Centralised Service on Network Infrastructure Performance monitoring and analysis Service (NIPS) Concept of Operations (CONOPS)

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The CNS infrastructure is a key enabler of a safe and efficient ATM system. The European Network Infrastructure Performance monitoring and analysis Service (NIPS) enables the creation of an ECAC wide, consistent, high quality CNS infrastructure performance monitoring and anomaly resolution service.

The scope of the service is the monitoring of the performance and the investigation of problems of the common distributed CNS infrastructure, including aircraft installation performance, air-ground data-link performance and navigation satellite infrastructure performance. CS7 addresses 6 functions which have been grouped under 3 sub-services that will be tendered separately:

- The CNS performance monitoring (CNS-PERF), which includes:
  - The performance monitoring of Data-link communication (DLS-CRO),
  - The functional & performance analysis of surveillance avionics (SUR-AV),
  - The performance analysis of TCAS function (CAS-TEC),
  - The RVSM Regional Monitoring Agency Altimetry System Error (RMA-ASE),
- The performance of 1030/1090 RF bands (SUR-RF),
- The monitoring and prediction of satellite navigation (SAT-NAV).

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EXECUTIVE SUMMARY

The CNS infrastructure is a key enabler of a safe and efficient ATM system. The European Network Infrastructure Performance Analysis Service (NIPS) enables the creation of an ECAC wide, consistent, high quality CNS infrastructure performance monitoring and anomaly resolution service.

An important part of the CNS infrastructure has been moving from the ground segment (traditionally owned and operated by ANSPs) to the airborne/avionics segment, making the airborne CNS installation more complex; it is anticipated that this trend will continue. For example surveillance functionality is moving from the ground radars to Airborne ADS-B installation and Navigation is becoming satellite based. In addition the CNS infrastructure is now used to support new air-air surveillance applications for which no ground infrastructure is involved.

For all these reasons the verification of CNS infrastructure performance to ensure an efficient and safe operation is also becoming more critical. Such verification requires common tools and approach while the investigation and resolution of anomalies require a high level of expertise.

The scope of the NIPS service is the monitoring of the performance and problem investigation of the common distributed CNS infrastructure, including aircraft installation performance, air-ground data-link performance and satellite infrastructure performance. CS7 addresses 6 functions which have been grouped under 3 sub-services that will be tendered separately:

- The CNS performance monitoring (CNS-PERF), which includes:
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- The performance of 1030/1090 RF bands (SUR-RF),
- The monitoring and prediction of satellite navigation (SAT-NAV).

After introducing the central services concept and the main purpose of CS7 the document describes the detailed scope, the components of each sub-service included in CS7 and the roles and responsibilities of the different parties involved.
INTRODUCTION

Introduction by the Director General of EUROCONTROL

Following a request of the European Commission in November 2012, EUROCONTROL developed the concept of Centralised Services (CS).

Version 2.0, dated March 2013 of the EUROCONTROL Proposal for a first set of nine Centralised Services to contribute to SES Performance Achievement is attached as Annex 3. A short description of the proposed CS is attached as Annex 4.

The Agency proposed the CS concept in order to significantly support:

- the Member States and their ANSPs to reach or at least to come closer to the EU performance targets,
- the implementation of SESAR results on a central pan-European level
- the development of high tech solutions by European ATM manufacturers to be deployed on a central level providing the services to all ANSPs of the EUROCONTROL Member States,
- the creation of pan-European operational concepts for the Centralised Services proposed
- the creation of a pan-European market for these ANS support services
- the implementation of market mechanisms for some ANS support services through tendering of the services with time limited performance based contracts
- the creation of market opportunities for the ANSPs of EUROCONTROL Member States to provide services outside of their national boundaries, cooperating in newly founded consortia,
- the strengthening of the European Network, increasing capacity and safety,
- in the planning and execution phase much more user friendly 4 D trajectories throughout the European airspace

EUROCONTROL works closely with the Member States, ANSPs, civil and military airspace users, airports, the aerospace industry, professional organisations, intergovernmental organisations and the European institutions.

On 29 April 2013 EUROCONTROL invited the Airspace Users to participate in a workshop where the concept of Centralised Services was briefed. The Minutes of this Workshop are attached as Annex 5.

EUROCONTROL also invited the EUROCONTROL Member States on 4 March 2013, the ANSPs on 24 April 2013 and the ATM Manufacturing Industry on 17 May 2013 to demonstrate the Centralised Services concept. The minutes of these workshops are respectively attached as Annex 6, 7 and 8.

Following the PC/39 on 16 May 2013 and PCC/31 on 2 July 2013 EUROCONTROL updated on the CS concept. The working papers and slides presented as well as an extract from the Minutes of both meetings are respectively attached as Annex 9 and 10.
EUROCONTROL advisory groups such as AAB, NMB, MAB, CMIC, as well as EU bodies such as the SSC, ICB and its subgroups were briefed. These briefings were followed by so-called CS specific workshops. This was a series of 9 workshops held in June and July 2013 – for each proposed CS one specific workshop was held; CS7 (NIPS) workshop was held on 8 July 2013. The slides presented as well as the minutes of this meeting are attached as Annex 11.

The questions asked and answered in an intensive dialogue since the beginning of the program are publicly available. We like to refer to the FAQ list that is constantly updated and available on the EUROCONTROL homepage.

The CBA figures presented in detail for all the 9 CS support the initial assessment done, that a 150 to 200 million € cost reduction for the airspace users is possible through the implementation of the 9 centralised services proposed by EUROCONTROL. Specific focus was put on the synergy effects foreseen between the different centralised services.

It was agreed with the stakeholders, that the Agency would invite the participants to the individual CS workshops, as well as the existing EUROCONTROL advisory groups to participate in specific meetings in September and October 2013 to develop a pan-European ops concept for each of the Centralised Services.

This draft ops concept has been prepared for the presentation and discussion with all interested stakeholders at the Ops Concept Workshop for CS7 (NIPS) which will be held on 21 October 2013.

The Ops Concept will be used by EUROCONTROL to develop requirements to be part of a Call for Interest and a Call for Tender for CS7 (NIPS). All proposed Centralised Services will be operated under performance based contracts by a Service Provider on behalf of EUROCONTROL.

Our partners are involved at every level of the corporate governance structure. The deployment and operation of CS will impact the remit of the Network Manager. Therefore, its governing body, i.e. the Network Management Board where the EC, EUROCONTROL, ANSPs, airspace user, airports and the military are represented could be extended in the future, the operation of the CS being supervised by EASA; the latter is already supporting the European Commission in the oversight of the Network Manager. Through its nomination as Network Manager, EUROCONTROL will be entrusted to manage the centralised services.

Frank Brenner
Director General of EUROCONTROL
October 2013
CHAPTER 1 – Context

1.1 Geographical applicability

The Network Infrastructure Performance Analysis Service (NIPS) is intended to be applied in all EUROCONTROL Member States. In certain cases (cf. the detailed description of each CS7 function), it is expanded to adjacent States and/or the ICAO EUR region.

It may be expanded to adjacent States if so required as part of the NM area of interest and in case it is identified as being beneficial for the overall ATM network or on requests from non-Member States.

1.2 Aim

The objective of the Network Infrastructure Performance monitoring and analysis Service (NIPS) is to provide an ECAC wide, consistent, high quality CNS infrastructure performance monitoring and anomaly resolution service.

This is becoming increasingly important as a more and more important part of the CNS infrastructure is airborne or satellite-based, resulting in performance problems and anomalies being common to all users.

The NIPS service scope is the monitoring of the performance and problem investigation of the common distributed CNS infrastructure, including aircraft installation performance, air-ground data-link performance and satellite infrastructure performance. The service contains 6 functions grouped in 3 sub-services that will be tendered separately:

- The CNS performance monitoring (CNS-PERF), which includes:
  - The performance monitoring of Data-link communication (DLS-CRO),
  - The functional & performance analysis of surveillance avionics (SUR-AV),
  - The performance analysis of TCAS function(CAS-TEC),
  - The RVSM Regional Monitoring Agency Altimetry System Error (RMA-ASE).
- The performance of 1030/1090 RF bands (SUR-RF),
- The monitoring and prediction of satellite navigation (SAT-NAV).

The objective of this document is to describe the operational concept of the NIPS Centralised Service and to identify the roles and responsibilities of the key stakeholders in CS7.

NIPS will be run under the auspices of EUROCONTROL as the Network Manager and will support an efficient CNS infrastructure helping the States and their ANSPs to reach or at least to come closer to the performance targets.
1.3 **Intended Audience**

The intended audience are the participants to the NIPS CONOPS workshop and all the stakeholders who are interested in the development of CS7 and related services, including all those who are currently involved in the services that are already in operation. The document will also be used to define the operational and technical requirements of the Call(s)-for-Tenders for the Centralised Service (Sub-services) on Network Infrastructure Performance Analysis Service (NIPS).

1.4 **Intended Benefits**

The improvements expected from NIPS will encompass the following benefits, supporting the KPAs on environment /flight efficiency, safety and capacity:

- easier and quicker confirmation of the causes of anomalies by comparing the performance of the same aircraft at different places;
- anomalies will be investigated once rather than multiple times by different ANSPs;
- requested corrections will be defined in a swifter manner;
- ANSPs will have access to easy means to measure the performance of the monitored systems;
- cost-effectiveness – one set of tools in use for the defined services across the applicable geographical area;
- commercial-level service provision – tools and services are provided under service-level agreements;
- competitive service provision – any future Service Provider has the same access to the service specification and tools required to provide the service.

The added value of the centralized service approach is to be able to extend the use of the existing subservices of CS7 to all States/ANSPs, and to improve the level of service while keeping the cost at a reasonable level using the synergies between the different sub-services and using competitive service provision.

1.5 **Evolution of the CNS infrastructure**

The CNS infrastructure is a basic enabler of a safe and efficient Air Traffic Management. An important part of the CNS infrastructure has been moving from the ground segment (traditionally owned and operated by ANSPs) to the airborne/avionics segment, making the airborne CNS installation more complex; it is anticipated that this trend will continue. For example surveillance functionality is moving from the ground radars to Airborne ADS-B installation and Navigation is becoming satellite based. In addition the CNS infrastructure is now used to support new air-air surveillance applications for which no ground infrastructure is involved.

As a consequence airborne CNS installations are becoming more and more complex as airborne equipment takes on more responsibilities and the different CNS elements are more and more inter-connected. The interfaces with the rest of the avionics are also playing an increasing role and require a higher level of interoperability.

