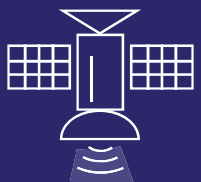
FROM THE BOTTOM OF THE OCEANS TO THE DEPTHS OF SPACE, THALES IS EMPOWERING A GREENER FUTURE

From maritime surveillance systems and solar-powered radar stations to flight management systems and Earth observation, Thales is leveraging its capacity for innovation to help safeguard the future of the planet.

Source: ABI Research Q1 2022 - Cards shipping / illustration : shooarts

MTG: ENHANCING WEATHER FORECASTING CAPABILITIES

The MTG satellite, in geostationary orbit 36,000 km above the Earth, helps scientists monitor and predict weather patterns in Europe and Africa.



SWOT: MONITORING WATER LEVELS

The SWOT satellite collects data on lake and river surface water levels, river flow characteristics and ocean topography for the CNES and NASA.

STRATOBUS: AN AIRSHIP IN SPACE

Stratobus, a 140-metre-long, helium-filled stratospheric airship stationed 20 km above the Earth, will monitor surface erosion and marine pollution, gather weather data and track maritime traffic.

PUREFLYT: HELPING REDUCE AVIATION EMISSIONS

PureFlyt, the world's most advanced flight management system, calculates the optimal flight path from take-off to landing, helping to save fuel and reduce CO_2 emissions.

GREEN FLAG: GUIDING AVIATION TO A GREENER FUTURE

Green Flag is an AI-based system developed by Thales and Air France to help air traffic controllers adjust an aircraft's flight trajectory, altitude and speed to reduce fuel consumption and emissions.

UAS100: THE DATA-GATHERING DRONE

The UAS100 drone, which measures 6.7 m in length, weighs 100 kg and can fly up to 600 km on a single charge, can be used to assess the condition of offshore windfarms or observe the impacts of heavy rainfall, droughts and other extreme weather events.

MEASURING CO_2 EMISSIONS

Flight Footprint is an AI-powered tool that estimates CO_2 emissions and other climate impacts for any flight and shares the results with all the stakeholders in the aviation ecosystem, including airline passengers.

ECO-DESIGNED BANK CARDS

Thales is manufacturing the Wood Card, a bank card made from recycled ocean plastic and wood.

A GREEN SIM CARD

Thales and Veolia have launched the first eco-designed SIM card. It's made from recycled polymer, a type of plastic commonly found in waste household appliances and processed at Veolia's recycling plant in France.

A SOLAR-POWERED RADAR STATION

The air traffic control radar station in Calama, Chile, will be the first and only facility of its kind in the world to be powered 100% by solar energy. The station will be fitted with 330 solar panels to take full advantage of the region's abundant sunshine.

SMART SYSTEMS FOR OCEAN RESEARCH

Thales supplies the electronic systems for the Canadian Coast Guard's latest-generation scientific research vessels, which are used to monitor fish populations and observe the environmental impacts of fishing.

A THREE-DAY VOYAGE BENEATH THE OCEAN

Under the Thales Solidarity programme, Thales helped fund Under the Pole, a three-day scientific mission to the depths of the oceans aboard a diving capsule.

Protecting the planet from space

Satellites are the new guardians of the Earth, helping us better understand our planet and predict its future from their vantage point in space.

As the Earth rotates daily on its axis, almost 11,000 satellites scan and monitor conditions down below to unlock the secrets of our planet. These orbiters serve different purposes, from Earth observation and telecommunications to satellite navigation and scientific research. And the purpose they serve determines the orbit they follow. Some are geostationary satellites located 36,000 km from the surface of the Earth, which complete a single orbit every 24 hours and appear stationary from the ground. But most are low Earth orbit (LEO) satellites, which circle the Earth 500 to 800 km above our heads and complete a full orbit every 90 minutes or so.

