



**MINISTÈRE
CHARGÉ
DES TRANSPORTS**

*Liberté
Égalité
Fraternité*



ANNUAL REPORT

DSNA

THE FRENCH AIR NAVIGATION SERVICE PROVIDER

2020 / 2021

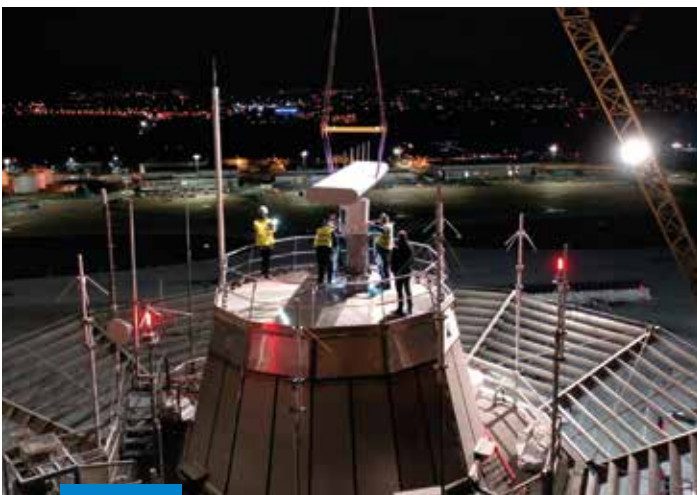
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Florian
Guillermet

French Air Navigation Services Director

Since my appointment on July 5th, 2021, I have been measuring the scale of the considerable challenges for which DSNA must prepare. I

would like to thank Maurice Georges for the significant groundwork carried out in recent years: DSNA will build its future on these achievements. Because 2020 was such an unprecedented year for the aeronautical sector, it seemed fitting to publish a single annual report covering both 2020 and 2021.

In 2020, the coronavirus health pandemic created an unforeseen crisis for the global air transport and tourism sectors. From March to December, air traffic in France stood at only 33% of its 2019 levels. With a total of 1,358,127 controlled flights, 2020 is on the same level as the late 80s. Revenues from air navigation charges were greatly affected. The DGCA, the French Civil Aviation Authority, was able to rely on loans to pursue the DSNA's main investment projects, which are essential to

its future and European network performance.

Covid-19 will have a structural impact on future air transport. Digital technology and highly ambitious environmental requirements will play a greater role in the fast-changing aviation sector. This crisis is challenging, both on professional and personal levels, and will result in extensive changes to how we organise our work. This means that we will have to adopt new ways of working.

As a public service and key driver in the air transport value chain, the DSNA is committed to making fundamental changes to adapt to these new challenges as best as possible. I firmly believe that our collective determination will enable us to successfully implement these necessary changes and that the DSNA will provide the right support to its customers, users and partners for gradual recovery to sustainable air traffic.

2020-2021 Highlights

► JANUARY 2020

ATC system modernisation

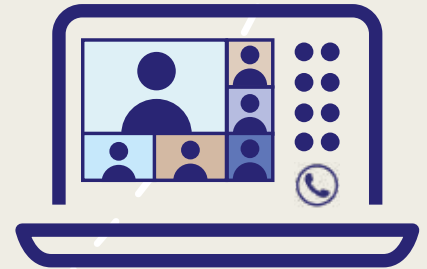
4-FLIGHT training programme kick-off at Reims and Marseille ACC pilot sites. This step takes the programme into the start-up phase.



► MARCH 2020

Organisation

France was locked down for 2.5 months to curb the first wave of the coronavirus pandemic, DSNA implemented a Business Continuity Plan (BCP).



► APRIL 2020

Air traffic

Mainland France IFR traffic collapsed.

- 93 %

compared to April 2019, i.e, 642 daily flights.



► MAY 2020

Drones

Operational assessment to integrate a drone with performance levels equivalent to those of a regional aircraft. The assessment was carried out in controlled airspace, in the south of France at a medium altitude, for nearly three hours.



► JUNE 2020

• Organisation

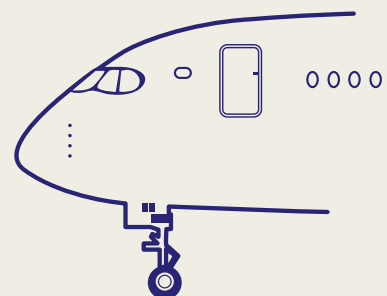
DSNA Business Recovery Plan implementation.

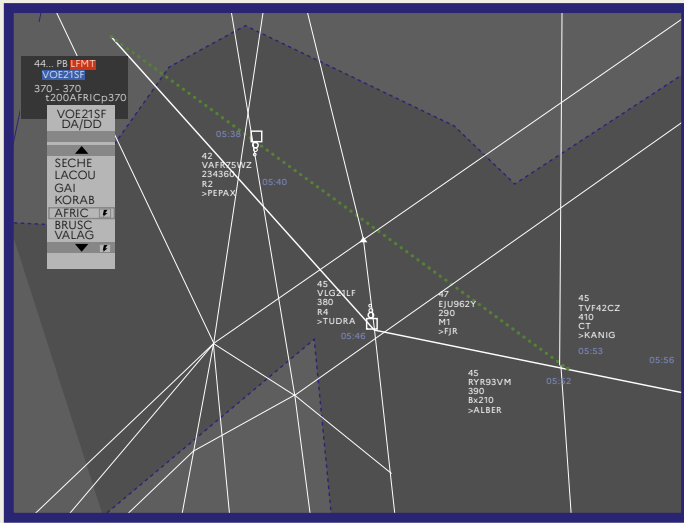
• Infrastructures modernisation

Operational flows migrated to NewPens, the new ground-ground communications network, to exchange with other European air navigation operators.

• Finance

DGCA was granted a €1.25 billion loan for 2020.





► JULY 2020

• **ATC modernisation**

Continuation of 4-FLIGHT assessments on real traffic in secure mode; urbanisation of Paris ACC operations room.

• **Infrastructure modernisation**

Renovated Toussus-le-Noble (Yvelines) watchtower opened.

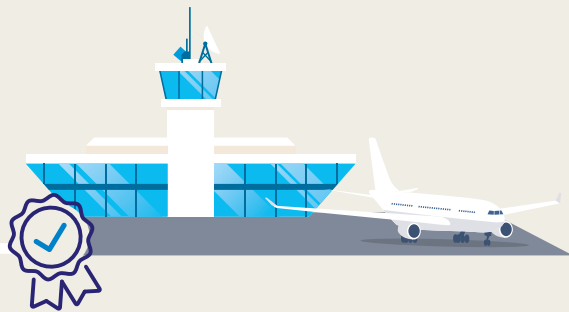
• **Communication system modernisation**

First Data Link radio frequency handovers from Paris ACC to the main Paris-CDG and Paris-Orly centralised approaches.

► SEPTEMBER 2020

Customer relations

Nice-Côte d'Azur airport labelled A-CDM (*Airport-Collaborative Decision Making*).



► OCTOBER 2020

Monitoring system modernisation

Emblematic ground radar at the top of Orly Tower replaced by a new, more efficient radar for apron movements.

► NOVEMBER 2020

• **Organisation**

Updated Business Continuity Plan following second lockdown.

• **Finance**

European air navigation operators' performance plans revised for 2020-2024, given the sharp drop in traffic.

► DECEMBER 2020

Innovation

First Coflight Cloud Services (CCS) phase successfully implemented. The aim of CCS is to provide remove flight data from Paris ACC to Geneva ACC (Skyguide).

I would like to congratulate all the DSNA staff who helped to successfully carry out these operations in a context that was made difficult by the health crisis. I am aware that, beyond providing a quality service which is increasingly adapted to our customers' and airspace users' needs, these achievements were a great source of motivation and professional satisfaction during a very complex time.

Florian Guillermet

► JANUARY 2021

Environnement

Live trial of continuous descent operations (CDO) at Paris-CDG with the aim of them becoming implemented H24.

► FEBRUARY 2021

Airspace

West SNA (Brest, Rennes, and Nantes) ceased FIR's continental airspace to Brest ACC, an enabler for the commissioning of Free Route in this region.

► MARCH 2021

• Communication system modernisation

New generation emergency radio system put into service in Paris-CDG (projet N-VCS).

• Infrastructures modernisation

Work started to extend the Paris-Orly technical unit to house the new technical booths, the SYSAT simulator, and the new IFR room.

► APRIL 2021

• Continuous training

New self-learning and computer-assisted learning tools introduced for operational staff. New simulator for Paris-CDG tower.

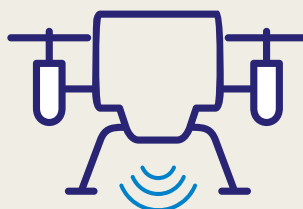
• Finance

DGCA was granted a €1.1 billion loan for 2021.

► MAY 2021

U-space

Initial results of experiments with the manufacturers selected in 12 controlled airspaces to gradually develop a French U-space.



► JUNE 2021

• Safety

Introduction of an additional monitoring system (WAM) for Nice and Cannes control units - a first for mainland France!

• Innovation

Transport Innovation Agency (AIT) created by the ministry to promote collaboration between the diverse modes of transport. DSNA oversees two environmental projects within the AIT.



► JULY 2021

• Organisation

DSNA's ISO 9001: 2015 certificate extended until July 2nd, 2024.

• Safety

Upgraded surveillance S mode radar implemented in Figari (southern Corsica). This is the only French radar which covers the south-east airspace over the Mediterranean Sea.

• Environnement

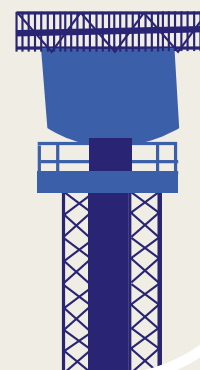
DSNA published a 2025 environmental strategy leaflet.

• ATC system modernisation

Latest live trial on 4-FLIGHT at Reims ACC before the planned commissioning on April 5th, 2022.

• Innovation

Emergency power supply for a radio antenna at a remote site in Dordogne with 75% energy autonomy (SEPPER project).



► AUGUST 2021

Air traffic

Commercial air traffic recovery in Europe, with high daily peaks France.

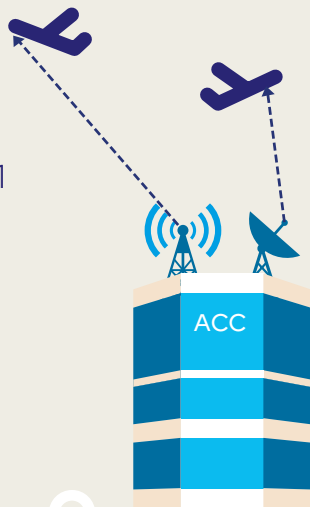
8 104 controlled flights on Saturday, August 28th

record traffic levels in France and Europe in 2021.

► SEPTEMBER 2021

Infrastructures modernisation

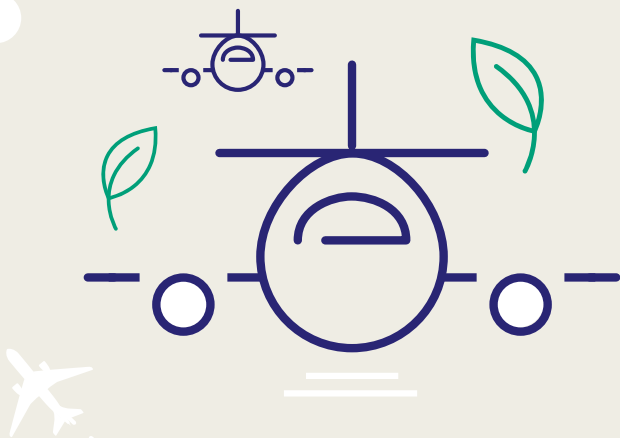
Renovated Toulouse watchtower put into service.



► NOVEMBER 2021

Innovation

Two A350s flying in formation over the North Atlantic Sea have proven wake energy retrieval technology for better environmental performance (fello'fly project).



► OCTOBER 2021

• Human Resources

DTI's new organisation aiming at a more efficient collaboration with DSNA departments and manufacturers.

• Communications system modernisation

Clearances can be given via Data Link at Reims ACC and Marseille ACC. The digitalised ground-aircraft data exchange capacity is now extended to the entire upper French airspace.

► DECEMBER 2021

• Airspace

Free Route implementation in France, in almost half of the upper airspace.

• Drones

Cross-border live trial between France and Spain to integrate REAPER, a military drone, in controlled airspace at medium altitude.

• ATC system modernisation

Operational assessment in secure mode on 4-FLIGHT at Marseille ACC in preparation for the implementation scheduled in December 2022.

• Communication system modernisation

First operational assessment at Brest ACC for ground-to-air and ground-to-ground communication services in ACCs (N-VCS project).



PART 1

COVID-19 : air traffic collapse and resilience

The global coronavirus pandemic hit Europe at the beginning of 2020. The virus was highly contagious, fatal for very fragile people and developed many variants. It was brutal, intense, and upturned our lives.

Air transport was significantly affected, and air traffic and air navigation charges fell to an unprecedented level. Our sector experienced the most severe economic crisis ever in all its history. In order to ensure its survival, the French State introduced exceptional emergency support measures. The challenge will be to gradually restore full freedom of movement for passengers. The desire to travel is still there, but clearly certain travel habits will change.

On a professional level, the health crisis has led to reviewing how work must be organised. And on a personal level, the health crisis was very difficult. Yet DSNA staff did the French public Air Navigation Service proud: whether it was in working on daily tasks, in operations, or on key modernisation projects.

As of summer 2021, the arrival of vaccines and our capacity to better protect ourselves brought hope. Despite a still uncertain context, DSNA strives to safely accompany a much-awaited air traffic resumption and ensure the future of air navigation in France.



The Covid-19 pandemic

Covid-19 (or « Coronavirus disease ») was identified in China in December 2019. It is an infectious respiratory disease caused by the SRAS-CoV-2 coronavirus. The virus can affect a person’s lungs, nervous system, taste and smell, and digestive system. To curb the pandemic, the French government declared a state of health emergency in mainland France from March 23rd, 2020 to June 1st, 2021 and put in place three lockdowns (travel was forbidden) between March 2020 and May 2021. The West Indies, French Guyana, Reunion Island, Mayotte, New Caledonia and French Polynesia also endured several lockdowns during the pandemic’s peaks.

perspectives. Thanks to new-generation vaccines developed in record time, a mass vaccination programme was led in the second half of 2021 in Europe and has enabled a return to semi normality. France is one of the countries with the highest vaccination coverage in the world. In June 2021, Europe introduced a health pass to simplify travel between European countries. Airlines, airport managers, and customs services all did their utmost to provide passengers with a secure service in terms of health. But, the health situation and economic context will remain uncertain until the pandemic is under control.

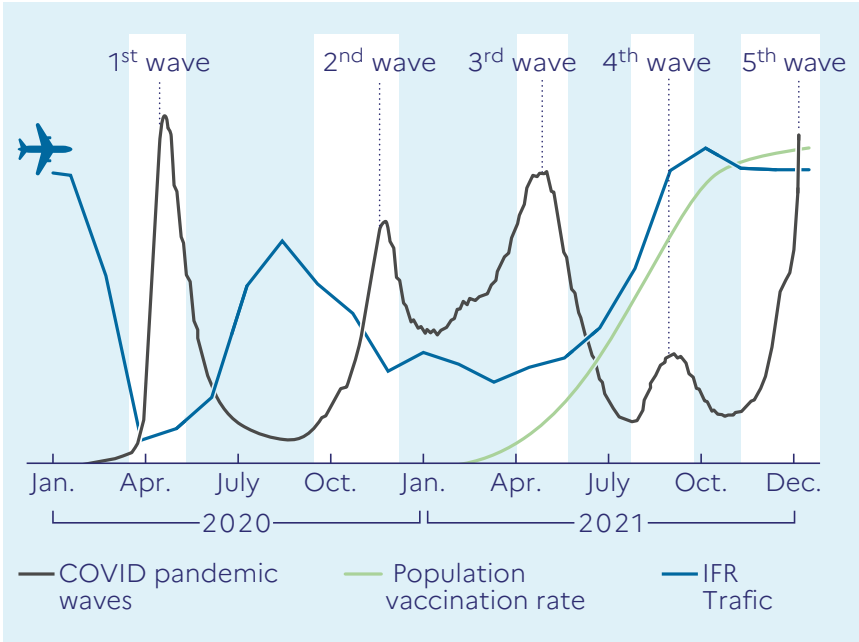
Santé publique France (the French National Public Health Agency) reported on December 31st, 2021 that around 10 million people had been infected in mainland France, whilst 77% of the population had been fully vaccinated.

This world health crisis was particularly progressive in space and time and resulted in mental exhaustion among populations, plus a sense of weariness linked to the lockdown/curfew/restrictions/lifting of lockdown cycles, without any long-term

A pandemic unlike SARS in 2003

The last major epidemic crisis which the global air traffic industry had to face was the SARS epidemic in 2003. SARS, which was less contagious than Covid-19, did not spread anywhere near as much outside of Asia. In France, 450 cases were reported. According to the World Health Organisation, the epidemic which broke out in China in December 2002 was officially contained on July 2nd, 2003. In spite of this episode, air traffic in France had increased by 1.6% in 2023 compared to 2002.

France : air traffic progression per pandemic waves and population vaccination rate



Source : Santé publique France / Covid Tracker and DSNA

A sudden and unprecedented impact on air traffic



Air transport was greatly affected by the global travel restrictions introduced to curb the spread of Covid-19. At the peak of the crisis in April 2020, 64% of the world's commercial fleet and aircraft leasing companies were grounded - i.e., more than 16,000 aircraft. In Europe, more than 5,000 aircraft were grounded in more than 200 airports. In France, 200 aircraft were parked in Paris-CDG and Paris-Orly airports. Aircraft were also stored at other sites such as Châteauroux, Vatry and Tarbes.

Paris-Orly : commercial traffic was interrupted from April 1st to June 25th, 2020 – this had never before been seen! The airport was transformed into a health facility and hosted unusual flights essential to the country's needs.



Vatry airport : medical supplies being unloaded from an AN 225 (April 19th, 2020).



During the first lockdown, France was able to maintain a minimum network of airports :

Mainland France : 7 airports remained open to traffic under normal conditions and 8 airports reduced their commercial capacity; 15 airports had no commercial activity but could still accommodate cargo flights, medical evacuation flights, evacuation flights, diverted flights and State aircraft.

French overseas territories : the following airports were opened with reduced commercial capacity : Saint-Denis, Pointe-à-Pitre, Fort-de-France, Cayenne and Nouméa. For the DSNA, the reduced number of operational airfields led to a significant increase in NOTAM requests (aeronautical information to pilots).

During the crisis, the aviation sector proved that it was strategic industry for States

The international aeronautical community pulled out all the stops to provide much-appreciated assistance : medical evacuations and aid, and rapid supply deliveries.

