D-1b] jumps in ADS-B position reports – transponder type 8
- [D-1c] jumps in ADS-B position reports – aircraft type 10
- [D-2] unexpected NIC=6 value reported – aircraft type 7
- [D-3] ACID/fid not squittered
- [D-4] no MCP/FCU selected altitude in ADS-B
- [D-5] ADS-B position outside the accuracy limits



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[D-6] inhibition of squitter transmissions – transponder type 5

## ‘E’ list – ADS-B anomalies on non-certified installations

- [E-1] NUCp drop to ‘0’ for a short period of time
- [E-2] NUCp: intermittent change of value repeatedly
- [E-3] very large position error with good NUCp
- [E-4] aircraft not detected by ADS-B ground station
- [E-5] NUCp: misleading integrity based on accuracy-HFOM
- [E-6] NUCp, FOM misleading integrity data on DO260 transponder
- [E-7] random position deviations with good NUCp
- [E-8] incorrect position on areas around 87° latitude
- [E-9] incorrect position is reported on transponder type 11
- [E-10] bad position with good NUCp after change of source
- [E-11] transponder type 9 squittering wrong position with NUCp=7
- [E-12] aircraft squittering barometric altitude <> mode c

## ‘G’ list – ground & system anomalies

- [G-1] BDS swap caused by fruiting
- [G-2] Mode S MB data never present in ASTERIX
- [G-3] wrong communication capability (CA) reported
- [G-4] closer in range roll-call plots on type 1 radar

## ‘X’ list - TCAS anomalies

- [X-1] transmission of spurious RA downlink
- [X-2] spurious RAs reported between FL303 and FL310
- [X-3] wrong v6.04 reported instead of TCAS v 7.1 on transponder type 1
- [X-4a] no reporting of TCAS operation – aircraft type 8
- [X-4b] no reporting of TCAS operation – air transport
- [X-5] intermittent reporting of TCAS operation in BDS1,0
- [X-6] transmission of spurious RA downlink on aircraft type 9
- [X-7] momentary corruption of pressure altitude to TCAS
- [X-8] unexpected TCAS 7.1 triggering spurious RAs
- [X-9] wrong v7.0 reported instead a TCAS v 7.1 by transponder type 02

## ‘S’ list – anomalies impacting surveillance on surface

- [S-1a] ACID replaced by a/c registration after landing –aircraft type 2
- [S-1b] ACID replaced by a/c registration after landing– aircraft type 10
- [S-1c] ACID replaced by a/c registration after landing – aircraft type 3
- [S-3] erroneous replies to “all call” on the ground
- [S-4] transponder air-to-ground transition logic too late
- [S-5] no transmission of ACID on the ground condition
- [S-7] acquisition and extended squitters disable on ground
- [S-8] transponder type loss reported on error log – aircraft type 12

## 16.5. Appendix 5 - List of sites having potentially operational need for surveillance in EASA MS

Source: EASA Survey 2016, combined with a list from 2007 provided by EUROCONTROL and confirmed by IATA





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Based on a list of 50 aerodromes with potential additional surveillance needs, respondents indicated that 25 aerodromes do not need additional surveillance needs, 2 aerodromes need additional surveillance and there was no answer for 23 aerodromes.

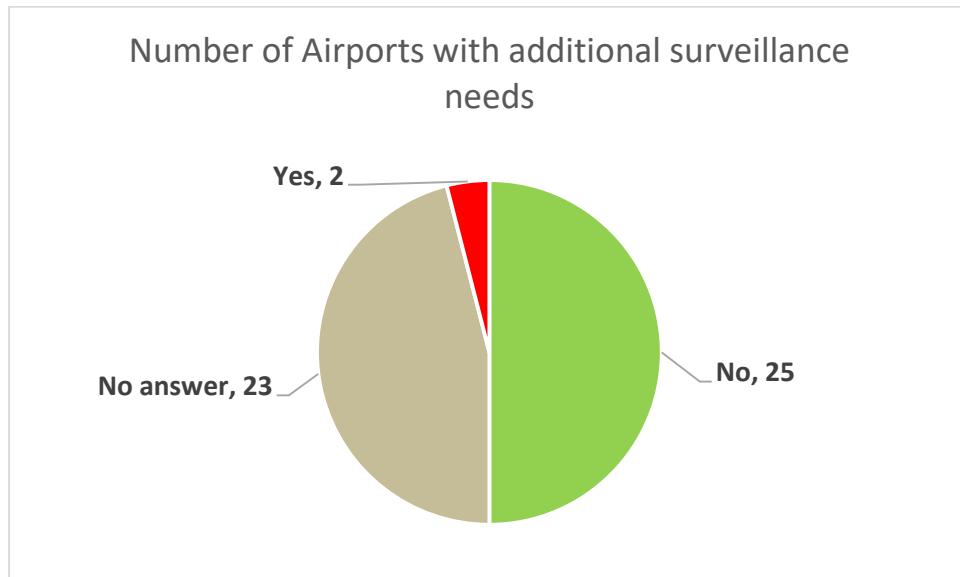


Table 13 – Detailed list of aerodromes with potential additional surveillance needs

Country	ICAO airport code	Aerodrome name	Location of aerodrome	Source for this information	Additional surveillance to answer to airspace users needs?
France	LFKJ	Ajaccio-Napoléon Bonaparte	Corse	EASA survey 2016	Yes
France	LFLB	Chambéry-Aix Les Bains	Rhône-Alpes	EASA survey 2016	Yes
France	LFAQ	Albert-Bray	Picardie	IATA list 2007	No
France	LFRS	Nantes-Atlantique	Pays de la Loire	IATA list 2007	No
France	LFRZ	Saint-Nazaire-Montoir	Pays de la Loire	IATA list 2007	No
France	LFBO	Toulouse-Blagnac	Midi-Pyrénées	IATA list 2007	No
Germany	EDDW	Verkehrsflughafen Bremen	Bremen	IATA list 2007	No
Germany		Hamburg Finkenwerder Airport	Hamburg	IATA list 2007 (not under EASA scope)	No
Greece	LGZA	Zakynthos Dionisios Solomos	Ampelokipi Zakynthos	IATA list 2007	No answer
Greece	LGKP	Karpathos	Karpathos	IATA list 2007	No answer
Greece	LGRP	Rodos Diagoras	Paradissi Rhodes	IATA list 2007	No answer
Greece		Corfu International Airport, "Ioannis Kapodistrias"	Corfu	IATA list 2007 (not under EASA scope)	No answer
Greece		Cephalonia International Airport	Cephalonia	IATA list 2007 (not under EASA scope)	No answer
Italy	LIBC	Crotone	Crotone	IATA list 2007	No





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Country	ICAO airport code	Aerodrome name	Location of aerodrome	Source for this information	Additional surveillance to answer to airspace users needs?
Italy	LICA	Lamezia Terme	Catanzaro	IATA list 2007	No
Italy	LIRN	Napoli Capodichino	Napoli	IATA list 2007	No
Norway	ENAT	Alta Lufthavn	Alta	IATA list 2007	No answer
Norway	ENKR	Kirkenes Lufthavn, Høybuktmoen	Kirkenes	IATA list 2007	No answer
Norway	ENKB	Kristiansund Lufthavn, Kvernberget	Kristiansund	IATA list 2007	No answer
Norway		Svalbard Airport, Longyear	Longyear	IATA list 2007 (not under EASA scope)	No answer
Poland	EPRA	Radom - Sadków		EASA survey 2016	No, very low traffic
Poland	EPSY	Olsztyn - Mazury		EASA survey 2016	No, very low traffic
Poland	EPZG	Zielona Góra		EASA survey 2016	No, very low traffic
Romania	LRAR	Arad Airport	Arad	IATA list 2007	No
Romania	LRBC	Bacău Airport	Bacău	IATA list 2007	No
Romania	LROP	Henri Coandă Airport	Bucureşti	IATA list 2007	No
Romania	LRCK	Mihail Kogălniceanu - Constanța Airport	Constanța	IATA list 2007	No
Romania	LRCV	Craiova Airport	Craiova	IATA list 2007	No
Romania	LRIA	Iași Airport	Iași	IATA list 2007	No
Romania	LROD	Oradea Airport	Oradea	IATA list 2007	No
Romania	LRSM	Satu Mare Airport	Satu Mare	IATA list 2007	No
Romania	LRSB	Sibiu Airport	Sibiu	IATA list 2007	No
Romania	LRSV	Stefan Cel Mare-Suceava Airport	Suceava	IATA list 2007	No
Romania	LRTM	Transilvania-Târgu Mureș Airport	Târgu Mureș	IATA list 2007	No
Romania	LRTR	Traian Vuia Airport	Timișoara	IATA list 2007	No
Romania	LRCL	Cluj-Napoca Avram Iancu Airport	Cluj-Napoca		No
Spain	LEMG	Malaga-Costa Del Sol	Malaga	IATA list 2007	No answer
Spain	LEAL	Alicante-Elche	Alicante	IATA list 2007	No answer
Spain	LEIB	Ibiza	Ibiza	IATA list 2007	No answer
Spain	GCRR	Lanzarote	Lanzarote	IATA list 2007	No answer
Spain	LEGE	Girona	Gerona	IATA list 2007	No answer
Spain	LEAM	Almeria	Almería	IATA list 2007	No answer
Spain	LEGR	Fgl Granada-Jaen	Granada	IATA list 2007	No answer