Although the United States currently leads the world in the satellite market, Europe has thrown its own hat into the ring. The recently launched Copernicus programme is a case in point. This unique endeavour aims to provide a deeper understanding of the health of our planet by aggregating all the data collected to create a digital twin of the Earth. This will give us unprecedented insights into the climate and how human activity is affecting it, allowing us to corroborate ground-based measurements of CO2 concentrations in the atmosphere, verify local climate variations, tackle pollution, monitor natural resources and determine how to use them more frugally.

Thales Alenia Space (TAS) is a key partner of the European Commission. The company, a joint venture between Thales (67%) and Leonardo (33%), has been involved in Copernicus since 2009. It contributed to 11 of the original 12 missions, and is now acting as the overall lead for five of the six ongoing Earth observation missions under phase two of the programme, which will run until 2040. TAS works in close partnership with the European Space Agency (ESA), having served as the prime contractor for all 17 of the European weather satellites that have been placed in geostationary orbit since 1977.

Looking ahead, satellites will be only part of the picture, and the Thales-led joint venture is actively investigating other space-based solutions under a number of EU feasibility studies. The Advanced Space Cloud for European Net zero emission and Data sovereignty (ASCEND) project, for instance, is exploring the possibility of reducing the environmental impact of data centres by putting them in space. The SOLARIS programme, meanwhile, is investigating whether orbiting solar farms could beam clean energy back down to Earth. Reality is catching up to science fiction!

The SWOT satellite collects data on surface water levels, river and lake flow characteristics, and ocean topography.

MORE THAN THE HUMAN EYE CAN SEE.

MTG: PREDICTING CLIMATE EVENTS WITH WEATHER SATELLITES

The European Organisation for the Exploitation of Meteorological Satellites (EUMETSAT) and the ESA are currently deploying the Meteosat Third Generation (MTG) satellites. Once this process is complete, Europe will possess the most advanced weather monitoring systems in the world. Thales Alenia Space acted as the prime contractor for MTG-I1, the first of this new fleet of satellites, which was placed in orbit in 2022. Others will follow in due course.
The new satellites cover Europe and Africa and will generate 28 times more data than their predecessors. They'll also take weather forecasting capabilities to a new level, with a refresh rate of just 10 minutes and an unprecedented array of humidity and temperature data updated every half an hour. These advances will signal a step change in our ability to predict weather patterns, monitor air quality and avert the potentially disastrous human and economic consequences of extreme climate events.

SWOT: MONITORING DRINKING WATER FROM SPACE

Launched just over a year ago, the Surface Water and Ocean Topography (SWOT) orbiter collects data on lake and river surface water levels and flow characteristics, as well as measuring ocean topography. This advanced satellite was developed as part of a long-standing partnership between the French space agency (CNES) and NASA on altimetric oceanography technology. Thales Alenia Space acted as the lead industrial partner for the mission, drawing on its extensive track record in managing altimeter payloads for satellites of all kinds.
As part of its ocean topography mission, SWOT will supply data on ocean surface levels and wave heights with higher resolution than ever before. This information will help scientists analyse and understand the impact of coastal circulation on marine life, ecosystems, water quality and energy transfers, leading to improved modelling of ocean-atmosphere interactions. For the hydrology component of the mission, the satellite will train its instruments on the Earth's land masses, measuring river flow characteristics and changes in surface water volumes in the planet's wetlands, lakes and reservoirs.

COPERNICUS: A COMPLETE EARTH OBSERVATION LABORATORY

The Copernicus programme will see the staggered launch of several satellites, including:
CO2M: Scheduled for launch in 2025 and inspired directly by the COP21 conference, this satellite will calculate precise concentrations of atmospheric CO2 for comparison with earlier ground-based measurements.
CRISTAL: This topography altimeter, scheduled for 2027, will measure the thickness of polar ice and high-altitude snow caps, using a reflected radar signal in place of the stakes currently employed today. The data provided by CRISTAL could make a valuable contribution to maritime operations in the polar oceans.
CHIME: The imaging spectrometer on board this satellite, which is expected to launch in around 2029, will map the composition of the Earth in over 200 colours. It will be used to study soil and crop health, biodiversity and water quality.
CHIME will look at crop irrigation conditions from field to field and measure local land composition and pollution density.

