Unmanned aerial systems are in huge demand. Manned and unmanned, autonomous, armed and unarmed. This highly flexible platform can be used for a variety of different sorties whether that is to gather information from a wide area or even to deploy weapons. The collection of data is probably the most critical function of the UAV. Being unmanned, they can get to areas and locations that manned expeditions cannot get to without exceptional risk to life. The information collected by the UAV is relayed quickly, often in real-time, back to base where it can be assessed and the next step of an operation planned. A UAV is also re-usable. It can be brought back to its original take-off point. It therefore can be a very cost-effective for the user.

The systems used today are very sophisticated and use a range of communications links and sensors. Satellite technology plays an important role in terms of communications links and an enormous amount of satellite capacity is being used by the military for UAVs. The use of unmanned systems has increased exponentially as they can carry out the dirty work – the tasks that are tedious, long and dangerous.

A UAV comprises different components. They are the vehicle itself, its payload and its ground control system. The vehicle enables the UAV to physically deliver the payload to its optimal position. The UAVs operate at all altitudes so the propulsion system must be tailored to suit each mission the UAV undertakes. Electric engines may be used for silent, shorter-range operations. However, UAVs operating over long distances and at high altitudes will require jet engines.

Multiple payloads may be carried on board a UAV at any time. The UAV must deliver or collect data in a dull, dirty and often dangerous environment. In fact, the payload is the most important element of the UAV as the vehicle itself does not deliver the message or collect the data.

The ground control system underpins the UAV. It is usually housed in a control centre or environmentally controlled cabin where the UAV pilot and commander control the UAV remotely. The ground control system is equipped with secure communications and constantly receives and monitors the information relayed by the UAV enabling informed and prompt decision-making and information dissemination.

UAVs offer an extremely wide range of military applications such as:

- Security and control;

Next generation UAVs

Militaries across the world are becoming much more heavily reliant on Unmanned Aerial Systems to carry out long-range surveillance and reconnaissance. These vehicles are constantly evolving, becoming stealthier, capable of carrying out attack and are even environmentally friendly. Satellite Evolution looks at the latest development in unmanned systems.
Autonomy in UAVs
At present, completely autonomous UAV technology is still being developed by projects such as the Autonomous UAV Mission System Project that is sponsored by the Office of the Secretary of State Joint Robotic Programme. UAVs are controlled via a base station manned by human operators but the belief is, that as the technology and its capabilities evolve, a UAV will be able to achieve all stages of its mission completely autonomously.

The ‘next-generation’ unmanned systems are starting to emerge in the form of demonstration aircraft and are becoming increasingly impressive in their capabilities. Here are just some examples of the UAS initiatives established today.

Taranis: BAE Systems
Taranis is an Unmanned Combat Aircraft System (UCAS) advanced technology demonstrator. Named after the Celtic God of Thunder, the project aims to contribute to the understanding of strategic UCAS, through the demonstration of relevant technologies and their integration into a representative UAV system. Taranis will provide the UK MoD with experimental evidence on the potential capabilities of this class of UAV and help to inform decisions on the future mix of manned and unmanned fast jet aircraft.

The Taranis initiative will explore and demonstrate how emerging technologies and systems can deliver battle-winning capabilities for the UK Armed Forces incorporating both an autonomous and survivable UAV concept design. Any future in-service systems based on such a concept design will be under the command of highly skilled ground based operators who will also be able to remotely pilot the aircraft.

Taranis is a similar size to BAE Systems Hawk Jet - 12m in length with a wingspan of 10m.

The project is funded by the UK MoD and UK industry and is managed by the UK MoD’s Unmanned Air Systems Project Team in the Defence Equipment and Support organisation based in Bristol, UK.

Initial ground-based testing commenced in 2010. In addition to the existing industry partners, the project will also ensure that the most appropriate test-ranges take place in the UK, but will be conducted in safe designated test areas under close supervision.

Final assembly of the Taranis technology demonstrator commenced in December 2008. Taranis has been designed to be an unmanned, stealthy autonomous combat aircraft ultimately capable of delivering weapons to a battlefield in another continent. It will be able to hold an adversary at continuous risk of attack; to penetrate deep inside hostile territory, find a target, facilitate either kinetic or non kinetic influence upon it, assess the effect achieved, and provide intelligence back to commanders.

From the outset, Taranis has been designed to utilise the most advanced means possible of achieving low observability, this includes both the systems and technology inside the aircraft as well as the shape, design and finish of the exterior of the aircraft. This does mean that there are aspects of the exterior design of the aircraft which remain classified.

