CNES MAG

EN FR

SPACE ● INNOVATION ● SOCIETY

#82
November 2019

SATELLITE TELECOMMUNICATIONS

WELCOME TO A NEW ERA

cnes
CENTRE NATIONAL D'ÉTUDES SPATIALES

INSIDE

PARTNERS:

Mentioned in this issue: p6 European Space Agency (ESA); p9-16-25-30 Airbus Defence & Space (ADS); p8-9-10-24-28-32 Thales Alenia Space (TAS); p10 ANFR, the French frequencies agency; p20 European operator Eutelsat; p29 CLS (Collecte Localisation Satellites), a subsidiary of CNES and Ifremer; p29 Hemeria (formerly Nexeya); p29 Syrlinks.

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EACH TELECOMMUNICATIONS SATELLITE TO ITS OWN ORBIT

Geostationary orbit (altitude 36,000 km)

GEOSTATIONARY SATELLITES

3.5 to 7 tonnes at launch, 17 to 35 m^3, like **Konnect VHTS** (see p. 20)

FLEXIBLE GEOSTATIONARY SATELLITES

> 2 tonnes at launch, approximately 10 m^3, like **Space Inspire** (see p. 25)

MINISATELLITE CONSTELLATIONS

150 to 800 kg at launch, 1 to 5 m^3, like **OneWeb** (see p. 16)

Low Earth orbit (altitude 400 to 2,000 km)

CONTRIBUTORS

ALEXANDRE VALLET

Currently Chief of the Space Services Department (SSD) in the Radiocommunication Bureau at the International Telecommunication Union (ITU), Alexandre Vallet began his career in satellite communications in 2000, at Orange's R&D centre. In 2006, he joined satellite operator Eutelsat to take charge of regulatory affairs. From 2007 to his arrival at the ITU, in 2017, he headed up the regulatory affairs department of ANFR, the French frequencies agency. Invisible but not infinite, radiofrequencies are a resource in growing demand. So how are they allocated? For this issue of CNESmag, Alexandre Vallet did us the honour of answering our many questions on radiocommunications regulation, frequency allocation and cooperation. You can read a fascinating interview with him at https://cnes.fr/en/cnesmag.

JEAN-PIERRE DIRIS

Jean-Pierre Diris heads CNES's Telecommunications and Navigation sub-directorate, where he's pursuing innovative projects with his teams developing commercial, dual-use and military telecommunications solutions for the French government. His modus operandi is tailored to the marketplace and to the skills and expertise of the industrial base. He opened his book of contacts for us to shed light on the technology and competitiveness challenges facing this highly competitive sector.

JEAN-PHILIPPE TAISANT

Jean-Philippe Taisant is head of Telecommunications and 5G programmes at the agency's Competitiveness and Economic Development sub-directorate. His mission is to support the space industry's competitiveness and downstream business development through space solutions. With his long experience working on telecoms projects and today in charge of strategy, he set out for us the history of satellite telecommunications from its origins to the present day, and the huge technological strides France has made in this sector.

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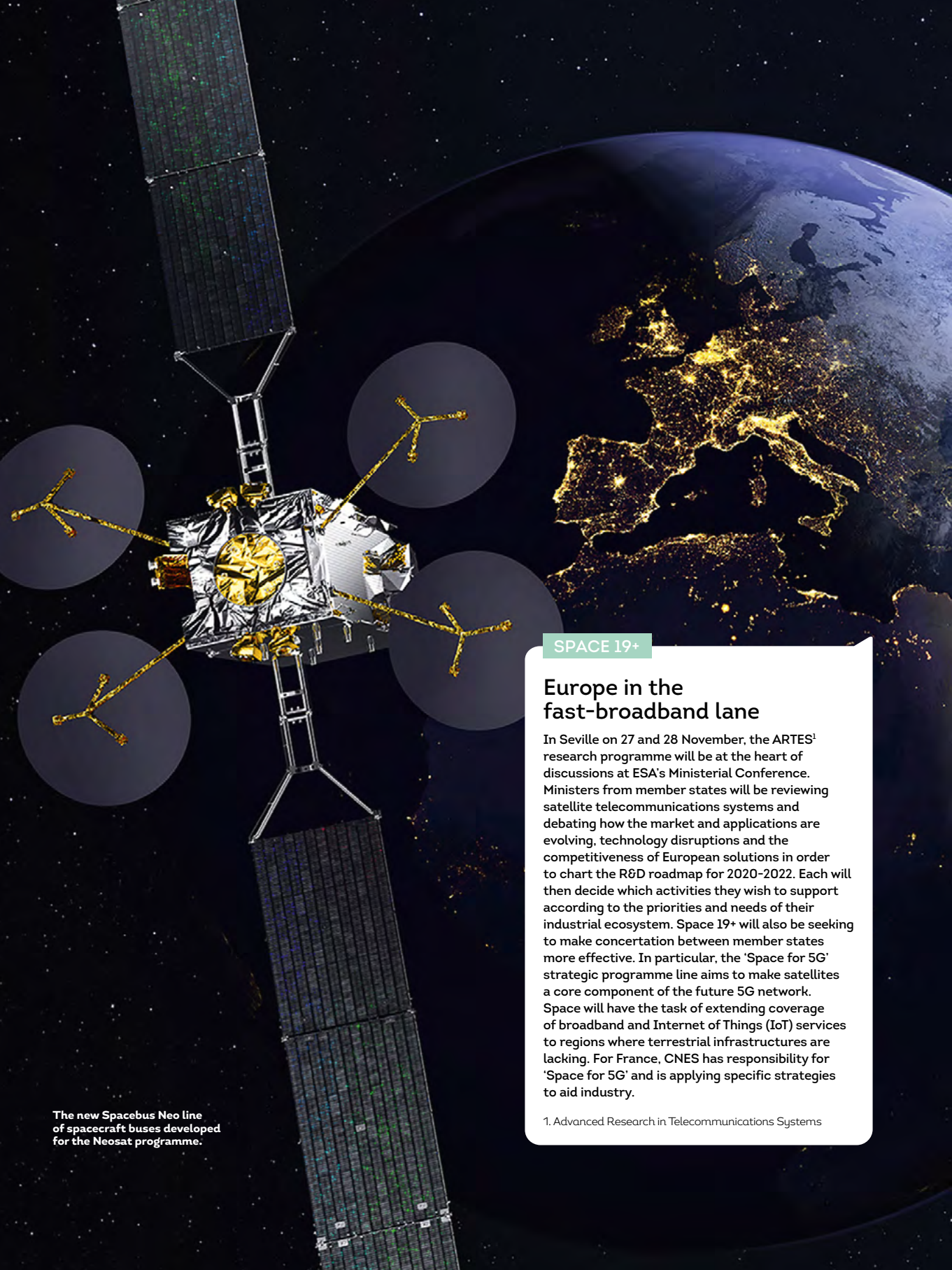
EDITORIAL

Ask our fellow citizens what satellite telecommunications bring to mind and the odds are they will say the conquest of space, giant antennas and interplanetary missions—a sort of cocktail combining Apollo 11, the famous radome and telecoms theme park at Pleumeur-Bodou in Brittany and the Blake and Mortimer comic series.

Few people imagine that it's satellite telecommunications that first brought space into our daily lives. Today, there's no programme on TV that isn't beamed through a satellite, no text message that doesn't make a detour via geostationary orbit and no positional fix that doesn't use signals from constellations circling Earth thousands of kilometres above our heads. This issue of CNESMAG takes us inside satellite telecommunications with some exceptional contributors who shed light on the political, strategic, regulatory, technological, industrial, commercial and societal aspects of this sector which, in the space of a few years, has changed the way we communicate, stay informed and move around—in a word, how we live. But this is just a start. In the hyper-connected world of the future, only satellites will be able to bring Internet services to everyone on the planet, not only so that people can communicate better but also to guarantee their safety and health, and to support many more applications yet to be invented. Because tomorrow, we will all be fired by the spirit of space!

JEAN-YVES LE GALL
CNES PRESIDENT



The new Spacebus Neo line of spacecraft buses developed for the Neosat programme.

SPACE 19+

Europe in the fast-broadband lane

In Seville on 27 and 28 November, the ARTES[1] research programme will be at the heart of discussions at ESA's Ministerial Conference. Ministers from member states will be reviewing satellite telecommunications systems and debating how the market and applications are evolving, technology disruptions and the competitiveness of European solutions in order to chart the R&D roadmap for 2020-2022. Each will then decide which activities they wish to support according to the priorities and needs of their industrial ecosystem. Space 19+ will also be seeking to make concertation between member states more effective. In particular, the 'Space for 5G' strategic programme line aims to make satellites a core component of the future 5G network. Space will have the task of extending coverage of broadband and Internet of Things (IoT) services to regions where terrestrial infrastructures are lacking. For France, CNES has responsibility for 'Space for 5G' and is applying specific strategies to aid industry.