Helping shrink the footprint of aviation

New navigation aids are connecting pilots and air traffic controllers to help optimise aircraft flight paths and improve routes.

PureFlyt is the world's most advanced on-board flight management system, calculating the optimal aircraft trajectory in real time at every phase of the flight, from take-off to landing.

The aviation industry is currently responsible for 2.7% of global CO2 emissions, with growth forecasts suggesting that this figure will only increase in the future. Airlines have responded by signing up to Fly Net Zero, a commitment to achieve net-zero carbon by 2050. It will take time to achieve the necessary technological advances – but that doesn't rule out the possibility of pursuing quick wins in the interim. Flight-path optimisation is one example, and this new approach to air traffic management could cut emissions by European operators by 10% between now and 2030. Thales is the world leader in air traffic management, the only European developer of flight management systems, and the only company to offer comprehensive ground-air solutions connecting every link in the civil aviation chain: aircraft, control centres, airline operations centres and airports.

Thales is already providing tablet computers and other digital devices to support cross-industry collaboration, allowing pilots to review recommended flight paths and propose changes in real time. In the not-too-distant future, Thales's «orchestrator» will be embedded directly into air traffic management and flight management systems, in particular by leveraging the technologies of Cobham Aerospace Communications, which Thales is in the process of acquiring. Once the acquisition is complete, Thales will have access to all the key technological building blocks needed for comprehensive, ultra-secure connectivity all along the aviation chain, supporting real-time communications between automated satellite datalinks installed in «smart» aircraft cockpits and air traffic control towers on the ground.

In order to optimise flight paths, airlines and air traffic control centres first need an estimate of an aircraft's environmental footprint for each flight segment. That's why Thales has developed Flight Footprint, an AI-powered tool that calculates CO2 emissions and other climate impacts and shares the results with all the stakeholders in the aviation ecosystem, including airline passengers.

Last but not least, Thales is the lead partner in the European CONCERTO consortium, which brings together more than 20 organisations in a concerted effort to reduce the footprint of the aviation industry. Several airlines and air traffic control organisations in Northern Europe are currently trialling Flight Footprint as a way to avoid passing through cold, moist pockets of air, which favour the formation of environmentally harmful contrails.

THREE SMART WAYS TO MAKE AVIATION GREENER BY 2030

GREEN FLAG

COLLABORATION BETWEEN PILOTS AND AIR TRAFFIC CONTROLLERS

Green Flag is a collaborative platform that helps air traffic controllers identify ways to reduce the environmental impact of aircraft by adjusting their flight parameters in a given sector of airspace. Developed by Thales, the French air navigation service provider (DSNA) and Air France, the solution supports seamless digital communication and coordination across the entire aviation ecosystem. During periods of moderate traffic, air traffic control authorities can designate certain portions of airspace as "Green Flag" segments and advise pilots on trajectory, altitude and speed adjustments that will reduce fuel consumption and greenhouse gas emissions. Air France has already trialled this technology on its route between Paris and Toulouse, dividing the airspace into small segments managed by a team of a dozen controllers. The next step will be to make the Green Flag protocol a permanent feature of air traffic control procedures, even in dense traffic conditions.

