“Conventional industrial robots are often dedicated to a single function. But with **cobotics**, it’s more like having a **Swiss Army knife**”

Jean-Philippe Jahier, director of Innovation and Industrialisation of New Technologies with Thales Alenia Space
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Cryptography for all

You could be forgiven for thinking that cryptography is the preserve of spies and governments. Indeed for many years this would have been true, but no longer. Today, as we leave more and more of our data online, our networked lives are increasingly in need of protection.

“"In the past, spying was possible only for agencies that had access to transmission cables and highly sophisticated equipment, as well as special authorisation. It was an isolated endeavour. Today, transferring information has become ubiquitous,” says Dietmar Hilke, director of Business Development and Cyber Security with Thales in Germany. “I can go into any wireless lounge and ‘sniff’ for transmissions using off-the-shelf equipment. I can do man-in-the-middle attacks and harvest PINs, credit card information and banking details. And I can do it with standard hardware and open source software that I can find on the net. The threat has moved from a highly sophisticated group of people to almost anyone.”

According to Hilke, our increasingly digital lives have led to a change in what he calls the threat vector. And it’s not just transmission of data that is vulnerable – computer malware is being used to harvest more and more valuable information from unsuspecting parties. Cloud computing is being used to store ever more data on third-party servers, trusting our private information to other people’s systems. The more connected we are, the more vulnerable we become.

“Securing information in transmission is no longer enough. Increased social interaction online means that we need end-to-end cryptography,” says Hilke. Cryptography relies on taking information, known as plaintext, and encrypting it so that it is rendered unintelligible. Encryption uses a cipher, which is a mathematical algorithm, and a “key” or secret piece of information. Attackers can obtain the cipher text and may even know the encryption method but, without the key, they will not be able to break the code and read the plaintext.

It is the mathematical equivalent of putting a message in a locked box. The difficulty is in transmitting the key securely. Eric Garrido, head of the Communications & Security cryptographic team at Thales specialises in the design and evaluation of cryptographic systems.

“Even if you have a good mathematical solution, we have to be sure that they are securely implemented,” says Garrido. “Bad hardware or software is like locking the door but leaving a window open.”

PayTV is a case in point: broadcasters send encrypted content to subscribers and give users individual keys. The broadcast is the same but each key is different. This technology originated in the early 1990s but it’s now in need of updating. This was the subject of a recent collaboration between Thales and Swiss digital media company Nagra.

“All the old protocols were too theoretical to be practical. There is a big gap between theory and practice. The goal was to make them realistic in practice,” says David Poncecheva, head of the crypto team at École normale supérieure, Paris, who worked on the collaboration.

The cost of hardware and software development is the main limitation when designing practical decryption systems. For example, the set top box needed to...
“In the past, spying was possible only for agencies that had access to transmission cables and highly sophisticated equipment, as well as special authorisation.”

Dietmar Hilke, director of Business Development and Cyber Security with Thales

Encryption: by the numbers

The 2005 Global Encryption and Key Management Trends Study, based on independent research by the Ponemon Institute in the United States and sponsored by Thales, revealed that the use of encryption continues to grow in response to consumer concerns, privacy compliance regulations and ongoing cyber attacks.

According to the survey of more than 4,700 business and IT managers in the US, UK, Germany, France, Australia, Japan, Brazil, Russia, India and Mexico:

- 54% use encryption extensively;
- 36% have an enterprise-wide encryption strategy;
- nearly half believe that encryption removes the need to disclose a breach;
- more than half identified key management as a major pain point, due to lack of corporate ownership, fragmented systems and inadequate tools;
- more than half view hardware security modules as an important part of a key management strategy;
- the number one perceived threat is employee error, and the top three reasons for deploying encryption are compliance with data protection mandates, to address specific security threats and to reduce the scope of compliance audits.

Standards of security

Cryptography is more important than ever and it is an ever-changing game. The current gold standard is known as RSA encryption. Described by MIT academics Ron Rivest, Adi Shamir and Leonard Adleman in 1977, it is like sending an open lock to the person wanting to send an encrypted message. The sender of the lock keeps the key to open the message when it is sent back.

The algorithm multiplies two large prime numbers together to produce an even larger number. Factoring the result is easy if you have the prime number key but almost impossible without.

“At the moment, we don’t know how to factor numbers that are larger than 650 digits efficiently. It could take dozens of years even with the most powerful computers,” says Pointcheval. Does this solve the problem? Is our data completely secure if we use this system?

Sady, not. Although factoring such vast numbers is almost impossible at the moment, scientists and engineers are working to build quantum computers that perform calculations in a fundamentally different way.

“If a quantum computer comes along in the next few years, then all the keys are broken,” says Pointcheval. As a result, Thales is working on new enciphering methods that even quantum computers would find difficult, if not impossible, to break.

Another goal is to develop so-called “fully homomorphic encryption” — what Hilke means by end-to-end encryption. It would guarantee privacy by keeping data encrypted even as it was being processed by a remote server. Pointcheval says it is exactly what is needed to make cloud computing safe.

At the moment, even if you encrypt data for transmission, it must be decrypted before it can be evaluated. Every time you return to the plaintext, the data becomes vulnerable. In the wake of the Edward Snowden leaks, which revealed the degree to which personal data was being accessed by certain government agencies, privacy has leapt to the fore for digital media companies. Guaranteeing privacy is now the number one priority and homomorphic encryption is the Holy Grail.

“With a homomorphic system, it’s possible to manipulate data in a fully encrypted way. You send the cloud encrypted information. It will do any computation that you wish and send you back the result, still fully encrypted. Since you are the only one who knows the key, you are the only one who can read the answer. The cloud never sees the unencrypted input or the output. It sounds like magic but with such functionality, you could do a google search that even google wouldn’t know what you are searching for. You can get answers without the person you are querying even knowing what you are searching for,” says Pointcheval.

Of course as soon as these systems are perfected – meaning that Internet users can do anything with guaranteed anonymity – there will inevitably be a dialogue about the needs of national security agencies to intercept communications to keep us safe. All in all, cryptography is set to become more and more important to all of us as time goes by.
With winter temperatures below -40°C, the Arctic is one of the harshest environments on earth and one of the most vulnerable to rising global temperatures and the race to secure the region’s untapped resources means this icy wilderness is under pressure as never before.