The exchanges between air and ground (and air-air) are also becoming more complex and require a higher level of interoperability to provide the benefits expected from new applications.
New surveillance airborne applications (see ICAO Draft Manual on Airborne Surveillance Applications [RD 12]) also require a good airborne Surveillance/Navigation infrastructure in which ANSPs are no longer directly involved.

For all these reasons the verification of the good performance of the CNS infrastructure is becoming more critical to ensure an efficient and safe operation. Such verification requires specific tools and approach while the investigation and resolution of anomalies requires a high level of expertise.

By having a more and more important part of the CNS system shared between the ANSPs and the Airspace Users it becomes more important to understand the performances, to centrally manage the different issues and anomalies that are found and to bring system-wide solutions in a swift manner.

The system components or functions that are critical for achieving the required performances need to be monitored and addressed in a consolidated way at European level so that necessary rectifications can be initiated at the lowest possible cost.
CHAPTER 2 – Operational Concept

2.1 General

The CNS infrastructure is a basic enabler of Air Traffic Management. In order to achieve safe and efficient ATM operations, the performance and the capacity of the CNS infrastructure need to be managed during the entire life-cycle of CNS systems (design, development, deployment and operations).

The necessity of such monitoring has been progressively recognised, often as a result of the difficulties faced by the community during different deployment programmes and operations of the infrastructure.

The need for such performance monitoring and anomaly resolution activities has been reinforced by different Single Sky regulations (See 3.1).

The increasing airborne side functionalities and higher interoperability requirements (see paragraph 1.5) result in a majority of anomalies impact the different users.

The current situation is that different initiatives for performance monitoring and anomaly investigation have been put in place, at different times, either centrally in EUROCONTROL or distributed in some States. Some ANSPs use the central facility while some have developed their own capability, while some others are not yet performing thorough monitoring. Rather than performing these activities in isolation it would be more efficient to perform them together under a centralised management.

The scope of CS7 is to provide a consistent and common Network Infrastructure Performance monitoring and analysis Service and is referred to as NIPS in the rest of this document. The NIPS Service enables the creation of a large scale, consistent, high quality CNS infrastructure performance monitoring and anomaly resolution service.

The service scope is the monitoring of the performance and problem investigation of the common distributed CNS infrastructure including aircraft installation performance, air-ground data-link performance and satellite infrastructure performance. The 6 functions of the service are grouped in 3 different sub-services which will be tendered separately:

- The CNS performance monitoring (CNS-PERF), which includes:
  - The performance monitoring of Data-link communication (DLS-CRO),
  - The functional & performance analysis of surveillance avionics (SUR-AV),
  - The performance analysis of TCAS function (CAS-TEC),
  - The RVSM Regional Monitoring Agency Altimetry System Error (RMA-ASE),
- The performance of 1030/1090 RF bands (SUR-RF),
- The monitoring and prediction of satellite navigation (SAT-NAV).

The performance as well as the detected anomalies will be available to local customers to
report the performance of their systems, and to the Network Manager who will evaluate the impact of the anomalies on the network operations and decide which actions are necessary to resolve them.

The service does not provide 24/7 control and maintenance of ANSP CNS assets.

In the future, the scope might be extended to the monitoring of Performance Based Navigation (PBN).

The NIPS consists of the following generic tasks:

- Measuring and/or predicting performance using data coming from operational systems or from specific sensors especially deployed to monitor the CNS infrastructure,
- Collecting CNS anomalies detected by operational services of ANSPs or Airspace Users (aircraft operators);
- Detecting anomalies by performing systematic analysis of CNS data;
- Reporting performance and anomalies;
- Investigating the impact of non-compliance, the lack of performance or anomalies of the CNS systems on the European ATM network performance;
- Taking actions to solve problems impacting the network operation and performance.

The functional relationship between these functions is shown on Figure 16 given in Annex A1.1.

The top level CS7 architecture diagrams (Figure 17) provided in Annex A1.2 provides an indication of the interfaces of the CS7 with the external world.

CS7 uses:

- reports from ANSPs or aircraft operators on issues detected in operation and provided through dedicated web interface,
- data from operational stakeholder systems such as data-link communication equipment, surveillance sensors and flight plans,
- data collected by specific monitoring sensors such as Height monitoring Unit, Satellite navigation receivers, 1030/1090 MHz sensors, VDL-2 sensors) and which are consider within CS7 (inside the green box around CS NIPS system on Figure 17).

All these data are analysed and used to produce reports on performance and anomalies. The publication of these reports takes into account the business sensitivity of the data.

Special procedures shall be applied to the recording, storing and processing of data related to state aircraft. Sensitivity of such data will require specific dispositions.

The performance reports are available through existing CS7 Web interfaces (eg. LISAT-PRISME interface, EDCN interface) and are used by ANSPs, Airspace Users, Military Authorities and the Network Manager.

Each aircraft operator will only have access to its own data. The aircraft issue data-base managed with an Issue Management Tool will be shared between the ANSPs in order to benefit from issues detected by other users and not discover again what has already been reported. The Network manager will have access to all data in order to evaluate the impact on the network performance and initiate the necessary actions as required to maintain a safe and efficient operation.

The service requires tools to manage issues reported by users, tools to perform systematic monitoring of the quality of service and tools to report performance and analyse anomalies.
Figure 18 to Figure 20 of Annex A provides a view of the different tools used by CS7 to measure performance and manage anomalies. Other tools used by the Network Manager to investigate anomalies (e.g. ramp tester, lab test bench) are not represented on these figures.

To operate the service as smoothly and cost-effectively as possible, roles and responsibility between the different actors need to be agreed.

The actors involved in CS7 are:

- Air Navigation Service Providers (ANSPs),
- Aircraft operators,
- Military authorities,
- Aircraft, avionics and ground CNS manufacturers,
- Air/Ground Communications Services Providers (ACSPs),
- International Civil Aviation Organisation (ICAO),
- National Supervisory Authorities (NSA),
- European Aviation Safety Agency (EASA),
- NIPS Service Provider,
- NM.

The following sections described the scope, the components, the roles and responsibilities of the different actors for each of the 3 sub-services of CS7.


2.2 CNS Performance monitoring (CNS-PERF)

2.2.1 General scope of CNS-PERF

This sub-service contains 4 functions to monitor the interoperability performance and identify/resolve anomalies between CNS aircraft systems and ground systems or between aircraft themselves. It includes the following functions:

- The performance monitoring of data-link communication (DLS-CRO),
- The functional & performance analysis of surveillance avionics (SUR-AV),
- The performance analysis of TCAS function (CAS-TEC),
- The RVSM Regional Monitoring Agency Altimetry System Error (RMA-ASE).

These functions measure and report the CNS performance and all anomalies impacting the good operation of aircraft in the network.

These tasks have been grouped because their main objective is to ensure the interoperability between aircraft and the rest of the CNS systems either through the provision of airborne data, position or other information through air-ground or air-air communication. Furthermore they necessitate similar activities for which a synergy will bring effectiveness and cost benefits.

In order to perform these tasks it is necessary to:

- collect data from operational data-link systems, surveillance/ACAS systems or from specific sensors (e.g. RMS-ASE); ADS-B data will be used to support Altimetry verification, other surveillance data verification, and Navigation verification,
- analyse the data to establish the performance of the operational functions globally and per aircraft,
- log all issues into a data-base to facilitate the follow-up of their resolution and facilitate the sharing of information to avoid multiple investigations of the same problem,
- identify aircraft and airborne equipment involved,
- provide information to determine whether the lack of performance is coming from the airborne or the ground system,
- report performance and anomalies in periodic reports,
- initiate and manage the actions necessary to obtain the right level of performance in the network.

These tasks require the following activities to support them:

- operating specific sensors deployed to collect data,
- developing, operating and managing tools facilitating the collection of data and their analysis,
- developing, operating and managing an issue management function to manage a large number of issues encountered with different aircraft,
- feeding and using a common aircraft data-base.

The different aircraft capabilities, CNS performance or anomalies collected are also of
interest for different parts of NM. It is therefore important to have this information stored in a common data-base such as the NM PRISME fleet data-warehouse environment.

Interface to feed this common aircraft data-base with data collected by the different tasks of the CNS-PERF will need to be developed.

Such data base and its interface shall comply with confidentiality and security requirements, e.g. to include data related to State Aircraft.

The following sections provide more detailed information for the different functions grouped under the CNS-PERF sub-service.

### 2.2.2 Performance monitoring of Data-link communication (DLS-CRO)

#### 2.2.2.1 Scope

The main objective of the DLS-CRO function of CS7 is to monitor the Air/Ground data-link communication infrastructure and applications in order to identify potential lack of performances and/or problem that could impact the network.

The NIPS/DLS-CRO shall cover the three main functions of the data-link DLS Central Reporting Office (CRO):

- monitor system performance,
- contribute to the investigation of system level problems,
- facilitate the sharing of knowledge among the data link community.

The DLS-CRO function provides a set of regular performance monitoring reports and a shared knowledge of (generic) descriptions of common problems/resolutions via the use of an issue management tool.

The DLS-CRO provides performance reports using tools that allow the Network Manager to create reports at the network level and the ANSPs to create the performance reports for themselves in compliance with the DLS-IR.

The network level performance monitoring reports are regularly published by NM. The reports at the other levels (per ANSP, per Aircraft Operator and per Avionics configuration) are normally restricted to EUROCONTROL and the relevant stakeholder.

Performance to be monitored includes the set of end-users measurable parameters as defined for the ANSPs by the DLS Central Reporting Office, Performance Monitoring Requirements [RD 1] to measure system performance, a set to measure the deployment of CPDLC, a more detailed set of system health, performance and behaviour metrics (For more details see DLS Central Reporting Office Provision of ANSP data to the CRO [RD 2]). It also covers the KPIs-parameters monitored by the MOON network as operated by the DLS-CRO service and by ANSPs that are connected to it.

System level problems impacting the network performance are investigated by the NM service team in order to determine the causes and trigger the actions necessary to correct the anomaly. The NM service team will also need access to ad-hoc performance reports to investigate specific problems.

The DLS-CRO function shall provide an Issue Management Tool to manage problem reports. The problem reporting tool allows the reporting party to determine who else is able to see it. Stakeholders involved in data-link (ANSP, CSP, Airlines, Airframe manufacturers) are currently encouraged to make their problem reports available to all registered users to allow experience sharing and so to avoid other users to waste time trying to understand problems already known.