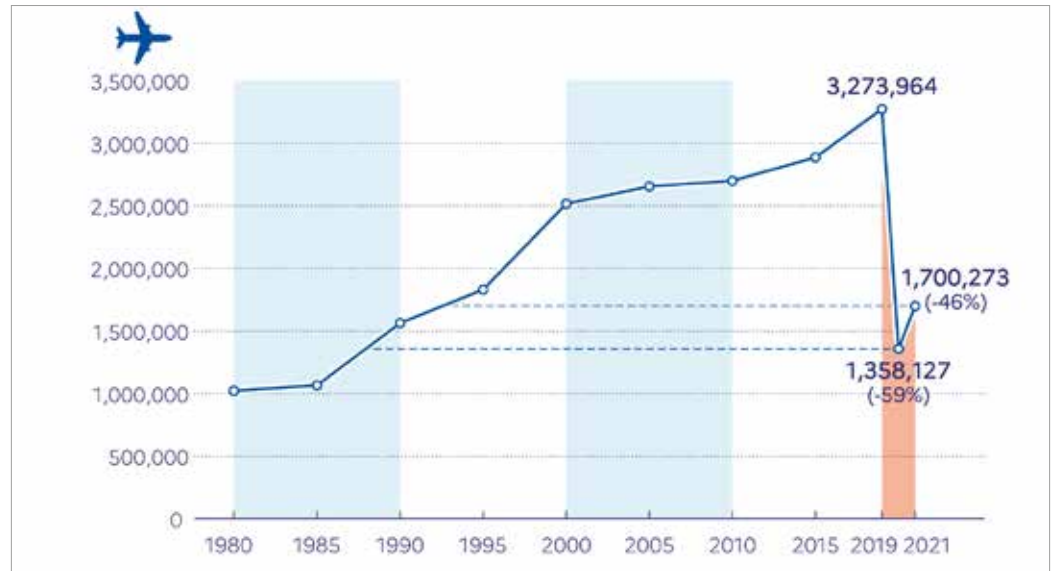
Air traffic in France

Traffic in 2020 dropped to level reported 30 years ago - this illustrates the extent of the crisis. In April and May 2020, France lost on average 92% of its traffic. Average daily traffic in April 2020 fell to 642 flights. 2021 saw resilience in the aeronautical sector, with a slow recovery in air traffic

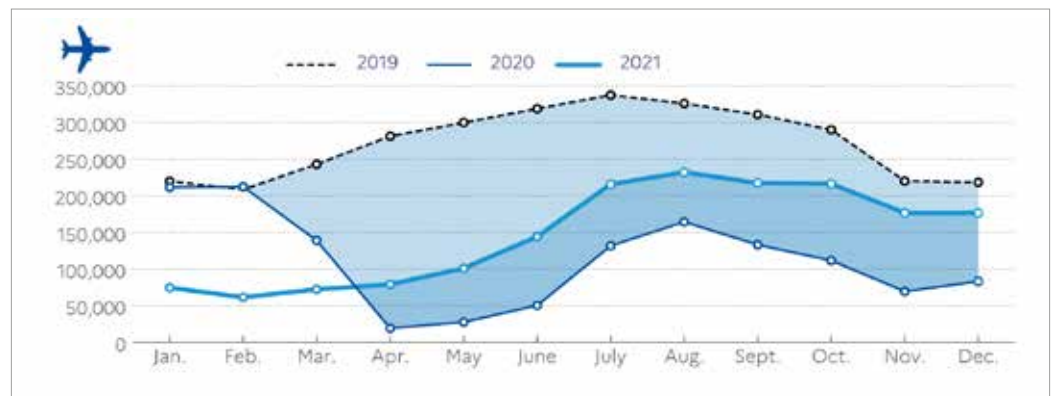
during the first half of the year, followed by a sharp rebound in summer 2021. In december, the traffic resisted relatively well despite a fifth Covid-19 wave due to a highly contagious, yet less virulent, variant. **In 2021, the French Air Navigation Service controlled 1,700,273 flights**, which was 54% of 2019 traffic.

After the first lockdown in March 2020, with air traffic at its lowest, activity began to resume only from the second half of 2021 with 69 % of the level of the second half of the year in 2019.

IFR traffic since 1980



Monthly IFR traffic breakdown



AVERAGE NUMBER OF FLIGHTS PER DAY

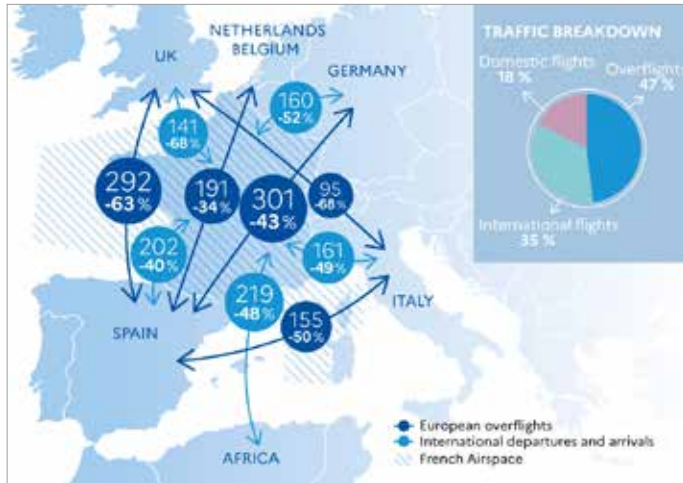
2019
8,970
2020
3,711
2021
4,850

IFR traffic structure progression



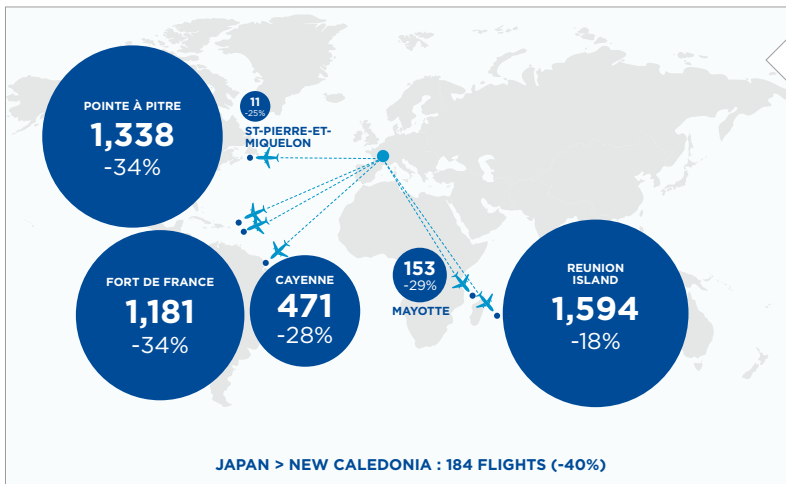
Main traffic flows in France

Average number of flights per day and 2021/2019 variation



Source : DSNA

Direct flights departing from mainland France in 2020 to French overseas territories (2020/2019 variation)



Source : DSNA

May 2020 : a sky (almost) empty of its aircraft... The DSNA's challenge is to contribute to gradual and sustainable air transport recovery in complete safety, whilst improving environmental flight performance.



During 2020 and 2021, trade with French overseas territories was greatly affected during the different pandemic waves but allowed french airlines to balance their activity somewhat.

Tarbes : around 100 commercial aircraft were parked at Tarmac Aerosave in May 2020.



France : IFR movements in main airports (arrivals and departures)



	2019	2020	2021	
Paris - CDG	505,380	220,880	226,645	45%
Paris - Orly	221,132	84,678	107,303	49%
Nice	145,991	66,408	78,332	54%
Marseille	104,250	48,762	54,771	53%
Lyon-St Exupéry	117,963	45,856	49,702	42%
Toulouse	111,290	51,531	47,692	43%
Paris-Le Bourget	53,685	33,526	47,258	88%
Bâle-Mulhouse	85,613	35,717	40,425	47%
Bordeaux	77,174	32,757	37,255	48%
Nantes	65,743	25,143	27,399	42%
Pointe-à-Pitre	28,863	18,569	19,878	69%
Fort-de-France	17,982	10,816	11,347	63%
St Denis La Réunion	13,922	7,088	7,040	51%
Tahiti Faa'a	21,554	13,414	16,407	76%
Nouméa	5,163	2,512	1,864	36%



XX % 2021 traffic share compared to 2019 traffic share

Paris-Le Bourget : monthly IFR traffic breakdown (arrivals and departures)

Europe's leading business aviation airport.



Toussus-le-Noble : monthly VFR traffic breakdown

Largest general aviation airfield (leisure, training, and helicopter flights) in France.



Business and general aviation were significantly less affected by the health crisis compared to commercial aviation.

An exceptional financial support scheme for an unprecedented crisis

The health crisis greatly destabilised the economy, bringing aircraft manufacturers and their subcontractors, airlines, and airport managers to their knees.

According to Eurostat, 2020 passenger demand in Europe dropped by 73% compared to 2019. The International Air Transport Association (IATA) estimated the industry's losses at almost \$140 billion in 2020, and \$52 billion in 2021 worldwide.

In response to this unforeseen crisis, the French State, with the European Commission's approval, injected €15 billion into the aeronautical industry through secured loans and repayable advances. The financial support was a strong commitment to maintaining some of the jobs and being ready for traffic resumption, but above all it greatly accelerated innovation in the ecological transition of air transport.

• Manufacturers

For civil aircraft manufacturers, 2020 was a bad year: airlines preferred to postpone aircraft orders to free up their cash flow.

But in 2021, thanks to clever positioning (p.43), aircraft deliveries strongly resumed for Airbus, ATR - the French-Italian group, and Dassault.

• European airlines

Initially, air traffic gradually resumed on

the intra-European market, just like in the US and China, but Europe struggled to harmonize the opening of its State borders.

This resumption was beneficial to low-cost companies (easyJet, Ryanair, Volotea, and Vueling) with their point-to-point business model. In 2019, their share in the European market had almost reached 32%. The major airlines, traditionally structured with an international network, were highly penalised on long-haul flights until November 2021 when the US market reopened to Europeans and the travel restrictions introduced in March 2020 were lifted. However, the Air France-KLM group, which has a more balanced network than its competitors, has shown great resilience.

In Europe, 2021 saw the bankruptcy of Alitalia, Italy's national airline, and the creation of its successor, ITA Airways. Thanks to State financial support, Air France is aiming for new operational goals whilst remaining competitive: fleet renewal; domestic network rationalisation for a 50% CO₂ emissions reduction by 2024; and a new strategy for its medium-haul network with Transavia to better counter the low-cost airlines with a fleet of 61 aircraft by April 2022.

The Covid-19 crisis also affected business

customers: these passengers turned to business aviation, which is more affordable and better adapted to health restrictions and more flexible given the changing international health situation. The health crisis also saw significant development in the cargo sector in response to new consumer habits (e-commerce).

• Airport managers

In 2019 in France, 174 million passengers travelled on international and domestic flights to mainland airports. Only 52 million passengers travelled in 2020, and 68 million passengers in 2021. By summer 2021, Aéroports de Paris had only reopened four out of nine terminals in Paris-CDG. International traffic was the most affected by the Covid-19 crisis. In France, the summer period saw a recovery in passenger traffic (+15 million compared to summer 2020) but the fourth quarter of 2021 was more difficult given the fifth wave of the pandemic. The repayable amount of loans granted to airport managers was €550 million. This was to cover security costs and other regulatory tasks normally financed by airport tax levied on airline tickets, as well as part of the additional costs associated with health measures. sanitaires.



Air traffic in Europe

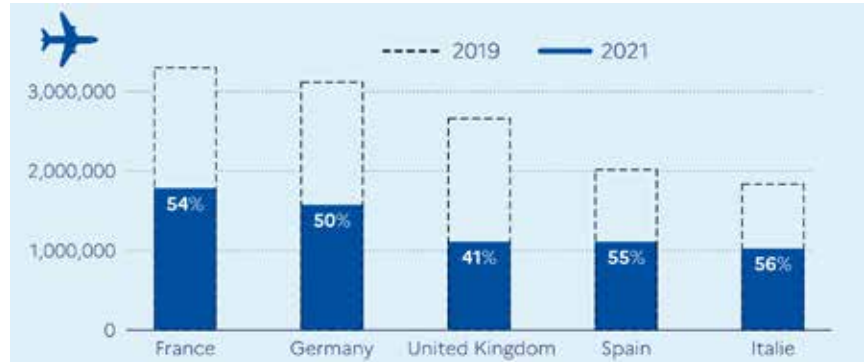
The impacts on air traffic depended on activity type :

- Following a sharp drop in April 2020, commercial air traffic (IFR flights) remained at a very low level until summer 2021. The second half of 2021 saw encouraging recovery prospects in the intra-European area thanks to vaccinations and health passes, with potentially volatile traffic flows depending on country access conditions. The European Commission and Member States created a "Remaining Safe" strategy to coordinate the uplifting of the health restrictions.

- The cargo sector has consolidated, in comparison to 2019. On commercial flights, the lack of passengers and their baggage was used to fill the holds. The rise in cargo is structurally linked to the development of e-commerce, to the extent that Air France's turnover increased from 8% before the crisis to almost 20% in 2021. On a global level, freight transport increased by 8% in the third quarter of 2021 compared to 2019. It is expected that the cargo fleet will grow considerably in Europe.

- The VFR leisure and business aviation activity have remained strong (p. 14).

Air traffic in Europe



Air traffic in the main European airports

FAB	Airport	2019	2020	2021	2021 traffic share compared to 2019 traffic share
FABEC	Amsterdam	503,642	235,702	276,228	55%
FABEC	Frankfurt	508,305	212,326	258,545	51%
FABEC	Paris-CDG	504,362	220,649	255,988	51%
South-West FAB	Madrid-Barajas	421,879	163,796	217,186	51%
UK-Ireland FAB	London-Heathrow	478,046	204,740	192,480	40%
South-West FAB	Barcelona	341,215	121,171	163,305	48%
FABEC	Munich	409,766	144,222	148,183	36%
Blue Med FAB	Rome-Fiumicino	306,787	103,267	113,821	37%
DK-SE FAB	Copenhagen	260,461	98,073	109,789	42%
UK-Ireland FAB	London-Gatwick	284,871	80,276	55,013	19%

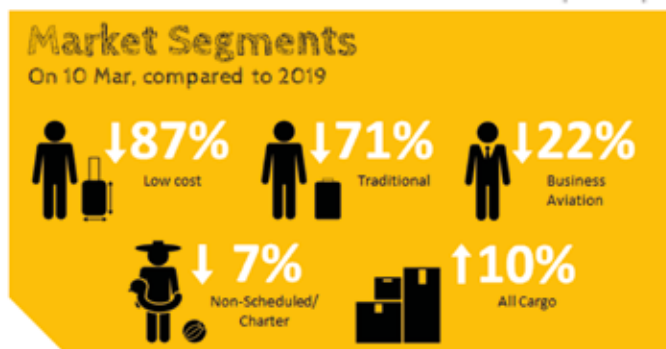
Source : EUROCONTROL

XX % 2021 traffic share compared to 2019 traffic share

FABEC is a Functional Airspace Bloc (FAB) which brings together 6 States : France, Germany, Switzerland, Belgium, the Netherlands and Luxembourg. It is situated at the core of the main western European traffic flows and controls some of the densest and most complex traffic in the world.

To better understand the extent of the crisis, EUROCONTROL published regular dashboards and developed different scenarios for air traffic recovery in Europe. A return to pre-crisis traffic is not predicted before 2024.

Market share evolution for the different types of activities, at European level, on March 10th, 2021 and November 24th 2021, compared to 2019



Source : EUROCONTROL – Dashboard « Covid 19 : impact on European aviation »

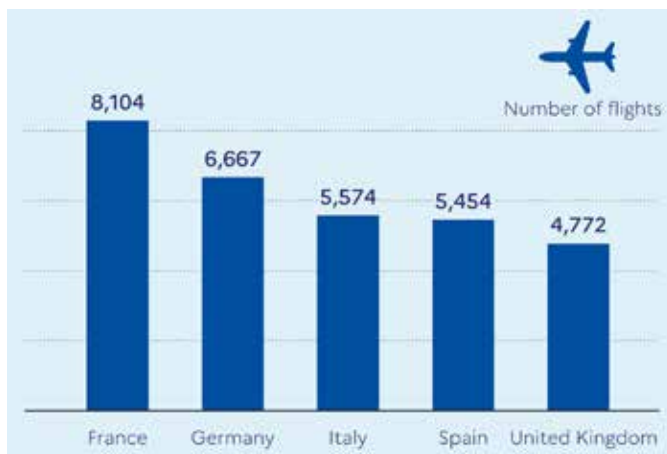
Drop in global air traffic on June 1st, 2020



Summer 2021: the turning point

Summer 2021 marked the recovery of commercial traffic in Europe. With 451,266 flights controlled in July and August 2021, France is the country which controlled the most flights in Europe, followed by Germany with 362,163 flights, and Spain with 293,094 flights. France also recorded several busy days with high traffic peaks such as on 28 August (8,104 flights) which was a European 2021 record.

Highest daily traffic peak during summer 2021



2021 punctuality (Average ATC delay per flight)



Within this context, France generated 43% of ATC delays in July and 30% of these delays in August in Europe.

The most penalising regulations concerned airspaces managed by Reims and Marseille Accs. This is due to several factors :

- Geographical and temporal traffic distribution, with high daily peaks in some areas. Examples : the Northern Europe-Greece weekend flow; in August 2021, Reims ACC reported 6 days at 25% of 2019 level daily traffic, and Marseille ACC 12 days at 20% of 2019;

- The impact of Covid-19 and safety guidelines for staff;
- A necessary mastery of the capacities to be recovered by operational staff to ensure safe air traffic management at the beginning of the summer.

For major airports, EUROCONTROL observed that, because of the health crisis, "Immigration, Customs and Health" accounted for between 10% and 20% of departure delays "all causes" this summer, depending on the country and airport. This was because health regulations per destination country and the correct combination of tests and vaccination certificates for passengers had to be checked. Before the Covid-19 crisis, this item caused only 1% of delays. In France, arrival delays were the highest at Paris-CDG, Paris-Orly and Nice airports.

No compromise on flight safety

Safety is at the heart of our job, it is our priority. Safety is a constant concern for DSNA staff. But because flight safety must never be taken for granted, DSNA has created a safety culture which is instilled as soon as initial training begins at ENAC and dispensed throughout continuous training.

vigilance, the controller knows how to use good practices to prevent any state of hypovigilance. They practice this sort of situation throughout their training because periods of low traffic can also occur at different times: seasonal highs and lows; adverse weather conditions; or during the middle of the night.

Ensure continued safe air navigation operations

The crisis meant that the DSNA had to adapt its operating methods to carry on its operational duties : maintain systems and facilities in operational conditions; provide an adapted ATC capacity to meet demand; and ensure air traffic controllers' skills.