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Country	ICAO airport code	Aerodrome name	Location of aerodrome	Source for this information	Additional surveillance to answer to airspace users needs?
Spain		Badajoz Airport	Badajoz	IATA list 2007 (not under EASA scope)	No answer
Spain		Getafe Air Base	Getafe	IATA list 2007 (not under EASA scope)	No answer
Spain		Salamanca airport	Salamanca	IATA list 2007 (not under EASA scope)	No answer
Spain		Valladolid Airport	Valladolid	IATA list 2007 (not under EASA scope)	No answer
Sweden	ESNQ	Kiruna Airport	Kiruna	IATA list 2007	No answer
UK	EGGD	Bristol	Bristol	IATA list 2007	No answer
UK	EGNR	Hawarden	Chester	IATA list 2007	No answer

**16.6. Appendix 6 – Cost and benefits for areas lacking surveillance****16.6.1. Appendix 6.1 – Cost and benefits for areas lacking surveillance**

(Source: EASA, report prepared by ALG-ALPAC)

See file: RMT0679 EC Report-BAR-Ax06-1 Low density areas.pdf

**16.6.2. Appendix 6.2 – Cost Benefits for non-radar areas – 3 case studies**

(Source: Eurocontrol)

See file: RMT0679 EC Report-BAR-Ax06-2 Low density areas-ECTL.pdf





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### 16.7. Appendix 7 - Civil ground infrastructure surveillance plans

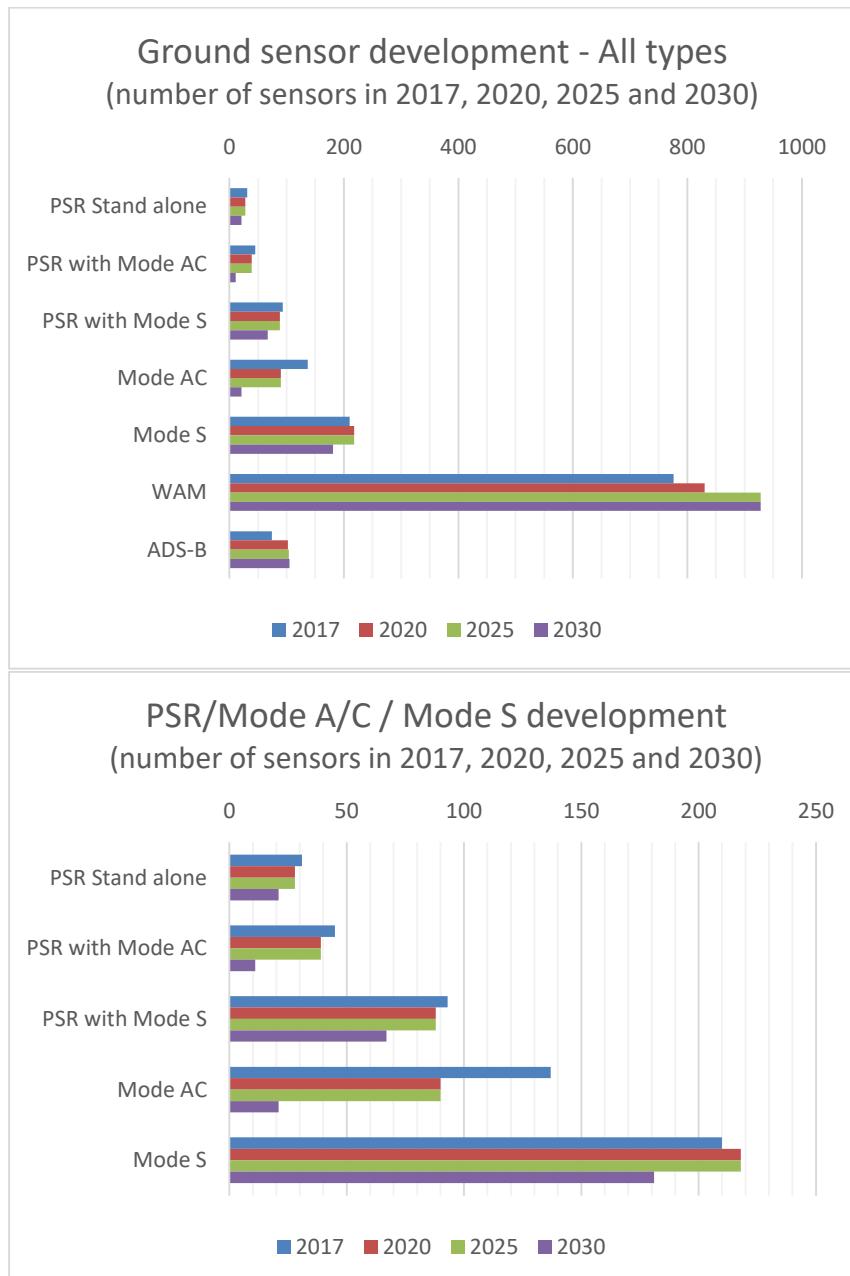
Source: EASA Survey

ANSPs are welcomed to comment and amend this table by sending information the EASA Impact Assessment Team ([impact.assessment@easa.europa.eu](mailto:impact.assessment@easa.europa.eu)).

Note: when a PSR with Mode A/C or Mode S is installed, there are always 2 lines in such case:

- one for the PSR, e.g. PSR with Mode A/C
- one for the SSR: e.g. Mode A/C.

**Figure 10 - Overall trends for number of sensors in 2017, 2020, 2025 and 2030 (EASA Member States)**





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14 Civil ground surveillance sensors in 2017, 2020, 2025 and 2030

Member State – ASNP - Location	2017	2020	2025	2030
<b>AUT</b>	<b>78</b>	<b>72</b>	<b>72</b>	<b>71</b>
<b>Austocontrol</b>	<b>78</b>	<b>72</b>	<b>72</b>	<b>71</b>
AustroControl Buschberg (APP+ERR)				
Mode AC	1			
AustroControl Feichtberg (APP+ERR)		1		
Mode AC	1			
AustroControl Graz (APP)		1		
Mode AC	1			
AustroControl Haunsberg (Salzburg) (APP+ERR)			1	
Mode AC	1	1		1
PSR with mode AC	1			
AustroControl KOR				
Mode S	1	1	1	1
AustroControl Linz (APP)				
Mode S	1	1	1	1
AustroControl VIE2				
Mode S	1	1	1	1
AustroControl Wien (APP)				
Mode AC	1			
AustroControl Wien (ASR)				
PSR with mode AC	1			
AUT_country wide				
WAM	68	68	68	68
<b>BEL</b>	<b>15</b>	<b>11</b>	<b>11</b>	<b>8</b>
<b>Belgocontrol</b>	<b>15</b>	<b>11</b>	<b>11</b>	<b>8</b>
Belgocontrol Bertem Off (ERR)				
Mode AC	1	1	1	1
Belgocontrol Bertem On (ERR)				
Mode S	1	1	1	1
PSR with mode S	1			
Belgocontrol Brussels CMB (APP)				
Mode AC	1			
PSR with mode AC	1	1	1	
Belgocontrol Brussels ModeS (APP)				
Mode S	1	1	1	1
Belgocontrol Charleroi Florennes (EBFS) (APP)				
Mode S	1	1	1	1
Belgocontrol Charleroi PSR (APP)				
PSR with mode S	1			
Belgocontrol Liege (APP)				
Mode S	1	1	1	1
PSR with mode S	1	1	1	1