At the heart of the Arctic question is the accelerating retreat of sea ice – the thick blanket of frozen seawater that cloaks the Arctic Ocean. This reaches its greatest extent at the end of the winter months. In 2015, however, the maximum area of winter ice was 130,000 square kilometres, less than its previous record low. It’s also getting thinner.

“What’s changing is that the amount of multi-year ice – the ice that survives the summer melt – is going down at a rate that is much greater than the overall reduction of sea ice extent,” explains Dr Stefan Hendricks, an expert in ice physics with the Alfred Wegener Institute for Polar and Marine Research. “Ice cover is becoming more seasonal, which means there are more regions which are ice-free in summer.”

While the wider environmental ramifications of these changes are only beginning to be understood, the geopolitical implications are already clear. Melting ice is redrawing the polar map and opening up previously inaccessible areas.

“The retreating ice makes the Arctic and all its resources accessible,” says Rear Admiral Nils Wang, Commandant of the Royal Danish Defence College and one of Denmark’s leading Arctic security analysts. “We are already seeing increased maritime activity in the area and this will grow in the coming decade.”

New Arctic economy

Easier navigation of the two great polar seaways – the Northeast Passage (NEP) and the Northwest Passage (NWP) – is a potential game changer. The increasing availability of these routes has the potential to transform the movement of global freight, shrinking sailing distances between Europe and Asian markets.

In summer, the NEP provides a link between the Atlantic and Pacific oceans with a route that skirts Norway and the north coast of Russia. The attraction is clear: this distance between Yokohama in Japan and Rotterdam in the Netherlands, for example, is just over 7,000 nautical miles via the NEP. The conventional Suez Canal route is 4,000 miles longer.

The NWP, the other major polar shortcut, skirts the north coasts of both Canada and the United States, offering an alternative to the Panama Canal. Again, distance savings can be significant. The trip between Canada’s west coast and Finland, for example, is around 1,000 nautical miles shorter via the Arctic.

Ships taking the polar option continue to face formidable challenges, though. Traversing
the Arctic depends on icebreaker support; in the case of the NEF that means calling on Russian assistance (Russia maintains the Northern Sea Route – the central stretch of the wider NEP). Having an ice-capable vessel also helps: even in near-open water, chunks of ice – known as growlers and bergs bits – are an ever-present hazard. And with the exception of the Northern Sea Route, maritime infrastructure such as search and rescue facilities is thin on the ground.

While a major shift in container traffic away from the lower latitude Panama and Suez routes is some way off, destination shipping within the region is already significant. Research carried out on behalf of the Arctic Council, published in 2009, counted some 6,000 ships and numbers are expected to rise in the coming years. Moves to exploit the region’s abundant natural resources are one reason for this.

The Arctic is rich in hydrocarbons: 13 per cent of the world’s undiscovered oil and 30 per cent of undiscovered natural gas could lie in the region, according to the US Geological Survey. The region is also a treasure trove of mineral wealth. Greenland, for example, possesses deposits of copper, iron, zinc, molybdenum, uranium and rare earth elements. Extraction and transportation will become easier as the ice retreats.

Who goes there?

Maritime and coastal security is a rapid identification of suspect ships. But trying to pinpoint a rogue vessel among hundreds of legitimate ones can be like looking for a needle in a haystack. Big data technologies being developed by Thales could be the answer. The likelihood that a vessel is engaged in unlawful activity – such as illegal fishing or piracy – is linked not only to its identity, but also to its current position, speed, direction, previous journeys and even the weather. This information can be gathered from sources such as AIS (ship tracking data), radar feeds and meteorological reports. By building models of suspicious behaviour, it’s possible to generate an automatic alert for any ship meeting the relevant conditions within the area under observation. Thales’ approach goes a step further: by applying techniques that combine analytics and machine learning, it’s possible to detect new and emerging patterns of illicit behaviour that might otherwise go unnoticed. This means new models can be created and existing ones continuously refined.

Emerging security needs

For governments in the region, escalating activity in the Arctic presents new security challenges: “All the Arctic states are trying to increase their capabilities to oversee what is going on up there,” says Rear Admiral Wang. “What’s missing at the moment is a complete real-time overview.”

Maintaining peace and stability in the region will increasingly hinge on the ability to monitor land and maritime frontiers. In addition, defence forces need tools to provide early warning of airspace incursions, as well as sonar capabilities to detect unauthorised submarine activity.

Then there’s the requirement to ensure the safety of civilian and military ships and aircraft operating in the region. To get the most out of scarce search and rescue capabilities, and to deploy resources effectively when things go wrong, governments need better real-time visibility of sea, sky and coast.

There’s also a need to monitor economic activity in the Arctic, particularly oil and gas exploration, fishing and shipping. Governments need to be sure that companies stick to the rules, that quotas are respected and that pollution and environmental impacts are kept in check.

Building the picture

Talking these complex and interconnected challenges will increasingly depend on the deployment of modern intelligence, surveillance and reconnaissance (ISR) systems. These need to be capable of offering both strategic and tactical visualisations – in short, allowing operators to zoom in on what’s happening.

“You need a layered surveillance suite that provides an overall view of what’s going on, and then the ability to drill down to get a detailed picture of a specific area of interest by inserting airborne and shipborne surveillance power,” says Wang. “These capabilities are necessary whether you are monitoring an oil spill, conducting a search and rescue operation or if there is military activity you want to have a closer look at.”

Delivering polar ISR means overcoming a number of hurdles. Logistics is one of them: coastlines are long, remote and sparsely populated; north of 83°30’N, the land stops and there is only ice. This makes it difficult to support ground-based infrastructure such as radar stations and transmitters.

Communication is another challenge. The enormous distances involved rule out extensive hardwired networks. Satellite coverage is patchy. And high frequency radio for long-distance communications is vulnerable to ionospheric interference at higher latitudes.

None of these problems are insurmountable says Marc Essig, Thales’ country director for the Nordic and Baltic region. “This is about smart defence,” stresses Essig. “The key will be to re-use existing equipment and to share data across countries.”

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Points North

The Arctic is the focus of a number of territorial disputes. These include conflicting claims to the extended continental shelf, a situation which has culminated in Canada, Denmark and Russia all laying claim to the North Pole. The legal status of the Northwest Passage is also contested. Long term, there are concerns that the retreating ice will ignite fresh territorial wrangling as the ‘threshold’ for resource opportunities.