Paradoxically, low traffic levels do not mean safer flight management: air traffic controllers were faced with new operational situations with a considerably reduced workload for a long period of time, and even sometimes a different workload and flights they were used to managing. When traffic demands alone no longer suffice to maintain increased

Creating a just culture

DSNA is very involved in a continuous safety management and improvement process. This strange period was the opportunity to continue raising awareness of a Just Culture for DSNA staff, which is a vital component to our safety culture. A Just Culture creates a trusting work environment based on continuous safety level improvement. A in-person or online training programme is available to all agents who wish to take it. This means that everyone can apply the principles of a Just Culture as best they can to their daily work.



The DSNA is ISO 9001: 2015 certified until July 2nd, 2024

This certification demonstrates that the DSNA's Safety Management System (SMS) functions correctly and is in line with European requirements.

In Spring 2021, the national renewal audit was successfully carried out, and highlighted the DSNA's resilience during the crisis. The audit praised the efforts made, reflecting DSNA's capacity to adapt to a fast-changing industry.



On an operational level, the lockdown, and the lifting of the lockdown, created high fluctuations in traffic at Paris ACC. Summer 2020 saw an increase in traffic and a structural change with a sustained VFR traffic load, a vast range of aircraft performances, and less frequented routes generating unusual, geographical potential conflicts. Our working methods (shift management, traffic segregation, coordination, and organic controller role) proved to be flexible and efficient for safe traffic management. The Occurrence Notification Forms, which are filled out by controllers for continuous improvement of safety, allowed us to better carry out our missions in this new context."

Isabelle, Paris ACC
Quality & Safety Subdivision Manger

Concrete safety initiatives

→ Avoid similitudes d'indicatifs de vol

JAF2051 et JAF2501, BAW2623 et BAW2653... Watch out for radio mix ups!
 When traffic resumed in June 2021, there was a high risk that similar call signs would be created, whether between flights from the same airline or between flights from different airlines. Even with the help of conflict identification software, the departments in charge of flight planning and call sign allocation had to be careful. A specialist group led by EUROCONTROL provided extensive information to European airlines to fully consider this issue in flight planning.



Similar call signs can be both visual and auditory, with similar sounds.



The BDR tool is available on a tablet and is set up between the radar controller and the organic controller.

→ En-route control: reducing airprox

When the controller authorises an aircraft to descend but a potentially conflicting aircraft is below, the safety net alert is only activated when the cleared aircraft begins its descent. This is too late to avoid an airprox!
 That is why a new safety aid tool called "Safety loop (BDR)" was developed. It takes the controller's or pilot's intentions into account to detect a conflicting clearance with a 3-minute horizon.
 This feature warns the controller with an audible alert that an erroneous clearance has occurred even before the aircraft begins to move. The controller is then able to correct the clearance and avoid an airprox below the separation minima, or by minimising the severity.

The experiment of this new tool was successfully carried out at Bordeaux ACC from March 2020 to March 2021 and enabled the safety study to be validated. The tool has been rolled out at Bordeaux ACC and will be rolled out at Brest ACC, as both these ACCs are equipped with ERATO. This feature will also be available in a more efficient format in the 4-FLIGHT system (p. 44).

→ A fourth position to better regulate controller workload in the airfield circuit

In 2020, the DSNA finalised the commissioning of a Flight Information Sector called "FIS Chevreuse", open from 10 am to 8 pm 7/7. It is managed by the Toussus-le-Noble (Yvelines) ATS unit with a dedicated frequency. This initiative helps to improve flight safety by better distributing the local (LOC) controller's workload and avoiding high traffic peaks in the airfield circuit.
 Smoother traffic means that student-controllers can also progress more quickly and reduce rating time.

The renovated watchtower was commissioned on July 30th, 2020. It accommodates four working positions: Apron, LOC, Coordinator and FIS (right) with modern equipment.



The Air Traffic Safety Bulletin's 40th anniversary

Since 1981, the modernisation of airline fleets, ATC systems and tools, and our advanced knowledge of human behaviour (work methods, human factors, and simulator training) have led to significant technological progress which has helped to accompany the development of even safer air transport. This anniversary edition reflects on the beginnings of DSNA's safety approach and highlights the progress which has been made.

Review continuous training tools for operational staff

It is always a challenge for air traffic controllers to provide a safe control service, with a certain level of traffic, and maintain their operational practice whilst being prepared to handle unusual situations. The health crisis led DSNA, with the participation of ENAC and in agreement with the DSAC (National Supervisory Authority), to put into place new teaching methods to sustain operational staff's skills by accelerating the development of self-learning and computer-assisted learning (CAL) tools, and simulator training.

Staff can connect to the CAL tools 24/7, including off-site, on an e-learning platform which is managed by the DTI and available on all sites, including French overseas territories. The aim is to develop increasingly interactive teaching support tools to simulate HMI and replay, and, in the long term, couple this technology with artificial intelligence to improve practices. For maintenance staff (ATSEP), DSNA is considering using augmented reality to provide training

programmes requiring specific handling and leading to the issuance of licences. Instructors will still play their role in this new environment as they will be able to spend more time with each student to ensure they are acquiring skills. These new training methods have been approved for use in theoretical assessments of operational staff.

As for the simulator offer, in addition to high-technology simulators such as 4-FLIGHT or in Paris-CDG, DSNA has identified simulation tools which are easy-to-operate but realistic, light and standardised. These tools can be used to complement on-the-job training sessions. DSNA is also aiming to increase simulator use in skills testing. This approach also helps to accelerate the initial training period for controllers.



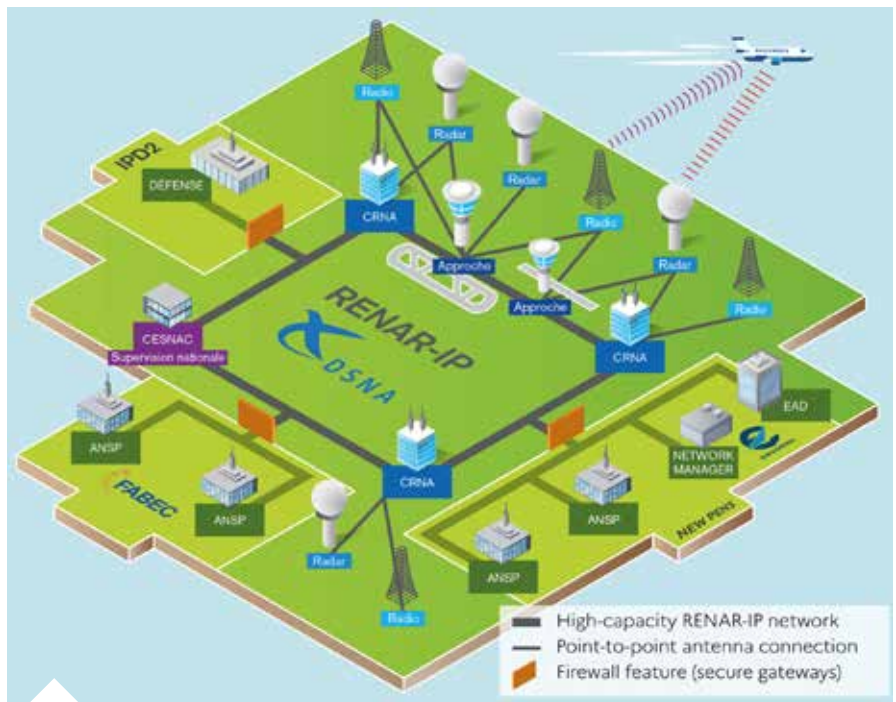
A local simulator in Paris-CDG : the Paris-CDG ATS unit has renovated its LOC simulator to provide training programmes which are as close as possible to operational reality. This new-generation equipment also requires less maintenance operations.

Concrete safety initiatives

→Marseille ACC secures its access to DSNA's secured network

Since 2017, external factors mean that Marseille ACC has had to deal with telecommunications network outages which seriously disrupt its links with isolated radar sites (loss of radar tracks), radio sites (loss of exchanges), and neighbouring control units. Thanks to interventions from Marseille ACC and CESNAC technical service teams, these critical outages have never affected flight safety and operational situations have remained nominal due to redundancy of technical means.

In collaboration with telecoms operator SFR, and despite working conditions complicated by Covid-19, the DTI was able to successfully complete this maintenance and secure two accesses to RENAR-IP (May 2021). This means that an outage in the telecoms network between Marseille ACC and SFR's first connection point will no longer result in the loss of half of the centre's connections because the secure connections will instantly switch to the second access.



RENAR-IP, a dedicated network for DSNA

The RENAR-IP network uses SFR's telecoms infrastructures to ensure data routing between DSNA sites in a secure mode. The network has remained operational despite numerous telecoms network outages. In adverse conditions, the RENAR-IP network routed the data flows without losses via the centralised approaches.

An additional, pioneering flight surveillance project in Nice and Cannes

Since June 30th, 2021, ATS units in Nice and Cannes have been benefiting from a new independent surveillance system called WAM (Wide Area Multilateration). The system - the first of its kind in mainland France - improves radar coverage for helicopter traffic between Nice and Monaco, Cannes' airfield traffic, and airspaces located overhead secondary radars in Nice and Grasse. WAM also compensates for the disturbances caused by the numerous building construction sites around Nice airport, that mask flight radar detection from Italy. Nice's WAM system relies on a network of 18 beacons, 13 of which are shared with the airport's advanced A-SMGCS system which monitors and identifies ground movements. The WAM project is paving the way for complementary coverage systems in mainland France!



To set up the WAM system, it was necessary to identify the sites for the beacons, install the telecommunication networks, deploy the beacons, qualify the entire system, integrate the data to the tools in use, and carry out a safety study.

A brutal and unprecedented impact on air navigation charges

→ A COLLAPSE IN REVENUES

The sharp drop in air traffic generated an unforeseen loss in resources for the DGCA's annexed budget for air control and operations (BACEA): from €1,591 million in 2019, the revenue from air navigation charges (metropolitan and French overseas territories) has fallen to almost €646m in 2020 (-59%) and €777m in 2021 (- 51%).

To help airlines cope with their cash-flow problems, the French government decided to postpone 2020 air navigation charges payments until August 2021 for en-route services (almost €150 million) and until 2022 for terminal services (mainland France: around €50 million, French overseas territories: around 10 M€).

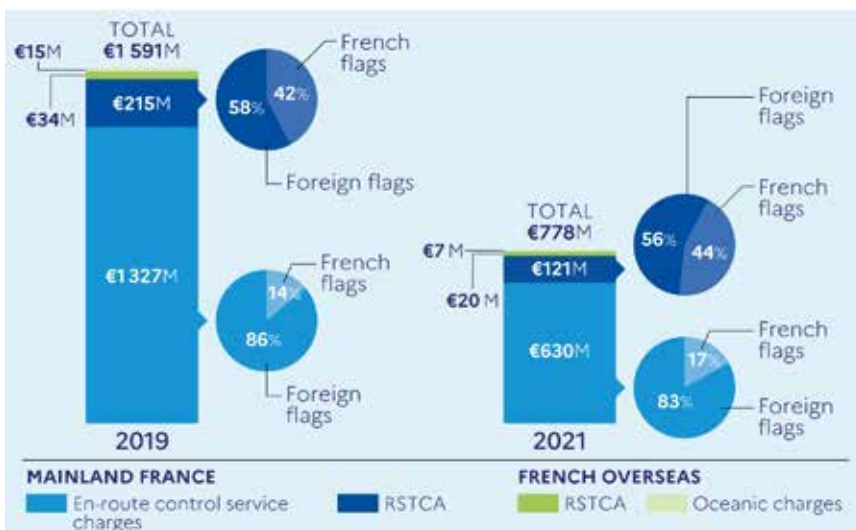
		Number of service units (USD)			Unit rate		
		2019	2020	2021	2019	2020	2021
Mainland France	En-route fee	21,606,671	8,388,235	9,843,111 46%	€ 60.81	€58.69	€58.87
	Terminal areas fee (RSTCA)	1,136,404	495,827	557,105 49%	€ 172.30	€172.05	€173.78
French overseas	Oceanic charges	419,229	273,274	252,640 60%	€ 35.78	€35.78	€35.78
	RSTCA	2,811,667	1,678,484	1,844,695 66%	€ 12.00	€12.00	€12.00

XX% 2021 UDS share compared to 2019 UDS

One service unit for en-route corresponds to ATC services performed on a 50-ton aircraft over a 100km distance. For terminal services, this is calculated starting from the aircraft's average take-off weight.

Revenues other than charges (sales of products and services) decreased from €50 million in 2019 to €24 million in 2021.

Proceeds for air navigation charges



In November 2020, the European Commission and Member States agreed on an exceptional measures regulation for the Single European Sky performance and charging system. Air navigation operators will be able, under certain conditions, to compensate their revenue losses in 2020 and in 2021 through increased unit rates as of 2023 for seven years.

In this negotiation, FABEC States and their air navigation operators played a decisive role in coordinating their actions towards the Commission. These contacts learnt to work together and demonstrated, for this occasion, the ability to communicate quickly and efficiently. Moreover, InterFAB coordination has made it possible to relay these initiatives on a wider scale to European authorities.

→ SECURE MAINTENANCE AND THE MAIN MODERNISATION PROGRAMMES, AND REDUCE EXPENSES

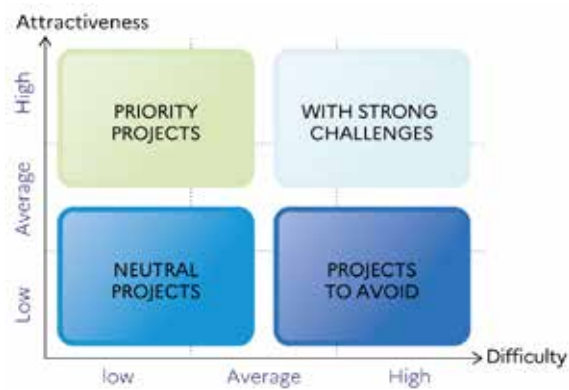
The lack of revenue was compensated by two State loans which matched the extent of the crisis: €1.25 billion in 2020 and €1.1 billion in 2021. For DSNA, these loans meant that maintenance of its infrastructures and systems and its main modernisation programmes, which are vital to the future, were sustained.

In June 2021, given the level of debt, the French Budget and Transport ministries jointly inspected the sustainability of the annexed budget (BACEA). This transparent approach to both public and air transport stakeholders enabled necessary actions to be taken to support the implementation of strategic operational and financial options while pursuing rationalisation and savings efforts (p. 54).

To prioritise projects, DSNA assessed their value and compared their level of attractiveness versus the difficulties. This means that some projects were postponed,

such as updating the N-VCS (for En-route) and CATIA (for approaches) radio systems, and the scalable maintenance of CAUTRA, the current ATC system, that will be replaced by 4-FLIGHT

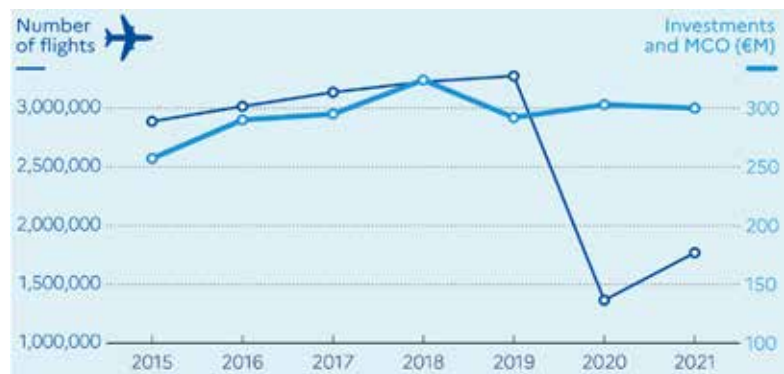
Project prioritisation method



Source : Acadys

In 2019, DSNA invested 44% in major technical programmes, 46% in the maintenance of existing installations and 10% in civil engineering and upgrades to existing systems. In 2021, this represented 44%, 41%, and 15% respectively. Economic measures had to be taken to cope with the crisis, especially for operating costs (highly restricted business travel) and contributions to external organisations (Météo France, EUROCONTROL, Aéroports de Paris, and ENAC, etc.). This crisis also led the DSNA to accelerate the use of new simulators for technical staff continuous training, financed by fungibility between expenditure items.

Investment plan and scalable maintenance (MCO) progression



Expenditure excluding payroll	2019	2020	2021
Contribution to organisations	€217M	€213M	€223M
Investments	€214M	€283M	€268M
Operating costs	€194M	€99M	€86M
TOTAL	€625M	€595M	€577M

Unforeseen changes to work organisation

The highly contagious nature of Covid-19 led European governments to take firm measures to protect their populations : barrier gestures, curfews, and lockdowns were introduced and directly affected how work was organised. However, because every crisis is made up of opportunities, this one resulted in widescale new work organisation methods which gave staff more accountability and empowerment.

To accompany these exceptional measures within the framework of its operator status and guide its actions, the DSNA successively implemented a Business Continuity Plan in March 2020, a post-lockdown Disaster Recovery Plan in May 2020, followed by a further Business Continuity Plan in November 2020 with the second lockdown. These plans enabled DSNA to fulfil its duties and continue its activities. They outlined the good practices of collaborative like videoconferencing for teleworking and specific measures for operational staff, in addition to general measures such as: distancing per roaster; geographical distancing; and partitions for teams. However, for well identified situations, certain employees could be placed on special leave of absence called "ASA".

On a human level, the period between March 2020 and June 2021 was difficult to manage and very uncertain resulting in a strong disorganisation and the gradual loss of professional social codes. In a bid to revive its team spirit, DSNA adapted its internal communications with #Restonsencontact (Lets Keep In Touch) an e-letter to share positive aeronautical projects and give back meaning to agents' work.

Adapt to a new hybrid organisation mode without dampening enthusiasm for our profession

Just like all crises, the pandemic highlighted weaknesses, but it also resulted in innovating, collective organisation initiatives. It accelerated the development of teleworking, a remote-work method which allowed the agents concerned to ensure work continuity. Everyone had to get used to new IT tools to ensure interaction with colleagues, and totally rethink work methods alternating remote and on-site work whilst respecting precautionary measures. The crisis has provided in a wealth of feedback on



The DSNA is proud of all its staff whose professional skills and commitment to DSNA's values enabled French public Air Navigation Service continuity, which is vital to national interest.

teleworking because each individual experienced it differently depending on their personal situation. Broadly speaking, increased autonomy and less commuting time were highly appreciated but remote work needs good practices if work commitment is to be sustained or being able to become used to a new work environment in one's own home or avoiding feeling isolated.

Working at home also means that people have to be able to detach from their personal lives. For young graduates, staff in the process of qualifying, or those just starting a new job, working full-time remotely during the lockdown periods made it hard for them to finish their training or fully settle into a new department.