The Taranis programme brings together a number of technologies, capabilities and systems to produce a technology demonstrator based around a fully autonomous intelligent system and builds on proven systems and control technology designed, built and tested successfully in other BAE Systems unmanned platforms such as Corax, Raven, HERTI and Mantis.

Information on the range of Taranis is classified, but clearly in order to fulfil the missions set for it, Taranis needs to demonstrate performance levels that deliver on speed, reliability and survivability.

MANTIS and HERTI
MANTIS and HERTI are next-generation autonomous air systems, with emphasis placed on the levels of autonomy designed into the system and the concept of operations developed for effective deployment and operation.

MANTIS, the UK’s largest fully autonomous unmanned aircraft, completed its maiden flight in Woomera, South Australia in Autumn 2009 and, during subsequent flights it successfully completed a series of trials demonstrating the capability of the system and the potential of large unmanned systems to support future UK Ministry of Defence (MOD) operational needs. The MANTIS programme is jointly funded by UK MOD and UK Industry.

With its ability to take-off, complete a full mission and land – all at the click of a computer mouse – HERTI has been designed to meet a wide variety of operational needs, both cost effectively and with extremely high levels of reliability while removing the need for an operator or pilot to control the aircraft from the ground. When coupled with BAE Systems’ Imagery Collection & Exploitation (ICE) system, the aircraft offers real potential in the fields of maritime, coastline, border and military surveillance as well as showing broader potential for areas such as pipeline, plant and infrastructure surveillance, and insurgent detection.

X-45: Boeing
The Boeing Joint Unmanned Combat Air System (J-UCAS) X-45 is the first highly autonomous, unmanned system specifically designed for combat operations in the network-centric environment of the 21st century. The Defense Advanced Research Project Agency, the US Air Force, and Boeing have completed the first two demonstration
blocks on the X-45A and are developing the X-45C. The X-45C will fly high-risk operational missions and deliver precision weapons on target. Controlled by either line-of-sight or satellite communications, the X-45 is highly adaptable to changing battle conditions.

Boeing began its unmanned combat aircraft program in 1998 and the following year, DARPA and the US Air Force chose Boeing to build two X-45A air vehicles and a mission control station under the J-UCAS Advanced Technology Demonstration Program. During its first flight, May 22, 2002, the X-45A flew for 14 minutes at NASA's Dryden Flight Research Centre at Edwards Air Force Base in California, reaching airspeed of 195 knots and altitude of 7,500 feet. Flight characteristics and basic aspects of aircraft operations, particularly the command and control link between the aircraft and the mission-control station, were successfully demonstrated.

By the end of 2004, the two X-45As flew 35 test missions at NASA's Dryden Flight Research Centre. The most significant X-45A test flights in 2004 included a precision weapon drop in April, when the X-45A demonstrator hit a ground target with a 250-pound inert near-precision-guided weapon released from its internal weapons bay, and the first unmanned, autonomous multi-vehicle flight in August under the control of a single pilot.

**X-47: Northrop Grumman**

The X-47B is a tail-less, strike fighter-sized unmanned system currently under development by Northrop Grumman as part of the US Navy's Unmanned Combat Air System Demonstration (UCAS-D) program. Under a contract awarded in 2007, the company has designed, developed and is currently producing two X-47B aircraft. In the 2013 timeframe, these aircraft will be used to demonstrate the first carrier-based launches and recoveries by an autonomous, low-observable relevant unmanned aircraft. The UCAS-D programme will also be used to mature relevant carrier landing and integration technologies, and to demonstrate autonomous aerial refuelling by the X-47B aircraft.

The US Navy recently awarded Northrop Grumman a six-year, US$635.8 million contract to conduct the first ever at-sea carrier launches and recoveries with the X-47B. The UCAS-D effort will mature critical technologies, reduce unmanned air system carrier integration risks and provide information necessary to support a potential follow-on acquisition milestone.

“We are proud of our legacy of innovation and creativity in developing new combat capabilities and are pleased to be selected to lead this revolutionary advancement in unmanned systems capabilities,” said Scott Seymour, President of Northrop Grumman’s Integrated Systems sector.

“The UCAS-D award is the culmination of several years of effort with the Navy to show the benefit of melding the capabilities of a survivable, persistent, long-range UCAS with those of the aircraft carrier,” said Gary Ervin, Vice President for Northrop Grumman’s Integrated Systems Western Region sector. “The UCAS-D program will reduce the risk of eventual integration of unmanned air systems into carrier environments.”