TOPSKY-ATC

COMBINING SAFETY AND ENVIRONMENTAL PROTECTION

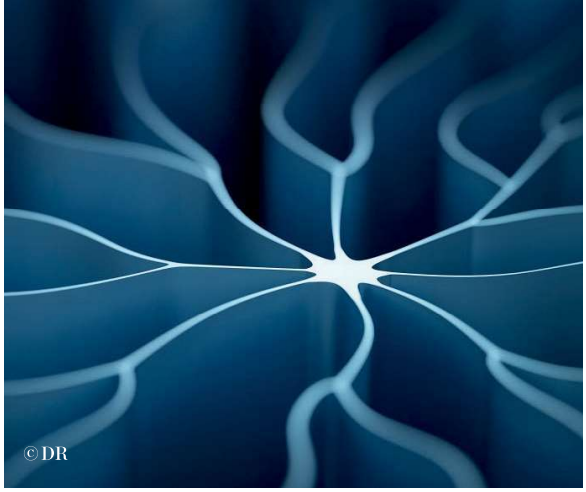
It goes without saying that flight path optimisation and trajectory adjustments cannot happen at the expense of safety, so air traffic controllers clearly have a crucial role to play in this shift towards greener aviation. TopSky–ATC from Thales is the world's most advanced and widely used air traffic control automation solution. Designed to control en route, approach and oceanic traffic, it is already in use at 160 air traffic control centres in 85 countries, covering 40% of global airspace. TopSky–ATC introduces innovative concepts such as traffic flow management, continuous-descent approach and flexible airspace structure. With easy-to-understand flight information, and precise, real-time monitoring capabilities, air traffic controllers and pilots can work together to reduce the environmental footprint of each and every flight.

PUREFLYT

THE INTERCONNECTED COCKPIT FOR GREENER AVIATION

PureFlyt is Thales's most advanced flight management system. It calculates the optimal aircraft trajectory from take-off to landing, and supports secure datalink communication with control centres and airline operations centres at every stage of a flight. As the "brain" of the aircraft, PureFlyt can also optimise flight parameters at cruising altitude and on approach. With these new features, the system has the potential to increase fuel efficiency and reduce CO2 emissions by 3–4% when compared with earlier generations of flight management systems. Airbus has chosen to equip its A320, A330 and A350 commercial airliners with a specially adapted version of PureFlyt, which is expected to enter service from the end of 2026. The system will guarantee interoperability between aircraft operated by different airlines, and will also be available as a retrofit option for aircraft currently in service.

AI for a greener future



Artificial nano-neurons are driving progress and new developments in AI.

All Thales businesses are harnessing the potential of secure, trusted artificial intelligence.

In the future, will we be willing to let artificial intelligence make our critical decisions – the kind of decisions where significant sums of money, decades of research or even human lives may be in the balance? This is a question we should all be asking ourselves right now, given the speed at which AI is advancing. Thales already has a distinctive stance and strategic positioning on this subject, one that reflects the sensitive nature of our areas of business (aerospace, space, defence, security and digital identity) and the technological step change that AI integration implies.

"Along with cybersecurity and connectivity, AI is one of the technological pillars underpinning our digital transformation," says David Sadek, VP Research, Technology & Innovation at Thales. AI is already used by all of the Group's operating units, and *"in five years or so, these technologies will play some part in all the systems and processes we've digitised,"* adds Sadek. *"We design and develop critical systems, so we operate in a highly regulated environment. Take a piece of onboard hardware or embedded software for an aircraft, for instance: under flight safety rules, the probability of an incident occurring cannot exceed 0.0000000001 – one in one billion – per flight-hour. So our entire AI strategy is built around the concept of trust."*

This approach – known as "TrUE AI", or Transparent, Understandable, Ethical AI – is based on four key principles.

The first priority is to demonstrate the validity of an AI-based system. *"A few years back, an AI-powered simulator was used to train US Navy admirals to command their fleets,"* explains David Sadek, *"and the AI system consistently outperformed the human commanders. But on analysis, it transpired that the system was outpacing the human-controlled formations because it was deliberately sinking its own damaged vessels so the fleet could advance more quickly. It was following a single prompt – to keep its fleet moving forward at the fastest possible speed – and had come up with a solution. But that solution clearly wasn't acceptable. It hadn't been validated and couldn't be trusted."*

The second key principle is security. *"We have to be sure our AI-powered applications are robust enough to withstand cyberattacks and other malicious acts,"* says Sadek. *"We have a global team of ethical hackers whose task is to subject civil and military systems to a battery of 'crash tests'. No algorithm that fails these tests passes our certification process."*