It is now clear, however, that post-crisis work methods will be more flexible, and remote work will be more common and will have a direct impact on the way we organise our work commutes. The accelerated digital transition has put a lot of pressure on IT departments. Moreover, in times of crisis, more attention must be paid to cybersecurity risks.

Specific measures for operational staff

- In terms of health measures, air traffic controllers' working conditions, whatever the control unit, were reviewed to prevent the virus from spreading. For example, protection measures for agents in the control room led to reviewing the daily actions needed at control positions and each shift changeover: disinfecting each control work position; installing the changeover team at a new position; reprinting paper strips; and disinfecting clipboards, etc.

As for the technical activities necessary to sustain operational conditions for systems and infrastructures, they were carried out with a minimal presence of agents.

- On an organisational level, ab-initio training programmes and job progression (controllers to be requalified) were greatly disrupted and resulted in delays of up to six-months for the delivery of the qualification.

On November 1st, 2020, because of staff overcapacity due to low traffic, DSNA implemented a specific operational reserve



system in the control units to legally establish the situation of air controllers who were not called to the control room or control tower.

In order to make the best use of their skills, short-term secondments were offered on a voluntary basis, allowing staff to take part in DSNA's key technical modernisation or Green Aviation projects.



Spotlight on the manager's job

The health crisis upended management codes and created an overload of stressful tasks for managers. The latter had to develop employee listening skills so that they could foster team cohesion in a hybrid work environment with constantly changing rules..

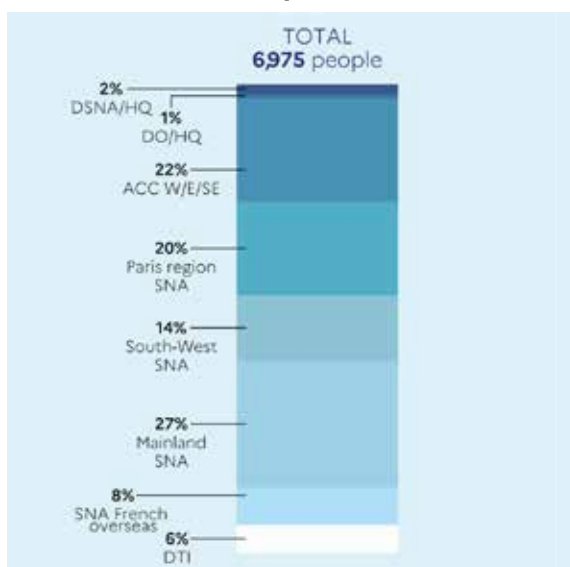
It was impossible to switch off from work during the crisis, which lasted until the vaccination programme rollout! It was hard to respect the right to disconnect given the constant questions about the numerous changes to roasters and the arming of positions (we had to avoid mixing teams and had to split them in two), how to implement the frequently changing health measures, the necessary coordination between shift leaders, and questions from the team controllers. We also had to balance as best we could the number of days worked between agents in a same team. It was tricky, given each individual situation. These difficult moments revealed a lot about our true personalities! ”

Armelle, Tower Team Leader

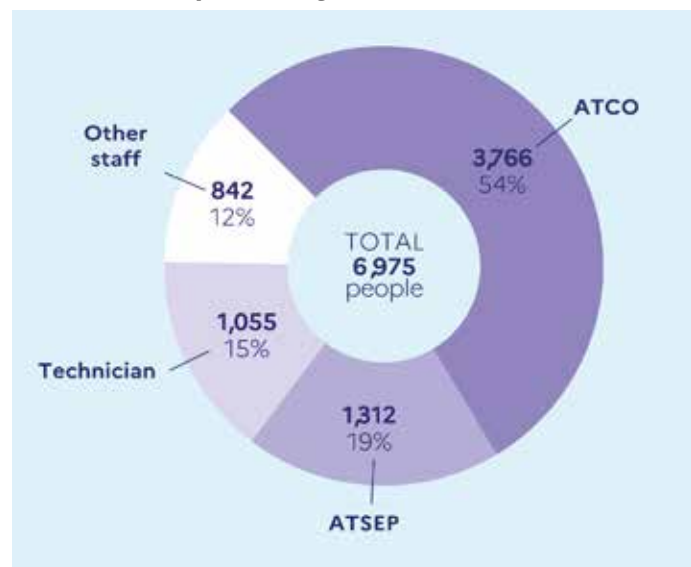
Human resources : key figures Data on 31 december 2021

On December 31st, 2021, DSNA workforce in mainland France and French overseas territories (West Indies - French Guyana, Indian Ocean, Saint-Pierre-et-Miquelon and overseas Pacific collectivities : French Polynesia, New Caledonia, Wallis and Futuna) amounted 6,975 people, with a male-female distribution of 73 % – 27 %. This number is down by 4.3% compared to 2020. 92 % of agents (6,430) worked in mainland France and 8 % (545) in French overseas territories. DSNA provides functional and technical support through agreements for Pacific air navigation services. DSNA manages the careers of three technical bodies: ICNA (ATCOs), IESSA (ATSEPs) and Senior technicians (TSEEAC). It participates in setting the criteria for their recruitment, which is assigned to ENAC. Together with ENAC, DSNA determines the contents and educational objectives of their initial training. DSNA also manages their assignments when they leave ENAC, and the professional mobility of its technical personnel.

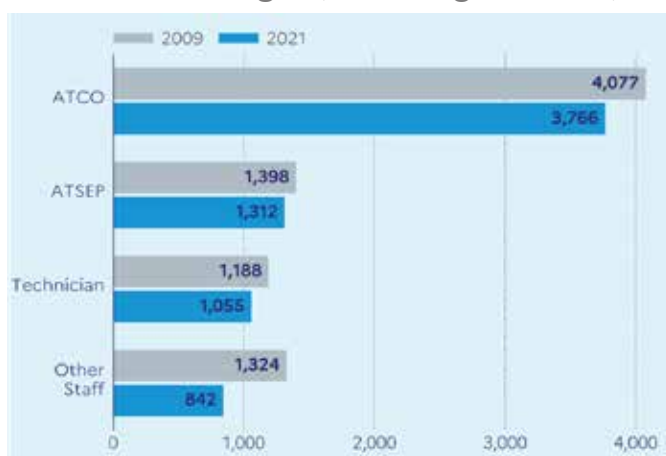
Staff distribution per service



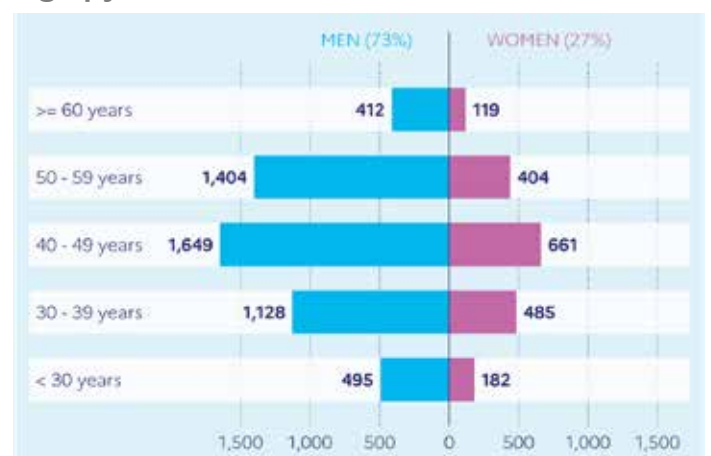
Breakdown per body



Workforce changes (excluding students)

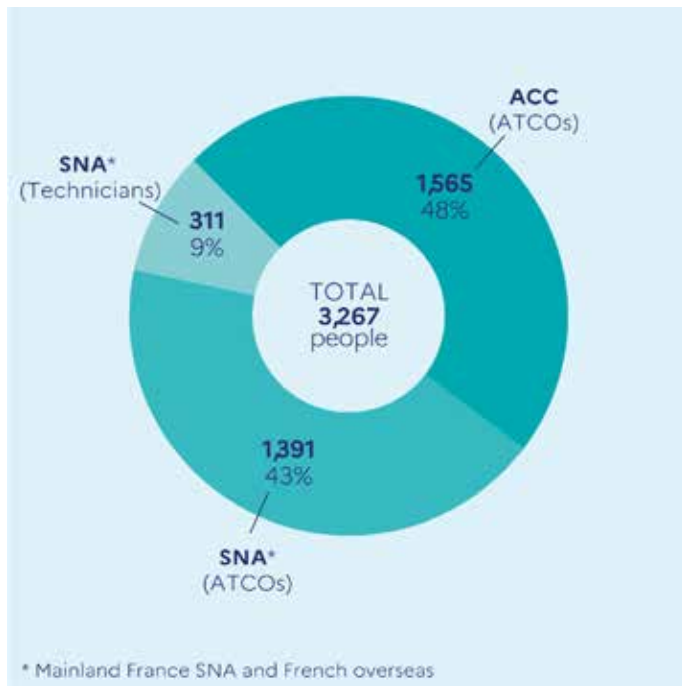


Age pyramid

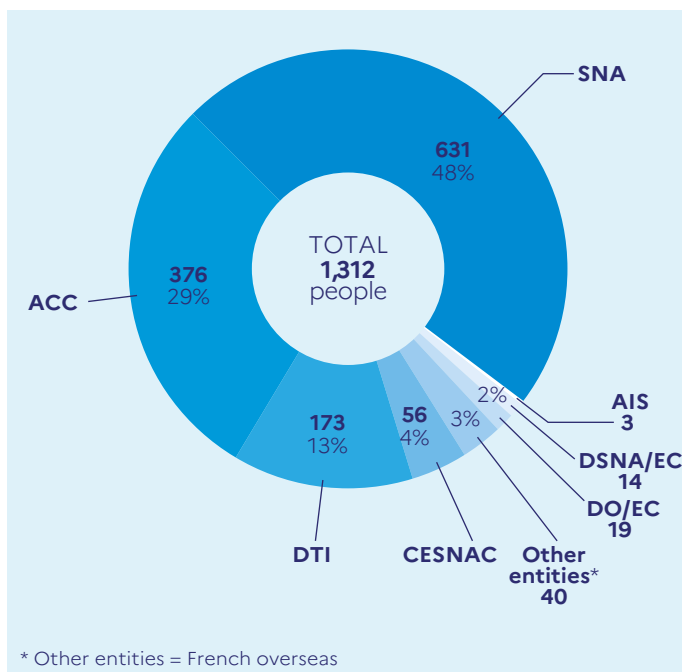


Variation 2021/2019 : -1,012 people

Distribution of controllers holding a valid license per control unit type

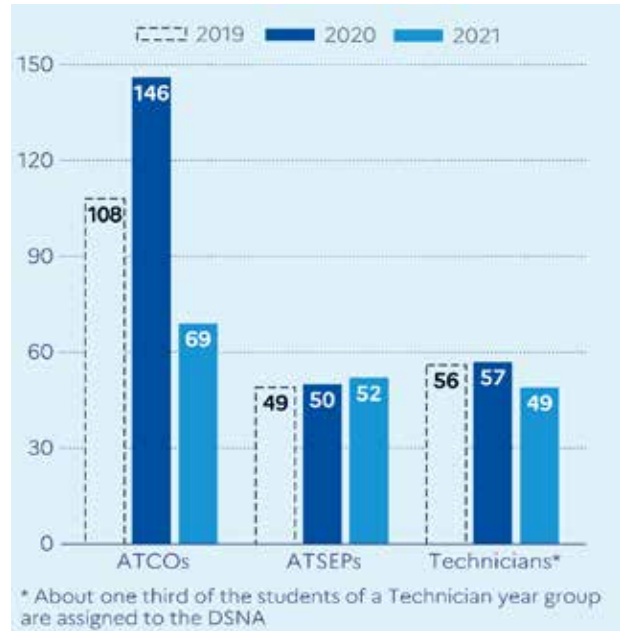


Distribution of maintenance personnel per service and control unit type



Recruitment

Number of ATCOs, ATSEPs and Technicians students in training at ENAC



En 2020, student intake at ENAC was significantly reduced due to the industry crisis. DSNA is promoting forward-looking management of its technical staff to cope with the numerous retirements expected at the end of the decade and considering the time required for their training.



ATSEP measuring the ILS signal on the runway axis at Paris-Orly airport (regulatory check).



PART 2

Main technical and operational **achievements**



To cope with the lack of revenue, DGCA had to take out a State loan of more than two billion euros for 2020 and 2021. This loan made it possible to secure DSNA's key modernisation programmes by prioritising added-value investments. Infrastructure and ATM system modernisation is an important issue, both for France and the European network. These projects reflect DSNA staff's commitment to continuously

improving infrastructures and upgrading ATC tools. During the complicated health crisis context, the successes of these projects generated motivation and pride amongst staff. They clearly helped agents to maintain meaningful work during this time.

Improving infrastructure



→ NEWPENS, THE INTERNATIONAL GROUND-GROUND COMMUNICATIONS NETWORK

Since June 10th, 2020, DSNA's international operational data flows have been migrated to NewPENS without ATC service interruptions.

This new interconnection network between 36 European air navigation operators and the EUROCONTROL *Network Manager* is

geared to meet the new challenges of modernisation, interoperability of air navigation systems, and cybersecurity. It will be accessible to new entrants (airlines, European Defence, and airports). The NewPENS project results from a SESAR solution (p. 52) and is a prerequisite for European air navigation digitalisation.



→ A RENOVATED WATCHTOWER IN TOULOUSE

The former watchtower was established in the 90s and its rehabilitation was necessary, within the framework of the DSNA's operational modernisation strategy. After three years of renovations, the new watchtower was commissioned on September 28th, 2021. Platform visibility has been greatly improved, the Tower Manager position is now facing the controllers and the runways for better situation awareness. Circulation flows within the watchtower have been optimised. This operation is fully in line with the DSNA's environmental objectives to reduce its carbon footprint: refurbished air conditioning; an energy-efficient cold production plant; the switch to LED lighting; and new glazing. A temporary watchtower had to be created underneath the new watchtower and a safety assessment was run so that the renovations could be carried out while maintaining the air control services.

This new watchtower provides us with a more user-friendly workplace and a very good visibility of the platform. It's a real plus for safety! Thanks to our teams' professionalism, the switch from the temporary to the renovated watchtower was safely and efficiently carried out, under excellent conditions. ”

Élodie, **Tower Manager**



→ SATELLITE NAVIGATION : AN EGNOS STATION IN SAINT-PIERRE-ET-MIQUELON

On May 10th, 2021, the DSNA and the European GNSS Agency (GSA) signed an agreement for a European satellite navigation system ground station (EGNOS) in Saint-Pierre-et-Miquelon. This station comes in addition to the Kourou and South Africa ground stations for the triangulation calculation of the geostationary satellite position. This success reflects DSNA's renown in this area.

The European Union's PBN regulation ranks EGNOS as a key contributor for runway accessibility and improved landings safety. As of 2025, the EGNOS V3 programme should provide improved and safe services to civil aviation and new land and maritime users in Europe. It will be the first augmented system (SBAS) to use both American GPS and European GALILEO signals.

→ AN INNOVATIVE SOLUTION FOR RENEWABLE ENERGY PRODUCTION

The SEPHER project, initiated at the Sarlat (Dordogne) pilot site the radiocommunications antenna used by Bordeaux ACC and Bordeaux and Clermont-Ferrand approaches is located, is a daring initiative using renewable electricity from photovoltaic cells and green hydrogen produced directly on site. DSNA selected the Bouygues & Services Group, in partnership with hydrogen start-up Powidian, and the BG Conseils engineering consultancy, to carry out this project.

This new power supply system was implemented on July 29th, 2021 and aims to achieve 75% energy autonomy for a system on an isolated site, to reduce greenhouse gas emissions by almost 60%. The solution has been awarded by the Solar Impulse Foundation, chaired by Bertrand Piccard.

This project is part of the DGCA's commitment to making the aeronautical industry an ambitious one in terms of sustainable development with a zero emissions target by 2050 (p. 40). It also allows France to bring its full expertise to



EUROCONTROL and SESAR's work in coordinating the development of this type of solution within other air navigation operators.

→ CUTTING-EDGE GROUND-GROUND COMMUNICATIONS AT ALL OVERSEAS SITES

The CSSIP project to renovate voice and data telecommunications under Internet Protocol in the French overseas territories was completed in 2021 with installations at all the overseas sites. The project allowed the installation of IP communications dedicated to internal exchanges between the various infrastructures (radionavigation, communications, surveillance) supplying the ATS unit and the central technical service, as well as between the control towers and the central approach service.

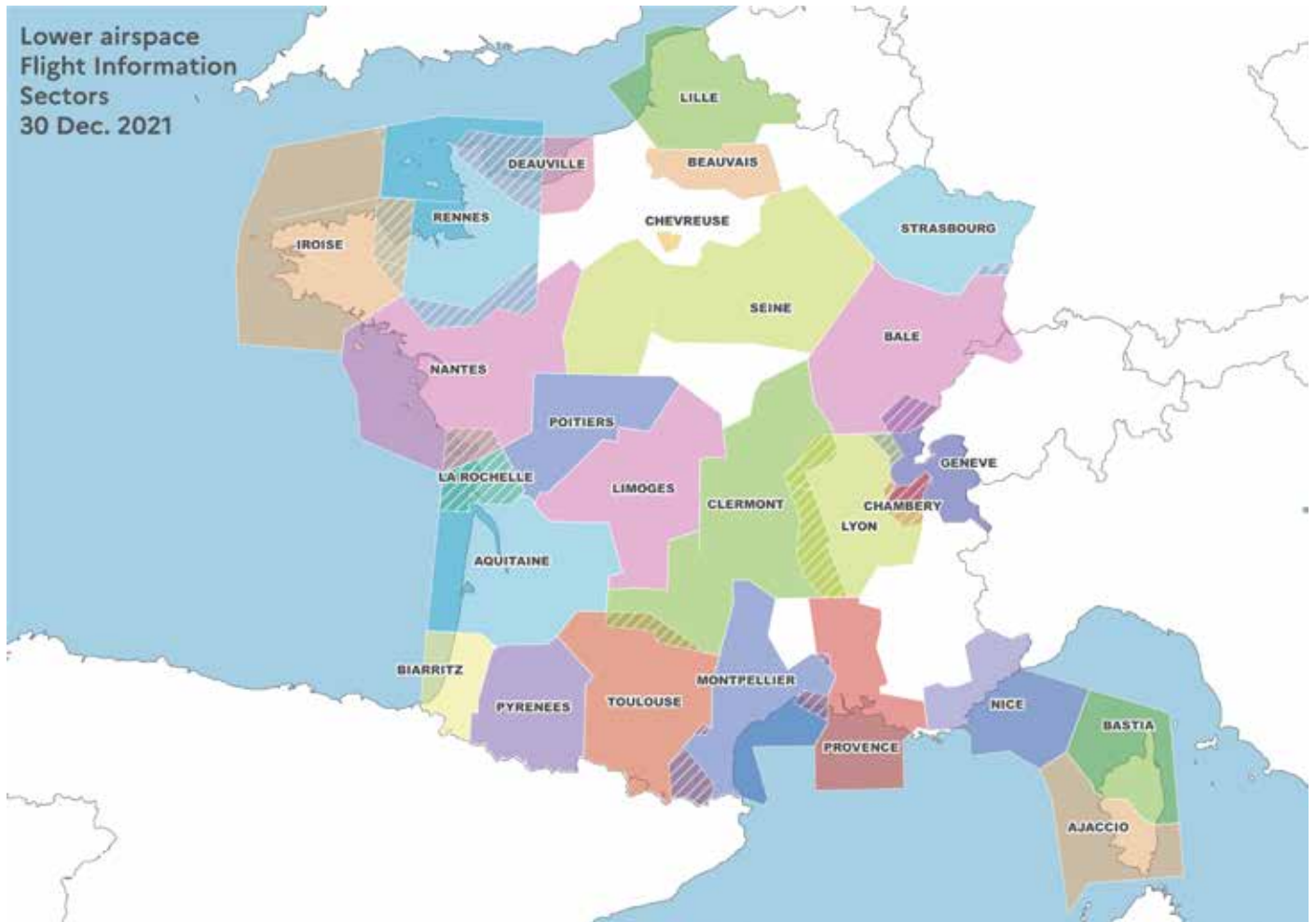
With a cyber protection, this network is a pre-requisite for each SNA for accessing international digital aeronautical links as part of the SWIM (global system for aeronautical information management) rollout.