1. Advanced Research in Telecommunications Systems

5G

NEW SERVICES FOR NEW LIFESTYLES

Whether you stream games or Netflix series to your smartphone, the good news is that 5G is expected to be 100 times faster than 3G. It's also designed to support the massive influx of connected objects and ultra-fast secure links. By enabling home monitoring, storage of personal data in a single cloud or e-health services to name just a few applications, 5G is set to transform our daily lives. But for that, terrestrial networks will first have to be upgraded and infrastructure significantly densified. Operators are already competing in this race that will initially benefit zones where coverage is densest. In 'not-spots' or underserved areas in France or when on the move, satellites will step into the breach to bring 5G to all. 5G also offers the opportunity to better integrate mobile and fixed communications networks with common management interfaces—the first step towards universal and multi-service connectivity that is transparent to operators and above all users.

28.9

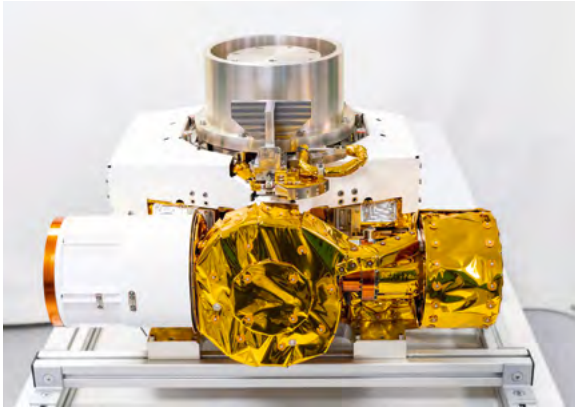
Million broadband and fast-broadband subscribers in France in 2018, across all networks.

PIA

AIDING INDUSTRY

Created by the French government in 2010, PIA future investment programmes are vital to the space industry. As the lead agency for space, CNES has the task of using PIA funding for research and development. These funds are reinvested in the industry, paving the way for new product lines that benefit the entire space ecosystem. Satellite telecommunications have thus taken advantage of the 'Satellites of the Future' PIA devoted to conceiving new-generation spacecraft buses. Today, nine satellites from these new product lines are in development for public and private operators, putting French manufacturers in pole position on the international stage. PIA funding has also supported the 'Electric-propulsion Satellite' (see p. 9) and THD-Sat programmes (see p. 24).

Electric thruster.



EPPM electric propulsion demonstrator from the ARTES programme.

ELECTRIC SATELLITES

TODAY, WEIGHT IS THE WATCHWORD

Electric propulsion really is the founding act of the communications satellite revolution. Its key advantage is the weight gains it affords, and weight is the main cost driver of a satellite. Electric propulsion can shave off 1½ to 2 tonnes by reducing fuel mass, generating a potential saving of up to 30%—an attractive argument for operators. To adapt to these new strategies and boost Europe's industry, CNES and ESA have conceived Neosat, which has spawned two lines of electric-propulsion spacecraft buses: Eurostar Neo from Airbus Defence & Space (ADS) and Spacebus Neo from Thales Alenia Space. Anticipating these new product lines, CNES has developed with ADS an EOR[1] version of the Eurostar E3000 bus. The 172B communications satellite ordered by European operator Eutelsat and launched on 1 June 2017 from French Guiana was the first mission for this version. It uses high-power electric propulsion for orbit raising and orbital manoeuvres. The weight gain with electric satellites is also an advantage for launch vehicles—Ariane 6, for example, will be positioned in the market for satellites in the 3-to-7-tonne class (see p. 26).

1. Electric Orbit Raising

DIGITAL SATELLITES

TOMORROW, COMPETITIVENESS WILL BE KEY

The shift to 'all-digital' signals the start of phase two of the satellite revolution. Whereas a conventional satellite receives signals and retransmits them as faithfully as possible, a digital satellite is able to process received and transmitted signals on board. And if you can process data, you can also encrypt them, a capability that is especially attractive for the military, which is already making extensive use of these technologies to securely interconnect conflict zones. The other advantage of all-digital is its flexibility, as algorithms can be reconfigured on orbit to serve new missions (see p. 27). The use of digital satellites is now also spreading to the commercial telecommunications sector, where operators will more easily be able to adapt to evolving market requirements. CNES is helping Thales Alenia Space to develop these digital systems built with VLSI[1] technologies to shorten lead times and cut costs.

1. Very Large Scale Integration

OPTICAL SATELLITES

BEYOND TOMORROW, CONNECTION SPEEDS WILL REIGN SUPREME

Act three of the revolution will be propelled by optical technologies. Those currently being studied are drawing their inspiration from terrestrial fibre optics, with lasers instead of radiofrequency waves transmitting the signal. From a business perspective, optical systems could prove more profitable than certain conventional links. Not only that, but at higher connection speeds on the order of one Terabit per second (Tbps), optical technology is today one of the most credible alternatives capable of supporting exponential growth in data volumes. It also has the advantage of not being subject to frequency authorizations. But before moving into the operational phase, optical satellite telecommunications still have a few obstacles to overcome. For example, optical connections are interrupted by clouds and disrupted by atmospheric turbulence. CNES and its partners are working to make these links more reliable as they traverse the atmosphere. Optical satellite telecommunications will also have to demonstrate they're safe for our eyes, notably for aircraft and helicopter crews. Programmes now underway include several trial phases before an operational demonstration phase aimed at having commercial services ready by 2025.

2

Americans pay twice as much for their Internet/telephone connection as Europeans and five times as much as the French. Telecoms prices in France are considered the cheapest in Europe.

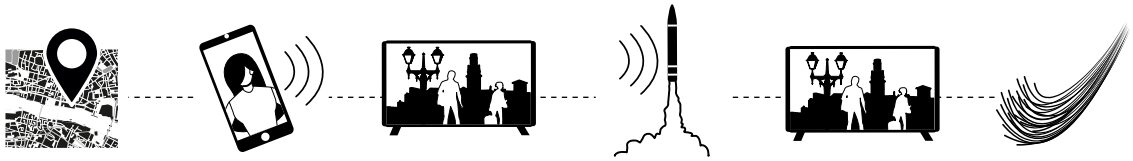
1%

More than 1% of the French population—that's nearly 670,000 people—has to make do with very slow ADSL connection speeds, and in some cases dial-up speeds. In all, 541 municipalities are in landline 'not-spots' with no Internet access.

260

With geostationary satellites 36,000 kilometres overhead, Internet signals take 260 milliseconds on average to make the round trip to the satellite and back to the user. That's five times slower than ADSL, which is why latency is one of the points on which R&D is focusing in the communications satellite sector.

FREQUENCIES AND ALLOCATIONS



L BAND
1.5 GHz
Navigation and positioning

S BAND
2.5 GHz
5G

C BAND
4/6 GHz
Television, VSAT

X BAND
6/8 GHz
Military systems

K_U BAND
11/18 GHz
Television

K_A/Q/V BANDS
20 to 50 GHz
Broadband and fast broadband

SATCOMS

FAINT SIGNS OF RECOVERY

While fast broadband and the Internet of Things (IoT) are moving into our homes, with fridges telling us when to renew stocks and baby phones keeping track of the relative humidity in our little one's play room, the geostationary telecommunications satellite market is in crisis. Only seven satellite orders were booked in 2017 and 2018, against an average of 15 to 20 in previous years. Euroconsult, a consulting firm specializing in space, sees this as a sign that satellite operators are hedging their bets in a climate of economic uncertainty in the telecommunications and television markets. A recovery appears to be on the way this year, however, with seven orders in nine months, of which three are for Airbus and its new flexible satellite. Such satellites that can be reprogrammed throughout their service life at lower cost could restore investors' confidence, but this trend remains to be confirmed.

FREQUENCY MANAGEMENT

A REAL HEADACHE

Managing frequency bands is a complex equation. In recent years, the proliferation of digital services has generated a glut of allocation requests and band saturation. For example, new mobile phone services have begun to 'eat into' the C band for satellite telecommunications, as people spend more time these days watching videos or downloading pictures than talking, thereby putting more pressure on available bandwidth. As a result, broader and higher bands are needed, but allocating several communications satellites to the same band would cause interference. Fuelled by economic necessity, frequency band availability has become a 'profitable' product for nations, to the extent that new band allocations are now a recurrent item on the agenda of the WRC[1]. But opening ever-higher-frequency bands isn't without its drawbacks, as propagation distances are shortened and quality of reception reduced. While CNES isn't the deciding authority for frequency allocations—that power is in the hands of ANFR, France's national frequencies agency—it is developing mitigation strategies, acting as a mediator and analysing for each project the best way to meet the operator's needs.