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Member State – ASNP - Location	2017	2020	2025	2030
Belgocontrol Ostende (EBOS) (APP)				
Mode S	1	1	1	1
Belgocontrol Ostende PSR (APP)				
PSR Stand alone	1	1	1	1
Belgocontrol St Hubert Off (ERR)				
Mode AC	1	1	1	1
Belgocontrol St Hubert On (ERR)				
Mode S	1	1	1	1
PSR with mode S	1			
<b>BGR</b>	<b>47</b>	<b>70</b>	<b>70</b>	<b>65</b>
<b>Bulatsa</b>	<b>47</b>	<b>70</b>	<b>70</b>	<b>65</b>
BULATSA BURGAS (APP)				
Mode AC	1	1	1	1
PSR with mode AC	1	1	1	1
BULATSA PLOVDIV (APP+ERR)				
Mode AC	1	1	1	1
BULATSA SOFIA (APP)				
Mode AC	1			
PSR with mode AC	1			
PSR with mode S	1	1	1	1
BULATSA SOFIA TAR				
Mode S	1	1	1	1
BULATSA Varbitza (ERR)				
Mode S	1	1	1	1
PSR with mode S	1	1	1	1
BULATSA VARNA (APP)				
Mode AC	1	1	1	1
PSR with mode AC	1	1	1	1
BULATSA Vitosha (ERR)				
Mode S	1	1	1	1
PSR with mode S	1	1	1	1
Sofia Airport ATC Tower SMR				
PSR Stand alone	1	1	1	1
Sofia TMA and Sofia Airport				
WAM	11	11	11	11
Sofia TMA and Sofia FIR West				
WAM		25	25	25
TMA Varna / TMA Burgas and Sofia FIR East				
WAM	22	22	22	22
<b>CHE</b>	<b>9</b>	<b>9</b>	<b>59</b>	<b>52</b>
<b>Skyguide</b>	<b>9</b>	<b>9</b>	<b>59</b>	<b>52</b>
0				
WAM			50	50
skyguide DOLS				



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Member State – ASNP - Location	2017	2020	2025	2030
Mode S	1	1	1	1
skyguide GT1S				
Mode S	1	1	1	1
skyguide GV1P				
PSR Stand alone	1	1	1	1
skyguide GV1S				
Mode S	1	1	1	1
skyguide GV2S				
Mode S	1	1	1	1
skyguide HL1P				
PSR Stand alone	1	1	1	1
skyguide HL1S				
Mode S	1	1	1	1
skyguide HL2S				
Mode S	1	1	1	1
skyguide LAGS				
Mode S	1	1	1	1
<b>CYP</b>	<b>10</b>	<b>10</b>	<b>10</b>	<b>10</b>
<b>ANS</b>	<b>10</b>	<b>10</b>	<b>10</b>	<b>10</b>
Beysour - Lebanon				
Mode S - Data sharing	1	1	1	1
DCAC Larnaka (APP)				
Mode S	1	1	1	1
PSR with mode S	1	1	1	1
KIONIA				
Mode AC	1	1	1	1
PSR with mode AC	1	1	1	1
Kionia Mountain				
ADS-B	1	1	1	1
LARA				
Mode S	1	1	1	1
Larnaka airport				
ADS-B	1	1	1	1
Pafos Airport				
Mode S	1	1	1	1
Paphos airport				
ADS-B	1	1	1	1
<b>CZE</b>	<b>38</b>	<b>38</b>	<b>38</b>	<b>36</b>
<b>CZ ANS</b>	<b>38</b>	<b>38</b>	<b>38</b>	<b>36</b>
ANS CR Prague - STAR2000/RMS 970S				
PSR with mode S	1	1	1	1
ANS CZ Bukop (ERR)				
Mode S	1	1	1	1
ANS CZ Pisek (ERR)				





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Member State – ASNP - Location	2017	2020	2025	2030
Mode S	1	1	1	1
ANS CZ Prague (ERR)				
Mode S	1	1	1	1
Brno system (P3D-LKTB)				
WAM	7	7	7	7
Ostrava system (P3D-LKMT)				
WAM	13	13	13	13
Prague system (P3D-WS Prague)				
WAM	8	8	8	8
#VALUE!				
ADS-B	3	3	3	3
PSR Stand alone	3	3	3	3
<b>DEU</b>	<b>86</b>	<b>88</b>	<b>90</b>	<b>69</b>
<b>DFS</b>	<b>86</b>	<b>88</b>	<b>90</b>	<b>69</b>
Berlin (SXF/BER)				
ADS-B			1	1
DFS Auersberg (ERR)				
PSR with mode S	1	1	1	1
DFS Auersberg C1 (ERR)				
Mode S	1	1	1	1
DFS Berlin Brandenburg North (ERR) C1				
Mode S	1	1	1	1
DFS Berlin-Schönefeld (APP)				
Mode AC	1	1	1	1
PSR with mode AC	1	1	1	1
DFS Bremen (APP)				
Mode AC	1	1	1	1
PSR with mode AC	1	1	1	1
DFS Brocken C1 (ERR)				
Mode S	1	1	1	1
DFS Deister (ERR)				
PSR with mode S	1	1	1	1
DFS Deister C1 (ERR)				
Mode S	1	1	1	1
DFS Dresden (APP)				
Mode AC	1	1	1	1
PSR with mode AC	1	1	1	1
DFS Düsseldorf Süd (APP)				
PSR with mode S	1	1	1	1
DFS Düsseldorf Süd C4 (APP)				
Mode S	1	1	1	1
DFS Frankfurt Süd (APP)				
PSR with mode S	1	1	1	1
DFS Frankfurt Süd C4 (APP)				





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Member State – ASNP - Location	2017	2020	2025	2030
Mode S	1	1	1	1
DFS Gosheim C4 (ERR)				
Mode S	1	1	1	1
DFS Götzenhain C4 (Test & ERR)				
Mode S	1	1	1	1
DFS Großhaager Forst (ERR)				
PSR with mode S	1	1	1	1
DFS Großhaager Forst C4 (ERR)				
Mode S	1	1	1	1
DFS Hamburg (APP)				
Mode AC	1	1	1	1
PSR with mode AC	1	1	1	1
DFS Hannover (APP)				
Mode AC	1	1	1	1
PSR with mode AC	1	1	1	1
DFS Köln Bonn (APP)				
Mode AC	1	1	1	1
PSR with mode AC	1	1	1	1
DFS Leipzig Nord (APP)				
Mode AC	1	1	1	1
PSR with mode AC	1	1	1	1
DFS Lüdenscheid (ERR)				
Mode AC	1	1	1	1
DFS Mittersberg (ERR)				
Mode AC	1	1	1	1
DFS München Nord (APP)				
Mode AC	1	1	1	1
PSR with mode AC	1	1	1	1
DFS München Süd (APP)				
PSR with mode S	1	1	1	1
DFS München Süd C4 (APP)				
Mode S	1	1	1	1
DFS Münster Osnabrück (APP)				
Mode AC	1	1	1	1
PSR with mode AC	1	1	1	1
DFS Neubrandenburg (ERR)				
Mode AC	1	1	1	1
DFS Neunkirchner Höhe (ERR)				
PSR with mode S	1	1	1	1
DFS Neunkirchner Höhe C4 (ERR)				
Mode S	1	1	1	1
DFS Nordholz (ERR)				
PSR with mode S	1	1	1	1
DFS Nordholz C1 (ERR)				