Ua Pou airfield (Marquesas Islands / French Polynesia).

This modernisation strategy will contribute to better technical integration of control units in the same ICAO region.

Modernising air traffic management



→ AIRSPACE REORGANISATION

On February 25th, 2021, Brest ACC airspaces located in lower airspace, above Nantes TMA, were transferred to the Nantes Approach. This technical and operational achievement is the final phase in both the airspace transfer operations carried out with Brest (November 2018) and Rennes (March 2020) Approaches. This means that Brest ACC no longer has airspace under FL 195 (5,950 metres) outside oceanic sectors. The takeover of Brest FIR's continental airspaces by West SNA allows

Brest ACC to optimise the organisation of its upper airspace and implement Free Route in its eastern area. It also means that the DSN can pursue its strategy for lower airspaces with joint Flight Information Sectors for the benefit of all users and their safety.

Moreover, thanks to this de-capping, arrival and departure trajectories can be optimised in a Green Aviation context with strategically separated flows and more continuous descents operations (CDO).

→ FREE ROUTE, HAS ARRIVED IN FRANCE !

Since December 2nd, 2021, three airspace cells managed by Brest ACC, Marseille ACC, and Paris ACC, covering almost 50% of France's upper airspace, offer Free Route above FL 195. By choosing, initially, to maintain existing entrance and exit points, the DSNA enables its controllers to keep control of traffic flows and ensure high safety level.

This success comes after several years of work, particularly to reorganise airspace and develop technical systems. It required close coordination within FABEC, and with the EUROCONTROL Network Manager, and Computerised Flight Plan Service Providers (CFSP).

Moreover, the Flexible Use of Airspace (FUA) rollout, a prerequisite for

an efficient Free Route, was made possible thanks to excellent collaboration with Defence.

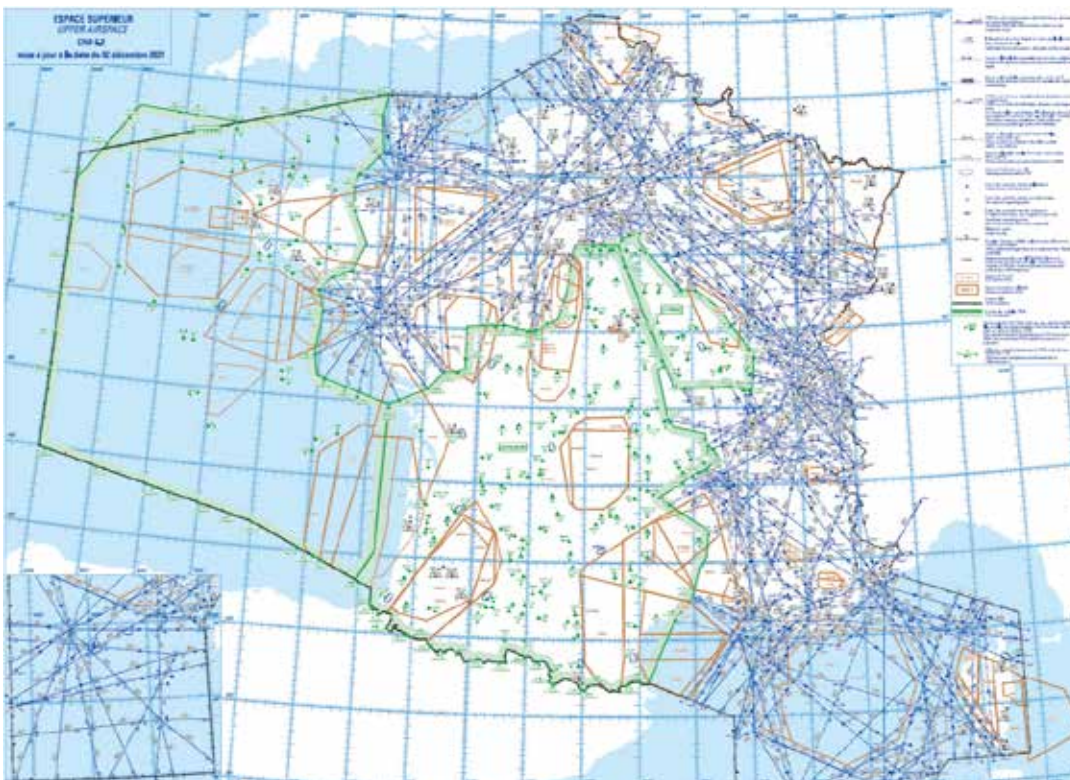
The Free Route, which has been deployed on a European scale, makes it possible to offer the best flight trajectories and aims to ultimately reduce CO₂ emissions by 10,000 tons a day in Europe. That is why this vital aviation decarbonisation project is much awaited.

The Free Route Airspace (FRA) project was initiated by the European SESAR programme. Free Route's full implementation in European airspace, at least above FL 305 (9,300 metres), is scheduled for December 31st, 2025. This will guarantee connectivity with the Approaches and enable direct cross-border planning.



Free Route gives airline companies a broader choice in planning shorter routes and managing their operations. This leads to changes in how air traffic controllers work: they give much less direct route clearances, and only view WayPoints and major traffic flows. The traditional route network no longer appears on their screen.

Free Route is expected to benefit the environment and provide better operational efficiency for airlines.



Free Route will continue to be rolled out in France in 2023 after the implementation of 4-FLIGHT at Reims ACC and Marseille ACC.



→ NICE AIRPORT LABELLED AIRPORT-CDM

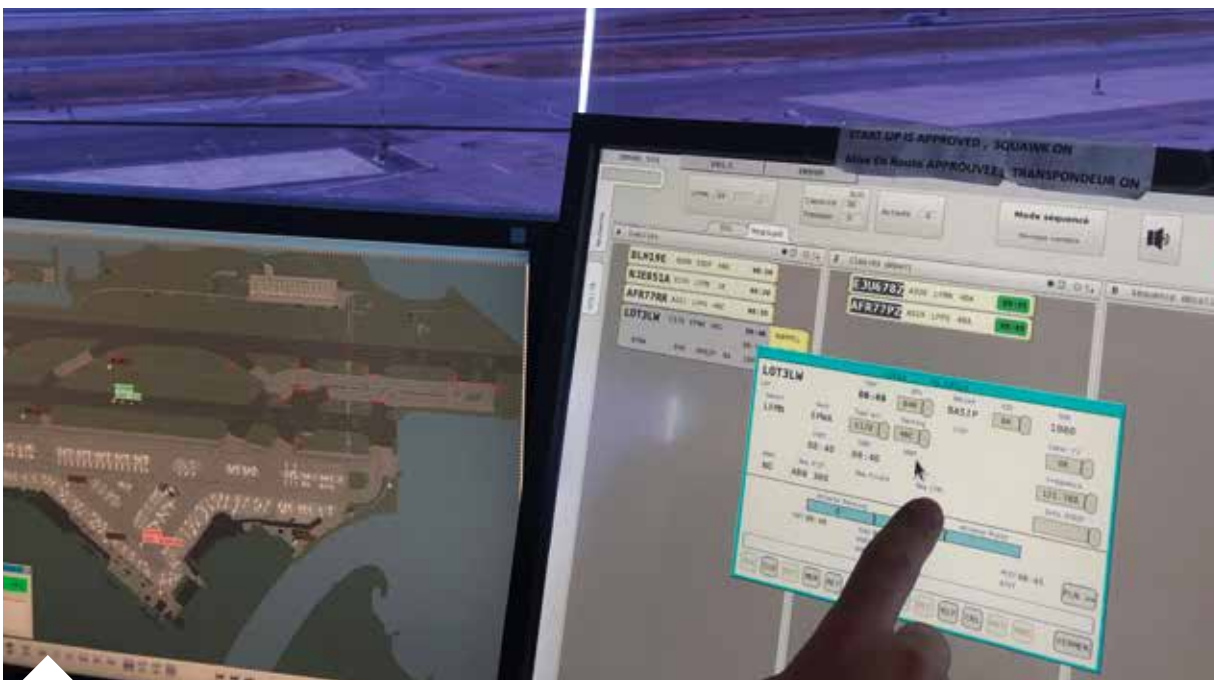
On September 30th, 2020, Nice was ranked amongst the main European CDM (Collaborative Decision- Making) airports. Using advanced tools, the controller can offer optimised and safe apron operations, which enable reduced fuel consumption, improved taxi time and significantly reduced noise on the platform with late engine start-up on departure. In France, four airports have been awarded the CDM label and are now included in the European flow management by the Network Manager: Paris-CDG, Paris-Orly, Lyon-Saint Exupéry, and Nice.

→ THE CDM@DSNA PORTAL

DSNA has extended the CDM (Collaborative Decision-Making) process to all flight phases. To this end, DSNA has developed the cdm@dsna portal, a professional tool which it builds on every year to meet its customers’ operational needs as closely as possible. Users have access to a host of information and a broad view of traffic flow management in France and Europe. They can consult flight lists, flights details, airspaces, and airports. Certain features enable users to analyse the impact of various strategies and assist them in their decision making. The site also provides support for curfew monitoring in Orly and Beauvais and to the French National Airspace Management Cell (AMC) for civil-military negotiations. An interface allowing NOTAM requests to be transmitted has been added.



The cdm@dsna portal has more than 2,000 users.



Nice control tower : DMAN tool for flight sequencing on departure.

“Exchanging this information and the full cooperation of operational players encourages a concrete “network” approach which benefits airlines and passengers and enables efficient operational decisions to be taken. This asset is even more useful in these times of crisis!”

Iacopo Prissinotti, **Network Manager director (EUROCONTROL)**





→ PROMOTE EXTENDED ARRIVAL MANAGER AT MAJOR AIRPORTS

A new advanced version of the AMAN tool for the extended management of arrival flight sequencing, was put into service on 9 November 2020 in Paris-CDG, Paris-Orly, Nice and Lyon. This new version provides controllers with a broader sequence calculation horizon. The next step will be an innovative solution which will combine the MAESTRO sequencer and the IODA HMI to improve flight management in the extended Paris region TMA, managed by Paris ACC. Live trials, as part of the European SESAR programme have shown significant environmental gains, particularly during busy traffic flows.



IODA displays an intuitive representation of arrival sequences up to H-4.



IODA (Innovative Operations for Departures and Arrivals)

DSNA designed this modern tool to optimise arrival flows at major airports. IODA integrates numerous real-time operational data and provides a user-friendly, tactile interface. Thanks to digitalisation, the Flow Manager (FMP) can easily transmit his/her actions to the EUROCONTROL Network Manager and adjacent French and foreign ACCs, and therefore optimise arrival flows in coordination with Approaches. After three years of R&D, IODA was installed at Paris ACC at the end of 2021. It will be an asset for greener arrival flight management at Paris-CDG and Paris-Orly!



Modernising communication, navigation and surveillance systems



Reims ACC: level clearance (FL) given by the controller via Data Link, symbolised by the lightning flash next to the AFR call sign.

→ DATA LINK SERVICE AVAILABLE THROUGHOUT THE UPPER FRENCH AIRSPACE SERVICE

Data Link provides a capacity of ground-airborne data exchange via digital links (CPDLC). In addition to safety benefits, these data exchanges free up radio time: EUROCONTROL currently estimates that 85 hours are gained daily in Europe. In France, Brest and Bordeaux ACCs have been offering a full CPDLC service since 2019 and report that around 75% of the data exchange is for frequency transfers and 25% for clearances (control instructions). Since October 26th, 2021, with the introduction of Data Link clearances at Reims and Marseille ACCs, which needed some considerable developments in the CAUTRA system,

DSNA provides the four CPDLC services required by European regulations throughout its airspace above FL 195 (5,950 metres) with: a service to enable aircraft to be connected to ATC systems; a microphone check service; communication management service (such as frequency transfer to the next control sector); and clearances and information service (flight level, direct routes, heading, and speed clearances).

In addition, DSNA has extended the Data Link service to the interface between an ACC and its major approaches. Since July 16th, 2020, Paris ACC can transfer its frequencies via Data Link to Paris-CDG and Paris-Orly Approaches.

→ A NEW RADAR AT PARIS-ORLY FOR INCREASED APRON MOVEMENTS SAFETY



The control tower has regained its pre-1983 silhouette, without its emblematic cap above the watchtower.

The primary radars for monitoring ground movements are at the core of the surveillance system for any vehicles moving at the airport. From September 21st-29th, 2020, during the airport's curfew and under the supervision of the SNIA, teams from Orly's Technical Department and the DTI replaced the existing radar at the top of the tower with a more efficient radar.

The new radar was made operational on March 2nd, 2021. This operation concludes the technical modernisation programme for covering apron movements at Orly airport. With its more modern technology, this new generation of radars significantly reduces emitted power and operates with maintenance-free, low-noise motors.

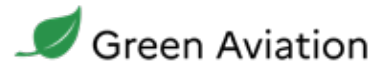


→ NEW BACK-UP RADIO SYSTEM AT PARIS-CDG

This new-generation equipment is the first phase of the N-VCS project (p. 47). It was commissioned in Paris-CDG in the IFR room and watchtower on March 8th, 2021. It provides operational gains in terms of

responsiveness thanks to its HMI ergonomics, robustness, and flexibility via dynamic frequency management allocated to the control position directly from the controller interface. In autumn 2022, a new version will include the security phone and intercom.

→ A NEW PARIS-CDG PLATFORM INFORMATION DISPLAY TOOL



To ensure safe management of apron movements, air traffic controllers need real-time situational awareness of the platform and its operating conditions. To do this, they use a display tool which is frequently updated.

To replace this system's built-in obsolescence, the Paris-CDG operations and technical departments have developed a new innovative tool called MAPS, using the Agile method. Since July 8th, 2021, this tool is used in three Paris-CDG watchtowers and fully meets operational staff expectations.

→ SATELLITE NAVIGATION

By 2030, European airspace's PBN operations will be exclusive for all flight phases, except for precision landings (ILS Cat. 3). By the end of 2021 in France, almost 100% of IFR runway ends still not equipped with precision approaches will have satellite-based approach procedures compatible with the various on-board equipment technologies. The French AIS has published 164 of these procedures, making DSNA the European leader in PBN procedure deployment. In parallel, because DSNA only sustains a minimal network of conventional ground navigation facilities serving regional airports, it can keep maintenance costs low and offer a competitive unit rate for the Air Traffic Terminal Charges (RSTCA).

At the end of 2020, DSNA launched a consultation with airport managers and users to rationalise 43% of VORs and abandon NDBs.



Raiatea airfield (Île sous-le-vent / Polynésie française).

→ NEW ADS-B-BASED SURVEILLANCE SYSTEM IN FRENCH POLYNESIA

In French Polynesia in 2020 and 2021, the French Air Navigation Service rolled out a new surveillance system based on ADS-B to back up an ageing and costly radar. This system based on data exchange between light-weight ground antennae and specific onboard equipment can cover twice as many islands and almost twice as much traffic thanks to a separation of 5 NM (9 km) between two aircraft, at a much lower cost. The full system will be operational in 2022.

→ NEW HYBRID ADS-B/WAM SURVEILLANCE SYSTEM IN NEW-CALEDONIA

Because New Caledonia's local government imposed an isolated situation to keep the region Covid-Free, the French Air Navigation Service team with remote DTI expertise pursued the implementation of Wide Area Multilateration (WAM) in addition to ADS-B based monitoring. Given the lack of radars in this area, this complementary system of surveillance will help to improve traffic display and enhance situational awareness for the air traffic controller, making it possible to reduce position reports by voice. Project updates are underway to consolidate the presentation of this new, much-awaited service.

PART 3



Shaping the future : providing support for the new air transport landscape



In November 2021 the fifth wave of the pandemic spread like wildfire through Europe.

Whilst a future without air transport is unthinkable, it is widely accepted that it is now time to re-think “business as usual” means for the sector. Post-Covid-19 air transport has entered a new era and must meet new requirements, shift to greener aviation, with more economical flights.

Considering these changes, which are also exciting challenges, DSN must transform itself to accompany these structural changes and prepare for its future, by:

- implementing its environmental strategy in collaboration with its customers, users and partners;
- successfully completing its technical and operational modernisation programme on schedule;
- developing its Research & Innovation in a structured way that benefits its strategy and performance;
- by increasing the efficiency of its internal organisation and by adapting to new work methods.

Each crisis brings opportunities: DSN will come out of this unprecedented crisis stronger and will be ready to accompany the gradual and sustainable air transport recovery.

The ecological transition of air navigation

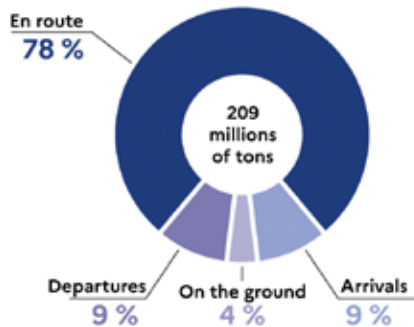
The air navigation sector's ecological transition aims to reduce the impact of aviation on air quality and noise pollution.

This transition is crucial to air transport's sustainability. Each operational player, in each sector, can rely on innovative technology to help ensure this transition which has become even more essential following the slump in activity caused by the global health crisis.