Despite territorial tensions, the Arctic states collaborate effectively in a number of policy areas. Non-military matters of regional interest are dealt with by the Arctic Council, an intergovernmental forum that brings together Canada, Denmark, Finland, Iceland, Norway, Russia, Sweden and the United States. The Arctic’s indigenous peoples are also represented.

Formed in 1996, the Arctic Council is increasingly influential on the world stage. At the council’s meeting at Kiruna in northern Sweden in 2013, members agreed to grant permanent observer status to China, India, Japan, Singapore, South Korea and Taiwan, and to add the growing international interest in the region’s natural resources and its potential as a shipping shortcut.

There’s also the question of dealing with illegal, unreported and unregulated fishing. The potential for flare ups shouldn’t be underestimated: the ‘Icelandic Cod Wars’ – the dispute between the UK and Iceland over fishing rights – triggered naval clashes in the North Atlantic as recently as 1976.

Emerging security needs

For governments in the region, escalating activity in the Arctic presents new security challenges: “All the Arctic states are trying to increases their capabilities to overcome what is going on up there,” says Rear Admiral Wang. “What’s missing at the moment is a complete real-time overview.”
For the first time, NATO will have a unified Air Command and Control System (ACCS) in Europe, enabling its members to manage all types of air operations, both inside and outside NATO countries.

Following successful tests of ACCS last year at two sites in Belgium and Italy, the system developed by ThalesRaytheonSystems will be rolled out to 15 locations across Europe over the next three years. The first site, in Italy, went live this year, over the Easter weekend. Many existing NATO and national air defence systems will be replaced by ACCS. Some centres will be run by NATO organisations, others will remain under national responsibility.

ACCS, which involved writing 14 million lines of computer code, has been described as the most complex software project ever attempted. It integrates defence activities that include air mission planning and tasking, air mission control, airspace surveillance, airspace management and air force management. Missile defences will be added to ACCS by the end of 2016, integrating the detection and interception of fast moving ballistic missiles and slower cruise missiles with aircraft operations.

“Before ACCS, each country had its own system. Now NATO members will have a single system and that is a revolution in air operations,” says Philippe Duhamel, CEO of ThalesRaytheonSystems, a joint venture between Thales of France and Raytheon of the US, and the first-ever transatlantic company created in the defence field.

“The scale of the programme is unprecedented: stretching from Norway in the north to Turkey in the east, ACCS will cover an area of more than 10 million square kilometres and link 300 sensor sites, connected to more than 40 different types of radar installation.

“Before ACCS was developed, the first notice the French air force may receive of an incursion by an aircraft in eastern Europe would be via telephone,” says duMont. Similar efficiency gains have been made in planning and executing operations. Previously, details of a mission may have taken officers days to put together before being faxed to operational units. With ACCS, planning and execution are part of the same system and information is transmitted in real time.

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“The grand vision of ACCS was a single system designed to control the entire air battle using all the resources – planes, weapons systems, personnel – available.”

Steve duMont, vice-president of NATO business for ThalesRaytheonSystems

systems limited what you could do together. With ACCS, the level of interoperability is extremely high.”

That interoperability means that European air defences will be much more resilient in future. Not only will one part of the system be able to take over if another is damaged, but it will be possible to orchestrate the defences of one country from another, if necessary. The degree of integration possible with a single system using standards such as NATO’s Link 16 for interfacing real-time data to aircraft, weapons and other systems is likely to have a big impact on costs.

“The cost from a cost perspective, it is what Nato refers to as smart defence, pooling funds and resources to achieve a common operational pool,” says duMont. “You have a single system maintained by a single service with a common spares pool and sites for operational training.”

A standard system also has the benefit of reducing the burden of training operators by enabling them to use the system in different countries without the need for extra instruction. NATO commanders are studying the possibility of establishing a training school to serve all the nations involved.

Savings will also accrue from the open standards used in developing ACCS. They will allow customers to choose which supplier they use, mixing and matching equipment from different sources. Several suppliers worked on the £1bn project in addition to lead contractor ThalesRaytheonSystems.

The system at work

ACCS consists of two closely integrated elements. At the sharp end is a real-time mission execution system known as ARS, which combines the Air Control Centre (ACC), Recognised Air Picture (RAP), Production Centre (RPC) and Sensor Fusion Post (SFP).

ARS links posts gathering sensor data with systems that create the operational picture of what is happening in the battlespace in order to direct NATO aircraft.

Combined Air Operations Centres (CAOCs), on the other hand, deal with non-real-time activities such as planning, tasking aircraft and monitoring missions. The effectiveness of ACCS is greatly aided by the fact that both ARS and CAOCs share a common database.

“We succeeded in managing the diverging constraints on the database, caused by its utilisation by these two types of system,” observes Lionel Eloy, technical director of ThalesRaytheonSystems’ operations in France. The CAOCs are designed to support a concept called the DODA loop (observe-orient-decide-act) which involves continuously observing and reacting to events faster than an enemy, confusing an opponent and disrupting their plans.

Generally, the dynamic reassessment of the DODA loop is not continuous or automatic and requires manual intervention. It will be much smoother in ACCS because when something happens and you have to modify your original plan, you have one database that mission planning will write to and mission control will read.”

Deployable versions of the two ACCS components have also been developed to help NATO members operate outside Europe. A key aspect of the development of ACCS is the Franco-American joint venture.

“Working on two sides of the ‘pond’ is not easy but we could not have developed ACCS without the French and US collaboration,” notes Duhamel. To ensure balance, each partner has equal numbers of board members and the leadership of the company rotates between French and American CEOs.

Initially, Thales was responsible for real-time elements of the project while Raytheon took on the non-real-time aspects of ACCS. But the two partners combined their efforts in France in 2010 to complete the work.

“The grand vision of ACCS was a single system designed to control the entire air battle using all the resources – planes, weapons systems, personnel – available. The ThalesRaytheonSystems collaboration gave us the ability to achieve this by drawing on the technical depth of two of the largest defence companies on the planet and to reach back into their significant domain expertise in the area of air and missile defence,” says duMont.

Duhamel. “We have developed a very large system, we have successfully organised a Franco-American collaboration and managed our internal organisation very effectively.”

