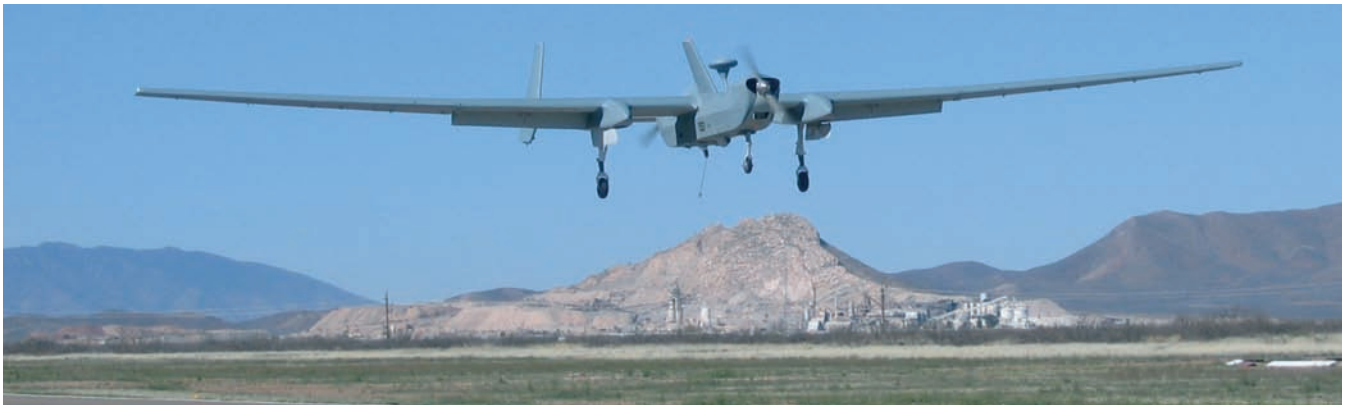
UAV directory 2006

The rapid evolution of unmanned air vehicles is highlighted by our third annual directory. We have expanded the range of systems described in terms of technology and geographic regions to reflect a truly global sector, where the dominance of traditional supplier nations is now under challenge. Technical specification and performance data tables to accompany each entry in the directory are available at www.flightglobal.com/uavdirectory

PETER LA FRANCHI / LONDON



Northrop Grumman/ Israel Aircraft Industries E-Hunter, an extended-range version of the Hunter, has an endurance of 30h

CLASSIFICATIONS

UAV classifications contained in this directory are largely based on manufacturers' own designations, but also take into account a variety of international classification standardisations, which are in a constant state of flux. Generally speaking, close-range UAVs are those which operate at low altitude at distances of less than 5km (2.7nm) with a payload below 5kg (11lb). Short-range UAVs are those which operate at low altitude at distances of up to 20km. Air vehicles in both these categories are also often referred to by the designations small-UAVS and mini-UAVs, as distinct from micro-UAVs. The latter category tends to have a wingspan of below 0.5m and a range of up to 2km. This directory standardises around the terms micro, close and short range.

Tactical UAVs are generally classified as having an endurance of around 6-10h on average, but with 10-15h becoming common for more capable systems in the class. Medium tactical UAVs may have an endurance of up to 24h and a maximum ceiling of up to 18,000ft (5,500m). Medium-altitude long-endurance UAVs fly for at least 20h above 18,000ft with endurance well above 24h commonplace – the General Atomics Aeronautical Systems MQ-1 Predator is already demonstrating in excess of 30h. High-altitude long-endurance UAVs have an endurance of greater than 24h at altitudes of above 50,000ft with operations in excess of 30h common for the few platforms in this class.

Unmanned combat air vehicles are classified in this directory as purpose-designed and -built aircraft in development for armed combat, such as the Boeing X-45 and Dassault-led Neuron types, rather than being a weaponised derivative of an existing UAV type. The term unmanned reconnaissance air vehicle has emerged within the European UAV community within the past 12 months and is adopted by this directory to designate systems that have the physical attributes of a UCAV, but are not optimised for that role at the outset. In this context URAVs should be seen as an evolution of low- and medium-altitude, deep-penetration concepts such as the EADS CL-289 and the former Lockheed Martin Darkstar system. The EADS Barracuda and Alenia Sky-X are two clear examples.