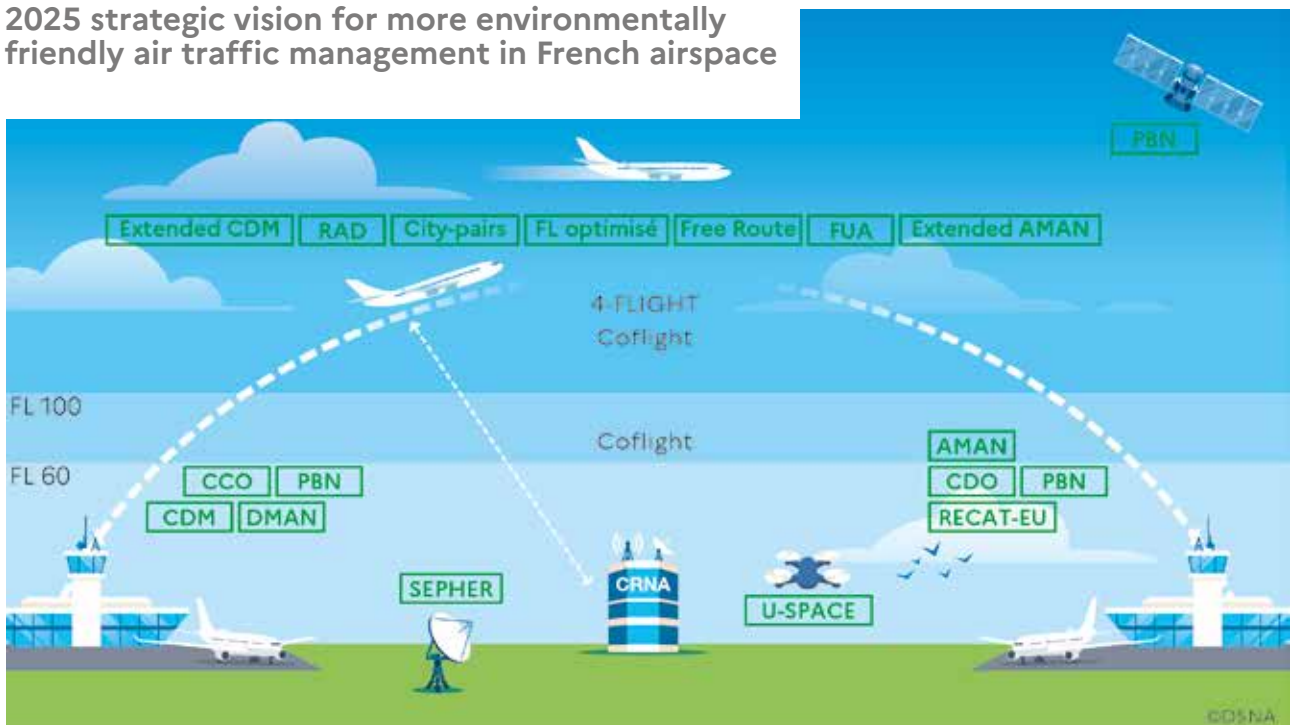
To accelerate the transition, DSNA has made reducing air navigation's environmental impact its key priority, after safety, starting with limiting noise pollution for the populations overflowed below 2,000 metres (FL 60) around airports, and reducing gaseous emissions above 3,000 metres (FL 100). The best compromise between FL 60 and FL 100 is sought.

DSNA is committed to significantly changing its culture to improve the environmental performance of flights and actively participate in the development of greener aviation. Its environmental strategy concerns all flight phases - climb, cruise, and arrival - to optimise flight efficiency along its entire route.

2019 CO₂ emissions per flight phase in the European airspace



2025 strategic vision for more environmentally friendly air traffic management in French airspace



Operational concepts for greener aviation

With levels of air traffic that have become so low, DSNA has been able to test and implement concrete actions to improve descent and climb profiles in the vicinity of major airports, reduce route network constraints, and optimise connections between major cities (*city-pairs*).

DSNA is also developing innovative tools to better measure and visualise environmental performance and fine-tune traffic flow management. Varied and structured initiatives have been launched to build a more environmentally-friendly aviation in France: from Free Route to 4-FLIGHT/

Coflight new ATC tools, new green energy production and storage solutions, to power ground equipment at isolated sites (SEPHER project), and national and European (SESAR) research projects.

On an institutional level, fully transparent dialogue, consultation, and information are the three pillars of DSNA's strategy when dealing with local residents, elected representatives, customers and partners.

2020 and 2021 initiatives



→ Initial training

ENAC focuses on providing a cross-sectional dimension to ecological transition of air transport in its training courses, so that future aeronautical professionals acquire a global overview of the climate and economic challenges within the air transport sector.

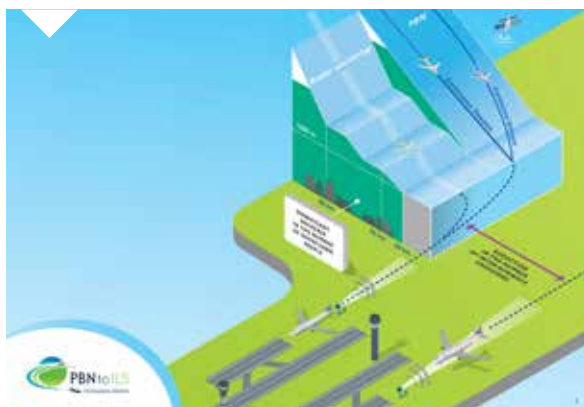
As key player, air traffic controllers receive environment training from the initial training at ENAC and they continue to develop this throughout their career. For example, ENAC has several types of aircraft simulators and this helps to raise students air traffic controllers' and pilots' awareness of flight procedures.



→ Paris-CDG : towards generalised CDOs all day long

To generalise the Continuous Descent Operations (CDO) throughout the day, including periods of dense traffic with high traffic peaks, DSNA must make significant changes to its air traffic pattern. Live trial of the "PBN to ILS" conducted on 756 flights during the first half-year in 2021 has validated the technical feasibility for safety issues and potential environmental gains. The reduction in flight dispersal for an entire year would minimise the number of people overflown under 2,000 metres by 70% and reduce CO₂ emissions by 7% for arrivals.

After having presented these results to elected representatives and residents' committees, DSNA is continuing to work on different scenarios.



→ Promoting dynamic airspace management

The French model of civil-military cooperation in Flexible Use of Airspace (FUA) is very advanced in Europe. This trust-based collaboration minimises the impact of military activity on civilian traffic flows. Dynamic airspace management promotes more direct flights, whilst taking safety and the needs of airline companies, civil airspace users, and military operators into account. The flexible airspace management system was initially intended to reduce delays but also optimises flight trajectories and reduces CO₂ emissions.

Rolling out these best practices in Europe will help to make Aviation greener. The entire aeronautical community is involved in this initiative, because only a global approach will be conducive to achieving these ambitious goals.



→ INTERNATIONAL SCOPE :
« DESTINATION 2050 » ROADMAP

Preparing for aviation’s environmental breakthrough is a genuine challenge! Four key measures have been identified to achieve the zero carbon emissions target in the European airspace by 2050: more ecological aircraft and engines; use of Sustainable Alternative Fuels; decreasing financial support schemes during the transition phase; and improvements in air traffic management and ground operations.

This measure will count for 6% of the reduction in emissions, but the role of air navigation operators will be essential during this transition phase. Significant short-term improvements must be achieved if these 2050 objectives are to be taken seriously by decision makers and public opinion. DSNA’s environmental strategy is fully in line with these objectives.

EUROCONTROL and EASA have defined five pillars to build a greener Single European

Sky by encouraging efficient flight trajectories (more direct routes, more adapted FLs, use of CDOs) and implementing a Close-to-Zero ATFM Delays plan. The traffic recovery challenge will be to maintain these objectives, for as long as possible, because in the current uncertain situation some operational scenarios are still difficult to forecast. For example, when some countries close their boundaries due to pandemic peaks, traffic flows must be re-routed, which means implementing tactical, fine-tuned measures to minimise delays.

In response to the European Commission’s concerns, FABEC has strengthened its environmental strategy and set up an Environment Standing Committee. In 2020, direct routes in FABEC airspace optimised 68 million kms of trajectories compared to filed flight plans. This is a savings of 204 million euros for airlines and a 1.4 million-ton reduction in CO₂.

FABEC now is well recognised on the international stage and won the 2020 ATM “Research, Innovation, Environment” award for its various achievements within the FABEC airspace: Free Route and advanced flexible civil-military use of airspace (FUA); the lifting of route restrictions offering shorter routes with optimised vertical profiles (continuous descents and climbs); and better flight efficiency in the horizontal plane than flight plans.



In 2021, DSNA communicated widely, including internationally, about its environmental strategy, by publishing a leaflet in French and in English. DSNA also made a presentation at the FABEC Ops Theatre at the international air navigation exhibition (World ATM Congress) in Madrid on October 26th.

On September 21st and 22nd, 2021, the DSNA took part in “Pioneering Sustainable Aviation”, a global conference organised in Toulouse by Airbus. With this initiative, Airbus wanted to bring together, and promote, the numerous innovative initiatives of all actors and create impetus for the aeronautical sector



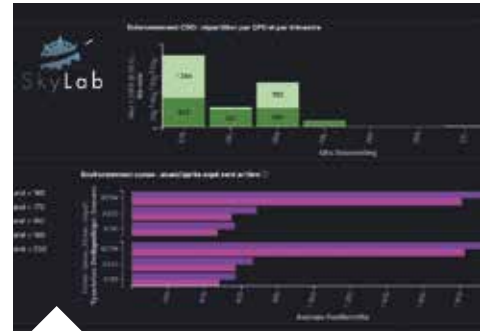
2020 et 2021 initiatives

→ SkyLab, an innovative tool to drive operational performance

This tool, developed by DSNA, automatically records numerous data related to Air Navigation Services.

It was commissioned in Paris-CDG in November 2020 and presents a series of safety, environment, capacity, and meteorology performance D+1 indicators. This information makes it possible to better understand the operational situations experienced, and the impact of decisions taken, and to lead various studies which meet needs as closely as possible.

Environmental performance is assessed by continuous climb and descent (CCO and CDO) use rates, aircraft transfer altitudes in the airspace managed by the Paris-CDG Approach, adherence rates on night approaches, compliance with procedures, fuel consumption, and CO₂ emission reduction balance sheets.



Paris-CDG : a SkyLab (post-operational tool) dashboard extract.

→ New high-environmental performance aircraft

The Covid-19 crisis greatly penalised old generation long-haul aircraft and has paved the way for more economical, single-aisle, aircraft with a lower environmental footprint. This is how the A321neo became a great commercial success. Its future very long-range version will be able to operate 10-hour flights, which until now were only operated by wide-body aircraft which are harder to fill.



In 2021, Airbus delivered 611 aircraft to 88 customers and received 771 orders. These encouraging results reflect airlines' new post-crisis strategies.

ATR, the regional French-Italian manufacturer, proved its robustness in 2021 with 29 firm orders from several airlines.

With its new-generation 40 -and 70- seats turboprop aircraft, ATR offers more eco-responsible regional mobility: 40% less fuel consumption than a similar jet, compatible with Sustainable Alternative Fuels, and 20% reduction in maintenance costs.

Covid-19 crisis led the European Union and France to accelerate studies to develop alternative fuels to fossil fuels (kerosene). As far as hydrogen for aviation is concerned, its carriage requires new technologies and equipment, and adapted facilities must be implemented on a global scale. For this vision to become reality, these decisions need to be validated by 2035!



Airbus and Dassault design high environmental performance aircraft, with their A220 (100 to 150 seats), A321neo (170 to 200 seats) and Falcon 10X Ultra-Long range business jet programmes.

DSNA's major modernisation programmes

→ MODERNISING ATM SYSTEMES



MAINLAND FRANCE

The 4-FLIGHT air traffic management (ATM) system for en-route and the SYSAT ATM system for towers and approach control centres will provide a new vision of ATM in France.

By integrating the Coflight advanced flight data processing system, these new-generation systems will deliver high-level operational performances promoting safer, smoother, and more eco-responsible air traffic. The European Union has recognised the benefits that these key innovative programmes will also bring to the European network and thus, has co-funded part of these investments. In January 2021, a director was appointed to strengthen the coherence of these complex programmes.

• 4-FLIGHT : a DSNA priority and collective commitment

As pilot-sites, Reims and Marseille ACCs will be the first centres to be equipped with this innovative stripless system, one of the most advanced in Europe. 4-FLIGHT was designed by DSNA and Thales, a worldwide company leader in air traffic management tools. It includes an advanced flight data processing system (Coflight) which updates flight plan

information in real-time, by taking ATC clearances into account, and optimises flight trajectory.

On the technical side, both pilot centres have pursued their operational tests on real traffic in secure mode (UOP) with more complicated situations, for several hours. These UOP, which require months of preparation, allow technical adjustments to be made and new work methods to be defined. They are an important part of the 4-FLIGHT development process and allow for operational staff to become familiar with the new system. In 2021, DSNA approved the target architecture and the basic features needed for 4-FLIGHT's implementation (required levels of reliability, redundancy, performance, and endurance) and ensured good connections with the CESNAC FDO (Flight Data Operator) terminal, EUROCONTROL's iFPS (Initial Flight Plan Processing System), the systems of adjacent centres and Approaches as well as with that of Defence. On the training side, it was necessary to provide extensive, quality training programme to some 600 civilian air traffic controllers from both pilot ACCs, military controllers, and maintenance engineers while carrying out day-to-day missions. Organisation like this had never been seen before!

After 10 years of studies and numerous assessments, DSNA is fully committed to implement 4-FLIGHT in 2022 in Reims and Marseille ACCs. An exchange process with airlines and the Network Manager (EUROCONTROL) was initiated to minimise the impact on air traffic flow. This ambitious project reflects DSNA's collective capacities!



4-FLIGHT : a Marseille ACC controller gives a Data Link route clearance.

More than just a job: Marie-Elisabeth PALLISER (DTI) tells us more...



4-FLIGHT validation team at the Directorate for Technics and Innovation (DTI).

How would you describe your job in three words ?

Strategy, coordination, and challenges! My workday is punctuated by defining validation strategies for the various 4-FLIGHT versions in the operational context. The tests are run in coordination with Thales, pilot sites, Paris ACC, the Approaches, but also French and foreign adjacent centres (this is known as an "integrated context"). The challenge is to organise these validations within a constrained timeframe with limited resources.

What is your favorite part of your job?

Working with the motivated teams in charge of this project. They are able to continuously adapt and find solutions!

Has there been a memorable moment since you were appointed ?

A successful operational test is a great source of pride because it means long hours of validations and investment from multi-site and multi-disciplinary teams.

Servicing the Paris region is also an important stake for 4-FLIGHT. Paris ACC has been involved since the development phase of the new system. The teams are already preparing a new version which will integrate the 4-FLIGHT implementation at Paris ACC, scheduled for winter 2023. By the end of 2021, Paris ACC had completed the urbanisation of its operations room, installed technical racks, and prepared the first training programme sessions (4-FLIGHT simulator settings, and exercises).

Until 4-FLIGHT is rolled out in the five ACCs, French air traffic management will rely on two systems: 4-FLIGHT; and the current CAUTRA system. This transition phase means adapting CAUTRA and implementing prerequisites such as migrating the air navigation systems to IP (Internet Protocol), installing new-generation S-mode radars, and supplying the Approaches and military control centres. In this way, DSNA regularly invests in CAUTRA's technical renovation so that the system can provide the service in line with the required safety and performance standards until it is fully decommissioned.



In 2020 and 2021, CAUTRA has, for example, evolved to meet regulatory European (Data Link, Free Route) and cybersecurity requirements.

• **SYSAT, the future ATM system for Approaches and Towers**

Main Paris airports

At the end of 2021, DSNA and industrial consortium SAAB-CS agreed that the industrial offer could no longer be provided in Paris-CDG and Paris-Orly at the time. As a result, it was decided that SAAB-CS would focus solely on eTWR@ORY (a new-generation ATC system in electronic environment) and its simulator. The aim is to implement these projects before the 2024 Paris Olympics Games, in the summer, by

using SAAB's iATS system which is already operational at other similar airports (Dublin, Stockholm, and Istanbul). A new roadmap is being drawn up to this end. The work already carried out to interconnect the iATS product to different DSNA tools, and to use a test platform to familiarise air traffic controllers with the new tool, are significant achievements. In 2021, the Orly control unit began extending the technical block which will house the racks, simulator and new IFR room. For Paris-CDG, given the end of the project with SAAB-CS, the systems modernisation is being continued as part of the scalable maintenance (MCO) contract with the manufacturer INDRA. The technical prerequisites have been launched and the ground monitoring system should be secured by summer 2024.

Regional airports

Concerning the other 69 French mainland airfields, a new scenario was introduced at the beginning of 2020 based on a service-oriented, open, and modular architecture. The activities focused on prototype technical feasibility for the following services: the new-generation ATIS (automatic information service in TMA); HMI General Information; the coordination between central approaches and towers; and the future Coflight flight plan processing system for approaches and towers at regional airports.



SYSAT simulator technical maturity assessment at the DTI in 2021.



Sharing local data in a centralised architecture. In November 2021, the first demonstration of general information display on the operational status of the site based on the Minimum Viable Product (MVP) was a success. For example, the Lyon-Saint Exupéry controller was informed, without phone contact, of Lyon-Bron (LFY) and Grenoble (LFLS) site operation status.



SEAFLIGHT simulator for West Indies-French Guyana in Pointe-à-Pitre.

Guadeloupe : the introduction of new electronic stripping-based work methods meant in-depth and progressive training programmes for air traffic controllers and justified the implementation of a 3D display simulator. These changes also affect the BRIA (Regional Office for Aeronautical Information). The safety study was restructured to bring it into line with new 373 regulations.
Martinique : the rollout was launched, given that the system had become more robust.
Guyana : the Cayenne Oceanic Control Centre's CACAO 2 system was given a hardware and a software upgrade. The use of Data Link in an electronic environment was a solution to solve the difficulties associated with poorly audible HF communications.

FRENCH OVERSEAS TERRITORIES

• **West Indies-French Guyana SEAFLIGHT**

This project to modernise the ATC system for the major West Indies-French Guyana SNA airports (Pointe-à-Pitre, Fort-de-France and Cayenne) carried out with the company ADACEL is planned to be implemented at the Guadeloupe pilot site in 2022. It must meet oceanic control, procedural control, and radar guidance control needs. With its latest features, SEAFLIGHT will increase flight safety and considerably improved coordination and data transfers with adjacent regional centres.



→ MODERNISING COMMUNICATION SYSTEM: THE N-VCS PROJECT

With the New Voice Communication System (N-VCS) project for the five ACCs and Paris-CDG, DSNA in collaboration with the industrial company Frequentis is pursuing its work to upgrade the main and back-up radio and telephone systems. This new-generation, safety-critical system offers important evolutions, such as voice for RENAR-IP (VoIP),

and radio/telephone interfaces at a single station for operators.

The main system has an architecture with a high level of overlapping. The back-up system will provide a functional level very close to the main system, which will be a considerable improvement in its operational capacities.