The NM service team identifies any commonly occurring problems in a generic way and
make them public.

The scope of NIPS/DLS-CRO function is to support the service as described above. New ANSPs deploying Data-link services will be required to provide their Data-link Front End processor data in the format defined in [RD 2] for processing by the central tool (LISAT). MOON coverage will be expanded by each ANSP implementing data-link.

2.2.2.2 Components

2.2.2.2.1 Data input

To perform its functions the DLS-CRO will routinely need data from both the ACSPs and the ANSPs as well as problem reports from all stakeholders.

To create the set of performance monitoring reports proposed in the previous section it is necessary for the ANSPs to provide the NIPS with the system’s CM/CPDLC logs and transport level logs.

The system CM/CPDLC logs shall contain all CM and CPDLC messages exchanged as well as recording any significant events (e.g. provider aborts).

In addition to receiving a description of the problem and any associated data, for the NIPS to be able to cross check problems against data from other ANSPs and look for common patterns or significant differences, it is necessary for the NIPS to have the System CM/CPDLC logs from all ANSP systems.

The System Transport level logs (OSI layer 4) will be added to investigate certain problem reports.

In addition, the DLS-CRO service will maintain an accurate database of the data-link avionics fitted to the various aircraft in the fleet asking airlines for an update periodically or when there is a suspected problem.

2.2.2.2.2 Current Architecture and tools

The following set of tools is currently used to support the service:

- **LISAT.** Statistical data collection and distribution based on CPDLC operational logs from ACCs, also used in problem investigation. Operates at the CPDLC operational level.
  
  This is currently integrated into the PRISME infrastructure to:

  - allow various users to gain access to subsets of the data (i.e. the data necessary to their own operations) and
  - gain access to other useful data (flight plan and position data from CFMU).

- **ROUTE-MON.** Passively collects and stores mobile (aircraft) and fixed ATN route information by connecting to the live ATN environment. It operates at the ATN routing level.

- **MOON.** Listens to VDL Mode 2 channels via Remote Monitoring Units (RMU), provides VDL-2/ATN statistics and alarms for monitoring and subsequent analysis. It operates at VDL Mode 2 radio-channel level.

- **CIMT.** DLS-CRO Issue Management Tool corresponds is used by the DLS-CRO to track problems found with the implementation of the data link services in Europe. It allows to manage:

  - problems that are reported and resolved locally, to be recorded centrally with the DLS-CRO, and
  - problems that are reported locally but which cannot be resolved locally, to be
passed on to the DLS-CRO for resolution. This may be for any reason, for example because the problem involves the interaction of several parts of the overall data-link system.

These tools generate regular statistical information that is made available to Stakeholders. They are also used to investigate specific problems with aircraft systems, ANSP systems or Communications Service Provider systems. Figure 1 provides an illustration of the tools and associated data streams.

**Figure 1 – DLS-CRO Summary of tools**

LISAT is currently being used to investigate problems and is also able to create a number of statistical reports ANSPs can also access it to analyse their own performance.

LISAT has an input format defined in XML [RD 6] for receiving recorded data from ANSPs. The ATSU responsible for the recorded data shall transform its own local format into this common XML standardised format for delivery to DLS-CRO.

The MOON monitoring system is made of local receivers stations named “Remote Monitoring Units” (RMU) communicating with a Central Monitoring Server (CMS). MOON infrastructure is totally independent of Communication Service Providers operating their own equipment for commercial VDL-2 service purposes.
MOON is currently operated by the DLS-CRO only in a limited area as shown on the Figure 3. MOON is extending on short/medium term by ANSPs implementing data-link service.

2.2.2.2.3 Future Architecture and tools
The NIPS/CNS-PERF Service Provider will use LISAT, MOON and an issue management tool. LISAT will be improved in order to make analyses at the transport layer level.
The NIPS/CNS-PERF Service Provider will provide the same service as currently provided by ROUTE-MON tool but using his own set of tools. It will monitor the performance of any data-link technologies which will support CS9-1 services in the future (e.g. AeroMACS).

### 2.2.2.3 Roles and responsibilities

#### 2.2.2.3.1 General

The Figure 4 describes the interactions between the main actors of the DLS-CRO.

![Diagram](image)

**Figure 4 – Relationships between the different actors of DLS-CRO**

#### 2.2.2.3.2 ANSPs

The ANSPs shall:

- Provide the NIPS with the data-link service logs and transport level logs using the LISAT interface in order to create the set of performance monitoring specified in [RD 1],
- Procure, install, maintain and ensure the connection of Remote Monitoring Units compatible with the MOON Central Monitoring Server (CMS) to have additional measurements of what happens at the air-ground link level, one multi-frequency MOON RMU will at least be required per State implementing data-link ideally positioned in the highest traffic area,
• Report anomalies with data-link using the Issue Management Tool,
• Perform check of their data-link equipment on request from NM.

Currently, the provision of data is not mandatory however providing data is a fundamental part of the CS Concept: a provision in the SES Regulations is necessary to make the technical migration to the CS mandatory for stakeholders concerned (e.g. by a further amendment to Regulation No 677/2011).

2.2.2.3.3 Aircraft operators
Aircraft operators shall:
• Provide the capability, type and version of the data-link equipment installed on their aircraft,
• Report anomalies detected in operation using the central Issue Management Tool,
• Perform check of their data-link equipment on request from NM.

2.2.2.3.4 Military authorities
Military authorities shall:
• Provide the capability, type and version of the data-link equipment installed on their aircraft,
• Report anomalies detected in operation using the central Issue Management Tool,
• Perform check of their data-link equipment on request from DLS-CRO.

2.2.2.3.5 Aircraft, avionics and ground CNS manufacturers
Manufacturers shall cooperate in the investigation of data-link issues.

2.2.2.3.6 CS9 Service Provider / Air Communications Service Providers (ACSP)
The CS9 Service Provider / Air Communications Service Providers (ACSP) shall:
• provide the DLS-CRO with appropriate A/G data-link logs and ATN A/G routers logs,
• inform the DLS-CRO of their A/G data-link infrastructure service disruption and maintenance,
• investigate and resolve anomalies registered by the DLS-CRO in the Issue Management Tool.

2.2.2.3.7 NIPS/CNS-PERF Service Provider
The NIPS/CNS-PERF Service Provider shall:
• measure and report the performance of data-link systems,
• detect, collect and report the details of data-link anomalies,
• identify aircraft and search for airborne equipment involved,

These tasks requires to:
• develop where necessary, operate and manage tools to perform statistics on messages exchanged such as the LISAT tool in areas where data-link is deployed;
• operate and manage the MOON central tool and its interface with RMUs,
• provide statistical analysis on ATN routing (equivalent to the analysis performed by the current Route-MON tool),
• operate and manage an Issue Management Tool,
2.2.2.3.8 NM

NM will:

- manage the contract covering the outsourced tasks,
- publish global data-link performance,
- undertake appropriate actions with the CS9 Service Provider in case the SLA obligations are not met,
- initiate actions with manufacturers and regulatory bodies to correct the anomalies,
- initiate update of standards as necessary.

2.2.3 Functional & performance analysis of surveillance avionics (SUR-AV)

2.2.3.1 Scope

The objective of the SUR-AV function is to ensure the performance of airborne surveillance infrastructure is sufficient to support smooth operation of the surveillance function of the network.

The SUR-AV function shall analyse the capability and performance of the airborne surveillance equipment and ensure its interoperability with ground and other airborne systems.

Airborne surveillance includes all cooperative surveillance capabilities: Mode A/C, Mode S and ADS-B.

The service uses:

- surveillance issues reported by ANSPs,
- samples of surveillance data coming from different sites in order to monitor flights performed in Europe. It is not necessary to use all surveillance sensor data. A subset is sufficient to cover a great percentage of IFR GAT flights performed in Europe. Data can be received through recordings or be made available in real time from CS3 input.
- flight plans to verify the Aircraft Identification declared in the flight plan with the Aircraft Identification downlinked by the aircraft surveillance chain.

The service includes the following tasks:

- Measuring and reporting the performance of airborne surveillance systems per
aircraft,

- Detecting, collecting and reporting the details of surveillance anomalies including erroneous altitude, and report the operational impacts of the anomaly,
- Searching for airborne equipment involved,
- Detecting and reporting in real time (delay to be defined) the GPS outages (area/size and start/end) to ATC using ADS-B reports from aircraft,

and:

- determining the impact of anomalies on the network operation,
- publishing global surveillance interoperability performance,
- managing the resolution of anomalies with avionics manufacturers, aircraft manufacturers, standardization bodies (ICAO, EUROCAE, RTCA, ARINC) and regulators (NSA and EASA),
- Providing guidance to avionics manufacturers, aircraft manufacturers and aircraft operators on the avionics surveillance systems.

The CNS-PERF subservice – function SUR-AV, will cover Mode A/C, Mode ELS, Mode S EHS and will be extended to ADS-B avionics capability and the real time quality monitoring of the GPS data transmitted in the ADS-B reports.

The list of aircraft with problems will be provided off-line to CS3 to reject erroneous data (ELS, EHS, ADS-B) provided by aircraft.

It will use an improved issue management tool.

The real time GNSS monitoring function is one of the mitigations identified in the PBN implementation which will be demonstrated.

This capability will allow avoiding getting reports from all pilots on a GPS loss, which would saturate the frequency. On the basis of this information ATC/NM could implement some mitigations (e.g. not allow GPS-only aircraft to fly into sectors affected and reduce capacity/complexity of affected sectors).

The use of the ADS-B data related to the quality of GPS data measured on-board will be processed on the ground and sent to NM and possibly the supervisor positions of ACCs concerned.

The real time GNSS monitoring could use ADS-B data coming from specific sensors or operational sensors data available at the input of CS3.

### 2.2.3.2 Components

**2.2.3.2.1 Data inputs**

In order to run the service, operational radar and ADS-B data from different sites are required. The service does not require receiving data from all radars. The objective is to cover more than 90% of aircraft flying IFR in Europe.

Corresponding Flight plan data are also used to detect inconsistency on ACID and 24 bit aircraft address.

In case of specific problems encountered in one area, ANSPs/States can ask for a monitoring of the traffic in their airspace if not yet covered by the service.