Since the contract was awarded in 1999, the company has had to contend with many difficulties and challenges. The great news is that all of this is behind us, ACCS is now entering operations for NATO at a time when it is most needed by the alliance,” concludes duMont. “And ThalesRaytheonSystems is very proud to be part of this important programme.”
Weather or not

Weather satellites have played a central role in improving the accuracy of meteorological forecasts – and thus in the protection of goods and people – for decades. As climate change and global warming became major concerns, the science of climatology took centre stage, with climatology satellites playing a pivotal role in its progress.

Along with telecommunications, meteorology has been one of the principal beneficiaries of the “satellite revolution” of the early 1970s. Having become more affordable and capable of carrying more sophisticated payloads over the decades, satellites in geostationary and low Earth polar orbits now continuously monitor the Earth, providing increasingly valuable and localized information to meteorologists.

Modern satellites can now deliver to scientists and researchers imaging and atmosphere sounding data in the visible, infrared and microwave wavelengths.

Meteorology has benefited enormously from satellites. The effort to monitor global weather patterns and produce forecasts is coordinated on an international level through the World Weather Watch, a collaborative body that brings together meteorologists and scientists to exchange data and models in order to improve forecasts and better predict potentially hazardous weather systems.

At the European level, the development and use of meteorology satellites is led by EuMetSAT, which designs each mission, exploits the satellites and disseminates their processed data to all European member states, in cooperation with the European Space Agency (ESA), which develops and launches the satellites.

At EuMetSAT HQ in Darmstadt, Germany, terminals receive incoming data from satellites, allowing researchers to geolocate and process their information. Among the data sent is a range of geophysical indicators including wind velocity vectors, cloud top height, as well as sea surface temperature along with others. This data is then sent to national meteorology centres, where they are used to prepare weather forecasts.

The European system includes geostationary satellites (Meteosat) – which provide permanent observation of Europe and Africa and are mainly used for “nowcasting” applications (short term weather predictions with particular focus on potentially dangerous, rapidly evolving weather phenomena) – and polar satellites (EPS), which are closer to the Earth and provide high value inputs to numerical models used for long term predictions, but with a much lower revisit rate.

Making a difference

Thales Alenia Space has served as a prime contractor on the three generations of Meteosat satellites produced since the 1970s, as well as prime contractor of the EPS Ground Segment and the infrared atmospheric sounding interferometer (IASI), the flagship payload instrument carried on board EPS satellites.

In particular, the performance of Meteosat Second Generation, which has been orbiting since the early 2000s, is an example of Thales’ expertise and is the standard all other members of the World Weather Watch are aiming to achieve by 2020.

In Brief

1. Satellites have played an increasingly important role in meteorology since the 1970s.
2. Space meteorology feeds into a range of areas, from security of goods and people to air and ground transport systems and infrastructure as well as energy and agriculture.
3. Space agencies, government and industry are using satellite data in the fight against global warming.
Studies have shown that, for every euro invested in meteorological space systems, there is an economic benefit of more than €10 across the economy.

In 2010, the image above (left) satellite image of land surface temperatures from a helicopter that affected most of Spain and Portugal in 2004; (left) coloured satellite image of the hole in the ozone layer above Antarctica; (below) coloured Landsat 7 image of Von Karman vortices in clouds over the Aleutian Islands.

The view from above: (far left) Satellite image of land surface temperatures from a helicopter that affected most of Spain and Portugal in 2004; (left) coloured satellite image of the hole in the ozone layer above Antarctica; (below) coloured Landsat 7 image of Von Karman vortices in clouds over the Aleutian Islands.

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It’s now more than 50 years since the world’s first industrial robot clocked on for work at GM’s Ternstedt car plant in Trenton, New Jersey in the United States. Fast forward to 2015 and robots have all but conquered the global automotive industry. Sales of industrial robots are now at record levels. According to the International Federation of Robotics (IFR), 2014 saw unit sales of robots exceed 200,000 for the first time, up more than 27 per cent on the previous year. Demand, which is greatest in China and South Korea, is being driven primarily by the automotive and electronics industries.

Large industrial robots are normally bolted to the factory floor and caged to protect the workforce. These tethered giants, prized for their precision, speed and ability to repeat the same task endlessly, require a huge level of capital investment. As a consequence, they are largely confined to high-volume assembly lines. But that could all be about to change.

“There are several factors that are really drawing our attention at the moment,” says Jean-Philippe Jahier, director of Innovation and Industrialisation of New Technologies with Thales Alenia Space-France. “The first is that off-the-shelf robotic components are becoming very affordable – you can acquire a robotic arm for around €60,000. The second factor is the development of cobotics: robotic systems that can work safely alongside humans.”

**Rise of the cobots**

Cobots – collaborative robots – are a recent development. Unlike the majority of industrial robots, cobots are adaptable, mobile and designed to work with people. They’re attracting the attention of industry because they’re easy to deploy and put the power of robotics within reach of low-volume manufacturers for the first time.

“Flexibility is one of the cornerstones of cobotics,” says Jahier. “Conventional industrial robots are often dedicated to a single function. But with cobotics, it’s more like having a Swiss Army knife: by changing tools, you can adapt a cobot for...”
different tasks quickly. The capability to move within the factory between different applications is very exciting and opens up new doors for us." One of the breakthroughs with cobots is that they learn by imitation: "Instead of needing specialised programmers, the end user is able to teach the cobot how to perform a given gesture," explains Jahier. "This is important, because it empowers operators on the shop floor. It’s also socially important, because the person using the tool is able to shape it to their own usage.

As one of the world’s leading satellite and payload manufacturers, Thales Alenia Space invests continuously to optimise production. Launched earlier this year, the company’s “Tomorrow’s Factory” initiative underlines this commitment, with an emphasis on combining state-of-the-art technologies, such as robotics and cobotics, with human expertise.

The need for innovation in satellite production is being brought into focus by major changes in the space market. One of these is the growing momentum behind what is being described as the “internet in space,” or Earth observation, which has come from the private sector. Smaller satellites and will trigger demand for satellite production on a scale not previously seen in the space industry.

"Shifting from building a single communications satellite in 30 months to rolling out a satellite every two days is a big change," says Jahier. "If you want to address the large constellation market, with satellites in the hundreds, you have no chance but to deploy robotic or cobotic assistance."

"Instead of needing specialised programmers, the end user is able to teach the cobot how to perform a given gesture. This is important, because it empowers operators on the shop floor.

Jahier envisages a number of shop floor applications for cobotic assistance. One of these is "kitting": the painstaking job of assembling all the components needed to carry out a given production task.