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Member State – ASNP - Location	2017	2020	2025	2030
Mode S	1	1	1	1
DFS Nürnberg (APP)				
Mode AC	1	1	1	1
PSR with mode AC	1	1	1	1
DFS Pfälzer Wald (ERR)				
Mode AC	1	1	1	1
DFS POEMS Düsseldorf Nord C1 (APP)				
Mode S	1	1	1	1
DFS Schmooksberg (ERR)				
PSR with mode S	1	1	1	1
DFS Schmooksberg C1 (ERR)				
Mode S	1	1	1	1
DFS Stuttgart (APP)				
Mode AC	1	1	1	1
PSR with mode AC	1	1	1	1
DFS Tegel (APP)				
PSR with mode S	1	1	1	1
DFS Tegel C1				
Mode S	1	1	1	1
Frankfurt (FRA)				
ADS-B		1	1	1
Hamburg (HAM)				
ADS-B	1	1	1	1
Köln/Bonn (KBO)				
ADS-B		1	1	1
München (MUC)				
ADS-B			1	1
PAM_FRA [37(35)]				
WAM	34	34	34	34
<b>DNK</b>	<b>61</b>	<b>60</b>	<b>60</b>	<b>52</b>
<b>Naviar</b>	<b>61</b>	<b>60</b>	<b>60</b>	<b>52</b>
Denmark country wide				
WAM	30	30	30	30
Faroe_Island_site1				
ADS-B	2	2	2	2
Faroe_Island_site2				
ADS-B	2	2	2	2
Greenland_CAN_site1				
ADS-B	2	2	2	2
Greenland_CAN_site2				
ADS-B	2	2	2	2
Greenland_CAN_site3				
ADS-B	2	2	2	2
Greenland_CAN_site4				





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Member State – ASNP - Location	2017	2020	2025	2030
ADS-B	2	2	2	2
Greenland_ICE_site1				
ADS-B	2	2	2	2
Greenland_ICE_site2				
ADS-B	2	2	2	2
Greenland_ICE_site3				
ADS-B	2	2	2	2
Greenland_ICE_site4				
ADS-B	2	2	2	2
Greenland_ICE_site5				
ADS-B	2	2	2	2
NAVIAIR AALBORG				
Mode AC	1	1	1	
PSR with mode AC	1	1	1	
NAVIAIR AARHUS				
Mode AC	1	1	1	
NAVIAIR Copenhagen (Kastrup 1)				
Mode S	1	1	1	
NAVIAIR Copenhagen (Kastrup 1)				
PSR with mode S	1	1	1	
NAVIAIR ESBJERG				
Mode AC	1	1	1	
NAVIAIR KASTRUP 2				
Mode AC	1			
NAVIAIR ROSKILDE				
Mode AC	1	1	1	
NAVIAIR ROSKILDE				
PSR with mode AC	1	1	1	
<b>ESP</b>	<b>46</b>	<b>45</b>	<b>45</b>	<b>30</b>
<b>ENAIRES</b>	<b>46</b>	<b>45</b>	<b>45</b>	<b>30</b>
Alicante airport				
ADS-B		1	1	1
Asturias Airport				
WAM	8	8	8	8
ENAIRES Alcolea (LEAL)				
Mode S	1	1	1	1
ENAIRES Alicante (LEAC)				
Mode S	1	1	1	1
ENAIRES As Pontes (erad-ASP)				
Mode S	1	1	1	1
ENAIRES BARAJAS (APP)				
Mode AC	1	1	1	1
ENAIRES BARCELONA (APP)				
PSR with mode AC	1	1	1	



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Member State – ASNP - Location	2017	2020	2025	2030
ENAIRES BARCELONA (APP+ERR)				
Mode AC	1			
ENAIRES Begas (APP)				
Mode S	1	1	1	
PSR with mode S	1	1	1	
ENAIRES Begas (LEEG)				
Mode S	1	1	1	1
ENAIRES CANCHO BLANCO (ERR)				
Mode AC	1			
ENAIRES EL JUDIO (APP+ERR)				
Mode AC	1	1	1	
ENAIRES ERILLAS (ERR)				
Mode AC	1	1	1	
ENAIRES ESPINEIRAS (APP+ERR)				
Mode AC	1	1	1	
ENAIRES Fuerteventura (GCFT)				
Mode S	1	1	1	1
ENAIRES Gran Canaria (GCGC)				
Mode S	1	1	1	1
ENAIRES HQ (Madrid, near Barajas airport)				
ADS-B	1	1	1	1
ENAIRES La Palma (erad-scp)				
Mode S	1	1	1	1
ENAIRES Malaga I (LEAG)				
Mode S	1	1	1	1
ENAIRES MALAGA II (APP+ERR)				
Mode AC	1	1	1	1
ENAIRES Monflorite (LEMI)				
Mode S	1	1	1	1
ENAIRES Palma Mallorca (APP)				
Mode S	1	1	1	
PSR with mode S	1	1	1	
ENAIRES Palma Mallorca (LEPM)				
Mode S	1	1	1	1
ENAIRES Paracuellos I (APP)				
Mode S	1	1	1	
PSR with mode S	1	1	1	
ENAIRES Paracuellos I (LEPU)				
Mode S	1	1	1	1
ENAIRES PARACUELLOS II (APP)				
PSR with mode AC	1	1	1	1
ENAIRES PARACUELLOS II (APP+ERR)				
Mode AC	1	1	1	
ENAIRES PENAS DEL CHACHE (GCPC)				



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Member State – ASNP - Location	2017	2020	2025	2030
Mode AC	1	1	1	1
ENAIRES RANDA (APP)				
PSR with mode AC	1	1	1	1
ENAIRES RANDA (APP+ERR)				
Mode AC	1	1	1	1
ENAIRES Solorzano (LESO)				
Mode S	1	1	1	1
ENAIRES TABORNO (APP+ERR)				
Mode AC	1	1	1	1
ENAIRES Tenerife (GCTE)				
Mode S	1	1	1	1
ENAIRES TURRILLAS (ERR)				
Mode AC	1			
ENAIRES VALENCIA (APP)				
PSR with mode AC	1	1	1	1
ENAIRES VALENCIA (APP+ERR)				
Mode AC	1	1	1	1
ENAIRES Valladolid (LEVI)				
Mode S	1	1	1	1
Granada airport				
ADS-B		1	1	1
<b>EST</b>	<b>26</b>	<b>24</b>	<b>24</b>	<b>25</b>
<b>EE ANS</b>	<b>26</b>	<b>24</b>	<b>24</b>	<b>25</b>
Country wide WAM				
WAM	24	24	24	24
Countrywide				
ADS-B				1
Estonian ANS Martna (ERR)				
Mode AC	1			
Estonian ANS Tallinn (APP)				
Mode AC	1			
<b>FIN</b>	<b>146</b>	<b>163</b>	<b>163</b>	<b>157</b>
<b>Finavia</b>	<b>146</b>	<b>163</b>	<b>163</b>	<b>157</b>
Finavia Helsinki 01 (APP+ERR)				
Mode AC	1			
Finavia Helsinki 04 (APP)				
PSR Stand alone	1			
Finavia Helsinki 06 (APP+ERR)				
Mode AC	1	1	1	1
Finavia Helsinki SMR1				
PSR Stand alone	1	1	1	1
Finavia Helsinki SMR2				
PSR Stand alone	1	1	1	1
Finavia Helsinki SMR3				