ACRONYMS

ACTD Advanced Concept Technology Demonstration **CAPECON** civil UAVs applications and economic effectivity of potential configurations **DARPA** US Defence Advanced Research Projects Agency **DSTO** Australian Defence Science and Technology Organisation **HALE** high-altitude long endurance **IMINT** imagery intelligence **J-UCAS** Joint Unmanned Combat Air System **LADP** low-altitude deep penetration **LALE** low-altitude long endurance **LRIP** low rate of initial production **LUAV** logistics unmanned air vehicle **MALE** medium-altitude long endurance **MTOW** maximum take-off weight **NBC** nuclear, biological, chemical **N-UCAS** Navy Unmanned Combat Air System **SIGINT** signals intelligence **TUAV** tactical unmanned air vehicle **UAV** unmanned air vehicle **UCAR** unmanned combat air rotorcraft **UCAV** unmanned combat air vehicle **URAV** unmanned reconnaissance air vehicle **USAF** US Air Force **USMC** US Marine Corps **USN** US Navy **VTOL** vertical take-off and landing **VTUAV** vertical take-off and landing tactical unmanned air vehicle

AAI

AAI, 124 Industry Lane, Hunt Valley, Maryland 21030-0126, USA. Tel +1 410 666 1400; fax: +1 410 628 3077; www.aaicorp.com

RQ-7A/RQ-7B Shadow 200

In production for the US Army as a standard TUAV system based on a modified RQ-7B configuration. It will also serve as the interim Class III (battalion level) UAV under the Future Combat System force structure. Each Shadow system is made up of four air vehicles, two ground-control stations, launcher and associated support equipment.

The Shadow 200A air vehicle first flew in 1998 and was selected by the US Army as a standard TUAV in 1999 with an LRIP contract signed in December of that year. Initial operational test and evaluation approvals from the US Army were granted in June 2002. The initial full-rate production contract, worth $86 million, was signed in January 2003, with nine systems to be delivered in a 20-month period. The first full-rate production system was delivered in September 2003.

The US Army announced in December 2003 that it was extending full-rate production contracts for Shadow 200 systems. A second full-rate production order for 11 systems worth $71.9 million was announced in March 2004. The 100th RQ-7A air vehicle was produced in July 2004. Deliveries of RQ-7B (also known as Shadow Plus) air vehicles began in August 2004 with air vehicles fitted for – but not with – tactical common datalink terminals.

The RQ-7B version adds a larger wet wing, modified tail assembly, and Athena Technologies GS-211e flight controller into the on-board avionics suite. The third full-rate production order for eight systems was awarded in January 2005, worth $71.9 million. An order worth $14.4 million for one additional system and three mobile maintenance facilities was announced in February 2005. The fourth full-rate order, worth $129 million, for 12 systems, was placed in July 2005. The fifth full-rate order, worth $87 million, was placed May 2006 for nine systems, with deliveries to complete in March 2008.

First deliveries to US Army operational users took place in October 2002, and 64 systems had been delivered by mid-2006. The system has been operational in Iraq since January 2004, with the fleet passing 50,000 flying hours in August 2005 and 100,000 combat flight hours in June 2006. Work is continuing within the army and at AAI on alternative sensor payload configurations, with this including sensors optimised for detection of improvised explosive devices. A modular logistics drop pod system is in advanced development for battlefield emergency support roles. Heavy fuel engine options continue to be explored. A potential Foreign Military Sales programme sale to Poland of two systems was announced 27 July 2006.

Shadow 400

Evolved Shadow 200, with improvements in payload capacity and an increased wingspan. It is in operational service with at least one international customer, believed to be the South Korean navy. AAI announced a $25.4 million international order for an unspecified UAV system in June 2001, with this including supply of shipboard air vehicle recovery nets.

Shadow 600

Evolved version of the Shadow 200/400 family, it incorporates a semi-swept outboard wet wing. Export sales of at least one system to Turkey and two systems to Romania have been made, with the initial Romanian deal, worth $20 million, announced May 1997.

ADCOM

Advanced Communications Systems Group, PO Box 25298, Abu Dhabi, United Arab Emirates. Tel: +971 2 5500 630; fax: +971 2 5500 631.

Yabhon Excellency

Developmental MALE system with a wing based on flexible, high-aspect ratio profile. The company-funded project with wing and tail was completed in November 2005, but with fuselage assembly still to start at that date. The proposed communications system includes a Ku-band satellite link, with the prototype mounting unveiled at the Dubai air show in November 2005. Its first flight was initially forecast for April 2006, but there have been no subsequent announcements.

Yabhon-H

Canard-delta wing tactical UAV with vacuum formed glassfibre epoxy construction, twin tails at wingtips and tricycle undercarriage with parachute back-up system. It was initially developed as a target drone. Reconnaissance version payload is based on a single electro-optic camera in an Adcom-designed turret.

Yabhon-M

Large tactical UAV based on evolution of basic Yabhon-H canard-delta wing airframe with increased payload provisions and retractable undercarriage.

Yabhon-R

Extended-range tactical UAV similar in configuration to Yabhon-M, but with double-delta wing, unveiled in late 2005. Development is continuing, with options including tail-less configuration.

Yabhon - VTOL

Developmental coaxial rotor extended endurance tactical VTOL system announced at November 2005 Dubai air show, with first flight projected for the first quarter of 2006. There have been no subsequent announcements.

ADI

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Cybird-2

Jet-powered UAV developed as a testbed for research into new forms of air vehicle navigation and sensor system localisation and tracking algorithms derived from the study of insect cognition and flight behaviours. The airframe was developed under subcontract by Turbo Jet Technologies.