"Efficient kitting is important and it’s linked to the concept of lean operations. The idea is to minimise disorder near to the place where you work," explains Jahier. "The cobot selects the components required for the job and these are given to the operator a few minutes before work is due to start. This is a key issue as regards the efficiency of the production flow."

Getting cobots to select components from the parts bin has other advantages. Using its built-in camera, a cobot can check components for damage and even measure them. "This eliminates a lot of errors— it’s difficult for a human operator to tell if a screw is 5mm too long or too short, for example, but for a cobot, it’s not a problem," says Jahier. Cobots also know where components have come from. This information can be collected for quality assurance purposes and fed directly to the back-office system to assist in compliance and inventory control.

"Off-the-shelf robotic components are becoming very affordable — you can acquire a robotic arm for around €60,000."

Jean-Philippe Jahier, director of Innovation and Industrialisation of New Technologies with Thales Alenia Space-France

One of the breakthroughs with cobots is that they learn by imitation: "Instead of needing specialised programmers, the end user is able to teach the cobot how to perform a given gesture," explains Jahier. "This is important, because it empowers operators on the shop floor. It’s also socially important, because the person using the tool is able to shape it to their own usage.

As one of the world’s leading satellite and payload manufacturers, Thales Alenia Space invests continuously to optimise production. Launched earlier this year, the company’s “Tomorrow’s Factory” initiative underlines this commitment, with an emphasis on combining state-of-the-art technologies, such as robotics and cobotics, with human expertise.

The need for innovation in satellite production is being brought into focus by major changes in the space market. One of these is the growing momentum behind what is being described as the “internet in space,” or Earth observation, which has come from the private sector. Smaller satellites and will trigger demand for satellite production on a scale not previously seen in the space industry.

"Shifting from building a single communications satellite in 30 months to rolling out a satellite every two days is a big change," says Jahier. "If you want to address the large constellation market, with satellites in the hundreds, you have no chance but to deploy robotic or cobotic assistance."

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A vision for robots

Spotting the next big thing in robotics is as much an art as it is a science. What do investors look for? Bruno Bonnell is head of Rebellion Capital, a Paris-based private equity firm that focuses on the development of robotics. Picking winners, he says, means focusing on three key criteria.

“The first thing we look for is what we call “hypertechnology” — a proposal has to be disruptive, not simply an improvement of something that’s already on the market,” says Bonnell. Technology must also meet customer expectations — without exceptions and with no excuses: “It has to be non-deceptive. For example, some of the automatic cars we have analysed depend on video. My first question is: what if there’s fog or it’s dark? If a car can’t work in these conditions, it’s absolutely useless.”

Robotic solutions must be easy to deploy and easy to use. That means delivering disruptive technology with minimum disruption.

“It has to be easy to implement without drilling, cabling or tearing up your living room,” says Bonnell. “The same principle applies in industry: if you have to make huge changes to your infrastructure, it won’t work.”

With a track record in technology stretching back more than 20 years, Bonnell’s career included eight years as CEO of the computer games business Atari! — an experience he says he uses to stop or move around obstacles, “points out Jahier. And by extending existing ID and authentication techniques, it’s possible to ensure that only authorised users get to issue commands. “The robot will only interact with somebody who’s already logged in. If you want to alter the execution sequence or change the operation, you will have to log in again.”

Despite the productivity gains promised by cobots, Jahier stresses that these robot recruits will be designed to assist, rather than replace, the existing workforce. “You cannot imagine a factory with 1,000 robots and one person deciding everything,” he emphasises. “Robotics and cobotics are about boosting competitiveness and consolidating growth — not reducing the headcount.”

As well making short work of time-consuming tasks, cobots make light work of awkward lifting operations by offering an intelligent “third hand.”

“Even if you’re assembling very fragile objects, the cobotic third hand can help the operator by lifting and holding components in exactly the right place while you go to fetch the missing tool,” says Jahier. Robots capable of moving around the factory floor on their own are still a relative rarity. But, as with autonomous cars, mobilising robots raises new questions. How do you avoid collisions? And what’s in charge? Low travel speeds, coupled with the cobot’s ability to learn and respond to its surroundings, means the risk of collision is minimal.

“They’re capable of scouting their environment and they can be programmed to stop or move around obstacles,” points out Jahier. And by extending existing ID and authentication techniques, it’s possible to stop or move around obstacles, “points out Jahier. And by extending existing ID and authentication techniques, it’s possible to ensure that only authorised users get to issue commands. “The robot will only interact with somebody who’s already logged in. If you want to alter the execution sequence or change the operation, you will have to log in again.”

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The Rafale is the most advanced combat aircraft of its generation.

Defence of the realm

Since the dawn of military aviation more than a century ago, combat aircraft have been judged on the basis of their speed, agility and firepower. Today, it’s not just muscle that matters, but also flexibility and intelligence.

Changing operational requirements mean that combat planes must be capable of performing a wide range of different tasks, from reconnaissance to air defence and precision strikes. They must also be capable of conducting several different missions in the same sortie.

The Rafale “omnirole” fighter is designed to meet these needs. Advanced avionics hold the key: from nose to tail, the aircraft is equipped with an array of sophisticated electronics systems and equipment. Among other things, these allow the pilot to gather and share high-resolution imagery, target guided weapons with pinpoint accuracy and defend the aircraft from hostile actions. Thales also provides the electronics for some of the missiles equipped by the Rafale.

In tandem with this, the Rafale supports pilots with an unprecedented level of “data fusion” — combining information from all the different systems and sensors to build a comprehensive tactical picture to assist in decision making. The Rafale’s onboard electronics systems, equipment and sensors are supplied by Thales and account for about 25 per cent of the plane’s value.

1 Spectra electronic warfare suite
Spectra is the first line of defense for the Rafale aircraft, identifying, locating and jamming electro-magnetic, infrared and laser threats. Multi-spectral sensors and smart data fusion offer high-sensitivity detection. Spectra’s multiple threat capability, including missile approach warning and decoy dispensers, helps to ensure success in hostile environments.

2 AREOS
Thales’ Airborne Reconnaissance Observation System – AREOS – provides rapid day/night imagery intelligence (DMINT) for reconnaissance and identification in any weather conditions. AREOS gathers high-definition imagery at long range and across a wide area, with information transmitted from air to ground via a high-capacity data link.