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Member State – ASNP - Location	2017	2020	2025	2030
PSR Stand alone	1	1	1	1
Finavia Jyvaskyla (ERR)				
Mode AC	1	1	1	1
Finavia Kangasala (APP+ERR)				
Mode AC	1	1	1	1
Finavia Kauhava (ERR)				
Mode AC	1			
Finavia Kuopio (ERR)				
Mode AC	1	1	1	1
Finavia Oulu (ERR)				
Mode AC	1	1	1	1
Finavia Pirkkala (ERR)				
Mode AC	1	1	1	1
Finavia Rovaniemi (APP+ERR)				
Mode AC	1			
Finavia Savonlinna (ERR)				
Mode AC	1			
Finavia Turku (APP+ERR)				
Mode AC	1			
Helsinki Airport Ground movement MLAT				
WAM	16	16	16	16
WAM with ADS-B, 1/4 of Finland (eastern area)				
WAM	23	23	23	23
WAM with ADS-B, 3/4 of Finland (southwest, western and northern areas)				
WAM	115	115	115	115
<b>FRA</b>	<b>142</b>	<b>151</b>	<b>151</b>	<b>139</b>
DSNA	142	151	151	139
Corsica-Ajaccio				
ADS-B	1	1	1	1
DSNA Auch (APP+ERR)				
Mode S	1	1	1	1
DSNA Avranches (APP+ERR)				
Mode S	1	1	1	1
DSNA Biarritz (ERR)				
Mode S	1	1	1	1
DSNA Bordeaux (Lestignac - APP+ERR)				
Mode S	1	1	1	1
DSNA Bordeaux Merignac				
PSR Stand alone	1	1	1	1
DSNA Boulogne (APP+ERR)				
Mode S	1	1	1	1
DSNA Brest (ERR)				
Mode S	1	1	1	1
DSNA Charles de Gaulle (APP)				





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Member State – ASNP - Location	2017	2020	2025	2030
Mode S	1			
DSNA Chaumont (ERR)				
Mode S	1	1	1	1
DSNA Dammartin				
PSR Stand alone	1	1	1	1
DSNA Figari				
Mode AC	1			
Mode S		1	1	1
DSNA Grand Ballon (APP+ERR)				
Mode S	1	1	1	1
DSNA Grasse (APP+ERR)				
Mode S	1	1	1	1
DSNA Grenoble (APP+ERR)				
Mode S	1	1	1	1
DSNA La Roche-sur-Yon (APP+ERR)				
Mode S	1	1	1	1
DSNA Limoges (ERR)				
Mode S	1	1	1	1
DSNA Lyon Satolas				
PSR Stand alone	1	1	1	1
DSNA Marseille				
Mode S	1	1	1	1
PSR with mode S	1	1	1	1
DSNA Marseille (APP)				
Mode S	1	1	1	1
DSNA Mont Ventoux (APP+ERR)				
Mode S	1	1	1	1
DSNA Montpellier (APP+ERR)				
Mode S	1	1	1	1
DSNA Mulhouse Bale				
PSR Stand alone	1	1	1	1
DSNA Nevers (ERR)				
Mode S	1	1	1	1
DSNA Nice				
Mode S	1	1	1	1
PSR with mode S	1	1	1	1
DSNA Nice (APP)				
Mode S	1	1	1	1
DSNA Orly				
PSR Stand alone	1	1	1	1
DSNA Paris CdG Est				
Mode S	1	1	1	1
DSNA Paris Nord (APP+ERR)				
Mode S	1	1	1	1



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Member State – ASNP - Location	2017	2020	2025	2030
DSNA Paris Saclay				
Mode S	1	1	1	1
DSNA Paris Sud (APP+ERR)				
Mode S	1			
DSNA Pierre-sur-Haute (APP)				
Mode S	1	1	1	1
DSNA Quimper - Saint Goazec (ERR)				
Mode S	1	1	1	1
DSNA Roissy				
PSR Stand alone	1			
DSNA Strasbourg				
PSR Stand alone	1	1	1	
DSNA Strasbourg Mode S				
Mode S	1	1	1	1
DSNA Toulouse Blagnac				
Mode S	1	1	1	1
DSNA Toulouse Blagnac				
PSR with mode S	1	1	1	
DSNA Tours (ERR)				
Mode S	1	1	1	1
France-Toulouse				
ADS-B	1	1	1	1
French Guyana-Felix Eboué				
ADS-B		1	1	1
French Guyana-Mana				
ADS-B		1	1	1
French Guyana-Maripasoula				
ADS-B		1	1	1
French Guyana-Mont Matoury				
ADS-B		1	1	1
French Guyana-Saint Georges				
ADS-B		1	1	1
Lyon Airport - Airport MLAT				
WAM	15	15	15	15
New Caledonia-Gouemba				
ADS-B	1	1	1	1
New Caledonia-Mont Dô				
ADS-B	1	1	1	1
New Caledonia-Mont Dore				
ADS-B	1	1	1	1
Nice Airport - Airport MLAT				
WAM	12	12	12	12
Nice Airport - WAM				
WAM	5	5	5	5



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Member State – ASNP - Location	2017	2020	2025	2030
Paris CDG				
WAM	27	27	27	27
Paris Orly				
WAM	14	14	14	14
Polynesia-Bora-Bora				
ADS-B	1	1	1	1
Polynesia-Maheana				
ADS-B	1	1	1	1
Polynesia-Mont Marau				
ADS-B	1	1	1	1
Polynesia-Moorea				
ADS-B	1	1	1	1
Polynesia-Rangiroa				
ADS-B	1	1	1	1
Polynesia-TBD				
ADS-B		7	7	7
Reunion-Colorado				
ADS-B	1	1	1	1
Reunion-La Table				
ADS-B	1	1	1	1
Reunion-Pierrefonds				
ADS-B	1	1	1	1
Reunion-Saint Denis				
ADS-B	1	1	1	1
Toulouse Airport				
WAM	15	15	15	15
<b>GBR</b>	<b>87</b>	<b>86</b>	<b>95</b>	<b>91</b>
<b>(ECTL)</b>	<b>16</b>	<b>16</b>	<b>16</b>	<b>16</b>
0				
Mode S	16	16	16	16
<b>Air Traffic Control Services Limited</b>	<b>8</b>	<b>7</b>	<b>7</b>	<b>7</b>
Doncaster Sheffield Airport - Raytheon ASR-10SS PSR				
Mode S	1	1	1	1
PSR with mode S	1	1	1	1
Doncaster Sheffield Airport - Raytheon Condor Series 300 MSSR (co-located on PSR)				
Mode S	1	1	1	1
PSR with mode S	1	1	1	1
Durham Tees Valley Airport - Watchman 10cm				
PSR Stand alone	1			
Hibaldstow (supporting Doncaster Sheffield Airport) - Thales STAR 2000				
PSR Stand alone	1	1	1	1
Liverpool John Lennon Airport - Raytheon ASR-10 SS Mk2 ASDP				
PSR Stand alone	2	2	2	2
<b>Glasgow Airport</b>	<b>1</b>	<b>1</b>	<b>1</b>	<b>1</b>



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Member State – ASNP - Location	2017	2020	2025	2030
Glasgow Airport				
PSR Stand alone	1	1	1	1
<b>HIAL</b>	<b>2</b>	<b>2</b>	<b>11</b>	<b>9</b>
Inverness Airport				
Mode S	1	1	1	
PSR with mode S	1	1	1	
WAM			9	9
<b>Humberside Airport</b>	<b>1</b>	<b>1</b>	<b>1</b>	<b>2</b>
Humberside Airport				
PSR Stand alone	1	1	1	2
<b>NATS</b>	<b>57</b>	<b>57</b>	<b>57</b>	<b>54</b>
Allanshill				
Mode S	1	1	1	1
PSR with mode S	1	1	1	1
Belfast				
Mode S	1	1	1	1
Bovingdon				
Mode S	1	1	1	1
PSR with mode S	1	1	1	1
Burrington Combined				
Mode S	1	1	1	
PSR with mode S	1	1	1	
Burrington SSR				
Mode S	1	1	1	1
Claxby				
Mode S	1	1	1	1
PSR with mode S	1	1	1	1
Clee Hill				
Mode S	1	1	1	1
PSR with mode S	1	1	1	1
Cromer				
Mode S	1	1	1	
PSR with mode S	1	1	1	1
Debden				
Mode S	1	1	1	1
PSR with mode S	1	1	1	1
Fitfull Head				
Mode S	1	1	1	1
Gatwick				
Mode S	1	1	1	1
PSR with mode S	1	1	1	1
Glasgow SSR				
Mode S	1	1	1	1
Great Dun Fell				