Brest ACC, pilot site

Installation works in the technical room were completed at the end of 2020. Technical and operational tests began during the second half of 2021. The first live trial in secure mode (UOP) was successfully carried out in December. the full N-VCS (main and back-up) system is planned in 2023 .



“Beyond the installation of a new system, the N-VCS project is also a new operator network for radio communications, a new supervision, a new room management tool, and a new recording system.”

Yann, **CNS Unit Specialist (Brest ACC)**

→ MODERNISING INFRASTRUCTURE

New technical block in Marseille

The contract for the first phase was awarded in November 2021. This extension will provide a 240 m² approach room and a 750 m² technical platform including a room for parameterization, a technical room to house the new racks linked to the modernisation of the systems, and a supervision room. The civil engineering deliverable is planned for the first half of 2023.

An important Indian Ocean SNA civil engineering project

In La Reunion Island, a multi-annual budgetary commitment authorisation was granted to put into service a new control tower and its technical unit. The funds cover the new infrastructure construction and technical system installation.



Research & innovation for optimising performance

Research & Innovation is part of DSNA's DNA. It was necessary to review objectives so that the projects could bring their full value to DSNA's strategy and benefit its customers, users, and new entrants. In the new post-Covid context, ATC will accelerate its digital transformation to better meet the needs of aviation and its territorial connectivity, and fully ensure its role in the ecological transition of air transport. These significant changes will generate structural technological developments. Innovation is therefore necessary both for projects with short development cycles and for major, safety-critical projects, respecting deadlines. It is also essential that this approach be part of the various aeronautical innovation bodies.

→ A DSNA-ENAC PARTNERSHIP FOR INNOVATION

This new partnership was made official on January 6th, 2021. It will lead to better structured initiatives from both entities for more efficient collaboration and tool sharing. It will also make DSNA and ENAC's actions more visible on the international stage.

The first collaborative projects dealt with safety (Bordeaux ACC safety loop p. 19, voice recognition p. 49) and the processing and the visualisation of flights for educational purposes (p. 9).

→ CORAC

CORAC, a public-private consultative body, chaired by the Minister for Transport, is responsible for guiding and financially supporting French aeronautical research on the environment, safety, and competitiveness. Three main areas to decarbonise aviation have been identified: electric aircraft, hydrogen aircraft, and optimised flight operations. DSNA brings its professional expertise to the study of innovative solutions, such as the WER project for the technical feasibility of civilian flights flying in formation.



Green Aviation

The WER (fello'fly) project aims to make long-haul civil aircraft with equivalent performance fly in formation for better environmental performance in an airspace where ATC does not need to separate traffic by frequent requests for changes in heading or flight level. The physical principle of formation flying uses the vertical component of wake vortices to provide additional lift to a following aircraft. The two aircraft must fly at the same speed thanks to automatic on-board computers.

The project is led by Airbus in partnership with EUROCONTROL and French (DSNA), English (NATS), Irish (IAA) and Canadian (NAV CANADA) air navigation operators, and the airlines Frenchbee and SAS.

In November 2021, Airbus carried out the first long-haul formation flight demonstration with two A350s. The aircraft were three kilometres apart in transatlantic airspace and flew safely between Toulouse and Montreal. For the east > west leg, Brest ACC's mission was to bring the pair of aircraft on to the same route, at the same speed, but separated by 1,000 ft. More than six tons of CO₂ emissions were saved during this trip: this confirms the potential for fuel savings of more than 5% on a long-haul route.

The next step is to certify this new operational concept.





Inauguration on November 22nd, 2021 by Jean-Baptiste Djebbari, the French Minister Delegate for Transport, of the AIT's civil branch located at the DTI (Toulouse).

→ THE INNOVATION AGENCY FOR TRANSPORT

This agency (AIT) was created on April 8th, 2021 to foster an innovation culture within the various services of the French Ministry for transport, federate national initiatives, and extend collaboration to all modes of transport. The AIT is jointly supported by DGCA and Defence and will thus accompany the implementation of projects to invent future "green" transport. Amongst the projects selected by the AIT, DSNA is supporting SEPHER (p. 31) and ACROPOLE (p. 49).

The AIT is supported by two branches, responsible for promoting synergies and driving innovative initiatives within a dedicated creative space. Within the DGCA, the AIT's work is coordinated by the French Civil Aviation Technical Department (STAC).

→ THE SESAR PROGRAMME, TECHNOLOGICAL PILLAR OF THE SINGLE EUROPEAN SKY

The aeronautical community must learn to think globally, not just at each individual player level. This is the ethos behind the innovative, public-private, SESAR partnership, made up of all the players in the sector, in charge of promoting and implementing this approach. The SESAR programme aims to modernise the European ATM system by developing new operational concepts in a new-generation technological environment. After analysing the maturity of the assessments led in simulation or on real traffic in secure mode, the new operational concepts become "SESAR solutions". They particularly help reach the objective to reduce the environmental footprint of air navigation by 10%. The DMAN, AMAN/E- AMAN, PBN to ILS, and Free Route projects, all implemented by DSNA, are the results of SESAR solutions. Within the framework of the current phase, called

"SESAR 2020", DSNA is taking part in 20 projects which represent €11.7

million of the total eligible budget. Some "SESAR solutions" are part of the CP1 (Common Project 1), a European regulation published in 2021 in replacement to the PCP (Pilot Common Project). Its implementation is steered by the SESAR Deployment Manager (SDM), which will be replaced by a new structure in 2022. The PCP/CP1 implementation is also financially supported by the European Union.

DSNA at the core of the new European ATM Research & Innovation programme.

As part of Horizon Europe, its new Research & Innovation programme, the European Commission has initiated partnerships in different strategic areas, including ATM. These partnerships were defined in a European regulation which was passed on November 19th, 2021. Two of them concern aviation: Clean Aviation and SESAR 3 JU. In the ATM partnership called SESAR 3, DSNA has a founder member status. To make ATM more resilient to traffic fluctuations and render the

Single European Sky an efficient airspace open to all aircraft, and environmentally friendly, SESAR 3 is built on the recommendations of the Strategic Research & Innovation Agenda (SRIA) published in 2020. The SRIA is the result of collaborative work with SESAR JU members. The document provides a work programme for the period 2022-2030 and foresees exploratory research actions, industrial research, and demonstrator networks for each theme. This is major evolution compared to SESAR's 2020 activities. The first SESAR 3 call, co-funded by the European Union, was published in September 2021. It focuses on two themes: U-space and Urban Air Mobility, and Aviation Green Deal..





New operational concepts under study

→ Ground-ground systems interoperability (IOP)

Air navigation systems interoperability in Europe is an enabler for reducing discontinuities at borders. This second validation exercise took place in June 2020 with the participation of DSNA and its partners (companies Indra, Leonardo, and Thales, and its

counterparts DFS, ENAV and MUAC). A total of 233 flights have been simulated across the seven participating en-route centres: Geneva, Karlsruhe, Maastricht, Milan, Padua, Reims, and Zurich. The results showed that the IOP solution provides improved better situational awareness and makes operations more seamless.

→ Optimising flight environmental performance

The ALBATROSS project led by Airbus aims to generalise the following in European airspace as soon as possible :

- More fuel-efficient (and, therefore, less polluting) flights by taxiing with one engine (or with a taxibot) or by cruising at an optimal flight level;
- Less noisy flights thanks to continuous climb and descent trajectories, avoiding level changes, and optimising speed.

At the Airbus Summit for sustainable aviation on September 21st, 2021, an Air France A320 operating the Paris-CDG > Toulouse route was the very first ALBATROSS flight out of a series of 1,000 flights scheduled in Europe until the end of 2022. The challenge for ATC will be to optimise these procedures in dense air traffic throughout the European network without penalising other flights.

The mature solutions resulting from these very large-scale demonstrations can be implemented for the short-term. This

→ Improving aircraft trajectory prediction for ATC

The ADSCENSIO project led by DSNA and with the support of Airbus, aims to build future European regulation on ATC needs to display aircraft trajectory profiles and alerts if there is inconsistency with the flight plan.

Live trials will be carried out in 2022 based on the use of ADS-C EPP (Automatic Dependant Surveillance Contract Extended Project Profile) data.

The ADS-C data from the Flight Management System (FMS) predictions relate to the 4D trajectory, start and end cruising points, estimated times on waypoints, predicted descent speed, etc. It will give controllers a more accurate view of the aircraft's optimal trajectory. A tool like IODA (p. 35) will display the most useful information.

Eight air navigation operators, including Paris and Reims ACCs for DSNA, will take part in this exercise, with Air France, easyJet, British Airways, Iberia, Wizzair and Novair aircraft already equipped with ADS-C technology.



ambitious project reflects European air navigation service providers' commitment to ensuring an efficient ATM ecological transition!





→ A COLLABORATIVE AND INNOVATIVE APPROACH

France is very involved in the gradual development of U-space to safely introduce drones without reducing capacity, while respecting the environment and privacy. DSNA and Defence have launched innovative partnerships with industry which are now jointly managed by the Transport Innovation Agency (p. 52) and the Defence Agency.

Minimum Viable Product (MVP) tests are currently being carried out in a dozen controlled airspaces around French airports with selected manufacturers. The purpose is to evaluate, in an operational environment, platforms providing U-space prefigurator services, particularly "geovigilance" (a tool detects forbidden geographical positions and alerts the drone operator) or "collaborative interface with the ATC" (authorisations to enter controlled airspace are managed electronically). The initial results have confirmed the expected benefits for drone mission simplification and preparation time. They also show that current platforms need to be adapted to the national operational and legal environment.

In 2022 the scope of these tests should be extended to all control units and low altitude airspaces to investigate more complex operational situations such as drone flight conflict detection, drone tracking, and drone flights in non-controlled G-class airspace.

On a European level, a U-space European regulation was adopted in April 2021, a very useful step in integrating new urban or low altitude airspace air mobilities.



An air traffic controller in Lille testing a solution.

→ LIVE TRIAL OF DRONE INTEGRATION IN CONTROLLED AIRSPACE AT MEDIUM ALTITUDE

DSNA, the French Air Force, and the French State Aeronautical Safety Directorate (DSAÉ) are carrying out tests on integrating MALE (Medium Altitude Long Endurance) drones in an IFR GAT environment in a non-segregated airspace.

On May 19th, 2020, for almost three hours in light traffic and in coordination with the military control units, Bordeaux and Marseille ACCs controlled, in class D airspace at least, an Air Force REAPER drone, without specific equipment between FL 145 (4,400 metres) and FL 230 (7,000 metres). The flight analysis showed

that the drone was able to follow its flight plan and make tactical changes when, for example, the controller cleared a heading or direct route change. This exercise continued with a cross border mission to Spain in December 2021.

These initiatives make France a European forerunner in facilitating the implementation of the European MALE programme and contribute considerably to developing the recommendations issued at the international level.



REAPER drone taking off from the Cognac military air base.



The first public aeronautical information mobile app

In December 2021, the French AIS deployed the **SOFIA VAC** mobile application in Apple Store. This was a major step for DSNA in digitalising of aeronautical information distribution. The application was developed in collaboration with future users (pilots and aeroclubs) and provides updated and geo-localised aeronautical data on mobiles. SOFIA VAC is intended to be used for flight preparation. The digital data used for this new service comes from NOPIA, the new aeronautical information production tool. The graphic restitution is based on the IGN's interface and on a web services platform developed by the AIS with technical support from CESNAC.

The European Commission has welcomed the virtualisation of technical ATC systems as a major technological driver in defragmenting the Single European Single Sky. With digital technology, DSNA is offering new virtual services as an ATM Data Service Provider (ADSP).

→ COFLIGHT CLOUD SERVICES (CCS)

With the CCS project, DSNA, ENAV and Skyguide are testing a pioneering remote flight plan processing initiative to provide a 4D trajectory service based on the Coflight product and rolled out in a Cloud architecture with standardised interfaces. CCS is a promising solution for air navigation operators' operational needs in terms of infrastructure rationalisation, resilience, and flexible airspace management.

In July 2020, DSNA and ENAV launched the first service agreement with Skyguide. The CCS project has entered phase two given that the provision of services in Skyguide's ATM environment for the Geneva control centre (Virtual Center) was successfully assessed in 2021. This phase will provide new features for the Swiss operator with an extended "technical integration service" and an "initial validation service" based on a dataset representing the Swiss airspace.

→ DIGITAL ADVANCED TOWER (DAT)

• Cannes helicopter platform (Quai du Large)

In 2021, DSNA equipped this busy heliport with a remote digital display system, acquired from the industrialist Searidge: seven high-tech cameras are installed on the Quai du Large lighthouse, including a camera that can aim and zoom.



2021 was devoted to finalising the technical installations for testing the remote display from the heliport to the control tower at Cannes-Mandelieu airport. This initial phase must also enable to learn more about the artificial intelligence technology to automatically detect aircraft on approach, landing, or take-off.

• Remote Tower Center (RTC)

The aim of a remote control tower is to control an airfield's air traffic from a distant location, for example several hundred kilometres away. This concept has already been implemented by several countries in Europe and benefits from advances in image capture, visualisation, and information processing systems.



The Paris ACC supervisor checks remote service performance provided to the Geneva control centre.

On July 1st, 2021, DSNA took over management of the Tours-Val de Loire airspace. This handover between military and civilian service providers is a first in France and is linked to the Tours Flight School transfer to Cognac. To maintain an ATC service, this airfield is the pilot site of the first DSNA RTC. This RTC is located in Toulouse in the SNA South building, with a new technical room and an operational room.

→ ACROPOLE, AN ARTIFICIAL INTELLIGENCE-BASED ENVIRONMENTAL PERFORMANCE DISPLAY TOOL

DSNA is developing an innovative tool called ACROPOLE for improved monitoring and more accurate evaluation of the environmental impact involved in air operations.

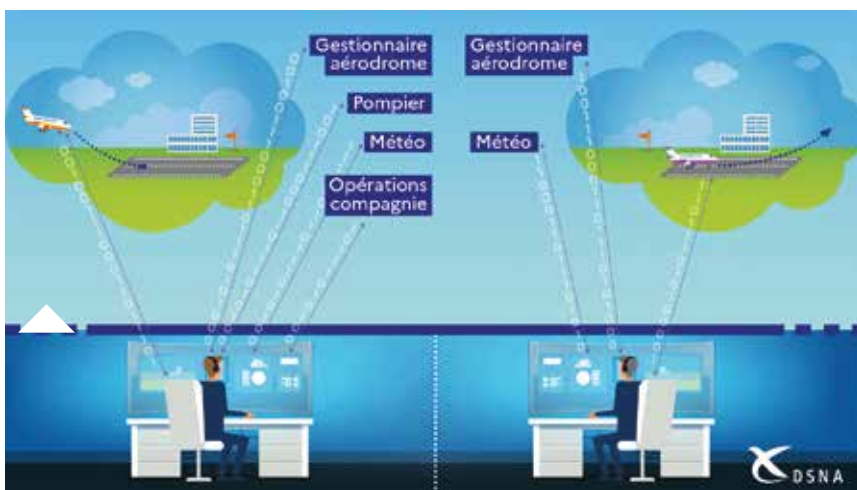
This tool combines radar flight data (position, altitude, speed) with estimated aircraft data (aerodynamic configuration, fuel consumption, etc.), using Machine Learning algorithms.

This technological challenge will add strong value for DSNA's radar data. The environmental benefits of the "PBN to ILS" experiment in Paris-CDG have been measured by ACROPOLE.

→ SCRIBE, AN ADVANCED SPEECH-RECOGNITION SOLUTION BASED ON ARTIFICIAL INTELLIGENCE

This solution has been developed in short, iterative cycles as part of DSNA Horizons Innovation Committee. It aims to roll out a Deep Learning voice recognition solution which is adapted to French air traffic controllers' multilingual voice exchanges. To begin with, SCRIBE will be used by the Quality of Service and Safety subdivisions of the ATS units in charge of transcriptions for their analyses of safety events.

Led by the DTI, Reims ACC, and the Paris-CDG control unit, the project was able to demonstrate by November 2021 that 70% of the English-speaking exchanges between controllers and pilots for En-route, Approach and Tower were correctly transcribed.

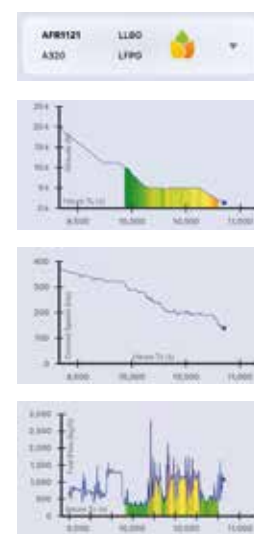


By 2029, DSNA will have created the first fully digital aerodrome control centre. This RTC will be able to provide air traffic services up to five regional airports.

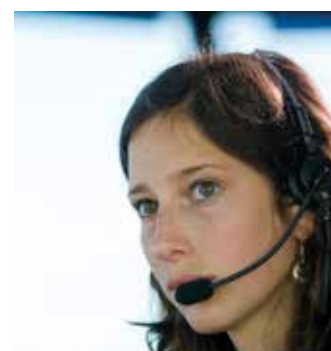
In time, the ACROPOLE tool will be used in tactical mode. The air traffic controller will be informed in real time about the environmental efficiency of aircraft trajectories on approach or take-off.



By clicking on the AFR1121 aircraft label on arrival at Paris-CDG, the approach controller is informed of the flight's environmental status (graphs on the right: noise, aerodynamic configuration, and fuel consumption calculated from artificial intelligence models).



A second Minimum Viable Product (MVP) exercise will be carried out in 2022 to improve English language recognition. In the long run, the national deployment of this transcription tool is planned through its integration into the ELVIRA tool for the replay and analysis of situations.



Adapting our organisation to new challenges

In 2020, DGCA thoroughly reviewed the organisation of all its support departments by regrouping them into eight interregional secretariats (SIR). The goal is to improve coordination and efficiency, and a 17% staff decrease by 2024. At the same time, in the second half of 2021, DSNA launched a thinking to deeply reorganise the services of its head offices. The changes were set in place as of January 1st, 2022.

→ DSNA HEADQUARTERS

To better meet its customers' and airspace users' high expectations, and upcoming technical and operational challenges, DSNA has changed its organisation within DGCA, based on a more structured and clearer governance. This reorganisation aims to better prepare DSNA's future, accelerate its technological modernisation, improve its performance and make better use of its employees' skills.

The new organisation chart is shown on page 57.



Focus on our customer relations

A specific mission has been created within the new Strategy & Resources Directorate (DSR)

to give greater clarity to our dealings with our customers, airspace users, and partners. In addition to regular operational meetings, and the continuous development of the `cdm@dsna` portal to meet airlines' needs as closely as possible, DSNA will pursue its collaborative decision-making approach to its air traffic management modernisation strategy, promoting coordination before any new deployment.