3 DAMOCLES and TALIOS
Thales’ third-generation laser designation pod, DAMOCLES, provides weapons guidance and a full suite of sensors for navigation and air-to-air target identification. It provides day/night recognition of targets at medium range, as well as long-distance reconnaissance capability. The pod’s infrared sensor is designed to perform effectively in both warm and humid conditions. TALIOS – an updated version of DAMOCLES – is an optronic multifunction pod that employs the latest generation of high-resolution sensors and high precision line-of-sight stabilisation, allowing for deep strikes with long-range missiles and bombs to air-to-air target identification and close-air support. It includes Non-Traditional Information, Surveillance and Reconnaissance (NTISR) capabilities and the Permanent Vision system provides wide-angle vision and critical contextual information.

4 Communication Navigation Identification suite
Secure state-of-the-art communication, navigation and identification capabilities covering every operational need, including ECCM (used to combat electronic countermeasures), IFP (identification friend or foe) and tactical data links.

5 Advanced Man Machine Interface (MMI)
Thales’ powerful visualisation tools provide instant situational awareness for the pilot and support well-informed tactical decisions. The MMI solution includes a combined head-up/head level display, lateral displays and a helmet-mounted sight display.

6 AESA RBE2
The Active Electronically Scanned Array (AESA) RBE2 antenna is a multifunction radar system that provides coverage over long ranges. AESA RBE2 is automatic and highly versatile, sorting and ranking tracked targets, and allowing the pilot to track multiple targets while scanning. It is the first active operational European radar antenna, and provides air-to-air and air-to-surface capabilities.

7 Front Sector Optronics (FSO)
Thales’ FSO includes extensive IT capability with laser electro-optics for passive long range target detection for air, sea and ground targets, designation and identification, all fully integrated into the aircraft. It allows the pilot to spot enemy aircraft without being detected and is immune to radar jamming because it operates in optical wavelengths.

8 Modular Data Processing Unit
A powerful mission computer providing all-sensor data fusion and enabling multiple mission reconfigurations.

The only totally “omnirole” aircraft in the world, able to operate from a land base or an aircraft carrier.

Smartler planes
Thales is to lead the upgrade of the Rafale electronic warfare, and identification and support systems used in French fighter planes under the terms of a contract to develop a new performance standard for the Rafale combat aircraft.

The P3 R standard, launched earlier this year, will play a vital part in ensuring aircraft are continuously improved to keep pace with changing operational requirements.

The upgrade will include deployment of Thales’ TALIOS next generation laser designation pod. This will provide enhanced imaging and engagement capabilities under day and night conditions. Both the Rafale and the Mirage 2000D can be equipped with the TALIOS pod. The programme will also see the integration of the European Meteor long-range air-to-air missile produced by MBDA. The equipment and solutions developed by Thales include RBE2 active and passive antennas, Spectra, IFP and maintenance support.

Export successes
The Rafale has enjoyed a string of major international successes in recent months, beginning with Egypt signing up to buy 24 Rafale omnirole combat aircraft in February 2015. And after many months of discussion, India has also signed a Letter of Intent to purchase 36 “ready-to-fly” Rafales for the Indian Air Force.

The latest contract comes from the Qatar Emir Air Force, which has announced it will acquire the Rafale omnirole combat aircraft. A total of 24 aircraft will be delivered under a contract between Qatar and Dassault Aviation. Thales is a member of the Rafale team with Dassault Aviation and Snecma (Safran).

The official signing ceremony was held in the Qatar capital Doha in the presence of the Emir of the State of Qatar, Sheikh Tamim bin Hamad Al Thani, the President of the French Republic, François Hollande, Dassault Aviation Chairman and CEO, Eric Trappier and Thales Chairman and CEO, Patrice Caine.
It’s not surprising that the boardroom and the military academy have looked to each other for inspiration, given the pressures of commanding large numbers of people, marshalling limited resources and handling an aggressive competitor.

The latest example of this cross fertilisation is what Charles-Édouard Bouée calls the “Light Footprint Strategy.” Bouée’s career in management consulting has taken him from Société Générale and Booz Allen Hamilton to his current role as CEO of Roland Berger Strategy Consultants. Bouée, who now spends his time between Shanghai, Munich and Paris, has developed a theory of Light Footprint management, which he says borrows directly from military developments of the past decade.

“In 1995, the US Army War College in Carlisle, Pennsylvania developed a course for the generals that focused on the emerging global environment,” Bouée explains. “The course was called VUCA – which stood for Volatile, Uncertain, Complex and Ambiguous. The world wasn’t living under those conditions yet, but the US military could see that things were changing and that they needed to be prepared.”

The US Army’s “shock and awe” strategy in the Iraq war in 2003 was, in part, a reaction to this new world view. Overwhelming force was used to defeat disparate enemy combatants and eliminate their means of retaliation. This approach required strict command structure, power concentrated at the top and a big in-country commitment in materiel, logistics and authority.

But then the situation changed. Shock and awe tactics were not sustainable and the situation on the ground demanded a different response – something more targeted, faster and streamlined. And thus a new, modern military doctrine was born.

From Napoleon’s organisational and command structures to Henry Ford using his “troops” on the production line, there has always been an overlap between military and business thinking. Now a new “Light Footprint Strategy” is challenging how businesses operate from the ground up.

A lighter touch in business

**In Brief**

1. There has been a longstanding overlap in strategic thinking between military and business.
2. The “Light Footprint Strategy” offers a new and efficient approach to business in an increasingly fragmented world.
3. At its best, the “Light Footprint Strategy” allows companies to spot trouble or failure quickly and move on.

**Innovations: Light Footprint Strategy**

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**A new approach**

“In the post-invasion phase, the military moved to a Light Footprint strategy,” explains Bouée. “The underlying principles of Light Footprint were designed to help a modern organisation negotiate its way through the new VUCA world. Those principles encompassed technology, organisation and culture.”

**Technology:** The strategy focuses on lighter weapons, better communications and fewer men on the ground. Systems are more automated, drones and networks came to the fore and intelligence and information are the most valuable commodities.

**Organisation:** It also calls for the company to be organised in a modular way, akin to small elite commando or Special Forces units – “In other words, away from all-powerful executive command structures to self-governing, interdisciplinary modules,” says Bouée. The individual parts of the company are interdisciplinary and largely autonomous, and coordinated by a central body.