The X-47B is the latest addition to a growing family of systems developed by Northrop Grumman, the leading producer of unmanned aerial systems. The UCAS concept builds on the company’s extensive experience with autonomous flight control that includes thousands of flight hours by the combat-proven RQ-4 Global Hawk, the MQ-5B Hunter and the MQ-8 Fire Scout vertical takeoff and landing systems.
Unmanned Aerial Systems

(VTOL) tactical unmanned system — the first completely autonomous VTOL aircraft to land aboard a Navy vessel is underway. The UCAS-D contract furthers Northrop Grumman’s legacy of building carrier-based airplanes such as the EA-6B and E-2D, with significant roles in the F/A-18E/F/G and F-35C aircraft programs.

Phantom Eye: Boeing

Boeing has unveiled the hydrogen-powered Phantom Eye unmanned airborne system, a demonstrator that will stay aloft at 65,000 feet for up to four days.

Phantom Eye is the first of its kind and could open up a whole new market in collecting data and communications,” Darryl Davis, President of Boeing Phantom Works, said today at the unveiling ceremony in St. Louis. “It is a perfect example of turning an idea into a reality. It defines our rapid prototyping efforts and will demonstrate the art-of-the-possible when it comes to persistent intelligence, surveillance and reconnaissance. The capabilities inherent in Phantom Eye’s design will offer game-changing opportunities for our military, civil and commercial customers.”

“The programme is moving quickly, and it’s exciting to be part of such a unique aircraft,” said Drew Mallow, Phantom Eye program manager for Boeing. “The hydrogen propulsion system will be the key to Phantom Eye’s success. It is very efficient and offers great fuel economy, and its only byproduct is water, so it’s also a ‘green’ aircraft.”

Phantom Eye is powered by two 2.3-litre, four-cylinder engines that provide 150 horsepower each. It has a 150-foot wingspan, will cruise at approximately 150 knots and can carry up to a 450-pound payload.

nEUROn

The nEUROn is a technological Unmanned Aerial Combat Vehicle demonstrator that was launched by the French Defence Minister at the 2003 Le Bourget air show. The demonstration goals of the initiative are to perform an air-to-ground mission, using network-centric warfare technologies and techniques, to evaluate the detection results (in radar cross section and infrared) of a stealth platform facing ground or aerial threats and to assess weapon delivery from an internal bay with stringent tempo constraint. Dassault Aviation is the prime contractor on the project.

Its aim is not to perform military missions, but to demonstrate maturity and effectiveness of technical solutions. Of course, this technological demonstrator will use all the command, control, communication, coordination and information technologies for unmanned air vehicles, integrated in tomorrow’s network centric warfare.

The nEUROn Demonstrator will provide European design offices with a project which will allow them to develop know-how and to maintain capabilities in the coming years. This project will be go beyond the theoretical studies that have been conducted until now in the European Union, as it plan the building and flight demonstration of an aircraft.

The French initiative is also a way to implement an innovative process in terms of European co-operative programme management and organisation. To be effective, a co-operative programme management needs a single point of decision, the French DGA and a single point of implementation, Dassault Aviation as prime contractor of the programme.

The nEUROn will perform demonstration with a modular and reliable avionics system, using COTS-based modular on-board computers, and high-productivity and high-quality critical real-time software.

It is clear that through these demonstration missions, the goals are to validate technologies around command and control of an unmanned vehicle of a size similar to a combat aircraft, with all back-up modes insuring necessary safety end security. This vehicle will be inserted into a network-centric warfare environment, giving capabilities of control and information exchanges.

The nEUROn platform will be stealth. In this field, mature technologies will be demonstrated. nEUROn will be the first large size stealth platform designed in Europe.

Saab AB has now delivered the front and central fuselage sections of the nEUROn European UCAV technology demonstrator to the Dassault Aviation. For both companies, this delivery constitutes an important milestone after six years of acquisition, sharing and strengthening of know how in the fields of technology and program cooperation. Both companies express their satisfaction about this success that will culminate in nEUROn’s maiden flight in mid-2012 to be followed by several flight test campaigns.

In the last quarter of 2011, the Dassault Aviation team will perform the ground tests of the nEUROn, followed by the first engine run-up by end 2011.

The future of military ISR

These systems represent just a few examples of key demonstrator programmes that are being executed in the areas of unmanned aerial systems. These initiatives will enable those companies that provide air systems to the military to see exactly what their capabilities will be moving forward into the future.

Taranis UAV, courtesy BAE Systems.