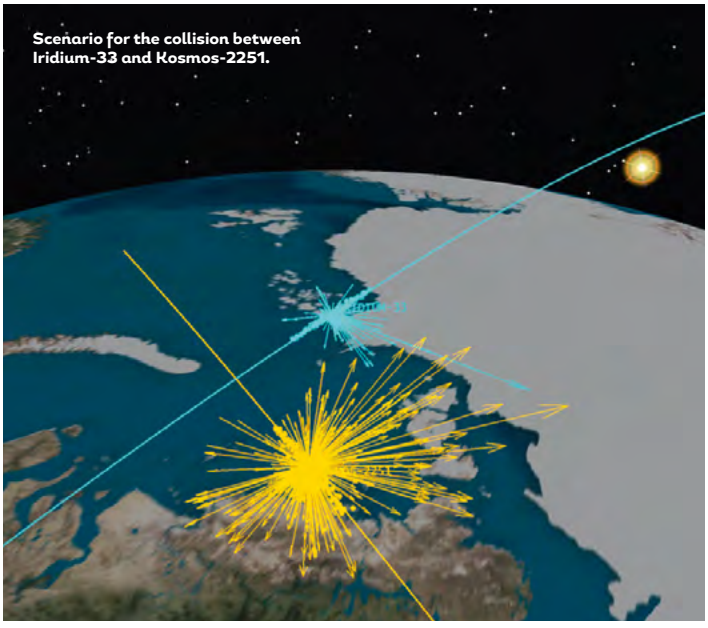
1. World Radiocommunications Conference, scheduled in November 2019 in Egypt.

SPACE TRAFFIC

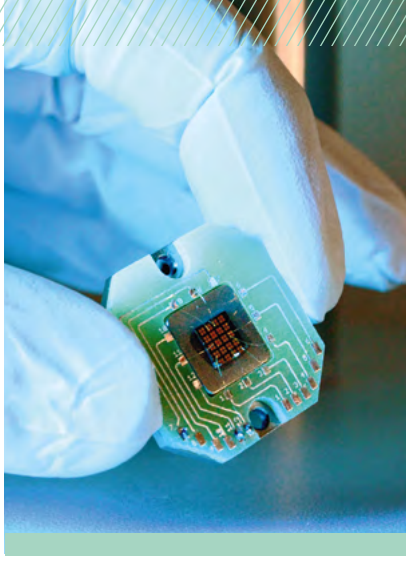
CLOSER COORDINATION FOR EXPONENTIAL RISKS

In 2009, the Iridium-33 and Kosmos-2251 satellites collided, generating a field of 2,000 pieces of debris larger than 10 centimetres to add to those already in space. Such debris still pose a collision risk for satellites operating today. In the years ahead, the situation could become even more critical with the diversification of private players and the growing number of Internet constellations. Given the stakes surrounding sovereignty in this domain, the member states of the EU Space Surveillance and Tracking consortium (EUSST) have adopted a pragmatic approach focused on developing space surveillance and better exchange of information on space objects. A shared database facilitates conjunction assessments, with 129 European satellites already protected notably thanks to CNES's CAESAR[1] service. These efforts are helping to establish closer coordination between operators, and greater transparency and trust between nations.

1. Conjunction Analysis and Evaluation Service, Alerts and Recommendations



Scenario for the collision between Iridium-33 and Kosmos-2251.



QUANTUM COMPUTING

THE REVOLUTION IS HERE

The first quantum revolution has already happened in the shape of the lasers, transistors and integrated circuits inside our computers. Now, the second quantum revolution is underway. Taking advantage of quantum physics, it employs quantum cryptography or encryption to make all communications uncrackable—a very promising capability for sensitive information like financial data, industrial secrets or diplomatic exchanges, for example. China and the United States have already invested in these technologies. In 2018, the European Commission launched its Quantum Flagship Programme to structure applied research and help to mature technologies. The challenge facing quantum communications is distance, which makes satellites the best channel to convey flows on a global scale. What kind of space-based architectures are the best and how to support manufacturers in this highly competitive ecosystem are just some of the questions focusing Europe's minds. Space agencies like ESA and CNES are quite naturally among those looking for answers, notably through R&D.

#COMMUNITY

Every day, CNES engages with you on social networks and you share your thoughts and questions with us. Join the conversation!

@DEPUTECABAREP

LaREM Member of Parliament for the 1st ward of Haute-Garonne / Member of the Foreign Affairs Committee / President of Friends of France-Kazakhstan group / Member of Women's Rights and Equality Delegation (DDF)/ Co-chair of aerospace study group

Successful launch by #Soyuz from @CNES's Guiana #Space Centre of first 6 satellites in the #OneWeb constellation. Bravo! A bold bid ➡️ to bring satellite Internet to every corner of the globe through a mega-constellation 🌍 @OneWebSatellit1

@GILLESPAYEN

Video reporter and writer - Video reporter instructor - Open to job offers - #i4emploiR - - - 📸 IG ~ Founder|CM @ParisCartePost

🚀#Space From positioning to connected objects, @CNES and @NEXEYA_FRANCE are set to launch the first French nanosatellite at the end of the year before orbiting the Kineis constellation in 2021 https://buff.ly/2UGL4s7 v @LaTribune #tech #telecoms #IoT #bigdata #aeronautique

@CONNECTBYCNES

We officially declare the #telemedicine and #ehealth day open. How satellites are helping to bring medical care to all. And we mean all! 😉 @CNES @Medes_IMPS @LafontSandrine

@CAROLEDELGA

President of the Occitanie Regional Council @Occitanie #Pyrénées #Méditerranée #Occitalité #ProduitEnOccitanie #AlimentationOccitanie

The @Occitanie region is stepping up its collaboration with @CNES to craft a data strategy serving aerospace, as well as the regional ecosystem, to support the Internet of Things, autonomous vehicles, climate change monitoring, the environment and agriculture. #PAS2019

Q & A

BRUNO LE MAIRE

MINISTER OF THE ECONOMY AND FINANCE in Édouard Philippe's government, Bruno Le Maire details for CNESMAG what sets the French telecommunications satellite sector apart while emphasizing the need for government and industry to work together to maintain France's technological sovereignty in this domain.

CAN YOU DESCRIBE THE CURRENT FRENCH SATELLITE TELECOMMUNICATIONS LANDSCAPE AND WHERE IT STANDS IN THE GLOBAL ARENA?

Bruno Le Maire: France has two world-leading manufacturers in Airbus Defence & Space and Thales Alenia Space. We also have a major international satellite operator in Eutelsat. These firms are at the pinnacle of a French ecosystem of suppliers and subcontractors that are among the best and most complete in the world.

WHAT PLACE DOES THIS SECTOR OCCUPY IN FRANCE'S ECONOMY?

BLM: Behind the question of telecommunications satellites, it's the whole space industry that's at stake. We need to maintain this broad vision because the health of our manufacturers depends on markets everywhere. Satellite manufacturing might seem a relatively marginal player in the French economy, supporting some 10,000 direct jobs and revenues of around €5 billion. But in fact, space infrastructures have become key assets for whole swathes of the economy. We rely on these infrastructures for weather forecasts and satellite-based geolocation services, for example. So mature orbital systems are vital to the national economy and have a real impact on French citizens' daily lives.

HAS THIS PLACE CHANGED IN RECENT YEARS AND WHAT TRENDS ARE EMERGING? HOW DO YOU SEE THINGS EVOLVING IN THE NEXT 5, 10 AND 20 YEARS?

BLM: The strategic nature of orbital systems isn't going to change in the future, quite the opposite in fact. To come back to telecommunications, today we're seeing a true revolution with the advent of fully flexible satellites that can be reconfigured on orbit by software. This is paving the way for series production of satellites as commodities, with sharp reductions in unit production costs achieved through optimized industrial processes. Over the next 10 to 20 years, we could see a radical transformation of this sector, potentially with leasing companies and second-hand satellites, as is already the case for civil aviation.

WHAT ROLE HAVE DIGITAL TECHNOLOGIES PLAYED HERE AND HOW IS FRANCE GEARING UP FOR THEM?

BLM: Digital technologies have played and continue to play a major role in the space industry's development. Digital telecommunications payloads are enabling more flexibility, digital production lines are necessary to drive series production and the digital transformation of society is fuelling growing demand for connectivity. For example, satellites are key to delivering fast-broadband Internet to not-spots and for mobile connectivity. The French government is working actively in all of these areas. Cases in point are the very-high-throughput satellite plan, the plan supporting the industry of the future and the Konnect satellite designed to bridge the digital divide.