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Member State – ASNP - Location	2017	2020	2025	2030
Mode S	1	1	1	1
PSR with mode S	1	1	1	1
Heathrow				
Mode S	1	1	1	1
PSR with mode S	1	1	1	1
Lowther Hill				
Mode S	1	1	1	1
PSR with mode S	1	1	1	1
Manchester				
Mode S	1	1	1	1
PSR with mode S	1	1	1	1
Mount Gabriel				
Mode S	1	1	1	1
Pease Pottage				
Mode S	1	1	1	1
PSR with mode S	1	1	1	1
Perwinnes				
Mode S	1	1	1	1
PSR with mode S	1	1	1	1
Sandwick Head 1				
Mode S	1	1	1	1
Sandwick Head 2				
Mode S	1	1	1	1
St Annes				
Mode S	1	1	1	1
PSR with mode S	1	1	1	1
Stansted				
Mode S	1	1	1	1
PSR with mode S	1	1	1	1
Tiree				
Mode S	1	1	1	1
PSR with mode S	1	1	1	1
UK_NorthSea				
WAM	16	16	16	16
<b>NATS in-fill radars</b>	<b>2</b>	<b>2</b>	<b>2</b>	<b>2</b>
Cumbernauld				
PSR Stand alone	1	1	1	1
Kincardine				
PSR Stand alone	1	1	1	1
<b>GRC</b>	<b>20</b>	<b>22</b>	<b>22</b>	<b>7</b>
<b>HCAA</b>	<b>20</b>	<b>22</b>	<b>22</b>	<b>7</b>
HCAA Atars (APP)				
Mode AC	1	1	1	1
PSR with mode AC	1	1	1	1





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Member State – ASNP - Location	2017	2020	2025	2030
HCAA Attaviros (ERR)				
Mode AC	1	1	1	1
HCAA Himittos (ERR)				
Mode AC	1	1	1	1
PSR with mode AC	1	1	1	1
HCAA Iraklion (APP)				
Mode AC	1	1	1	1
PSR with mode AC	1	1	1	1
HCAA Kamara (APP)				
Mode AC	1			
PSR with mode AC	1	1	1	1
HCAA Karpathos (ERR)				
Mode AC	1	1	1	1
HCAA Kerkira (APP)				
Mode AC	1			
PSR with mode AC	1	1	1	1
HCAA Kithira (ERR)				
Mode AC	1			
HCAA Lefkas (ERR)				
Mode AC	1	1	1	1
HCAA Merenda (APP)				
Mode AC	1	1	1	1
HCAA Pilion (ERR)				
Mode AC	1	1	1	1
HCAA Rodos (APP)				
Mode AC	1	1	1	1
PSR with mode AC	1	1	1	1
HCAA Thessaloniki (APP)				
Mode AC	1			
PSR with mode AC	1	1	1	1
NE Athinai FIR				
WAM		6	6	6
<b>HRV</b>	<b>5</b>	<b>5</b>	<b>5</b>	<b>4</b>
<b>Crocontrol</b>	<b>5</b>	<b>5</b>	<b>5</b>	<b>4</b>
CroControl Kozjak (LDKO) (APP+ERR)				
Mode S	1	1	1	1
CroControl Monte Kope (LDMK) (APP+ERR)				
Mode S	1	1	1	1
CroControl Pleso				
PSR with mode AC	1	1	1	1
CroControl Pleso (APP+ERR)				
Mode S	1	1	1	1
CroControl Psunj (LDPS) (APP+ERR)				
Mode S	1	1	1	1



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Member State – ASNP - Location	2017	2020	2025	2030
<b>HUN</b>	<b>8</b>	<b>8</b>	<b>8</b>	<b>2</b>
<b>Hungarocontrol</b>	<b>8</b>	<b>8</b>	<b>8</b>	<b>2</b>
HungaroControl Ferihegy TAR1 (APP)				
Mode S	1	1	1	1
PSR with mode S	1	1	1	1
HungaroControl Ferihegy TAR2 (APP)				
Mode S	1	1	1	1
PSR with mode S	1	1	1	1
HungaroControl Kőrishegy (ERR)				
Mode S	1	1	1	1
PSR with mode S	1	1	1	1
HungaroControl Püspökladány (ERR)				
Mode S	1	1	1	1
PSR with mode S	1	1	1	1
<b>IRL</b>	<b>14</b>	<b>12</b>	<b>12</b>	<b>10</b>
<b>IAA</b>	<b>14</b>	<b>12</b>	<b>12</b>	<b>10</b>
IAA Cork (APP+ERR)				
Mode AC	1	1	1	1
PSR with mode AC	1	1	1	1
IAA Crockalough (ERR)				
Mode S	1	1	1	1
IAA Dooncarton (ERR)				
Mode S	1	1	1	1
IAA Dublin 1 (APP+ERR)				
Mode AC	1			
IAA Dublin Head 2 (APP+ERR)				
Mode AC	1	1	1	1
PSR with mode AC	1	1	1	1
IAA Dublin Head 3 (APP+ERR)				
Mode S	1	1	1	1
PSR with mode S	1	1	1	1
IAA Mt Gabriel 2 (APP+ERR)				
Mode S	1	1	1	1
IAA Mt Gabriel Head 1 (APP+ERR)				
Mode S	1	1	1	1
IAA Shannon (APP+ERR)				
Mode AC	1			
PSR with mode AC	1	1	1	1
IAA Woodcock Hill (APP+ERR)				
Mode S	1	1	1	1
<b>ISL</b>	<b>14</b>	<b>14</b>	<b>14</b>	<b>9</b>
<b>Isavia</b>	<b>14</b>	<b>14</b>	<b>14</b>	<b>9</b>
Iceland_Blafljoll				
ADS-B	1	1	1	1



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Member State – ASNP - Location	2017	2020	2025	2030
Iceland_Bolafjall				
ADS-B	1	1	1	1
Iceland_Gunnolfsvikurfjall				
ADS-B	1	1	1	1
Iceland_Hafell				
ADS-B	1	1	1	1
Iceland_Haoxl				
ADS-B	1	1	1	1
Iceland_Thorbjorn				
ADS-B	1	1	1	1
Iceland_Tvetafjall				
ADS-B	1	1	1	1
Iceland_Vidarfjall				
ADS-B	1	1	1	1
ISAVIA Bolafjall (ERR)				
Mode AC	1	1	1	1
ISAVIA Faeroess (Sornfelli on Faroe Islands) (ERR)				
Mode AC	1	1	1	1
ISAVIA Gunnolfsvikurfjall (ERR)				
Mode AC	1	1	1	1
ISAVIA Keflavik (APP+ERR)				
Mode AC	1	1	1	1
ISAVIA Midnesheidi (ERR)				
Mode AC	1	1	1	1
ISAVIA Stokksnes (ERR)				
Mode AC	1	1	1	1
<b>ITA</b>	<b>73</b>	<b>69</b>	<b>69</b>	<b>57</b>
<b>ENAV</b>	<b>73</b>	<b>69</b>	<b>69</b>	<b>57</b>
Alghero Airport				
ADS-B	1	1	1	1
Ancona (VOR)				
ADS-B	1	1	1	1
Bari Airport				
ADS-B	1	1	1	1
C.Marmo				
ADS-B	1	1	1	1
Cagliari Airport				
ADS-B	1	1	1	1
ENAV Bari				
Mode S	1	1	1	1
PSR with mode S	1	1	1	1
ENAV Bergamo (APP)				
Mode S	1	1	1	1
PSR with mode S	1	1	1	1