In addition, the light footprint company relies heavily on alliances with other organisations – spotting potential partners, assessing the likely points of mutual interest and sharing the risk of a venture by pooling resources where appropriate. The current fight against ISIS in Syria, Iraq and beyond is a perfect example: the US and its partners are allying with local forces, sharing intelligence and recognising where partners may offer better expertise and letting them proceed. Crucially though, the strategy does still feature heavy investment and conventional forces in order to produce the necessary response.
Culture: This is where several seemingly contradictory factors come into play. “Light footprint demands greater openness and transparency, connecting people and giving up on the old doctrine. If you look at the corporate world, that’s in line with companies like Uber and Airbnb,” says Bouée. “But at the same time, if you have an open model, then you still need to be secretive and protective of your intelligence. That’s important, because with light footprint you’re not telling your opponent ‘I’m going to set off a drone strike at 5pm.’ Under shock and awe, you could signal your intentions because it didn’t matter — it was just a matter of time before you would topple them, and they knew you were coming.”

For Pierre-Jean Lassalle, a former officer of the French Special Forces now leading business development for defense activities at Thales Communications & Security, as well as controlling the flow of intelligence, the most important aspect of light footprint, especially in terms of its corporate application, is what he calls the “matching effect.”

“The military footprint is intended to match the ‘effect’ sought, and businesses could learn a lot from this,” he explains. “This may mean smaller teams carrying less equipment but it can also be applied to the ‘political footprint’.” As Lassalle explains, the risks of committing to a project have been demonstrated by the US military, proving that over-committing to a project have been of the ‘footprint’. “As Lassalle explains, the risks of introducing a new technology means that buying what you need when you need it makes you more agile and responsive.”

Now, as more start-ups grow using light footprint principles and more established businesses seek to incorporate aspects of it in their own operations, the opportunities are growing. For Thales, this means using its expertise to help its defence and security clients build a secure and successful light footprint strategy.

“The logistics of light footprint operations involve more back office activity, either on site or in a neighbouring country, or even in country in specialised local regional hubs,” says Lassalle. “This requires a new model and expanded services. It means more electronics and communications, and is therefore more vulnerable. The industrial skills of organisations like Thales are needed to ensure the security of such operations.” However, Bouée points out that, as with every other successful strategy, it won’t be long before the competition works out how to adapt it to their own ends. “Like any military strategy, light footprint is designed to help you cope with a challenging environment,” he says. “In five to ten years, I think everyone will be incorporating some elements of Light Footprint Strategy in their business. It allows companies to mitigate risk and helps them prosper.”

1995

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In-flight entertainment and communications systems have moved beyond the basic “food and a film” model. Innovations in technology mean that passengers can enjoy a wide range of options whenever they want while in flight. Tomorrow’s systems will only improve, offering higher resolution and brighter graphic user interfaces.

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Above the clouds
In-flight entertainment once amounted to little more than a magazine and, for the lucky few, a strictly scheduled movie broadcast through the tinniest of headphones. Today, in-flight entertainment is undergoing a new burst of innovation as it keeps pace with the giant leaps being made in consumer tech.

To understand where the in-flight entertainment and connectivity market is heading, it’s important to look at where it has been. It wasn’t until the late 1980s that in-seat systems offering on-demand video and radio first emerged and a good number of years later that such features became commonplace.

“In-flight entertainment began as a very vertical market,” says Fred Schreiner, chief technical officer, Thales InFlyt Experience. “That vertical has evolved over the past few decades with improvements in size, weight and power, and we are now adding connectivity.”

The hardware used to meet passengers’ entertainment needs became more efficient with the introduction of smarter communications and data transmissions systems. This is partly thanks to advancements made in technologies used by the airplanes themselves to communicate over ethernet bus networks. It also has much to do with harvesting features that have underpinned the boom in tablets and smartphones, from compact memory to HD displays and high-speed microprocessors.

However, physical advances are only half of the story. The software became more modular with more open architecture and then came applications, so it developed and matured in a vertical sense. This was followed by the explosion of connectivity and the proliferation of tablets,
and all of the infrastructure and technology advances that come with that. The IFE business opportunity combines the classic in-flight entertainment vertical market – from ground transport to the hotel – with connectivity, and now is changing with the connected world," says Schreiner.

"For all other aspects of travel – from in-flight retail, connectivity services and live television streaming. Passenger using Thales’ IFE systems can now access more than 100 channels of live television programming. At a top level, the deal gave Thales InFlyt Experience business significant and immediate capabilities in aircraft connectivity," says Schreiner.

"We have leveraged Thales’ well broad network setup, which is an L-band satellite, but the acquisition filled in that capability with Ka-band technology and helped to complete our services with in-seat displays and the streaming of live television shows. It was a great match for us and the integration is going well," LiveTV had established itself as a leader in retrofitting narrowbody fleets in this space, making us the smart choice for the connected airlines. "You need a lot of scale to be successful in this space and that’s something we didn’t previously have," says Moeller. "With Thales, we can now do things we would never have been able to do before."

In 2014, Thales acquired LiveTV from American airline JetBlue. The tech firm specialises in equipping airplanes with in-seat screens, connectivity services and live television streaming, passengers using Thales’ IFE systems can now access more than 100 channels of live satellite programming. At a top level, the deal gave Thales InFlyt Experience business significant and immediate capabilities in aircraft connectivity, says Schreiner.

"For all aspects of travel, Wi-Fi and connectivity are now becoming mainstream. That is not the case for most flights. That is one of the biggest differences between airlines and all other components of business travel”

Vincent Lebunetel, head of Innovation at Carlson Wagonlit Travel
Operators of public transport systems across the world are always on the lookout for ways to improve passenger experience while keeping costs under control and maintaining efficiency. Recent developments in smartphone and cloud technology have added two important tools to that effort, and Thales has harnessed the latest tech to offer operators a genuine step forward in how they collect fares and run their system.

The central principles of the TransCity concept are flexibility, convenience and responsiveness. The system will allow passengers to pay their fares in a range of ways and will encourage users to pay with contactless banks cards and smartphones via the use of near-field communication.

Of the many advantages of the system, it will remove the need for passengers to have a system-specific travel card, making it easier for cities to collect fares efficiently from visitors. Cities with high numbers of tourists in particular will benefit from TransCity by eliminating queues of visitors confused as to which travel card to buy. It will also allow operators to customise tariffs easier as well as reducing the need to invest in large amounts of ticketing infrastructure in stations.