**2.2.3.2.2 Current Architecture and tools**

Currently the BDAMS (Base de Données Avions Mode S) tool is used to automatize the
analysis of the surveillance and TCAS technical capability and anomalies. However it is still necessary to have an operator reviewing the results produced by the tool in order to filter false alarms.

The Figure 5 shows the different tools used (green boxes) to collect, process, calculate capability and performance statistics, store aircraft anomalies and avionics design anomalies. The data from sensors can be fed in real time to the BDAMS tool or be provided through weekly recordings.

2.2.3.2.3 Future Tool

Current BDAMS has limited ADS-B functionality that shall be improved to deliver the CNS-PERF service.

Interfaces between BDAMS, the issue management tool and a common aircraft data-base shall also be developed.

An additional functionality will need to be developed to handle GPS data quality information provided through ADS-B to detect and report GPS outage (area/size and start/end).

The use of other tools is acceptable provided they bring a cost effective solution and their fit for purpose is demonstrated (Phase 1 of the CS Programme).
2.2.3.3 Roles and responsibilities

2.2.3.3.1 General
The following figure describes the interactions between the main actors involved in the SUR-RF function.

Figure 6 – Relationship between actors involved in NIPS/CNS-PERF SUR-AV function

2.2.3.3.2 ANSPs
ANSPs will report surveillance issues found during operation.
ANSPs will provide surveillance data and associated flight plan information to be used to establish the airborne capability, performance and anomalies. These data may be provided in real time or in recordings provided each week for off-line analysis.

2.2.3.3.3 Aircraft Operators
Aircraft Operators shall:
- report unresolved surveillance issues detected during operation,
- provide the information on surveillance equipment installed on their aircraft,
- perform maintenance check on request of NM,
- initiate measures to overcome detected anomalies.

2.2.3.3.4 Military authorities
Military authorities shall:
- provide releasable information on surveillance equipment used on board their aircraft,
- perform maintenance check on request,
- investigate causes of anomalies on request of NM,
- initiate measures to overcome detected anomalies.

### 2.2.3.3.5 Aircraft, avionics and ground CNS manufacturers

Aircraft, avionics equipment and ground CNS manufacturers shall provide information on the type of equipment and version used and shall perform the investigation of problems reported and implement measures to overcome detected anomalies.

### 2.2.3.3.6 NIPS/CNS-PERF Service Provider

The NIPS/ CNS-PERF Service Provider shall:

- measure and report the performance of airborne surveillance systems per aircraft,
- detect, collect and report the details of surveillance anomalies including erroneous altitude, and report the operational impacts of the anomaly,
- search for airborne equipment involved,
- detect and report in real time (delay to be defined) the area where GPS is not operating correctly using ADS-B reports (interference).

These tasks require to:

- operate and manage an issue management tool used to manage the surveillance anomalies,
- operate and manage tools to measure the performance and to detect surveillance anomalies due to air-ground problem of interoperability (e.g. BDAMS),
- analyse the surveillance data received from ANSPs,
- provide periodic surveillance performance report,
- provide periodic list of aircraft with their surveillance capability and/or anomalies encountered during the last period,
- contact civil aircraft operators to obtain the type and version of surveillance equipment, FMS, GPS receiver or other equipment involved,
- collect and manage surveillance anomalies reported by ANSPs and aircraft operators,
- provide a separate list of state aircraft in anomaly,
- as part of CS7 phase 1, demonstrate the capability to monitor the GPS outage in real time using ADS-B reports.

All recorded data shall be provided to NM who may perform specific investigation based on the periodic report to better understand the impact on the network operation and decide the necessary actions with national regulators and EASA.

Specific security requirements shall apply to the recording, storing and processing of data related to aircraft. Sensitivity of such data shall receive the necessary attention.

### 2.2.3.3.7 NM

NM will periodically receive the lists of aircraft with their capability and anomalies from the NIPS/ CNS-PERF Service Provider.

NM will manage the aircraft data-base and the contract covering the outsourced tasks, NM will:

- Determine the impact of the anomalies on the network operation,
- Publish global surveillance interoperability performance,
• Manage the resolution of anomalies with avionics manufacturers, aircraft manufacturers, standardization bodies (ICAO, EUROCAE, RTCA, ARINC) and regulatory bodies (NSA and EASA).

When necessary and when the problem is specific to one aircraft, NM will contact the aircraft operator to request the necessary maintenance of the surveillance avionics installation.

NM will investigate and determine the sources of anomalies (airborne or ground) of common issue and will contact the involved manufacturers to develop a solution.

NM will contact the relevant oversight bodies (NSA or EASA) to ensure the correction is applied.

NM will initiate the correction of international standards to ensure global interoperability.

• Provide guidance to avionics and ground system manufacturers, aircraft manufacturers and aircraft operators on the avionics surveillance systems.

Depending on future agreement and regulatory approach NM may be requested to apply restrictions on flight plans of aircraft not compliant with the applicable regulation and impacting the network performance.

2.2.4 Performance analysis of TCAS function (CAS-TEC)

2.2.4.1 Scope

This function shall analyse the capability and the technical performance of the TCAS equipment, detect technical issues and undertake the necessary actions to resolve them.

TCAS technical monitoring covers declared capability, erroneous Resolution Advisory (RA) reports and lack of detection of other aircraft in close proximity. The last point consists in detecting aircraft that verify the criteria for a TCAS action and for which the TCAS has not initiated any TA (Traffic Advisory) or RA action.

The service does not analyse all TCAS safety issues such as airspace hotspot, pilot / controllers interaction, which are safety issues managed under safety activities or operational monitoring outside the scope of CS7.

The service tasks require:

• Collecting ACAS technical issues reported by ANSP, aircraft operators or other safety monitoring systems (e.g. EUROCONTROL EVAIR),

• Collecting surveillance data coming from specific sites in order to monitor flights performed in Europe and/or ACAS data directly recorded on the RF bands,

• Measuring and report the capability of airborne ACAS systems per aircraft,

• Reporting aircraft not equipped with the right ACAS version,

• Reporting aircraft transmitting erroneous RA reports,

• Reporting aircraft not detecting other aircraft in vicinity or aircraft with a poor probability to be detected by other ACAS systems,

and

• Determining the impact of the anomalies on the network operation,

• Managing the resolution of anomalies with avionics manufacturers, aircraft
Centralised Service on Network Infrastructure Performance monitoring and analysis Service (NIPS) Concept of Operations (CONOPS)

manufacturers, standardization bodies (ICAO, EUROCAE, RTCA, ARINC) and regulators (NSA and EASA).

2.2.4.2 Components

The components are similar to those used to support the functional & performance analysis of the surveillance infrastructure SUR-AV (see 2.2.3.2).

Surveillance data, ACAS platform capabilities (for example through transponder register 1016), RA reports available from Mode S radar, ADS-B or direct listening of the bands are collected for monitoring.

The tool shall provide:

- a list of aircraft with their ACAS capability,
- a list of aircraft transmitting erroneous RA reports not corresponding to existing threat.
- a list of aircraft not well detected by other ACAS system based on proximity criteria and the presence of Traffic Advisory or Resolution Advisory and whether they are referenced by their Mode S address.

Current tools used (BDAMS) only provides aircraft with ACAS capability and erroneous RA reports.

The ACAS detection issue function needs to be demonstrated as part of CS7 phase 1.

2.2.4.3 Roles and responsibilities

2.2.4.3.1 General

The roles and responsibilities are similar than those defined for the Functional & Performance analysis of surveillance Avionics described in section 2.2.3.3 apply.

2.2.4.3.2 ANSPs

ANSPs shall report technical ACAS issues encountered during operation.

ANSPs will provide surveillance data to be used to establish the airborne capability, performance and anomalies. These data may be provided in real time or in recordings provided each week for off-line analysis.

2.2.4.3.3 Aircraft Operators

Aircraft Operators shall:

- report unresolved technical ACAS issues encountered during operation,
- provide the information on ACAS equipment installed on their aircraft,
- perform maintenance check on request from NM,
- initiate measures to overcome detected anomalies.

2.2.4.3.4 Military authorities

Military authorities shall:

- provide releasable information on ACAS equipment used on board their aircraft,
- perform maintenance check on request,
- investigate causes of anomalies on request from NM,
- initiate measures to overcome detected anomalies.
2.2.4.3.5 Aircraft, avionics and ground CNS manufacturers

Aircraft, avionics equipment and ground CNS manufacturers shall provide information on the type of equipment and version used, shall perform the investigation of problems reported and implement measures to overcome detected anomalies.

2.2.4.3.6 NIPS/ CNS-PERF Service Provider

The NIPS/ CNS-PERF Service Provider shall:

- collect ACAS technical issues reported by ANSP, aircraft operators or other safety monitoring systems (e.g. EUROCONTROL EVAIR),
- collect surveillance data coming from specific sites in order to monitor flights performed in Europe and/or ACAS data directly recoded on the RF bands,
- measure and report the capability of airborne ACAS systems per aircraft,
- report aircraft not equipped with the right ACAS system,
- report aircraft not transmitting correct RA reports,
- report ACAS aircraft not detecting aircraft in vicinity or aircraft with a poor probability to be detected by other ACAS systems.

These tasks require to:

- operate and manage an issue management tool to manage the ACAS avionics anomalies,
- operate and manage tools to measure the performance and to detect technical ACAS anomalies (e.g. modified BDAMS),
- analyse the surveillance/ACAS data collected,
- provide periodic ACAS capability report,
- provide periodic list of aircraft with their ACAS anomalies encountered during the last period,
- contact civil aircraft operators to obtain the type and version of ACAS equipment involved,
- provide separate list of state aircraft in anomaly.

All recorded data shall be provided to NM who will perform specific investigation based on the periodic report to better understand the impact on the network operation and decide the necessary actions with national regulators and EASA.

Specific security requirements shall apply to the recording, storing and processing of data related to aircraft. Sensitivity of such data shall receive the necessary attention.

2.2.4.3.7 NM

NM will periodically receive the lists of aircraft with their ACAS capability and anomalies from the NIPS/CNS-PERF Service Provider.

NM will:

- Determine the impact of the anomalies on the network operation,
- Manage the resolution of anomalies with avionics manufacturers, aircraft manufacturers, standardization bodies (ICAO, EUROCAE, RTCA, ARINC) and regulators (NSA and EASA).
When necessary and when the problem is specific to one aircraft, NM will contact the aircraft operator to request the necessary maintenance of the surveillance avionics installation.

NM will investigate and determine the sources of anomalies of common issue and will contact the involved manufacturers to develop a solution.