MORE BROADLY, WHAT ARE THE STRENGTHS AND WEAKNESSES OF THE FRENCH TELECOMMUNICATIONS SATELLITE INDUSTRY IN THE COMPETITIVE GLOBAL MARKETPLACE?

BLM: This sector has many assets, such as its technological excellence, exceptional human talents, two prime contractors leading a broad-based ecosystem of top-flight suppliers and subcontractors, and strong government agencies like CNES and ONERA[1]. What sets it apart is that it's strongly exposed to a highly competitive commercial

"SPACE INFRASTRUCTURES HAVE BECOME KEY ASSETS FOR WHOLE SWATHES OF THE ECONOMY."

BRUNO LE MAIRE

MINISTER OF THE ECONOMY AND FINANCE

"OUR SPACE INDUSTRY RUNS THE RISK OF LOSING ITS RANK."

market, unlike its U.S. or Chinese competitors, who benefit from domestic institutional demand. This situation is firing French firms' innovation and creativity, which I believe is another big advantage.
Despite all of these assets, our space industry runs the risk of losing its rank. We've seen the emergence of a host of new players like SpaceX, the development of projects to launch mega-constellation of satellites into low Earth orbit—none of them European—and most recently the launch of the first commercial space tug, also developed in the United States. More and more nations are showing an interest in space and looking to acquire their own launch capability, there's a growing risk of militarization of space and the race to the Moon and Mars is stoking the rivalry between the United States and China. All of this suggests to me that these deep transformations of the space sector are only just beginning.
We're not adapting quickly enough to these shifts, which call for a strategic vision shared by industry and governments at European level. ESA's governance rules were set to further scientific cooperation, not to respond rapidly to competitive developments driven by disruptive technologies and business models. What's more, in spite of recent advances, Europe's leading powers are still finding it hard to agree on a truly optimized industrial organization at European scale. It's together that governments and industry must respond to preserve our technological sovereignty in space.

WHAT ROOM FOR PROGRESS DO YOU SEE IN TERMS OF COMPETITIVENESS AND HOW COULD WE ACHIEVE THAT?

BLM: We need to work together to fuel development of technology building blocks for the future, to spawn new applications of satellite data to support private demand for orbital systems, and above all to continue optimizing Europe's launcher and satellite industries.

WHAT SPECIFIC ROLE DO YOU THINK AN AGENCY LIKE CNES HAS TO PLAY IN THIS SECTOR?

BLM: CNES must be central to the transformation of the national space sector and gear itself to accompany these changes. For example, I think CNES can increase its impact in supporting emerging technology building blocks and in spinning off technologies to the private sector. It could also emphasize its oversight role as a prescriber of institutional needs, while handing more responsibility to prime contractors. And lastly, it could certainly look at how to better coordinate its actions with those of ESA in response to the challenges facing the sector.
I expect CNES to be a driving force shaping the future in all of these areas.

1. Office National d'Etudes et de Recherches Aérospatiales, the French aerospace lab

Profile

2010-2012
Minister for Agriculture, Food, Fisheries, Rural Affairs and Land Planning

2009-2010
Minister for Agriculture, Food and Fisheries

2008-2009
Junior Minister for European Affairs

FORDISM IN LOW EARTH ORBIT

Taking its cue from the business model first employed in 1910 by Henry Ford to build cars, U.S. firm OneWeb is series-producing satellites on three automated digital assembly lines, one of which is in France and was developed with Airbus. Each line builds two 150-kilogram satellites a day, shown here in testing, optimized to operate for exactly five years. The first six satellites in the fleet were launched in February this year from the Guiana Space Centre. Soon, a constellation of 648 comsats in low Earth orbit will offer low-latency connectivity anywhere in the world. If the system proves profitable, other giga-constellations are already waiting in the wings.

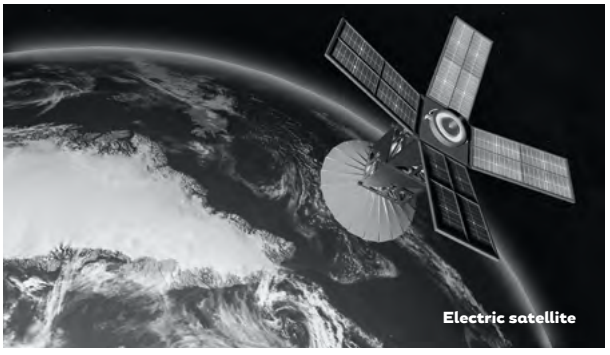
A BALLOON THAT ISN'T ALL IT SEEMS

Loon isn't a giant jellyfish but rather a type of stratospheric balloon released in clusters by Google. The aim is to bring high-speed Internet to the remoter regions of the globe. Drawing its inspiration from the 'pumpkin' balloon developed by CNES, Google had the great idea of making its balloon manoeuvrable to keep it aloft over the same zone, at an altitude of 16 to 21 kilometres, for 100 days. How? The main envelope, inflated with helium, has a second balloon inside filled with air. Riding the winds with the aid of some amazing algorithms, the balloon descends by adding air and vice versa. CNES was quick to offer its balloon expertise to Google, which has given it the opportunity to qualify sensors for the Strateole project on Loon.

FAST-BROADBAND PLAN FRANCE

This plan aims "to bring good connection speeds to all by 2020, fast broadband in 2022 and ultimately Gigabit-per-second (Gbps) connectivity by 2025". **Satellites will naturally fill the gaps in terrestrial infrastructures in so-called 'not-spots' and underserved areas. The Konnect very-high-throughput satellite will be actively contributing to the plan's objectives. With speeds of 500 Gbps in Europe, the system will be able to deliver fast-broadband Internet services at a price comparable to that of terrestrial offerings. At the same time, the project will be showcasing French industry's know-how for future export sales.**

PRODUCT LINES



Electric satellite

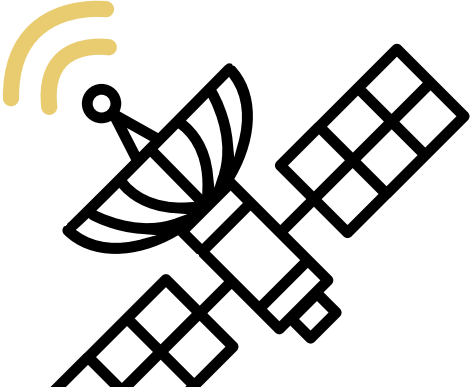
Electric propulsion offers additional payload capacity for operators, while manufacturers are also leveraging it to create new product lines. Under the 'Electric- propulsion satellite' budget line of the government's second future investment programme (PIA2), a line of intermediate electric spacecraft buses called Eurostar EOR has been developed. Not only has this bus supplied the first electric-propulsion satellite solution, it has also made it possible to carry three payloads on the same platform, including an innovative K_u-band multi-beam payload designed to support inflight broadband Internet services. Such increased capacity brings substantial gains in competitiveness for operators. The development of these product lines is a perfect illustration of the great partnerships CNES is forging with industry.