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Member State – ASNP - Location	2017	2020	2025	2030
ENAV Bologna (APP)				
Mode S	1	1	1	1
PSR with mode S	1	1	1	1
ENAV Caraffa (ERR)				
Mode AC	2	2	2	
PSR with mode AC	1	1	1	
ENAV Cima Canestreddu (ERR)				
Mode S	1	1	1	
ENAV Colle Marmo (APP)				
Mode S	1	1	1	1
ENAV Firenze (APP)				
Mode S	1	1	1	1
PSR with mode S	1	1	1	1
ENAV Genova (APP)				
Mode S	1	1	1	1
PSR with mode S	1	1	1	1
ENAV Lambro (APP)				
Mode S	1	1	1	
PSR with mode S	1	1	1	
ENAV Lamezia (APP)				
Mode S	1	1	1	1
PSR with mode S	1	1	1	1
ENAV Maccarese (ERR)				
Mode S	1	1	1	
PSR with mode S	1	1	1	
ENAV Malpensa I (APP)				
Mode S	1	1	1	1
PSR with mode S	1	1	1	1
ENAV Malpensa II (APP)				
Mode S	1	1	1	1
PSR with mode S	1	1	1	1
ENAV Masseria Orimini (ERR)				
Mode S	1	1	1	
PSR with mode S	1	1	1	
ENAV Monte Codi (ERR)				
Mode S	1	1	1	1
PSR with mode S	1	1	1	1
ENAV Monte Lesima (ERR)				
Mode S	1	1	1	1
PSR with mode S	1	1	1	1
ENAV Monte Stella (ERR)				
Mode S	1	1	1	1
PSR with mode S	1	1	1	1
ENAV Napoli (APP)				



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Member State – ASNP - Location	2017	2020	2025	2030
Mode S	1	1	1	1
PSR with mode S	1	1	1	1
ENAV Olbia (APP)				
Mode S	1	1	1	1
PSR with mode S	1	1	1	1
ENAV Palermo (APP)				
Mode S	1			
PSR with mode S	1			
ENAV Peschiera (ERR)				
Mode S	1	1	1	1
PSR with mode S	1	1	1	1
ENAV Poggio Lecceta (ERR)				
Mode S	1	1	1	1
PSR with mode S	1	1	1	1
ENAV Ravenna (ERR)				
Mode S	1	1	1	1
PSR with mode S	1	1	1	1
ENAV Roma Fiumicino FM				
Mode S	1	1	1	1
PSR with mode S	1	1	1	1
ENAV Roma Fiumicino FS				
Mode S	1	1	1	1
PSR with mode S	1	1	1	1
ENAV Ronchi (APP)				
Mode S	1	1	1	1
PSR with mode S	1	1	1	1
ENAV Torino (APP)				
Mode S	1			
PSR with mode S	1			
ENAV Ustica (ERR)				
Mode S	1	1	1	1
PSR with mode S	1	1	1	1
ENAV Venezia (APP)				
Mode S	1	1	1	1
PSR with mode S	1	1	1	1
Fiumicino				
ADS-B	1	1	1	1
Genova Airport				
ADS-B	1	1	1	1
M.Orimini				
ADS-B	1	1	1	1
M.Stella				
ADS-B	1	1	1	1
Malpensa				



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Member State – ASNP - Location	2017	2020	2025	2030
ADS-B	1	1	1	1
Olbia Airport				
ADS-B	1	1	1	1
P.Lecceta				
ADS-B	1	1	1	1
Parma Airport				
ADS-B	1	1	1	1
Satellite ADS-B				
ADS-B	2	2	2	2
Vieste				
ADS-B	1	1	1	1
<b>LTU</b>	<b>6</b>	<b>6</b>	<b>6</b>	<b>6</b>
<b>Oro navigacija</b>	<b>6</b>	<b>6</b>	<b>6</b>	<b>6</b>
Kaunas MSSR/PSR (EYKA)				
Mode S	1	1	1	1
PSR with mode S	1	1	1	1
Palanga MSSR/PSR (EYPA)				
Mode S	1	1	1	1
PSR with mode S	1	1	1	1
Vilnius MSSR/PSR (EYVI)				
Mode S	1	1	1	1
PSR with mode S	1	1	1	1
<b>LUX</b>	<b>3</b>	<b>2</b>	<b>2</b>	<b>1</b>
<b>ANA</b>	<b>3</b>	<b>2</b>	<b>2</b>	<b>1</b>
ANA Luxembourg Airport TAR1				
Mode AC	1			
ANA Luxembourg Airport TAR2				
Mode S	1	1	1	1
PSR with mode S	1	1	1	1
<b>LVA</b>	<b>7</b>	<b>6</b>	<b>6</b>	<b>5</b>
<b>LGS</b>	<b>7</b>	<b>6</b>	<b>6</b>	<b>5</b>
Kaunas (APP+ERR)				
PSR with mode S	1	1	1	1
Klaipeda (APP+ERR)				
Mode AC	1			
PSR with mode AC	1	1	1	
Oro Navigacija EYKA				
Mode S	1	1	1	1
Oro Navigacija EYPA				
Mode S	1	1	1	1
Oro Navigacija EYVI				
Mode S	1	1	1	1
Vilnius (APP+ERR)				
PSR with mode S	1	1	1	1





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Member State – ASNP - Location	2017	2020	2025	2030
<b>MLT</b>	<b>8</b>	<b>7</b>	<b>7</b>	<b>4</b>
Malta Air Traffic Services	8	7	7	4
MATS Dingli (ERR)				
Mode AC	1	1	1	
PSR with mode AC	1	1	1	
MATS Fawwara				
Mode S	1	1	1	1
MATS Fawwara (ERR + APP)				
Mode AC	1	1	1	1
MATS Hal Far				
Mode S	1	1	1	1
MATS Hal Far (APP)				
Mode AC	1	1	1	1
MATS Luqa (APP)				
Mode AC	1	1	1	
PSR with mode AC	1			
<b>NLD</b>	<b>59</b>	<b>58</b>	<b>58</b>	<b>57</b>
<b>LVNL</b>	<b>59</b>	<b>58</b>	<b>58</b>	<b>57</b>
LVNL Eelde (APP+ERR)				
Mode AC	1			
LVNL Schiphol Airport MLAT				
WAM	25	25	25	25
LVNL Schipol TAR West (004-025)				
Mode S	1	1	1	1
LVNL Schipol TAR West (SAC SIC 004-025)				
PSR with mode S	1	1	1	1
LVNL Schipol TAR1				
Mode S	1	1	1	
Netherlands_NorthSea				
WAM	30	30	30	30
<b>NOR</b>	<b>106</b>	<b>103</b>	<b>103</b>	<b>100</b>
<b>Avinor</b>	<b>106</b>	<b>103</b>	<b>103</b>	<b>100</b>
Avinor AS , Gardermoen TAR				
PSR with mode AC	1			
Avinor AS Bergen TAR				
PSR Stand alone	1	1	1	1
Avinor AS Gardermoen (Oslo) TAR				
PSR Stand alone	1	1	1	1
Avinor AS Sola (Stavanger) TAR				
PSR Stand alone	1	1	1	1
Avinor AS, Oslo Airport Gardermoen (Oslo) TAR				
Mode AC	1			
Avinor Flysikring AS Alesund (ERR)				
Mode AC	1			



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Member State – ASNP - Location	2017	2020	2025	2030
Avinor Flysikring AS Alta				
Mode S	1	1	1	1
Avinor Flysikring AS Bardufoss				
Mode S	1	1	1	1
Avinor Flysikring AS Bodø TAR				
Mode AC	1			
Avinor Flysikring AS Evenes (APP)				
Mode AC	1			
Avinor Flysikring AS Evje (ERR)				
Mode AC	1			
Avinor Flysikring AS Heidrun				
Mode S	1	1	1	1
Avinor Flysikring AS HKS (Haukåsen - Oslo)				
Mode S	1	1	1	1
Avinor Flysikring AS Kirkenes				
Mode S	1	1	1	1
Avinor Flysikring AS Klettkov (ERR)				
Mode AC	1			
Avinor Flysikring AS Lifjell (ERR)				
Mode AC	1	1	1	1
Avinor Flysikring AS ORL (Orland)				
Mode S	1	1	1	1
Avinor Flysikring AS PYT (Pyttane)				
Mode S	1	1	1	1
Avinor Flysikring AS Pyttane (APP+ERR)				
Mode AC	1	1	1	1
Avinor Flysikring AS Sola (Stavanger) TAR				
Mode AC	1			
Avinor Flysikring AS TORP				
Mode S	1	1	1	1
Avinor Flysikring AS Tromsø Kjolen (ERR)				
Mode AC	1			
Avinor Flysikring AS Tron (ERR)				
Mode AC	1			
Avinor Flysikring AS Trondheim TAR				
Mode AC	1			
Avinor Flysikring AS Vardasen				
Mode S	1			
Avinor Flysikring AS Bergen TAR				
Mode AC	1	1	1	1
Avinor Flysikring AS Vega (ERR)				
Mode AC	1			
Balder				
ADS-B		6	6	6