NM will contact the necessary oversight bodies (NSA) or EASA to ensure the correction is installed.

NM will initiate the correction of international standards to ensure global interoperability.

NM will manage the central aircraft data-base.

Depending on future agreement and regulatory approach NM may be requested to apply restrictions on flight plans of aircraft not compliant with the applicable regulation and impacting the network performance.

### 2.2.5 RVSM Regional Monitoring Agency Altimetry System Error (RMA-ASE)

#### 2.2.5.1 Scope

The RMA is operated on behalf of the ICAO European Air Navigation Planning Group (EANPG) to provide safety oversight of operation in RVSM airspace.

In order to perform flights in Reduced Vertical Separation Minimum (RVSM) airspace an aeroplane shall be provided with equipment providing an accurate indication of the flight level being flown and shall be authorized by the State of the operator for operation in the airspace concerned (see requirements in ICAO Annex 6 Part 1 & 2, [RD 4] and [RD 5]).

A mandatory requirement of the RMA is to estimate the Altimetry System Error (ASE) of aircraft flying RVSM. ASE is the difference between the indicated altitude of the aircraft and the true altitude. Containing Altimetry System Error (ASE) within acceptable limits is critical to maintaining safe vertical separation, particularly as it is not a visible characteristic to the pilot, the ATCO or TCAS.

The function of RMA is to provide:

- Continual analysis of Altimetry System Error (ASE) data to identify individual airframes and generic aircraft types which do not comply with the permitted tolerances of ASE.
- Investigation with operators, applicable State airworthiness authorities, EASA and if appropriate manufacturers to ensure ASE problems are correctly addressed and performance improved.
- Verification of the status of aircraft operating as RVSM approved in Europe. For this purpose it maintains a database of RVSM approvals which is constantly being updated by close coordination with 48 accredited European States and 12 Regional Monitoring Agencies from other RVSM regions. The EUR RMA audits flight plans and Height Monitoring Units (HMU) data to identify non-approved aircraft which are then reported back to the airworthiness authorities which are responsible for determining appropriate action.
- An annual RVSM Safety Monitoring Report which includes statistical collision risk estimates derived from height monitoring data and operational altitude deviation reports, as well as an overview of ASE performance issues and flights by non-approved aircraft.
Operating procedures and Practices for Regional Monitoring Agencies are defined in ICAO Doc 9937 [RD 3].

In Europe the responsibility to conduct this task, and other RVSM related safety oversight activities, is currently delegated to the EUR Regional Monitoring Agency (EUR RMA), which has been operated by EUROCONTROL since 2003. The EUR RMA was established in 2003 by the Permanent Commission at the request of the ICAO European Air Navigation Planning Group (EANPG).

The principle customers of the EUR RMA are the 48 Member States accredited to the EUR RVSM region through the ICAO European Air Navigation Planning Group (EANPG).

The scope of the function NIPS/RMA-ASE is to provide height monitoring data for the purpose of estimating aircraft Altimetry System Error (ASE) in support of the activities described above.

Standard surveillance systems cannot detect ASE and so specialised systems have been developed to monitor aircraft performance. In Europe an aircraft can be monitored for estimation of ASE in two ways:

- first, by flying within the coverage area of one of the three EUROCONTROL Height Monitoring Units (HMU), and
- second, by carrying an expert on-board the aircraft monitoring a system called a GPS Monitoring Unit (GMU).

New systems for estimating ASE have been developed in the US and Australia based on specialised processing of ADS-B data; however at present only initial feasibility studies have been conducted in Europe.

The service will include - as part of the CS7 Programme Phase 1 - the development of a demonstrator of a system providing height monitoring data derived from ADS-B data.

2.2.5.2

2.2.5.3 Components

2.2.5.3.1 Data inputs

There are two principle data inputs. The first consists of aircraft monitoring results from the 3 EUROCONTROL-owned and operated Height Monitoring Units (HMU) deployed in Austria, the Germany/Luxembourg and the Switzerland/France border areas as shown on Figure 7.

These systems employ very sensitive multilateration techniques to measure the 3 dimensional positions of aircraft to within a few metres accuracy. Height monitoring software developed by EUROCONTROL then measures deviations from valid RVSM flight levels and estimates the aircraft Altimetry System Error (ASE) using advanced processing techniques including corrections for variations in meteorological pressure levels.

The second principle input is the RVSM approvals from the 48 accredited States.
The HMU systems provide monitoring results for 99% of the aircraft that fly an appropriate profile within the coverage area (45 nm of the central location). With all systems operational and under normal traffic patterns the RMA receives approximately 20,000 results every week. These results are matched with specific airframes within the database of RVSM approvals by correlation through 24-bit ICAO identifiers.

For a successful HMU measurement it is necessary for the aircraft to fly straight and level for a minimum of 5 minutes, between FL290 and FL410 (inclusive) and within the coverage of the HMUs.

RVSM approval updates are received from individual NSAs, regional airworthiness authorities, military authorities and Regional Monitoring Agencies responsible for other RVSM regions. Including new approval records, aircraft de-registrations, operator and status changes, the RMA processes several hundred records every month.

Accurate ASE estimation is reliant on the accurate determination of the fluctuations in the geometric height of pressure levels. This is achieved by applying meteorological corrections obtained from an appropriate meteorological Service Provider several times a day.

In addition to data from the EUROCONTROL systems, the annual safety assessment includes height monitoring data from the UK NATS operated HMU system in Wales, although the EUR RMA does not apply any quality control processes to these data. Height monitoring data from other RVSM regions is also available to support aircraft performance reviews and operator compliance with global height monitoring targets.

2.2.5.3.2 Current Architecture and tools

Each HMU system consists of 5 geographically separated receivers, a Central Processing System (CPS), an ASE estimation processor called Total Vertical Error Monitoring Unit (TMU) and an intra-site communication network. The 5 receivers, the intra site communication network and the CPS are collectively known as the Height Monitoring Element (HME). The HME is a highly accurate system that uses passive detection to monitor
aircraft transmissions and determines aircraft 4 dimensional position using multilateration techniques. The HME provides a one plot per second output to the TMU for each aircraft that it is tracking. The TMU processes the individual HME plots applying smoothing algorithms and meteorological corrections for variations in air pressure levels. The TMU outputs a single record for each aircraft track including the ASE estimation. It is possible for an aircraft to produce more than one result when passing through the HMU coverage area.

The performance of an HMU is limited by the geometric configuration of the receivers and the local terrain. The ideal HMU receiver configuration is in the form of a square with 1 receiver on each corner and 1 in the centre, with the sides of the square from between 80 to 120 Km. However, practical, economic, and environmental limitations result in a best fit compromise.

Data from the 5 receivers is transmitted to the CPS using a network of microwave links and where line of sight is not available, radio relays. The TMU is co-located with the CPS and the final output is transmitted to the RMA via commercial communication networks. Meteorological data is received and forwarded to each of the HMUs 4 times per day.

HMU operation and all file transfers are fully automated and the systems run 24/7 365 days of the year. HMU operation is monitored by the RMA during normal working hours only using a proprietary Control and Monitoring System (CMS).

2.2.5.3.3 Future Architecture and tools
Since 2010 it has become mandatory (ICAO Annex 6, [RD 4], [RD 5] ) for all operators of RVSM approved aircraft to participate in height monitoring programmes.

Figure 8 – EUR RMA tools and interfaces
Height monitoring by HMU is cheap and convenient for those operators whose flight operations take them through the coverage area described here above. By comparison an individual height monitoring result by GMU is very expensive (several thousand Euros per aircraft). However there are many aircraft operating on the periphery of the EUR RVSM region which currently have no alternative to GMU as a diversion to one of the 3 HMU systems is prohibitively expensive in terms of fuel.

EUROCONTROL has conducted feasibility studies into the possibility of making use of aircraft ADS-B transmissions through a modified TMU for height monitoring purposes. Although some ADS-B height monitoring programmes do exist, primarily in Australia and the US, no studies have been conducted to determine whether they provide equivalent performance to HMU used in Europe.

A demonstrator of this new TMU will be developed as part of the CS Programme-Phase1 to measure the achievable performance. If successful and confirmed by a safety analysis, an operational ADS-B Height monitoring system would be deployed to complement the existing system as part of CS7. This would allow any operator flying within ADS-B coverage with the appropriate equipment to be height monitored at no additional cost. Major issues to be resolved include identification of the airframe, ADS-B geometric height reference system and static source/GPS position compensation.
2.2.5.4 Roles and responsibilities

2.2.5.4.1 General
The following figure describes the interactions between the main actors of the RMA-ASE.

![Figure 9 – Relationship between actors involved in NIPS/CNS-PERF RMA-ASE function](image)

2.2.5.4.2 Aircraft operators
An operator shall only operate an aircraft in RVSM airspace with a valid RVSM approval issued by the appropriate airworthiness authority.

Aircraft operators shall take appropriate actions upon notification of a technical problem or non-compliance associated with ASE performance requirements defined in TGL6 [RD 16].

2.2.5.4.3 Military authorities
An operator shall only operate an aircraft in RVSM airspace with 1000ft vertical separation with a valid RVSM approval issued by the appropriate airworthiness authority.

Military Authorities shall take appropriate actions upon notification of a technical problem or non-compliance associated with ASE performance requirements defined in TGL6 [RD 16].

2.2.5.4.4 NIPS/ CNS-PERF Service Provider
The NIPS/ CNS-PERF Service Provider shall:
- operate and manage the HME and TMU infrastructure. It includes the responsibility to acquire meteorological data, maintain the integrity of the system and maintain the TMU software.
• deliver ASE data per aircraft to NM in accordance with agreed quality standards and an applicable SLA, the data to be provided consists of averaged ASE information per track crossing a HMU coverage and raw HMU data (1 per second) to verify the quality of measurement on aircraft with a bad ASE,

• as part of the CS Programme Phase1 develop a representative set-up of an ADS-B based monitoring system.

2.2.5.4.5 NM

NM will manage the outsourced CS service contract.

NM is responsible for conducting all aircraft performance analysis and initiating investigations with operators, applicable state airworthiness authorities, EASA and if appropriate manufacturers to ensure ASE problems are correctly addressed and performance improved.

NM is responsible for identifying Non-approved aircraft and reporting them to the appropriate state approval authorities who are responsible for determining appropriate action.

NM will maintain a data-base of aircraft RVSM approvals which is constantly being updated by close coordination with 48 accredited European States and 12 Regional Monitoring Agencies from other RVSM regions.