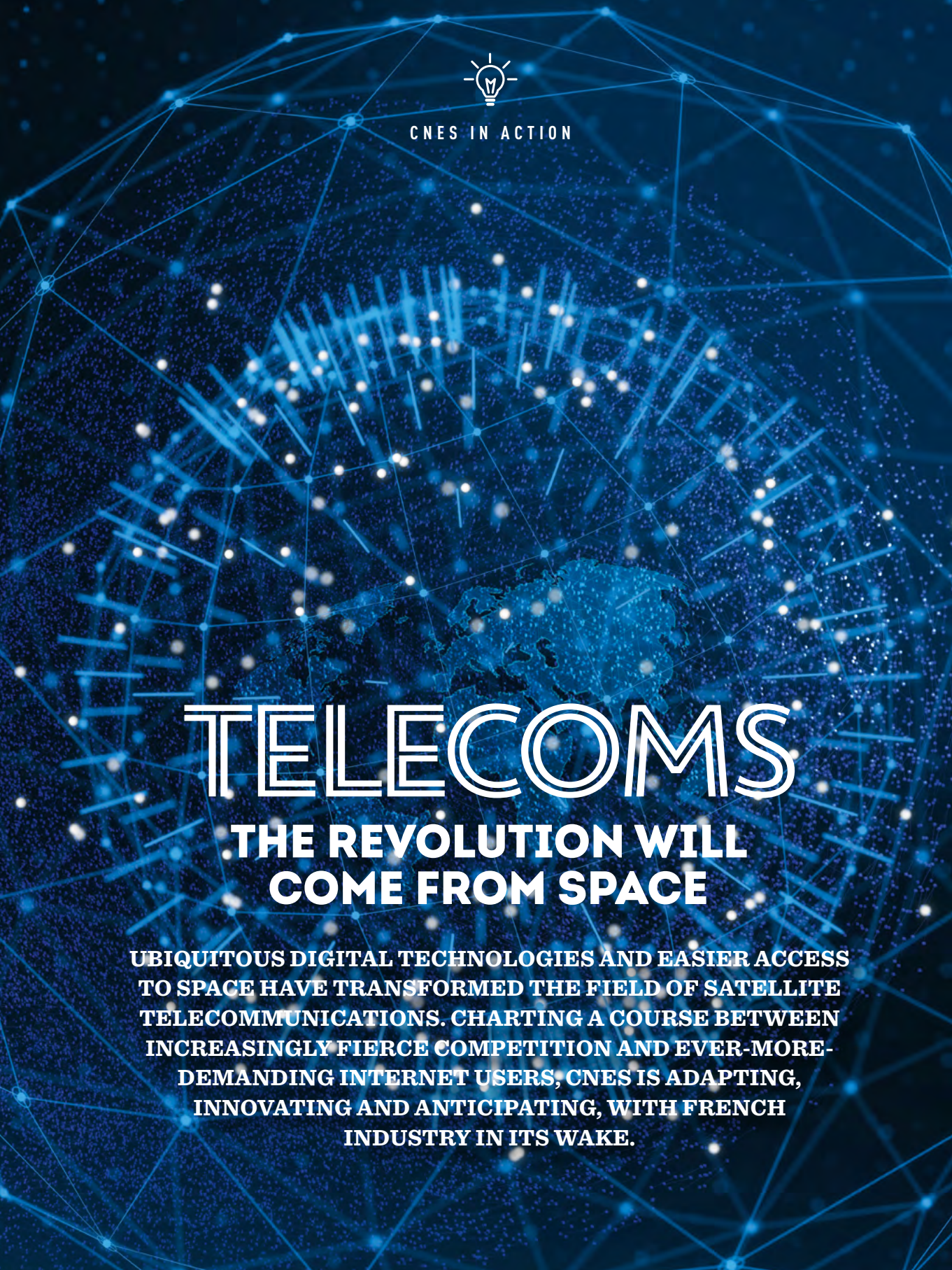
5G

Why 5G? Firstly, because it's the fifth generation of mobile phone standards, and secondly, because operators want to capitalize on five of its features: speed, latency, network coverage, capacity and density. 5G is expected to pull together mobile and landline telecommunications networks, spanning 2G, 3G, 4G, fibre, cable and satellite.

3%

Estimated number of French homes that won't have landline access to broadband before 2035, for whom satellite broadband is designed.





TELECOMS

THE REVOLUTION WILL COME FROM SPACE

UBIQUITOUS DIGITAL TECHNOLOGIES AND EASIER ACCESS TO SPACE HAVE TRANSFORMED THE FIELD OF SATELLITE TELECOMMUNICATIONS. CHARTING A COURSE BETWEEN INCREASINGLY FIERCE COMPETITION AND EVER-MORE-DEMANDING INTERNET USERS, CNES IS ADAPTING, INNOVATING AND ANTICIPATING, WITH FRENCH INDUSTRY IN ITS WAKE.

In 2018, four billion people were estimated to be using the Web. And we ain't seen nothing yet! This trend is likely to continue in the years ahead as 5G, 6G and even 7G kick in—provided of course that coverage can be guaranteed and extended using all terrestrial and space-based assets. CNES's R&D initiatives have always fuelled innovations to benefit users and French industry alike.

SPACE AS A GO-TO ALTERNATIVE

From their orbital perch 36,000 kilometres above our heads, telecommunications satellites have been instrumental in popularizing CNES's activities. For example, from 1984 to 1996 the agency launched no fewer than seven satellites for France Telecom subsidiary Telediffusion Française (TDF). These initial orders were publicly funded, but with the arrival in 1990 of pay television 'bouquets', commercial considerations took precedence over institutional needs as operators were privatized. From 1994 onwards, the large-scale deployment of cable and fibre to support a landline Internet service left many areas unserved. CNES stepped into the breach with space solutions to complement this terrestrial service, immediately helping to bridge the digital divide. But that's not all. Emergency response teams operating in the remotest regions of France, telemedicine and video-assistance in retirement homes in rural areas and the International Charter on Space and Major Disasters all rely on satellite telecoms too.

ACTIVELY SUPPORTING INDUSTRIAL COMPETITIVENESS

Today, "*the space sector is experiencing a seismic shift driven by the digital revolution, miniaturization of technologies and cheaper access to space*," explains Jean-Pierre Diris, who heads CNES's telecommunications and navigation projects sub-directorate. All of these factors are stoking competition and "*forcing space to reposition itself within broader ecosystems*," he says, so it's no surprise that space features prominently in the national fast-broadband plan (see p. 18) launched by the French government in 2013 to boost the economy. CNES is investing in research and development of high-added-value technology building blocks to benefit industry and the French space ecosystem. The THD-Sat project, for example, combines a number of technology 'nuggets' (see p. 23) and its innovations will be reinvested in the Konnect VHTS satellite for European operator Eutelsat. At the same time, the agency is also assisting constellation projects like OneWeb (see. p.16), which proposes a new approach to delivering fast-broadband Internet service.

SPANNING THE VALUE CHAIN

In this new landscape governed by the need to stay competitive, CNES is taking its role very seriously. "*Contributing to the development of the nation's economy is in CNES's*

DNA," stresses Jean-Pierre Diris. Besides technologies, the agency is also helping to shape the broader national strategy, channelling and verifying the effectiveness of government funding like that from the PIA future investment programmes (see p. 7) through a systems approach spanning the complete project chain. With its intimate knowledge of the economic stakes of space, it is helping industry to make the right technical choices and fuelling cross-fertilization of innovations to nurture new applications.
Just like satellite coverage, CNES doesn't stop at borders. As a leading member of ESA, it's involved in numerous initiatives like the ARTES and Satellite for 5G programmes (see p. 6). And it's setting its sights on the future with optical and quantum technologies and new kinds of satellites (see p. 8 to 11) that will redefine how we communicate.

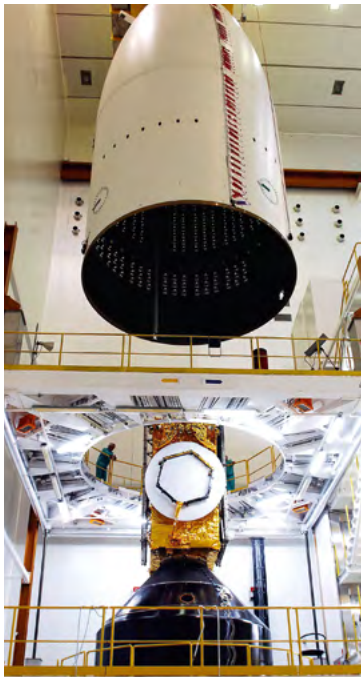
50%

Despite
a significant drop in orders for telecommunications satellites (see p. 10), prime contractors Thales and Airbus hold a 50% share of the global commercial geostationary satellite market.

MILITARY TELECOMS

SAFE FROM PRYING EYES

The military, for whom secrecy and security of intelligence are vital, are also heavily reliant on bandwidth. As its partner, CNES works to the very strict specifications of DGA, the French defence procurement agency, when designing military satellites. This was the case for the Syracuse series of satellites that have been delivering secure communications in external theatres of operations for more than 30 years and supporting national security. Newer generations offer strong resistance to jamming and much faster connection speeds. And dual-use civil/military satellites have proved their worth for less sensitive missions. For example, Athena-Fidus—a joint effort of France and Italy launched in 2014—not only provides back-up for military satellites but also serves the needs of institutional users requiring secure satellite communications, such as civil protection agencies, the police and anti-terrorist squads.
The European Union is also keeping a close eye on sensitive communications between its member states conveying confidential information on humanitarian aid, emergency response and diplomatic communications. It is working on the GovSatCom project to pool and share information between European nations that will be able to serve certain institutional objectives like the Common Security and Defence Policy (CSDP) or the European Border and Coast Guard Agency (Frontex).



The Syracuse 3 military satellite is encapsulated inside its fairing.