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Member State – ASNP - Location	2017	2020	2025	2030
Ekofisk				
ADS-B		4	4	4
NORWAM stage 1(West Coast WAM)				
WAM	18	18	18	18
NORWAM stage 2 ( Tromsø, Værnes, Sogn)				
WAM	54	54	54	54
Ørland				
PSR with mode S	1	1	1	1
Statfjord				
ADS-B	3	3	3	3
Statoil Gullfaks (ERR)				
Mode AC	1	1	1	
Svalbard-mainland corridor				
ADS-B	2	2	2	2
<b>POL</b>	<b>28</b>	<b>24</b>	<b>63</b>	<b>56</b>
<b>PANSA</b>	<b>28</b>	<b>24</b>	<b>63</b>	<b>56</b>
Country-wide system (in addition of PANSA Gdansk)				
WAM			39	39
Kraków				
PSR with mode S	1	1	1	1
PANSA Gdansk				
PSR with mode AC	1	1	1	
WAM	9	9	9	9
PANSA Gdańsk				
Mode AC	1	1	1	
PANSA Katowice				
Mode AC	1	1	1	
PSR with mode AC	1	1	1	
PANSA Krakow				
Mode S	1	1	1	1
PANSA Poznan				
Mode S	1	1	1	1
PANSA Poznań				
Mode AC	1	1	1	
PANSA Pultusk				
Mode AC	1	1	1	
PANSA Rzeszow				
Mode AC	1			
PANSA Szczecin				
Mode AC	1			
PANSA Warszawa				
Mode AC	1			
Mode S	1		1	1
PSR with mode AC	1			

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Member State – ASNP - Location	2017	2020	2025	2030
PANSA Wrocław				
Mode S	1	1	1	1
PANSA Wrocław				
Mode AC	1	1	1	
Poznań				
PSR with mode S	1	1	1	1
Warszawa				
PSR with mode S	1	1	1	1
Wrocław				
PSR with mode S	1	1	1	1
<b>PRT</b>	<b>89</b>	<b>92</b>	<b>92</b>	<b>90</b>
<b>NAV Portugal EPE</b>	<b>89</b>	<b>92</b>	<b>92</b>	<b>90</b>
NAV Portugal Faro (APP)				
Mode AC	1	1	1	
Mode S		1	1	1
NAV Portugal Foia (ERR)				
Mode AC	1			
Mode S		1	1	1
NAV Portugal Lisboa (APP)				
Mode AC	1			
Mode S		1	1	1
NAV Portugal Montejunto (ERR)				
Mode AC	1			
Mode S		1	1	1
NAV Portugal Porto (APP)				
Mode AC	1			
Mode S		1	1	1
NAV Portugal Porto Santo (ERR)				
Mode AC	1			
Mode S		1	1	1
NAV Portugal Santa Maria (ERR)				
Mode AC	1	1	1	
Mode S		1	1	1
Portugal_Azores_Central				
WAM	11	11	11	11
Portugal_Azores_West				
WAM	6	6	6	6
Portugal_Lisbon				
WAM	22	22	22	22
Portugal_Madeira				
WAM	12	12	12	12
Portugal_Porto_NE Portugal				
WAM	14	14	14	14
Portugal_São Miguel				



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Member State – ASNP - Location	2017	2020	2025	2030
ADS-B		1	1	1
Portugal_VISTO				
WAM	17	17	17	17
<b>ROU</b>	<b>46</b>	<b>46</b>	<b>46</b>	<b>44</b>
<b>ROMATSA</b>	<b>46</b>	<b>46</b>	<b>46</b>	<b>44</b>
ROMATSA Bacau (MSSR - ERR)				
Mode S	1	1	1	1
ROMATSA Bucharest (ERR)				
Mode S	1	1	1	1
ROMATSA Buciumeni (MSSR - ERR)				
Mode AC	1	1	1	1
ROMATSA Cluj (MSSR - ERR)				
Mode S	1	1	1	1
ROMATSA Constanta (APP)				
Mode S	1	1	1	1
ROMATSA Manastur (ERR)				
Mode S	1	1	1	1
ROMATSA Otopeni (MSSR - APP)				
Mode S	1	1	1	1
PSR with mode S	1	1	1	1
ROMATSA Topolog (MSSR - ERR)				
Mode AC	1	1	1	1
WAM ROMATSA Cluj Sibiu Tg. Mures				
WAM	23	23	23	23
WAM ROMATSA SUD				
WAM	14	14	14	14
<b>SVK</b>	<b>8</b>	<b>8</b>	<b>8</b>	<b>6</b>
<b>LPS SR</b>	<b>8</b>	<b>8</b>	<b>8</b>	<b>6</b>
LPS SR Bratislava TAR				
ADS-B	1	1	1	1
Mode S	1	1	1	1
PSR with mode S	1	1	1	1
LPS SR Kosice TAR				
PSR Stand alone	1	1	1	1
LPS SR Mosnik				
Mode S	1	1	1	1
LPS SR Poprad TAR				
PSR Stand alone	1	1	1	1
LPS SR Velky Bucen				
Mode S	1	1	1	1
LPS SR Velky Javornik				
Mode S	1	1	1	1
<b>SVN</b>	<b>6</b>	<b>7</b>	<b>7</b>	<b>4</b>
<b>Slovenia Control</b>	<b>6</b>	<b>7</b>	<b>7</b>	<b>4</b>



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Member State – ASNP - Location	2017	2020	2025	2030
ADS-B Kum				
ADS-B		1	1	1
Slovenia Control Brnik (APP+ERR)				
Mode AC	1	1	1	
PSR with mode AC	1	1	1	
Slovenia Control CHARLIE (CHR_VRH)				
Mode S	1	1	1	
Slovenia Control LJBR-S (Brnik Charlie LJCH) (APP+ERR)				
Mode S	1	1	1	1
PSR with mode S	1	1	1	1
Slovenia Control Oljska Gora (ModeS - ERR)				
Mode S	1	1	1	1
<b>SWE</b>	<b>76</b>	<b>80</b>	<b>80</b>	<b>68</b>
<b>LFV</b>	<b>76</b>	<b>80</b>	<b>80</b>	<b>68</b>
Askersund				
Mode S		1	1	1
Bällsta				
Mode S	1	1	1	1
PSR with mode S	1	1	1	1
Country-wide WAM with ADS-B capability				
WAM	61	61	61	61
Landvetter				
Mode S		1	1	1
LFV Angelholm (APP+ERR)				
Mode AC	1	1	1	
LFV Arlanda (APP+ERR)				
Mode AC	1	1	1	
LFV Askersund (APP+ERR)				
Mode AC	1	1	1	
LFV Landvetter (APP+ERR)				
Mode AC	1	1	1	
LFV Lulea (APP+ERR)				
Mode AC	1	1	1	
LFV Östersund (APP+ERR)				
Mode AC	1	1	1	
LFV Romele (APP+ERR)				
Mode AC	1	1	1	
LFV Ronneby (APP+ERR)				
Mode AC	1	1	1	
LFV Sundsvall (APP+ERR)				
Mode AC	1	1	1	
LFV Umea (APP+ERR)				
Mode AC	1	1	1	
LFV Uppsala (APP+ERR)				





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Member State – ASNP - Location	2017	2020	2025	2030
Mode AC	1			
PSR with mode AC	1	1		1
LFV Visby (APP+ERR)				
Mode AC	1	1		1
Ronneby				
Mode S		1	1	1
Umeå				
Mode S		1	1	1
Visby				
Mode S		1	1	1
<b>Grand Total</b>	<b>1367</b>	<b>1396</b>	<b>1496</b>	<b>1335</b>

## 16.8. Appendix 8 – FABEC rationalisation study

See file: RMT0679 EC Report-BAR-Ax08 FABEC.pdf