NM will continue to manage the RVSM RMA on behalf of EANPG.

NM is responsible for conducting all RVSM airspace safety evaluation.

2.2.5.4.6 States & ICAO

The EANPG States are the principle customers of the RVSM RMA service.

The EANPG States shall provide their RVSM approval to NM.

States are responsible for ensuring appropriate action is taken in the event of an aircraft reported for performance issues associated with ASE.

ICAO European Air Navigation Planning Group (EANPG) ensures coordination amongst the 48 Member States.
2.3 **Performance of 1030/1090 RF bands (SUR-RF)**

2.3.1 **Scope**

The scope of the SUR-RF sub-service is to survey the usage of the 1030/1090 RF bands and to initiate the actions to ensure its long term usability.

The cooperative surveillance systems including Mode A/C radar, IFF systems, Mode S radar, ADS-B, Multilateration systems and TCAS use the 1030/1090 MHz RF bands to operate.

The objective of this sub-service is to monitor the RF bands to understand the contributions of the different sources and take the necessary actions to maintain the bands useable and within the limits defined in EU 1207/2011 regulation.

The SUR-RF sub-service includes:

- Reporting on 1030/1090 MHz RF band usage at different places in Europe using airborne and ground measurements,
- Determining the sources polluting the RF band,
- Investigating and understanding the causes of the RF band pollution,
- Assessing current and estimating future 1030/1090 RF usage using a RF model calibrated with RF recordings,
- Determining the impact of the RF pollution sources on the network operation,
- Developing guidance/recommendation and managing actions with respective oversight authorities (NSAs, EASA), operators, manufacturers and international standardization bodies to keep the band useable,
- Planning the network capacity taking into account new transmissions and developing acceptability criteria.

All anomalies detected in the transmission or in the use of the Mode S formats and Mode S procedure will also be reported.

The principle is to record video signals provided by 1030/1090 MHz receivers and to analyse these recordings off-line.

The recordings are done with a limited duration at different places in Europe either on the ground or on the airborne side. There is no need to perform continuous recording at both places.

Ground measurements will be conducted at different places in Europe in order to establish the level of usage of the 1090 MHz Band (1030 MHz transmissions measured on ground are not always representative of what an aircraft is subject to). In low density area, the measurement will be repeated with a long time interval (i.e. several years) or when a significant change has happened (air traffic density change, new functions installed or new active sensors installed).

Currently airborne recordings are performed using flights of opportunity, such as flights performed by Beluga aircraft, in order to measure more regularly the evolution of 1030/1090 MHz RF band occupancy in high density areas. The use of opportunity flights is driven by cost effectiveness; however the flights of opportunity are not always guaranteed to happen.
There is also a need to make on request specific ground or airborne measurements at specific places. The Beluga aircraft is not foreseen to be used for this type of recording and the possibility to equip a specific aircraft is an option to be considered and assessed - Operational, Technical and financial point of view - as part of the Phase1 of the CS Programme. For example such flights could also be used as a cost effective way to perform the RF recordings at different places in Europe.

A report on the situation at different places in Europe shall be produced twice a year using data collected by ground recordings and by airborne recordings on flights of opportunities.

Specific measurements will be performed on request to determine the possible causes of bad performance on 1030/1090 RF bands.

Using these reports the NM team determines the reasons and impact of the RF pollution on the network operation, and proposes actions to clean the RF bands.

Using results of planning tools (RF model) and the knowledge acquired through the periodic measurements the NM team develops guidelines to facilitate the management of the bands by the States including acceptability criteria for the new transmissions.

2.3.2 Components

2.3.2.1 Data inputs
Data are collected using specific systems to receive signal on 1030 and 1090 MHz RF bands. Data collection is done on a sampling approach using ground sensors and airborne sensors. This is not a 24h/7d recording.

2.3.2.2 Architecture and tools
The following two figures shows the tools currently used to collect and analyse 1030/1090 MHz transmission data. There are two chains: one to record 1030 MHz signal and another one to record the 1090MHz signal.

![Diagram of 1030/1090 MHz analysis functional chain](image.png)
A similar set of tools is used to record 1030/1090 MHz on the ground. In this case the recorder does not need to be certified for airborne operation and different receivers can be used including ADS-B or Multilateration receivers.

A simple RF model running in Excel is used to estimate the RF pollution in current and future environment.

The current level of recording is the video level signal. Future tools used by CS7 could records signals at a different level; however data will need to be converted to a format readable by the RFAT.

### 2.3.3 Roles and responsibilities

#### 2.3.3.1 General

The following figure describes the interactions between the main actors of the SUR-RF.
2.3.3.2 NSA

Anomaly resolution will be undertaken by NSA.
NSA will receive the 1030/1090 RF reports and shall derive actions on the 1030/1090 MHz band users operating in their area of responsibility to maintain the RF bands operational.

2.3.3.3 ANSPs & Military authorities

ANSPs and Military authorities shall apply the recommendations proposed to maintain the RF bands operational.

2.3.3.4 NIPS/SUR-RF Service Provider

The NIPS/SUR-RF Service Provider shall:

- provide reports on 1030/1090 MHz RF band usage at different places in Europe using airborne and ground measurements,
- determine the sources polluting the RF band,
- investigate and explain the causes of the pollution,
- estimate 1030/1090 RF usage based on air and ground scenarios using a RF model,
- provide airborne and ground measurement capability for specific measurements (airborne capability other than the BELUGA is subject to feasibility analysis & demonstration in Phase 1).

To support these tasks, the NIPS/SUR-RF Service Provider shall:

- operate and manage the 1030/1090 MHz RF recording chains,
- coordinate recordings performed on flight of opportunities operated by a third party;
- operate and manage an RF Analysis Tool (e.g. the RFAT),
- provide raw data in the format defined in [RD 17] or another format to be implemented in the RFAT tool,
- operate and manage the simple NM RF model allowing a first order estimation of RF usage (the IPR of this tool shall remain with NM). Other tools can be used to provide more accurate estimation.

The reports shall provide an indication of the RF traffic generated by the different sources.
The reports shall be made available to NM and possibly directly to NSAs when agreed with NM.

2.3.3.5 NM

NM will:

- define the areas where periodic measurements of the 1030/1090 RF activity,
- determine the impact of the pollution sources on the network operation,
- develop guidance/recommendation and manage the associated actions with NSA, operators, manufacturers and international standardization bodies in order to keep the band useable;
- provide capacity planning taking into account current transmissions and future transmissions, and develop acceptability criteria for new transmissions.
To support these tasks NM will:

- review the measurement reports and estimation provided by the Service Provider,
- specify specific ground or airborne measurements of 1030/1090 RF activity together with ANSPs and NSA.

NM will review and publish the reports and propose actions to regulatory (NSAs) and standardization bodies to keep the performance of the 1030/1090 RF bands.

NM will publish guidelines for manufacturers, ANSPs and NSA based on the 1030/1090 RF measurement reports.
2.4 Monitoring and prediction of satellite navigation (SAT-NAV)

2.4.1 Scope

2.4.1.1 General

This sub-service of CS7 shall cover two sub-functions:

- measuring the performance of the GNSS constellations using a Global Navigation Satellite System (GNSS) Data collection Network (GDCN),
- predicting the GPS Receiver Autonomous Integrity Monitoring (RAIM) availability (AUGUR).

The provision of both GDCN and AUGUR sub-functions is currently partly outsourced to Industry through EDCN and completely outsourced for AUGUR.

2.4.1.2 GDCN

EUROCONTROL Navigation Steering Group 18 Information Paper 10 proposes that the operators of GNSS core constellations do not need to be certified according to SES regulations. However the paper proposes that data from the GNSS core constellation is continuously collected to enable periodic monitoring and performance assessment in Europe. The goal is to measure compliance with performance and reliability figures defined in ICAO SARPs [RD 18], and with requirements in the related reference material (e.g. GPS SPS Performance Standard and future Galileo Open Service Definition Document) that are critical for augmentations (e.g. RAIM and future Advanced-RAIM developments).

The objective of the GDCN sub-function is to provide an independent performance monitoring of the GNSS service initially limited to GPS and to be later extended to other satellite constellations (e.g. Galileo) as they become used in aviation.

The network could use several different receiver types, including certified aviation equipment, stations from EDCN network or stations from EGNOS Ranging and Integrity Monitoring Stations (RIMS).

The SAT-NAV sub-service will re-use current existing EDCN service but will focus on GPS RAIM and future Galileo performance monitoring as specified in ICAO Annex 10 Volume I and will include new functions such as legal recording and local view.

Additionally, GNSS performances will be assessed with respect to performance requirements of PBN and ADS-B applications based on GNSS.

2.4.1.3 AUGUR

AUGUR is a RAIM Availability prediction service used by operators to confirm adequate availability of GPS for their planned operations. AUGUR coverage is limited to ECAC States. Other regions of the world such as the USA provide similar services.

AUGUR has been developed to meet the requirements of:

- Sub-section 5.2 (Normal Procedures) of Section 5 (Operational Criteria For Use Of GPS Stand-Alone Equipment) of EASA AMC 20-4 [RD 13],
- Sub-section 10.2.1.3 (Pre-flight Planning) of JAA TGL 10 [RD 14],
- Sub-section 1.1.1.f (Pre-flight planning) of Appendix 4 (Operational Procedures) to
EASA AMC 20-27 [RD 15].
The scope of CS7 SAT-NAV is to provide a service similar to current AUGUR service.

2.4.2 Components

2.4.2.1 GDCN

2.4.2.1.1 Data inputs
A set of monitoring stations owned by ANSPs, Academic institutions, the European Commission and EUROCONTROL, is currently used by EDCN to monitor the GNSS signals at 32 different locations in Europe. The location of these stations is illustrated below; they could be re-used for GDCN.

![Figure 13 – The Current EDCN Network of Monitoring stations](image)

2.4.2.1.2 Current Architecture and tools
Performance data is processed locally at each monitoring site using the PEGASUS Tool developed by EUROCONTROL. PEGASUS is a toolset which allows analysis of GNSS data collected from different SBAS systems implementing the algorithms issued in the MOPS documents. The toolset provides several functionalities such as the computation of position simulating MOPS-compliant receivers, the determination of GNSS augmentation attributes like accuracy and integrity, the computation of trajectory errors, the prediction of continuity and availability.