CHALLENGE

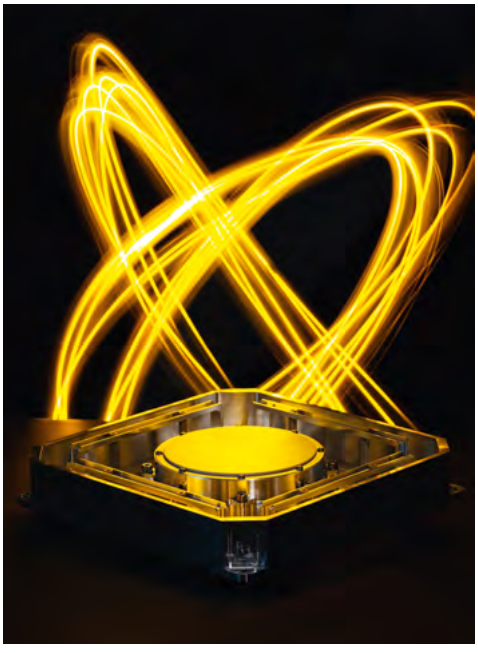
NEW WAYS OF CONNECTING, ANYTIME, ANYWHERE

Telecommunications users' expectations in terms of speed, availability and ubiquity are higher than ever before; meeting them while keeping pace with the fiercely competitive giants of the digital age is the challenge now facing the space sector.

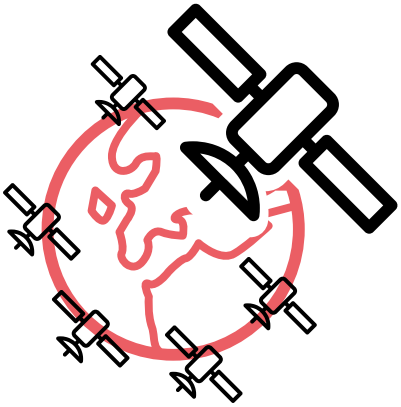
Today, we no longer simply want to speak on the phone. Telephony services are only a small part of what users want; they're more interested in receiving news in real time and being able to buy things on line with secure payment, from their homes, when on the move and abroad. How are they connected? By cable, fibre or satellite? And in the future by balloons or drones? They don't really care. With 5G (see p. 7), people will get a 'transparent' service, i.e., without knowing what technology or supplier is delivering it. This is the context to which French industry must adapt to survive in the face of fierce competition, in particular from the GAFA giants (Google, Apple, Facebook and Amazon) who are challenging regulatory constraints and data protection rules. Without strict regulations, the use of certain frequency bands (see interview with Alexandre Vallet in the digital version of CNESmag) could interfere with Earth remote-sensing or weather satellites. By moving into the telecommunications infrastructure market, these new players could seriously impact it with their global-scale projects.

BOOSTING CONNECTION SPEED

To help French industry keep pace with the competition, CNES has made the requirement for 'anytime, anywhere' connectivity central to its R&D efforts. Its priority is to boost connection speeds, and the higher the frequency the faster the connection. New generations of communications satellites will therefore use the Q/V and K_a bands (see p. 9) to increase satellite bandwidth to up to one Terabit per second. Payloads will benefit from a range of innovations such as beam sampling. Optimized transmission and new standards are also crucial advances to satisfy tomorrow's Internet users. These cutting-edge technologies are already available for manufacturers to respond to operators' requirements. While geared towards fast-broadband Internet, they will also enable more-flexible solutions tailored to market needs—and galvanize the recovery we are starting to see.



Telecommunications antenna on the ANGELS nanosatellite.



PERFORMANCE
THE MANY FACETS **OF SPACE**

Whether via very-high-throughput satellites, flexible payloads or constellations, space offers a plethora of solutions for current and future shifts in the market. The common denominator in all of them is innovation.

Geostationary telecommunications satellites were designed in the first place to transmit data and voice. However, they are not as good at delivering certain Internet services, given the latency created by double signal round-trip times. Several avenues are being explored to resolve this issue.

INTERNET FIRST IN LINE

THD-Sat is a high-tech programme funded through the Digital Economy budget line of the French government's PIA future investment programme. It's designed to identify technology building blocks geared towards meeting Internet requirements. Konnect VHTS, a very-high-throughput satellite ordered by Eutelsat in 2018 in partnership with French operator Orange, is set to benefit from this effort. This satellite

Konnect VHTS satellite.

is one of the most ambitious responses to bridging the digital divide. Built around a Spacebus Neo platform supporting an instant bandwidth of around 500 Gpbs, it will be carrying completely unique instruments that are the result of 10 years of research and development at CNES. Its innovations—electric thrusters, a fast-broadband digital processor, active thermal control and multi-beam K_a-band and Q/V-band antennas—are exceptional. Konnect VHTS will extend Internet coverage to hundreds of thousands of homes in remote regions, offering services and performance equivalent to optical fibre.

CONSTELLATIONS TO THE RESCUE

To reduce latency for the most time-critical applications like on-line gaming or high-frequency trading, near-Earth constellations are seen as the solution. Formed of communications minisatellites in low Earth orbit (1,000 kilometres) like OneWeb (see p. 16) or balloons like Loon (see p. 17), these constellations have the advantage of reducing the distance travelled by signals and therefore the latency. Another advantage is the protection they offer against acts of aggression, as it would be hard to destroy an entire network of hundreds of thousands of satellites. However, because the satellites are in non-synchronous orbits, a large number of them are needed to assure continuous service. SpaceX and Amazon have impressed the world market with announcements for constellations of several thousands of satellites. But Europe isn't lagging behind: with CNES's support, French manufacturers have already launched the first six prototypes of the OneWeb fleet that ultimately plans to operate 648 minisatellites in the 150-kilogram class.

AGILITY IS THE NEW WATCHWORD

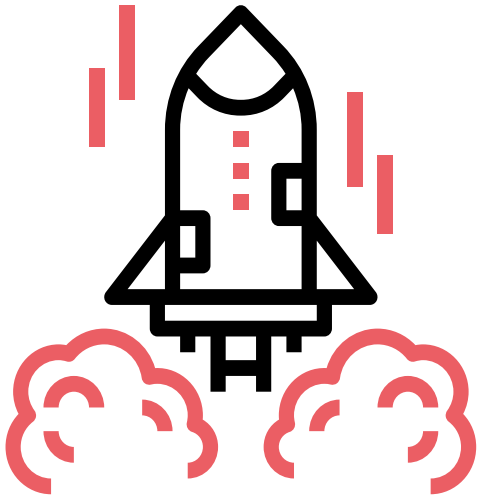
In such a fast-changing sector, CNES is planning for the long term and looking beyond the horizon. The idea of a generic, multi-service low-cost satellite—in a word, a flexible one—is gaining traction. What operator wouldn't dream of having a satellite able to reconfigure itself on orbit and adapt to demand in real time? That kind of agility requires new technologies first identified by CNES more than ten years ago. In the late 2000s, it initiated two ambitious programmes, FLIP and FAST, to support their development. These precursor programmes nurtured innovative flexible satellite solutions like Space Inspire™ from Thales Alenia Space, a line of all-digital satellites weighing around two tonnes and capable of switching mission in orbit. These satellites are now commercially available.

Airbus Defence & Space is also poised to test flexible solutions with historic UK operator Inmarsat. OneSat, a 'ready-to-fly' electric spacecraft bus, could transform the market with its ability to be reconfigured in orbit thanks to onboard processing and active antennas. These satellites will allow the operator to adjust coverage, power and channels in near-real-time to match operating requirements.

17

Electric propulsion

is bringing a new lease of life to the space industry. With government funding, 17 satellites are currently in construction or development for public and private operators.



LAUNCHERS
ADAPTING **SUPPLY**

The communications satellite and launcher markets are closely intertwined. To stay competitive, France's launcher offering also has to reconcile shorter times to orbit with lower costs.

At the Guiana Space Centre, one-third of launches are today for government customers and two-thirds for commercial orders, chiefly for telecommunications. CNES and ArianeGroup are keenly aware of the seismic shift in the world satcom market and are adapting to new commercial requirements. For this, they have a trump card up their sleeve called Ariane 6. Modern communications satellites are lighter than their predecessors, the new norm being closer to three tonnes. And Ariane 6 is more than just a clone of previous generations of launchers, as it was designed from the outset to meet current market requirements.

Ariane 6.

To get satellites into final operating orbit faster, the first critical point was their transfer orbit. Work initially focused on using different orbits. "*With restartable engines and fuel control systems, we now have the technical capability to inject satellites into low Earth and medium Earth orbits, thus providing more launch opportunities*," explains Jérôme Vila, head of CNES's Future and Innovation for Launchers sub-directorate. This move has been successful, with satellites now launched directly into their final orbit, "*saving time and money for operators*," he says.

The expertise acquired from the Ariane series is also an advantage in bringing down launch costs. "*We're not starting from a blank page; we know how to build an effective launcher*," adds Vila. The time savings will automatically have a knock-on effect on launch costs.