→ TECHNICAL AND INNOVATION DIRECTORATE (DTI)

The DTI's new organisation, which will be implemented on October 1st, 2021, will have to respond to the following new challenges : rethink the technical architecture of air navigation systems to move towards a more open and modular version; retain control of technical architectures; meet Single Sky challenges and prepare DSNA as an aeronautical data provider (ADSP); better meet operational and user needs; and develop the use of Agile methodologies and innovation and pass on the benefits to the operational centres. The new organisation chart is available on page 59.

The expected benefits include:

- More efficient management for projects and programmes by reinforcing DTI teams' technical skills and monitoring industrialists;
- Lower costs for infrastructure evolution and maintenance through better architecture control;
- Improved collective performance thanks to simplified processes, better information sharing and less coordination meetings;
- Increased responsiveness when dealing with problems.



→ THE DIRECTORATE OF OPERATIONS (DO)

The Directorate of operations is firmly committed to adapting operational jobs to meet new modernisation and air transport challenges in the coming decades.

• The technical sector

DSNA's technical services will have to implement a very dense systems modernisation programme whilst maintaining current tools in operational condition during the transition phase. This technological modernisation, which is essential, will have to meet the challenges of: safety and cybersecurity; the aviation sector's green recovery; and ACCs capacity and productivity. It requires a strong commitment from all agents.

To cope with a significant future decrease in the number of operational staff due to retirements, DSNA has initiated discussions about subjects such as:

- ATSEPs recruitment and training, by aiming to increase the initial ENAC training capacity and reduce training time until licence acquisition;
- Better staff distribution in the different entities, services and directorates;
- Organise working time with the possibility of overtime for voluntary agents;
- Continue work on technical service organisation combined with a shared vision of the level of service offered between technical services, operations, and territories.

• The control sector

DSNA is committed to continually improving its performance and productivity. The improvement of en-route air traffic controllers's productivity is planned as follows:

- Transfer lower airspaces to Approaches (+ 5 %);
- More intense simulator training (reduction of training time by 20 %);
- More suitable work organisation (+ 15% during the summer);
- New tools in electronic environment (+ 15 % in 2017 compared to commissioning in 2015; 4-FLIGHT : +25% in 2025 compared to the commissioning in 2022).

DSNA has taken specific measures for human resources management for 2021 and 2022 to plan ahead for the resumption of traffic as best as possible. In addition to the



operational reserve system (p. 25), the number of agents in a requalification situation in a new centre has been limited to consolidate staffing of the centres, especially in Paris and Reims ACCs.

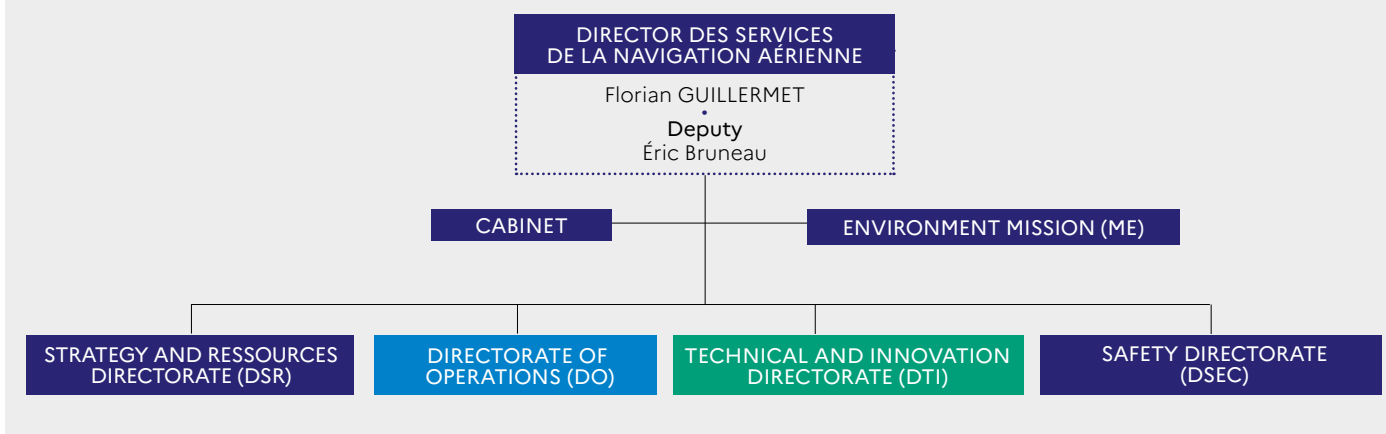
• AIS services consolidation

The strategy for the modernisation of aeronautical information aims to regroup BRIA (information and flight support regional office) activities. A first important step was taken on 2 December 2021 when BNIA (the national office for information and flight support) took over Le Bourget BRIA activities for flight plan and flight assistance and the BNI (Bureau NOTAM International) took over Le Bourget BRIA NOTAM activities. This new entity will thus become more efficient, improving working conditions and the service provided to users.

Glossary

ACC	Area Control Centre	GNSS	Global Navigation Satellite System
ADS	Automatic Dependent Surveillance	HMI	Human Machine Interface
AIT	French Transport Innovation Agency	IATA	International Air Transport Association
AMAN	Arrival Management	IFR	Instrument Flight Rules
A-SMGCS	Advanced-Surface Movement Guidance and Control System	ILS	Instrument Landing System
ATCO	Air Traffic Controller (ICNA)	ISO	International Organisation for Standardisation
ATFCM	Air Traffic Flow and Capacity Management	ISS	Information Systems Security
ATM	Air Traffic Management	LOC	Control position for airfield circuit management
ATSEP	Air Traffic Safety Electronics Personnel (IESSA)	MVP	Minimum Viable Product
BACEA	Annex Budget for Air Control and Operations	NewPENS	New Pan-European Network Service
BDR	Safety loop	NOTAM	Notice To Airmen
BRIA	Information and Flight Support Regional Office	N-VCS	New Voice Communication System
CAL	Computer-Assisted Learning	PBN	Performance Based Navigation
CAUTRA	Automatic air traffic coordination	PCP	Pilot Common Project
CCO	Continuous Climb Operations	RENAR-IP	Internet protocol air navigation network
CCS	Coflight Cloud Services	RSTCA	Air Traffic Terminal Charge
CDM	Collaborative Decision Making	SAF	Sustainable Aviation Fuels
CDO	Continuous Descent Operations	SARS	Severe Acute Respiratory Syndrome
CPDLC	Controller-Pilot Data Link Communications	SBAS	Satellite-Based Augmentation System
DGCA	Directorate General of Civil Aviation	SDM	SESAR Deployment Manager
DMAN	Departure Manager	SEPPER	Hydrogen fuel cell and renewable energy electric back-up
DSAC	National Supervisory Authority	SESAR	Single European Sky ATM Research
EGNOS	European Geostationary Navigation Overlay System	SMS	Safety Management System
ENAC	National Academy for Civil Aviation	SNA	Regional structure in charge of aerodrome and approach control
ERATO	En-Route Air Traffic Organizer	SNIA	National Airport Engineering Service
FABEC	Functional Airspace Block Europe Central	SYSAT	Program to modernise aerodrome and approach and tower control systems in mainland France
FIS	Flight Information Sectors	TMA	Terminal Manoeuvre Area
FL	Flight Level	TSEEAC	Senior Civil Aviation Technician
FMP	Flow Management Position	UOP	Live trial in secure mode
FRA	Free Route Airspace	VFR	Visual Flight Rules
FUA	Flexible Use of Airspace	WAC	World ATM Congress
		WAM	Wide Area Multilateration

FRENCH AIR NAVIGATION SERVICES DIRECTORATE (DSNA)



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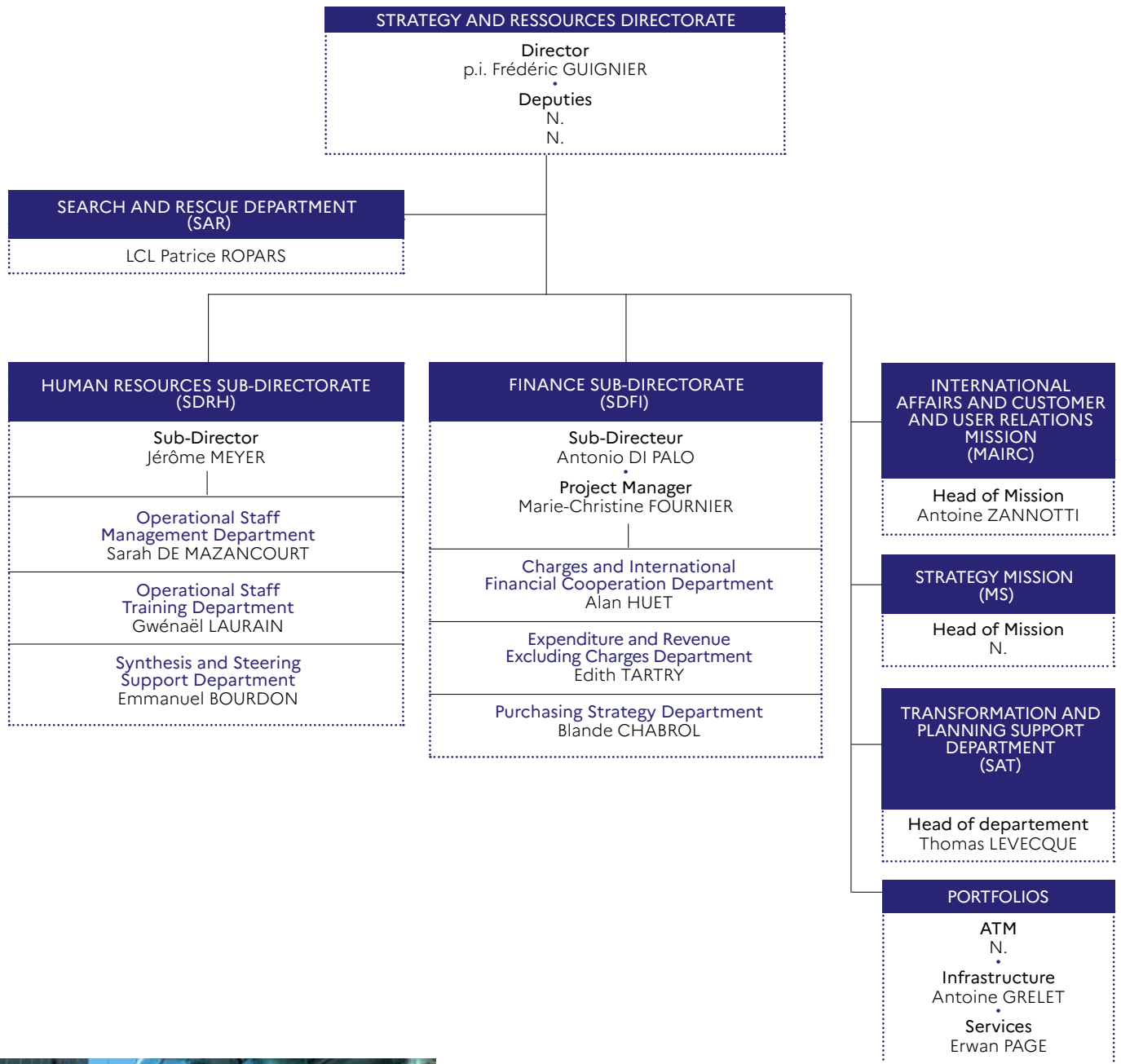
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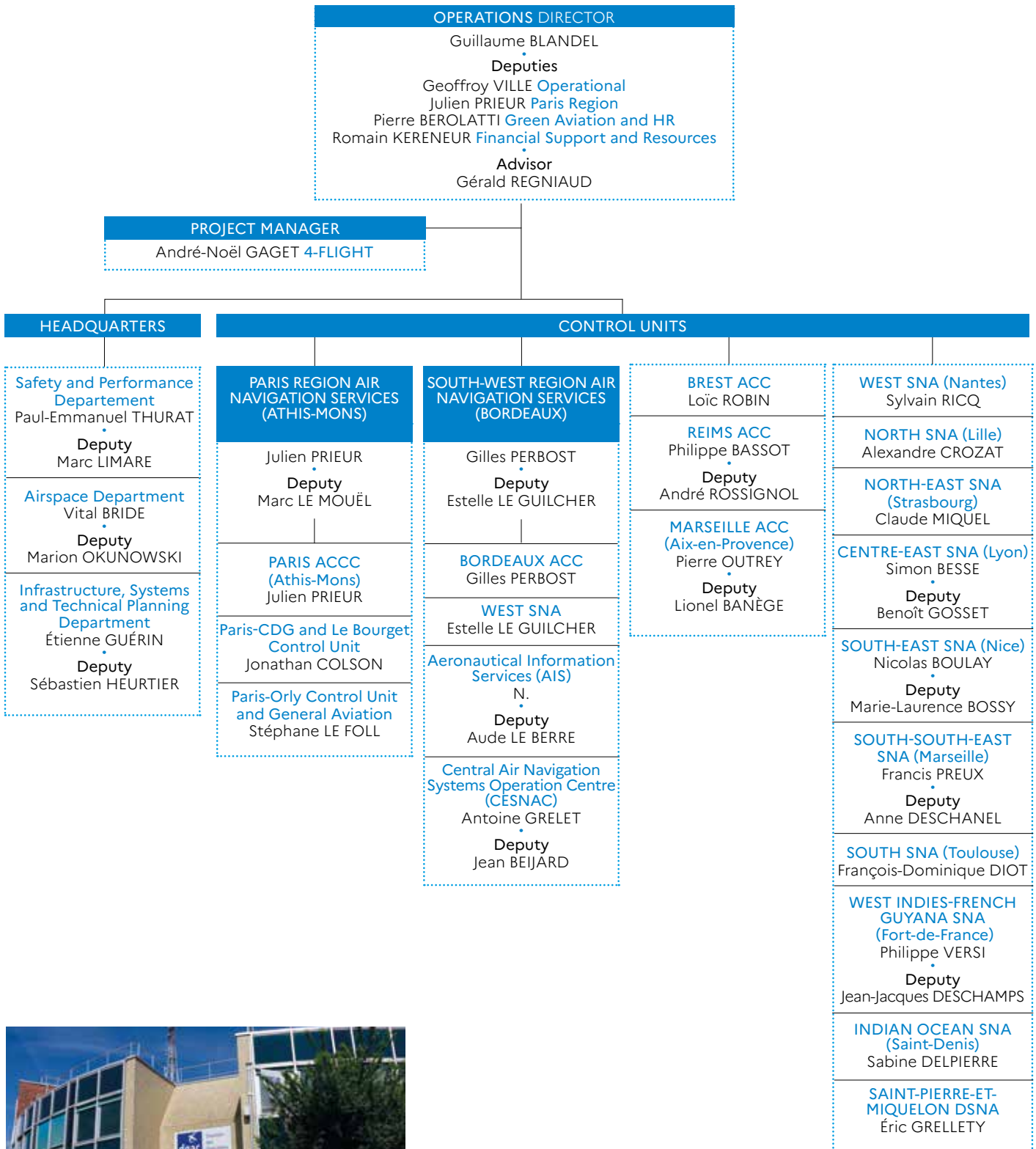
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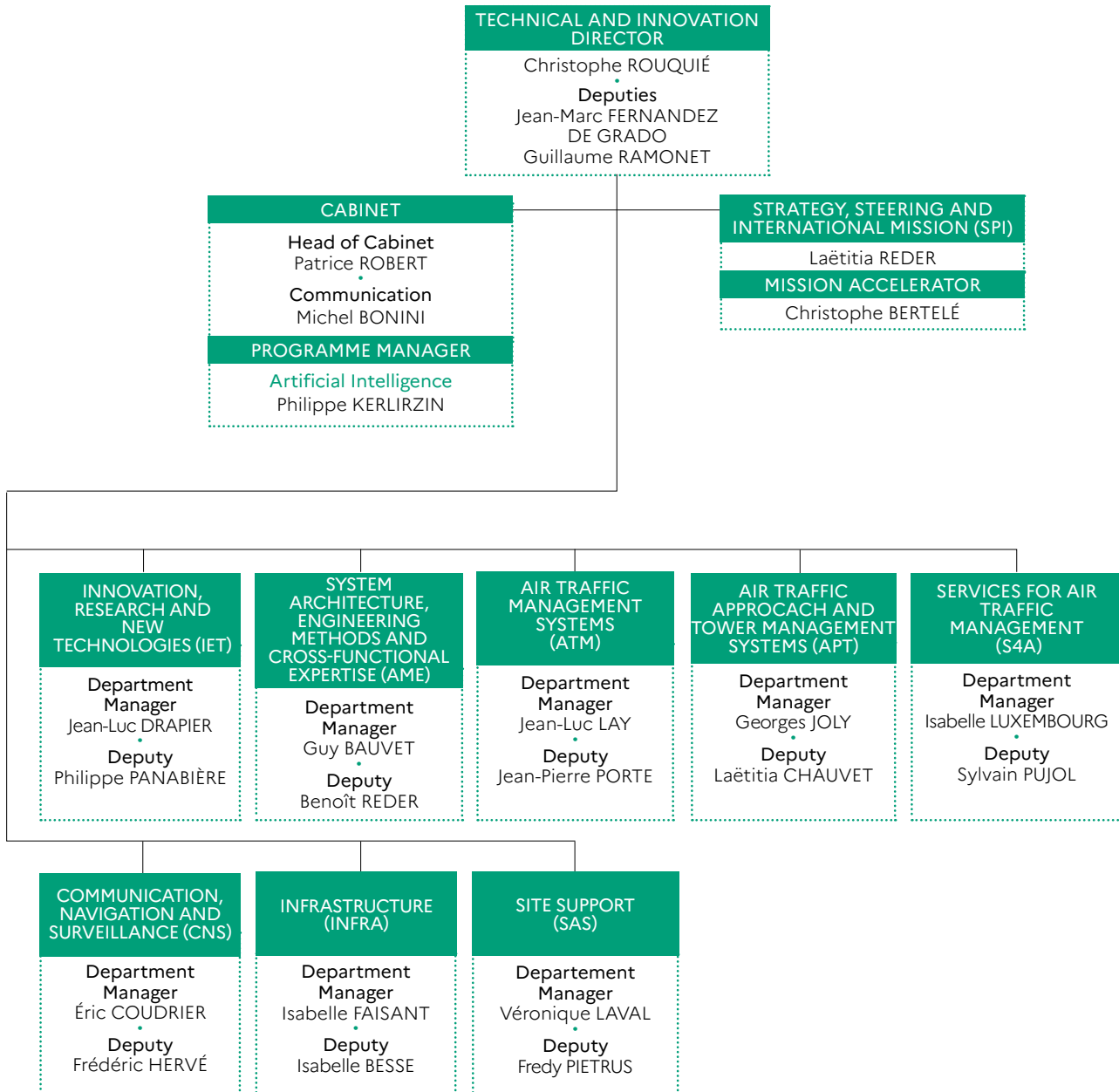
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**MINISTÈRE
CHARGÉ
DES TRANSPORTS**

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