The results are automatically sent to a central server where they are stored and used to present combined performance results over the airspace of all EUROCONTROL Member States.
The results are updated daily on the EDCN website. Newsletters showing summary results over a period are provided bi-monthly. Any detected anomalies are highlighted to the operator of the central server for further analysis. The source of the anomaly is identified and contacted to develop a solution. The number of anomalies does not necessitate the use of an issue management tool.

### 2.4.2.1.3 Future architecture and tools

The CS7 will transform the EDCN functionality into a GDCN (GNSS data Collection Network) by adding the monitoring of GPS RAIM, the possibility to have local view and legal recording. The monitoring of signals provided by core constellations (GPS, GLONASS) that are operated by non-certified Service Providers will become the primary mission of this GNSS monitoring network.

### 2.4.2.2 AUGUR

AUGUR is a RAIM Availability prediction service used by operators to confirm adequate availability of GPS for their planned operations. AUGUR coverage is limited to ECAC; other regions of the world such as the USA provide similar services. AUGUR provides one function per type of operation:

- the “en-route” function for B-RNAV routes (RNAV 5)
- the “terminal” function for TMA where GPS-based P-RNAV procedures are published (RNAV 1); and
- the “approach” function for airports where RNP APCH to LNAV minima procedures are published.
AUGUR is made available via a web-based interface which can be found at:
http://augur.ecacnav.com/augur/app/home

Four different functions are provided on this interface:

- **GPS Status Tool** – provides the information on the status of GPS constellation according to the US Coast Guard (number of healthy satellites and satellite outages planned (NANUs))
- **Terminal and Approach Tool** – RAIM availability predictions for specific aerodromes.
- **Visibility Tool** - provides more details about the number and the geometry of GPS satellites visible from a particular location
- **Route Tool** – calculates RAIM availability for points along a defined route.

Information on GPS RAIM availability to support RNP approach (RNP APCH) operations is also provided by AUGUR in the form of NOTAM proposals to those ANSPs who have registered to receive this service for specific airports where RNP Approach procedures have been published. The GPS RAIM NOTAM proposals are provided through the European AIS Database (EAD) as a service to the States which have the obligation, as applicable, to publish NOTAMs. States have to request this type of NOTAM to EAD not directly to AUGUR. AUGUR provides the proposed NOTAM to EAD which will then provide it to the national offices in charge of NOTAM publication.

A tool to provide the GPS RAIM prediction will need to be developed during CS7 phase 1.

### 2.4.3 Roles and responsibilities

#### 2.4.3.1 **NM**

NM will:

- manage the contract for the outsourced tasks,
- define the necessary upgrades to maintain the tools,
- develop and maintain the PEGASUS tool.

#### 2.4.3.2 **NIPS/SAT-NAV Service Provider**

The NIPS/SAT-NAV Service Provider shall:

- operate and manage the GDCN Central Server,
- collect the data from local PEGASUS tools,
- publish global and local performances,
- perform legal recording,
- provide AUGUR service.

#### 2.4.3.3 **ANSPs and other authorities**

ANSPs and other authorities (Research laboratory, University) will ensure that local receivers are running and connected to the GDCN central server.
2.5 Safety

NIPS is not an operational service therefore it is not expected to be necessary to perform safety cases. The NIPS service contributes to improve safety by proactively detecting and resolving CNS operational system anomalies.

This will be reassessed as part of the CFT preparation

2.6 Security

Critical and sensitive information will be handled by the NIPS service including commercial in confidence data about aircraft management, ANSP operational data, and information about military aircraft and operations.

All these information shall be protected against the use by non-authorised persons.

The data will not belong to the companies to which tasks will be outsourced. This will be protected by specific Non-Disclosure Agreements. The contractor will need to develop a security plan to ensure the protection of data.

Specific security requirements apply to the recording, storing and processing of data related to State aircraft. Sensitivity of such data may require that their processing remains within the Network Manager's.

Exchange of data between NIPS Service Providers and NM will need to be secured. This could be achieved by using the Security Certificate Service which will be provided by CS6 and transporting data using CS8.

2.7 Service level Agreement

The services provided are not operational services and are not all provided 24/7.

NIPS/SAT-NAV (GDCN, AUGUR) subservice, the GPS outage function (NIPS/ CNS-PERF SUR-AV function) and the NIPS/CNS-PERF RMA-ASE function shall run 24h/7d.

Other sub-services do not need 24h/7d availability. A minimum operational availability will be defined in the respective SLAs.

Data from operational systems (e.g. radar data) will be provided to the NIPS service through appropriate contractual arrangements and Service Level Agreements with ANSP’s owning the ground sensors and also with alternative commercial providers of surveillance data (mainly ADS-B proprietary networks). Surveillance data from military organisations may also be used, provided that adequate arrangements and Service Level Agreements are in place.

2.8 Data property

All collected data and reports will be the property of NM.
CHAPTER 3 – Regulatory requirements

3.1 Existing applicable regulation

3.1.1 EU SES Package

At the level of European Union, no regulatory provisions address yet specifically the centralised services and the NIPS in particular. However, the following regulations are worth considering in relation to CS7:

- Regulation (EC) No 551/2004 of the European parliament and of the Council of 10 March 2004 on the organisation and use of the airspace in the SES, (as amended) in particular its Article 6;
- Commission Regulation (EC) No 29/2009 of 16 January 2009 laying down requirements on data link services for the single European sky; it addresses in its article 5.6 the required monitoring of the quality of service of communication services performance;
- Commission Implementing Regulation (EU) No 1207/2011 of 22 November 2011 laying down requirements for the performance and the interoperability of surveillance for the single European sky; its article 4.4 provides that the ANPS have to identify aircraft with anomaly and report it to the operator for investigation and rectification. In addition Article 7.2 of this regulation requires that aircraft operators ensure that a check is performed at least every two years and investigate and rectify data-items which are not correctly provided.

The result of the surveillance monitoring performed by the NIPS centralized service could be considered as a means of compliance with this specific requirement (2-year check requirement) and with the requirements of the above-mentioned regulations.

The following regulations, related to the oversight should also be considered:

- REGULATION (EC) No 216/2008 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 20 February 2008 on common rules in the field of civil aviation and establishing a European Aviation Safety Agency (as amended);
- COMMISSION IMPLEMENTING REGULATION (EU) No 1034/2011 of 17 October
2011 on safety oversight in air traffic management and air navigation services and amending Regulation (EU) No 691/2010 (as amended): Article 3.d of this Regulation foresees that the safety oversight of organisations providing pan-ATM/ANS is exercised by EASA.

The RVSM approval is required by EU.OPS 1.241 of Commission regulation (EC) No 859/2008 of 20 August 2008 amending Council Regulation (EEC) No 3922/91 as regards common technical requirements and administrative procedures applicable to commercial transportation by aeroplane [RD 11].

Finally, the European Commission has issued in its Communication of 11 June 2013¹ a proposal to revise the SES package, with a view notably to reinforce the role of the Network Manager.

### 3.2 Requirements for new/updated regulations to implement/operate the CS7 (NIPS)

#### 3.2.1 Requirements related to the EU framework

A provision in the SES Regulations is necessary to make the technical migration to the future centralized services (or ‘support services’) mandatory for stakeholders concerned (e.g. by a further amendment to Regulation No 677/2011).

For CS7 (NIPS), provisions should also be envisaged to mandate the provision and sharing of data to allow CNS performance monitoring by CS7.

#### 3.2.2 Requirements related to the EUROCONTROL framework

The NIPS will be implemented as a Pan-European Service in the applicability area of the EUROCONTROL Member States. To unlock the full benefits for the Network on one side and the ANSPs and other operational stakeholders on the other side, it is pivotal that all Member States cooperate in the set-up and implementation of the service.

While the above-mentioned EU regulations will apply to EU Member States and their operational stakeholders, as well as ultimately to non EU Member States bound by these Regulations because of relevant agreements with the EU for the implementation of aviation regulations (e.g. ECAA), the intention is to achieve consent in the Provisional Council and Permanent Commission of EUROCONTROL to make full use of the services in all EUROCONTROL Member States.

Therefore, it is expected that by a Decision, the Permanent Commission of EUROCONTROL will make the centralised services and their related conditions binding on all the EUROCONTROL Member States and their operational stakeholders. The EU regulatory framework would just reinforce this obligation for the States concerned.

#### 3.2.3 Requirements related to the national legal/regulatory frameworks

Updated/amended EU regulations are directly applicable in the EU Member States and

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¹ Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions “Accelerating the Single European Sky” of 11 June 2013 (COM (2012) 408 final)
would not require measures at national level.

For EUROCONTROL Member States not bound by EU Regulations, appropriate rules and regulations would have to be adopted at national level to comply with the obligations deriving from the decision of the Permanent Commission of EUROCONTROL.
CHAPTER 4 – Links of the CS7 (NIPS) to ICAO GANP, SESAR deployment, ESSIP – current procedures and future evolution

4.1 Baseline – Interim Deployment Programme (IDP)

Centralised Services (CS) are in line with the Interim Deployment Programme (IDP). The conformity analysis was initiated by EUROCONTROL and further completed at the Interim Deployment Steering Group (IDSG) Expert Team in the meeting of 27 June 2013.

The possible relationships between CS and IDP deployments have been analysed and clustered in four categories of potential interactions, which are:

1. **No relationships** between IDP activities and CS. This means that the functions and services deployed in a centralised manner by the CS do not directly interface any of the deployments of the IDP.

2. IDP deployment is improved by the independent CS capabilities. The functions and services deployed in a centralised manner by the CS will be used by one or several IDP deployments but in an independent way. This is the case when CS does not impact functionalities already deployed, i.e. Independent function improvements, or when the CS implements some add-on function or services such as equipment performance monitoring, centralised management of shared parameters, i.e. Development of supporting option.

3. IDP is a pre-requisite for CS. This means that the functions and services deployed in a centralised manner by the CS reuse an IDP deployment.

4. IDP deployment is an alternative to the CS solution. The functions and services deployed in a centralised manner by the CS offer a different implementation of an IDP deployment.

The NIPS centralised service proposes services to manage in a cost-effective way CNS infrastructure performance monitoring supporting ANSPs to address regulatory obligations. The proposed services will monitor the performance of the following CNS services/systems: Air-Ground Data-Link, Altimetry systems, 1030/1090 MHz frequency, Surveillance sensors and satellite navigation systems.