Last but not least, launch rates will also be crucial, as the future lies in launching constellations like OneWeb (see p. 16). The first six experimental satellites in this constellation have already been sent into orbit from French Guiana. ArianeGroup is pursuing a new 'custom' strategy predicated on distributing satellites and managing multiple launches into several orbits towards different destinations. Depending on how satellite mass evolves, solutions based on electric propulsion and/or ridesharing are also envisioned.

2/3

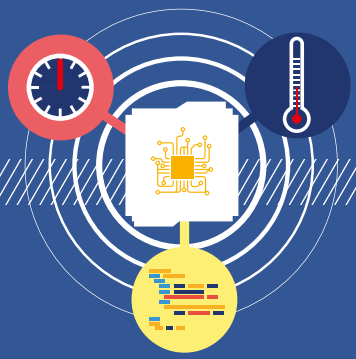
Commercial telecommunications satellites
account for two-thirds of Ariane launches.

FLEXIBILITY

THE MAGIC OF DIGITAL

FIFTEEN YEARS IN ORBIT IS A LONG TIME, LONG ENOUGH FOR NEEDS TO CHANGE COMPLETELY. Luckily, digital technologies are now giving communications satellites the unique ability to fully reconfigure themselves on orbit and change their mission, for example switching from TV broadcasting to Web services—ideal to quickly grasp new commercial opportunities. In practice, a digital payload transposes microwave signals into series of bits that are processed onboard before being converted back into analogue format for transmission to users. This feat of technology is made possible by miniaturized components packed with intelligence and consuming very little power. This same process is enabling smaller, active antennas capable of forming multiple beams to widen coverage, which until now has been fixed, and adapt it to network traffic.

Silicon wafer from which chips constituting the core of ASIC components are fabricated.



OBJECTIVE

ARGOS **FOR THINGS**

If we replaced animals with objects, Argos would be making its presence felt in IoT. This is precisely what Kineis aims to do, enhancing the system to maintain its environmental mission while capturing new commercial applications. For that, it has three tools: a constellation of 25 nanosatellites, a miniaturized Argos instrument reduced in mass from 30 kilograms to just 2 kilograms, and new mini-transmitters. The constellation architecture will mean shorter revisit times, allowing Kineis to offer positional fixes every 15 minutes by 2022 rather than every two hours today.

UNIQUE

SMALL SIGNAL, **BIG ON AUTONOMY**

Kineis's unique selling point is its small, easy-to-use transmitters. Their mini-chips send a limited amount of data and as a result consume very little power. This system is sufficient to send positional information and data acquired by a sensor, like for example a temperature or pressure reading. Satellites operating in low Earth orbit serve as a relay for transmitters. Kineis is looking to increase its base of some 20,000 transmitters today to two million within the next ten years.

TIMELINE

IMMEDIACY AND PERFORMANCE ARE THE RULE IN TODAY'S WORLD, AND TELECOMMUNICATIONS ARE NO EXCEPTION. FOLLOWING IN THE FOOTSTEPS OF THE FAMOUS ARGOS[1] SYSTEM AND BOOSTED BY A CONSTELLATION OF 25 NANOSATELLITES, KINEIS HAS THE INTERNET OF THINGS (IOT) IN ITS SIGHTS, A MARKET ESTIMATED TO COVER 30 BILLION CONNECTED OBJECTS BY 2020.

1. Argos is a satellite-based location and data collection system dedicated to environmental monitoring.

UTILITY

APPLICATIONS **GALORE**

Agriculture, fishing, logistics and pleasure boating are just some of the sectors set to benefit from this low-cost tracking system. Looking for connected solutions for industry, like for example digital technologies to support task automation, Objenious by Bouygues Telecom and the Wize Alliance (SUEZ, GRDF, Sagemcom, etc.) have already signed a partnership agreement with Kineis. In a different domain, extreme sports enthusiasts will like Kineis Adventure, a lightweight positioning kit with an autonomy of nearly one month—against two days until now—and a Sarsat distress beacon.

FOUNDATION

PERFORMANCE **MADE IN FRANCE**

Kineis is a subsidiary of CLS (Collecte Localisation Services), the Argos operator formed in 1986 by CNES. The agency is today seconding an integrated project team to turbocharge the company's development, leveraging its latest technologies. Hemeria (formerly Nexeya) is building the 25 nanosatellites around the ANGELS cubesat bus (a CNES demonstrator), while Syrlinks is supplying the miniaturized Argos instruments. To support the system architecture, Thales Alenia Space is developing the mission centre, ground stations and payload software.

CHRISTOPHE OUTIER

Director of Development and External Affairs at NordNet

"New usage trends require greater speed and bandwidth. If you live in an outlying area, satcoms is the only solution."

The customer, as they say, is king—and Christophe Outier is like the king's 'wine taster' of telecommunications, testing new technologies before we buy and consume. "*When people move house, the first question they ask is what kind of Internet connection they'll get at their new address.* ***As an Internet service provider, our job is to meet the needs of domestic and business customers by leveraging the best technologies available at the point of delivery—whether fibre, ADSL, wireless or satellite."*** It's a package of technologies recognized by the French government, which has certified NordNet's offering and provides financial support for satellite solutions, depending on the location. Christophe Outier was one of the first to join this Orange subsidiary, formed in 1995 with the Web and now a market leader in satellite Internet access in France. He remembers the keys that unlocked this market: "*The technology was finally made available to everyone in 2008 with easy-to-install connection kits and affordable prices. Subscriptions included a whole package of services at market prices, with Internet, television and landline and mobile telephony.*" ***The next revolution was connection speeds. These have hugely increased in 10 years, thanks to improvements in hardware and new K_a-band satellites, which as well as higher throughput have also introduced the concept of unlimited traffic. "*** *That's been the big news in 2019,*" he continues, referring to the unlimited high-throughput satellite package launched by NordNet in May.Often in contact with satellite operators to convey subscriber expectations, Christophe Outier also hails CNES for its outreach work to promote satellite solutions: "*Forewarned is forearmed, as they say!* ***Pending the full roll-out of fibre, or as a back-up solution, satellite telecommunications offer ease of use, security and openness to the rest of the world."***

FRANÇOIS GAULLIER

Senior Vice-President Telecommunication Satellites for Airbus Space Systems

"New, more flexible satellites will help boost capacity before the advent of optical connections..."

Newly hired by Matra to work on human factors for the Hermes spaceplane, François Gaullier was told on his first day that the project had been cancelled. **So he turned to satcoms, working in engineering, projects and then production, while Matra progressively became Airbus Space Systems—a global leader in this sector.** *"In 2019, we've won 6 of the 10 contracts in the open market,"* says Gaullier with satisfaction, now in charge of the entire satcoms line. Like his counterparts, he's seeing a "*sector in rapid transformation, with an upturn driven by the arrival of new products with in-orbit configurability.*" **Airbus offers this kind of in-orbit flexibility with the OneSat product line, with the first three satellites planned to launch in 2023.** Featuring a standardized design for geostationary orbit, these satcom satellites, weighing around three tonnes, can be developed rapidly and built in just 18 months. To achieve this, Airbus is tapping into its experience with OneWeb, for which it designed the satellites, and its Toulouse production unit. But the company is still pushing its flagship products: "*Large geostationary satellites take 24 to 42 months to build, but they're fine-tuned for a specific mission, whereas smaller standardized satellites give us the flexibility we need in new and emerging markets.*"
CNES's support is vital for achieving and maintaining French leadership, and François Gaullier says "*cooperation is needed at a very early stage around the requirements of future missions and the technologies, so when the time comes we'll be ready.*" And there are many opportunities ahead. In the new markets opening up with the arrival of 5G, satcoms are set to play a major role. **Looking further ahead, Airbus as an aircraft manufacturer will be able to leverage its space segment to offer optimized solutions for in-flight connectivity.** By 2025, François Gaullier says satcom satellites will use "*optical connections, instead of radio, where the frequency spectrum is already relatively saturated, to massively increase capacity.*"

PASCAL HOMSY

Executive Vice-President of Thales Alenia Space's Telecommunications business

"We have to move away from a case-by-case model..."