The use of cloud computing will also change the infrastructure of fare collection. Traditional fare systems store payment information and other data on cards. With TransCity, that data will be stored on servers, meaning that access to data will be seamless. The system has five core areas:

- **Collect:** Ticket gates and control devices process transactions with different payment methods such as contactless cards or tickets, bank cards, ID cards, smartphones, bar codes (printed or on mobile phone screens).
- **Select:** Top-ups and multichannel sales options for tickets, including vending machines, post offices, call centres, mobile payments, online.
- **View:** Intelligent, pluggable, scalable monitoring system to oversee the entire ticketing system, from individual components to a national level.
- **Open:** Simple and economical small to medium size back-office ticketing system.
- **UP:** Back-office system that manages interoperability and supports compensation and settlement operations between transport agencies, processes payment transactions and integrates with banking systems. It is modular and scalable, and can be used either in transport agency data centres or hosted on the cloud, offering resources on demand.

Additionally, the use of Big Data and analytics in public transport systems has grown in recent years. Some cities have introduced journey mapping through the use of smart cards in order to understand traffic flow and demand cycles. Many operators have already used the data gathered through their card systems to gain a better understanding of passenger behaviour. Plans for the future include increasing the capacity for real-time analytics and working on integrating an even wider range of data sources, to better plan services and inform customers.

TransCity builds on these foundations to help operators monitor critical periods to better accommodate travellers’ needs such as regulating train traffic or entrance-exit configuration.

The launch of TransCity comes at an opportune time. The market for ticketing technology and solutions is growing at a rapid rate. According to a recent estimate, the SmartTransportation market reached US$45.05bn in 2014 and is expected to reach $104.19bn by 2019 – a CAGR of 18.3 per cent between 2014 and 2019.

TransCity is currently being rolled out at a number of sector conferences across the world and has already attracted interest from several cities. Bordeaux Urban Community awarded Thales a 10-year contract in December 2014 to install a new multi-media fare collection system by 2017 covering its light rail, bus and ferry network, and this will include the passenger monitoring element of TransCity. Thales has also signed a new contract to modernise the ticketing system for Gautrain in South Africa, as the operator has expressed its desire to move to contactless bank card payment.
In his new book, Digital Humanitarians: How Big Data is Changing the Face of Humanitarian Action, Patrick Meier explores how technology can be a game changer across the world’s disaster zones. A leading expert on humanitarian technology and innovation, Meier runs iRevolutions, an NGO devoted to bringing together tech pioneers to tackle humanitarian crises.

“Within 24 hours of the first tremors in Nepal, the UN asked us to initiate AIDR and MicroMappers so that we could immediately begin gathering tweets related to the destruction,” writes Meier. “This early activation meant we had the opportunity to put together live crisis maps of the most affected areas and then feed these to several relief agencies before they had even arrived in Nepal. This meant that responders had a good picture of the areas that had received the worst of the damage before they had even touched down in Kathmandu.”

The use of unmanned aerial vehicles (commonly known as UAVs or drones) in the crisis relief effort may surprise some: their reputation as a major leap forward in defence and intelligence operations is by now well known, but recent developments have seen their deployment in a number of disaster zones recently. For example, the cyclone in Vanuatu in March 2015 caused such devastation that conventional search and rescue operations were limited. Into the breach stepped the Humanitarian UAV Network, an organisation supported by Meier and others working in the field. Working closely with the Australian Defence Force and the local authorities, the UAV team set up its multi-rotor UAVs to fly over the affected areas.

Meier explains that the drones weren’t simply reporting basic data back to base. Far from it, in fact. “Oblique imagery [captured from UAVs] has been identified as more useful, though the multi-angle imagery also adds a new dimension of complexity, as we experienced first-hand during the World Bank’s UAV response to Cyclone Pam in Vanuatu,” he wrote on his blog in the wake of the mission.

Typically, in the wake of an earthquake or typhoon or other natural disaster, local authorities (often in collaboration with international bodies like the Red Cross or UN) will carry out a detailed assessment of the damage caused.

“Technology has the power to transform our response to humanitarian crises,” said Justine Greening, the former secretary of state for international development in the UK, when the initiative was launched. “We are already trialling the use of mobile phone apps, text alerts and GPS technology in humanitarian crises. The more focused and effective our response to disasters, the more quickly people can rebuild their homes and their lives and the further our money will stretch.” Recent disasters have shown how technology is already at the forefront of rapid response.

Indeed, the Nepali earthquake demonstrated quite what impact technology could deliver in a disaster zone.

The recent earthquake in Nepal engendered a typically generous response from the international community: calls for donations led to an outpouring of help from across the world, while teams from military and civilian organisations converged on the country to offer immediate assistance. The use of technology in the rescue efforts was little remarked upon but was vital in assessing damage and co-ordinating the response. And people are beginning to understand its potential on a large scale. In 2013, the UK government announced a new fund “to back mobile, text and other innovative technologies which can be used to help those hit by humanitarian crises – such as earthquakes, floods or drought.” The initiative was created with the US government and was intended to “scale up existing projects and processes that use technology or innovation to support humanitarian responses across the world.”

“The use of technology in humanitarian efforts is on the rise around the world, making a significant difference. Whole basics such as contact with disaster victims and evacuation efforts are fundamental, technology can go even further. Technology firms are getting behind NGOs to offer their support and new approaches to their work on the frontlines.”

The human equation
Disaster relief is no longer limited to food, water, medication and evacuation. In the wake of large scale incidents, technology is proving to be a vital ally, as expert and author Patrick Meier explains in his latest book.

Christian Doherty
“...we had the opportunity to put together live crisis maps of the most affected areas and then feed these to several relief agencies before they had even arrived in Nepal.”

Patrick Meier, author of Digital Humanitarians

“The Thales Foundation, established in 2016, was created as an initiative for innovative projects to support humanitarian efforts around the world and to offer help during humanitarian crises. The Foundation supports programmes related to science, teaching and classroom innovation around the world, and has already launched a series of initiatives from Cambodia to Haiti and Mali. Each initiative has its own level of education and qualification, that represents a great amount of skill and innovation to draw upon. The Foundation is based on three core principles:

• Social innovation: helping to develop and implement new products, services, models or methods that most social needs and create new relationships and interactions within the community.
• Collective intelligence: combining the expertise of community organisations and Thales employees.
• International replicability: potentially serving as a model for similar projects in other cities and other countries.