This centralised service is categorised as development of supporting options, which
means that it can improve cost effectiveness of the operations of the IDP deployments. The NIPS centralised service develops or enhances CNS network infrastructure performance management services. IDP Deployments do not address this area but need performance management.

The benefit dependency is that this centralised service will enhance the benefits of some of the SESAR IDP activities, such as:

- monitoring of the Air-Ground Data-Link communication performance will contribute to the benefits of “Air-Ground Data-Link” (WP4); and the
- monitoring of Satellite Navigation performance will contribute to the benefits of “RNP Approach” (WP6).

Therefore the NIPS centralised service is related to the two above-mentioned IDP Work Packages.

The figure below illustrates the IDP Breakdown structure for the NIPS relevance.

4.2 Pilot Common Projects (PCP) and Common Projects (CP)

Centralised Services interact with the Pilot Common Project (PCP). Interdependencies between Centralised Services and the six ATM Functionalities (AFs) of the Pilot Common Projects (PCP) have been analysed.

The Centralised Services will influence the future Common Projects (CP).

The NIPS centralised service is categorised as development of supporting options and is related to the following PCP ATM Functionalities:
The NIPS centralised service provides monitoring capabilities that will increase the benefits of CNS PCP deployments (AF#1 and AF#6).

**4.3 European Single Sky ImPlementation (ESSIP)**

The possible relationships between CS and ESSIP, being the Level 3 of the European ATM Master Plan, have been analysed.

The NIPS centralised service is categorised as **development of supporting options** and is related to the ESSIP Objectives:

- ITY-AGDL “Initial ATC air-ground data link services above FL 285 (A/G via VDL-2)”
- NAV10 “Implement Approach Procedures with Vertical Guidance (APV)”
- ATC16 “Implement ACAS II compliant with TCAS II change 7.1”
- ITY-SPI “Surveillance performance and Interoperability”

The NIPS centralised service will supplement the future “Aircraft Identification for Surveillance (ACID)” ESSIP Objective.

Furthermore, it provides additional performance monitoring services and supports the improvements of the mentioned ESSIP Objectives.

**4.4 ICAO Global Air Navigation Plan (GANP)**

The possible relationships between CS and ICAO Global Air Navigation Plan (GANP) have been analysed.

The NIPS centralised service contributes to more efficient CNS infrastructure, related to a number of enablers in GANP CNS roadmaps.

TCAS analysis is a tool for:

- B0-ACAS – ACAS Improvements
- B2-ACAS – New Collision Avoidance system.

The NIPS centralised service surveillance performance monitoring supports:

- B0-ASUR – Alternative surveillance; and
- B0-SEP, B1-SEP, B2-SEP and B3-SEP – Airborne separation.
ANNEX 1 – Current procedures and future evolution
Information flows

A1.1 Operational process

Note: Figure 16 depicts the generic approach followed by CS7 however different functions are used by the different subservices and are represented with more details on the figures in annex A1.2.
A1.2 Technical process

Figure 17 – Technical process

- = CS7 (dashed line = optional)
- = NM development / upgrade
- = Stakeholder 1 development / upgrade
- = Stakeholder 2 development / upgrade
A1.3 Monitoring Infrastructure

Figure 18 – CNS-PERF Monitoring infrastructure
Figure 19 – SUR-RF monitoring infrastructure
Figure 20 – SAT-NAV monitoring infrastructure
ANNEX 2 – Data set

High level data flows have been highlighted in other sections of this document. Detailed data sets will be refined during the CS Programme Phase 1 and/or at time of CFTs.
ANNEX 3 – EUROCONTROL Proposal for a first set of Centralised Services to contribute to SES Performance Achievement, March 2013

ANNEX 4 – Brief description of the Centralised Services

ANNEX 5 – Minutes of the 29 April 2013 Airspace Users CS workshop

ANNEX 6 – Minutes of the 4 March 2013 Member States CS workshop

ANNEX 7 – Minutes of the 24 April 2013 ANSPs CS workshop

ANNEX 8 – Minutes of the 17 May Manufacturing Industry CS workshop

ANNEX 9 – Working papers, slides and extract from the Minutes of PC/39, 16 May 2013

ANNEX 10 – Working papers, slides and extract from the Minutes of PCC/31, 02 July 2013

ANNEX 11 – Slides and Minutes of CS7 specific workshop of 08 July 2013

These annexes are provided in a separate file.
REFERENCES

[RD 1] DLS Central Reporting Office, Performance Monitoring Requirements. Version 0.6
[RD 2] DLS Central Reporting Office Provision of ANSP data to the CRO edition 0.4
[RD 3] ICAO Doc 9937 Operating Procedures and Practices for Regional Monitoring Agencies in Relation to the Use of a 300 m (1,000 ft) Vertical Separation Minimum Between FL 290 and FL 410 Inclusive, First Edition 2010
[RD 4] ICAO Annex 6 Part 1
[RD 5] ICAO Annex 6 Part 2
[RD 6] The Link2000+ XML Based ATC Information Exchange Format, version 1.6, 24/06/2013
[RD 14] JAA TGL 10, Airworthiness And Operational Approval For Precision RNAV Operations In Designated European Airspace
[RD 16] JAA TGL6 rev1, Guidance material for the approval of aircraft and operations in airspace where the vertical separation minimum above FL 290 is 300m (1,000 ft) (RVSM Operations)
[RD 17] RF Video Recording ICD, Edition 1.0, 05/07/04
### GLOSSARY

<table>
<thead>
<tr>
<th>Term</th>
<th>Description</th>
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<tbody>
<tr>
<td>Altimetry system error (ASE)</td>
<td>The difference between the altitude indicated by the altimeter display, assuming a correct altimeter barometric setting, and the pressure altitude corresponding to the undisturbed ambient pressure.</td>
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<tr>
<td>24 bit aircraft address</td>
<td>A unique combination of twenty-four bits available for assignment to an aircraft for the purpose of air-ground communications, navigation and surveillance.</td>
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<tr>
<td>Multilateration</td>
<td>A surveillance technique that relies on signals from an aircraft’s transponder being detected at a number of receiving stations. Multilateration system uses a technique known as Time Difference of Arrival to establish surfaces that represent constant differences in distance between the target and pairs of receiving stations. The aircraft position is determined by the intersection of these surfaces.</td>
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### ABBREVIATIONS

<table>
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<tr>
<th>Abbreviation</th>
<th>Description</th>
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<tbody>
<tr>
<td>EUR RMA</td>
<td>Regional Monitoring Agency for European EUR RVSM airspace</td>
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<td>A/G</td>
<td>Air Ground</td>
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<td>ACAS</td>
<td>Airborne Collision Avoidance System</td>
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<td>ACC</td>
<td>Area Control Center</td>
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<td>ACSP</td>
<td>Air/Ground Communications Service Provider</td>
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<tr>
<td>ADS-B</td>
<td>Automatic dependent surveillance — broadcast</td>
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<td>ANSP</td>
<td>Air Navigation Service Provider</td>
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<tr>
<td>AO</td>
<td>Aircraft Operator</td>
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<tr>
<td>ARINC</td>
<td>Aeronautical Radio Incorporated (US)</td>
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<tr>
<td>ASE</td>
<td>Altimetry System Error</td>
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<tr>
<td>ATC</td>
<td>Air Traffic Control</td>
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<td>ATM</td>
<td>Air Traffic Management</td>
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<td>ATSU</td>
<td>Air Traffic Service Unit</td>
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<tr>
<td>AUGUR</td>
<td>Web-based tool to check the availability of GPS integrity (RAIM)</td>
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<td>B2B</td>
<td>Business to Business</td>
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<td>B2C</td>
<td>Business to Customer</td>
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<td>BDAMS</td>
<td>Base de Données Avions Mode S</td>
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<td>CIMT</td>
<td>CRO Issue Management Tool</td>
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<tr>
<td>Abbreviation</td>
<td>Full Form</td>
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<tr>
<td>CMS</td>
<td>Control and Monitoring System</td>
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<td>CONOPS</td>
<td>Concept of Operations</td>
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<td>CP</td>
<td>Common Project</td>
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<td>CPDLC</td>
<td>Controller-Pilot Data Link Communications</td>
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<td>CPS</td>
<td>Central Processing System</td>
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<tr>
<td>CRO</td>
<td>Central Reporting Office</td>
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<td>CS</td>
<td>Centralized Service</td>
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<td>DB</td>
<td>Data Base</td>
</tr>
<tr>
<td>DLS</td>
<td>Data Link Service</td>
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<tr>
<td>DLS-CRO</td>
<td>Data Link Service – Central Reporting Office</td>
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<tr>
<td>EAD</td>
<td>European AIS Database</td>
</tr>
<tr>
<td>EANPG</td>
<td>European Air Navigation Planning Group</td>
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<tr>
<td>EASA</td>
<td>European Aviation Safety Agency</td>
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<tr>
<td>ECAC</td>
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<tr>
<td>EDCN</td>
<td>EGNOS Data Collection Network</td>
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<tr>
<td>ESSIP</td>
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<tr>
<td>ESSP</td>
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<tr>
<td>EUR RMA</td>
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<tr>
<td>EUROCAE</td>
<td>European Organisation for Civil Aviation Equipment</td>
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<tr>
<td>EVAIR</td>
<td>EUROCONTROL Voluntary ATM Incident Reporting (system)</td>
</tr>
<tr>
<td>FPD</td>
<td>Flight Plan Data</td>
</tr>
<tr>
<td>Acronym</td>
<td>Description</td>
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<tr>
<td>Galileo</td>
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</tr>
<tr>
<td>GBAS</td>
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<td>Global Navigation Satellite System</td>
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<tr>
<td>GPS</td>
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<tr>
<td>GPS SPS</td>
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<tr>
<td>HME</td>
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<tr>
<td>ICAO</td>
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<td>MOPS</td>
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<tr>
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<td>Notice Advisory to NAVSTAR Users</td>
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<tr>
<td>NM</td>
<td>Network Manager</td>
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<td>NOTAM</td>
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<td>Prototype EGNOS and GBAS Analysis System Using SAPHIRE</td>
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<tr>
<td>RA</td>
<td>Resolution Advisory</td>
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<tr>
<td>RAIM</td>
<td>Receiver Autonomous Integrity Monitoring</td>
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<td>RF</td>
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<td>(EGNOS) Ranging and Integrity Monitoring Stations</td>
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<td>RNP</td>
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<td>RVSM</td>
<td>Reduced vertical separation minimum</td>
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<td>SARPS</td>
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