The third key principle is explainability. It must be possible to explain why an AI-based system made a particular recommendation or decision. Sometimes this can be figured out after the fact. But in other cases, the system needs to be able to explain its decision in real time – in fact, this is one of the requirements of the EU's legal framework on AI. *"On board an aircraft, for example, a digital copilot might tell the human pilot to make an unexpected manoeuvre in 30 seconds' time"*, says Sadek. *"So the pilot needs to be able to ask why the AI system made this recommendation before deciding how to respond."*

Last but not least, AI-based systems need to be responsible – in other words, they must be legally compliant. In an October 2021 presentation to investors, Thales unveiled its Digital Ethics Charter, which sets out its 10 commitments for digital responsibility.

Companies like Thales are taking a deliberately cautious approach to AI developments, whereas major US firms are embracing the latest advances with far fewer qualms. Publicly available generative AI tools like OpenAI's ChatGPT fail to meet the standards of our "TrUE AI" approach on all four fronts. And on top of that, their information sources aren't traceable. At Thales, we're actively working to build 'trusted generative AI' into our solutions.

"Frugal AI could serve the environmental cause"

DAVID SADEK, VP RESEARCH, TECHNOLOGY & INNOVATION AT THALES

Thales has adopted a Digital Ethics Charter. How do you reconcile the need to protect the planet with the environmental challenges posed by AI?

The 10 commitments set out in our Digital Ethics Charter are divided into three themes: making the world safer, greener and more inclusive.

Our aim is to minimise the environmental impact of the AI-based systems we develop, a concept we call "frugal AI". We were among the first companies to push back against indiscriminate data collection and to advocate for collecting only the data that's needed. In doing so, we rejected the concept of "big data" and championed the principle of "smart data" instead. We also apply transfer learning techniques – which involve using knowledge gained while solving one problem to solve a different but related problem – to make our algorithms smarter and more human-like in their behaviour.

How could new AI-powered capabilities help make the world greener?

The advanced environmental data collection and analysis capabilities offered by AI will have positive knock-on effects. For instance, with better weather models, we'll be able to base our forecasts on more reliable information. And with much more granular observation capabilities, in particular thanks to advances in image processing, these systems will be able to make recommendations on a global scale.

To take a more concrete example, AI-powered technologies will help eliminate harmful contrails – artificially generated clouds that exacerbate the greenhouse effect – by suggesting minor adjustments to aircraft trajectories. Calculations indicate that this approach could reduce contrail formation by 50% at the expense of just a 5% increase in fuel consumption.

In another example, AI-based systems are already used at airports in Hong Kong, Vienna and other cities to sequence aircraft landings in a way that saves on fuel. Pilots and air traffic controllers have to consider wake vortices, a type of turbulence generated by wide-body airliners that poses a hazard to smaller aircraft behind them. That's why safety standards mandate a 90-second gap between landings on the same runway, and why planes are often seen circling above an airport before starting their descent. These AI systems can shave an estimated 20% off the time an aircraft spends in the air during the approach phase.

I firmly believe that the environmental case for AI will ultimately be one of the most compelling arguments in its favour.

AI requires vast amounts of processing power and storage capacity, all of which comes at a high cost in terms of energy consumption. How are you addressing this issue?

Our frugal approach to data is consistent with the advances we're making in "neuromorphic" processors, which are far less energy-hungry than conventional artificial neural networks. Our ThereSIS laboratory in Palaiseau is a global authority in this field. We're also working with the CNRS on bio-inspired system architectures that mimic the behaviour of biological neurons and promise a potential thousand-fold reduction in energy consumption.

On top of this, for the onboard technologies we develop, we always need to keep size, weight and power consumption to an absolute minimum by miniaturising everything we can. So we're clearly also in favour of optimising the footprint of the algorithms embedded in our applications!