After graduating in 1991, Pascal Homsy was wavering between aviation and space when he was strongly recommended to choose space—because, he was told, "*there'll be work for at least 20 years!*" Good advice! **And he has so excelled in telecommunications that Thales Alenia Space appointed him earlier this year to head up its fast-moving telecoms business.**

"*The market has been dominated by television, which is shifting from linear to video on demand,*" he says. "*We think it'll peak in 2022, when it'll be overtaken by mobility and the Internet of Things, driven by the arrival of 5G.*" For 5G read ultrafast mobile broadband able to interconnect and control billions of devices and set to become the new global telecommunications standard. "*This means* ***telecom satellites will be an integral part of the 5G infrastructure, delivering services alongside terrestrial coverage or where it's patchy or non-existent.***" To this end, Thales Alenia Space has unveiled its new Space Inspire™ (INstant SPace In-orbit REconfiguration) line of ultra-flexible satellites for low or medium Earth orbit. Weighing around two tonnes, they're fully reprogrammable to adjust coverage and/or orbital position. "*Their capacity can also be partitioned to serve multiple customers, and their high degree of standardization means we can build six to eight satellites a year—more than with conventional satellites.*"

At a time when many telecom satellites are reaching the end of their lives and operators need to replace them, France is home to two of the three industry leaders—not to mention CNES. "*CNES has been crucially important to our development programmes, helping us to achieve undisputed leadership in the VHTS segment—extremely powerful satellites for some of the largest flying objects. Now, more than ever, we need CNES to help us finalize Space Inspire and launch the first craft in 2022.*"

Jacques Arnould,
science historian
and theologian,
CNES ethics officer.

ETHICS CORNER

JACQUES **ARNOULD**

CONSPIRACY

Seemingly unhindered by all obstacles—both spatial and temporal—never have we communicated so much with one another, while also running the risk of ignoring our fellow humans!

From the ancient Greek meaning 'far off', the prefix *tele* has come to be associated with technologies that close the gap in space and time. "*Here is no more, everything is now…*" In this pithy phrase, French thinker Paul Virilio summed up the essence, principle and function of the telecommunications technologies we take for granted today, as well as remote observation and surveillance. These systems—these powers—in many ways embody what our forebears attributed to the inhabitants of the celestial vault, whether gods, angels or demons: ubiquity, instantaneity, immediacy, simultaneity, omnivoyance and omnipotence.
And when these systems happen to move in space, the resemblance becomes all the more uncanny: are we ready or able to take on the responsibilities that come with such powers?
The network that now girdles the Earth, enabling us to be always connected and communicate with previously unimaginable ease and speed, bears out what Canadian philosopher Marshall McLuhan claimed many years ago: the 20th and now 21st centuries have built a reality where we readily talk about a 'global village' or a planetary 'sphere of reason'—or 'noosphere' to coin the term popularized by thinkers past. But is this actually the case?

INDIFFERENCE? NO THANKS!

Clearly, we've closed the spatial and temporal gaps, but not without the risk of conjuring away the all-important sense—the tangible, perceptible way we engage with other people and things—in favour of 'virtually' experiencing them. "*Without an immediate perception of reality,*" writes Virilio, "*there's a terrible imbalance between what we understand and what we physically experience.*" An imbalance from which symbolic practice had previously protected us. Indeed, while symbolism sets up a distance between people or with reality, it doesn't overcome that distance. Conversely, it gives it meaning and significance by creating a conspiracy around what we feel and understand. And such a conspiracy should inform the development of our communication systems. Communicating—especially remotely—should therefore ensure we avoid any 'desertion' from the real world, or confusion of anything else for it. Both those cases are a rejection pure and simple of the other, or in other words an invitation to insensitivity and indifference. Maybe, then, we feel the shame described by Peter Sloterdijk: "*the fact of not having propelled enough against the ubiquitous debasement of the physical, living other*". How can we not insist that our technical advances spare us from such shame?!

CESARS

Expert advice on satellite telecoms

You could be an industry professional, company director or other specialist in your field but know nothing about satellite telecommunications. Yet whatever your sector of activity or volume of business, you can't do without telecoms. So, what to do when there's no network, coverage is patchy or connection speeds are slow? For the answer, look skyward! CNES is helping businesses and public-sector organizations with CESARS. Our team of expert engineers is on hand to listen to your needs, determine the best satellite solutions and point you to the right service provider. Want to see it working? We have a complete technical demonstrator and can run tests in real-life conditions, either remotely or at your premises. CESARS is open to all and free (up to a maximum of 10 days a year).

SYMPOSIUM

INTERNATIONAL TECHNICAL SYMPOSIUM ON NAVIGATION AND TIMING

After five years of success, organizers CNES and the ENAC civil aviation engineering school are bringing a new dimension to the ITSNT symposium. The two-yearly symposium is associated with the Toulouse Space Show currently scheduled for the spring of 2020.
The first new-format ITSNT will be part of the very first event at the newly opened MEETT exhibition and convention centre in Toulouse. This exceptional venue allows a greater number of sessions and participants, further extending its influence.

MORE DETAILS AT **WWW.ITSNT.FR**

TELEMEDICINE

A HASSLE-FREE SOLUTION

The French government has allocated €40 million to extend access to telemedicine at residential care facilities for the elderly. But for telemedicine to work, you need telecoms. So what about outlying areas, where connection speeds can be too slow? Simply sign up to a satcom provider and enjoy high-data-rate connectivity anywhere in France. If finding the right solution is proving tricky, CESARS (see opposite) is here to help.
Freeing up the emergency services isn't the only benefit of telemedicine at residential facilities for the elderly. It means they don't have to travel to appointments, which ties up a carer as well. It also enables more regular follow-up of residents, making for better health and wellness. The pilot at the care facility in Bizanet near Narbonne can be reproduced anywhere in France. Installation takes a few days and high-speed access costs just tens of euros a month.
In addition, telemedicine could be extended to other communities and residents in traditionally 'closed' environments. Lannemezan prison, for example, now has a satellite link. Sick or injured inmates can be diagnosed and monitored on-site, thereby avoiding transfers to an outside hospital, with all the risks and security measures that go with it.

SPECIALLY ADAPTED COMMAND POST

When a fire destroys everything in its path, or the streets become a river of mud, the authorities must act fast. But they also need to gather, analyse and share information. This is the role of the emergency operations command. From a command vehicle, the team provides operational and technical support, including communications. To do this, they need a fast-enough Internet connection to videoconference with the country's interior ministry, local government and other authorities.

The Maine-et-Loire fire and rescue service in France attends around 40,000 incidents a year across a vast rural area, where floods are a regular occurrence. The service has recently invested in two new command vehicles to enable a faster and more effective response. The onboard equipment is designed to integrate with the intelligence chain for all types of situations, from well-connected urban districts to outlying areas where coverage is patchy or non-existent. Via the satcom antenna, responders have access to the full range of telecommunication services: telephony, Internet, video exchange and videoconference functionality. They also have all the IT equipment they need, since this mobile command post boasts a satellite link, 3G/4G connectivity and Wi-Fi hotspot. The service made an informed choice and now has exactly the capabilities it needs thanks to the help of the CESARS team (see p. 34). *"CNES's expertise was vital for determining our requirements,"* says fire chief Nicolas Quélin. *"The recently delivered vehicles are a perfect fit for our purposes."*

DIARY

NOVEMBER 2019
World Radiocommunication Conference
Sharm el-Sheikh (Egypt)

RENDEZ-VOUS

NetSat Day

Organized by CNES's Network Access Unit, NetSat is a showcase of the latest research in satcom ground segments. Radio resources, transport protocols, optimally secure communications, integration of satellite telecoms into global networks and more—the event is designed to foster effective collaboration, and proved a great success last year. In 2020, it is scheduled to be one of the side events at the Toulouse Space Show.

SMALL CIRCUIT, BIG SUCCESS

Oxford is the name of a chip devised by CNES that will soon be a key component of your terminals and decoders. Its job will be to bring you the full benefits of fast broadband. CNESmag explains.

Tomorrow, satellites will be bringing fast broadband to every corner of the Earth. But to be able to experience its full benefits, your terminal or decoder must be able to receive the signal in optimum conditions. After scouring the European and commercial-off-the-shelf markets without success for the 'silver bullet' able to optimize fast-broadband reception, CNES specified and mandated development of a multi-channel chip called Oxford. ASIC[1] manufacturer STMicroelectronics was chosen to fabricate this mini-circuit after years of research and development work.

CNES COMING TO YOUR DECODERS

Funded under the government's PIA future investment programme, Oxford's aim was to offer a high-performance circuit that could be integrated in consumer terminals at a cost of a few euros. The chip uniquely bears the CNES logo alongside that of its fabricator, a first for a space agency in the commercial market. Oxford has been an immediate success and is set to feature in most satellite Internet terminals and decoders. It has also won plaudits in world markets. Far from resting on its laurels, CNES is already working on the second generation of Oxford to keep pace with the evolution of the DVB standard, but with the same goal of developing a low-cost chip to serve consumer markets. The objective is to anticipate the arrival of 5G and growth of Internet connectivity for aircraft and ships.

1. Application Specific Integrated Circuit

EN

1 million

Oxford boasts exceptional performance, with data rates supported by the 1-sq.cm chip of 600 Megabits per second, equivalent to optical fibre. The target of one million units sold could quickly be reached.