The vehicle first flew in early 2003 and was publicly unveiled in October 2003. Potential development of a high-speed, short-range tactical UAV, loitering missile and target drone variants is being studied. It is being further developed under the Australian DSTO's Project Air 5434 Bioseeker advanced concept technology demonstration project, with initial funding awarded in the first quarter.

Jandu

Jet-powered UAV under development as a high-speed platform to carry electronic intelligence gathering equipment. It is larger than the Cybird-2 and may carry two engines. Proposed application of the vehicle, which has a 50kg payload capacity, is high-speed mapping of the electronic order of battle in threat areas. Being further developed under the Australian DSTO's Project Air 5436 is the Jandu advanced concept technology demonstration project, with initial funding awarded in the first quarter of 2005. No specification data has been released.

ADVANCED CERAMICS RESEARCH

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USA. Tel: +1 520 573 6300; fax: +1 520 573 2057; www.acrtucson.com

Manta

Developmental convoy escort UAV developed in conjunction with the US Naval Research Laboratories and based on operational lessons emerging from US military operations in Iraq from 2003. Initial flights took place in early 2004 and the prototype air vehicles were unveiled at the AUVSI Unmanned Systems North America exhibition in August 2004. Mantas were used by the Scripps Institute, NASA and the US National Science Foundation to carry out a mid-atmosphere monitoring role over the central Indian Ocean in early 2006 and by Raytheon and USN Air Systems Command to demonstrate co-operative UAV operations with an unmanned ground vehicle for US Special Operations Command in April 2006.

Silver Fox

Tactical UAV designed by US Navy Office of Naval Research (ONR) to support exploration of swarming UAV operations in the battlefield. Licensed production is by Advanced Ceramics, with air vehicles supplied to ONR deployed to Iraq in mid-2003 to assist in meeting ongoing surveillance requirements. The first export sale, worth $649,000, was made to the Canadian Defence Forces in April 2004 via Thales Systems Canada to support ongoing UAV experimentation activities. Silver Fox was used by the US Forest Service in October 2004 to monitor the volcanic eruption of Mt St Helens in Washington. A USMC order for a Block 2B system with improvements to air vehicle avionics was placed in November 2004 for continued experimentation in defining Tier-2 TUAV requirements. These UAVs are operated by the 15th Marine Expeditionary Unit. Silver Fox is a candidate for a current USMC Tier-2 TUAV competition.

AERONAUTICAL DEVELOPMENT ESTABLISHMENT

Aeronautical Development Establishment, Defence Research and Development Organisation, Ministry of Defence, New Thippasandra, Bangalore 560 075, India. Tel: +91 80 2528 3188; fax: +91 80 2505 7007; www.ada.gov.in

Nishant/Gagan

A multimission tactical UAV with extended development history, it received initial government funding in October 1991 and the first prototype flew in August 1996. Five additional prototypes were built and tested up until 2002. An initial Indian army production order for 12 aircraft and ground systems was placed in mid-November 2004, with the deal based on initial production and delivery of four aircraft by the end of 2006, with payments then to be released for the remaining eight aircraft. However, deliveries are now not expected until mid-2007. There is also potential Indian coastguard interest. The air vehicle unit cost is around $3.5 million at February 2004 prices. The vehicle is catapult launched with a combined airbag and parachute recovery system. Forty systems are expected to enter Indian army service by 2010.

AERONAUTICS DEFENSE SYSTEMS

Aeronautics Defense Systems, Post Office Box 169 Yavne 81101, Israel. Tel: +972 8 943 3600; fax: +972 8 932 8912; www.aeronautics-sys.com

Aerolight

Close-range UAV developed for intelligence and surveillance missions, but also being marketed as a UAV operator training system. Some aircraft have been acquired by the USN PMA-273 UAV programmes office.

Aerosky

Twin tail-boom pusher-propeller configuration UAV, it is used as the baseline air vehicle for Aeronautics' business model, which is based on offering UAV services rather than selling air vehicles. It was contracted in March 2002 by the Israeli defence forces to provide "surveillance by the hour" services. It was marketed internationally via a seven-year agreement with IAI signed in 2001. Customers include the US Navy PMA-263 UAV programmes office.

Aerostar

Based on the Aerosky airframe, but with a more-capable engine and significantly increased payload capacity. A small number of aircraft and ground systems (along with Aerosky and Aerolight aircraft) were acquired by the US Navy PMA-263 office via a June 2001 solicitation, with systems located at NAS Patuxent River, Maryland. A 2003 contract ws signed with the Israeli defence forces to provide routine security monitoring within Israel's borders and a two-year service contract was announced in May 2004 to provide security monitoring for Chevron Texaco-operated oilfields in Angola.

Aerostar was selected by Irkut in 2004 as the UAV component of its proposed emergency response complex based on use of a UAV to cue airborne firefighting missions by Beriev Be-200 amphibians. A teaming arrangement with General Dynamics Ordnance and Tactical Systems was established in September 2004 to pursue sales and service-based contracts in the USA and allied markets, with Aerostars to be manufactured at the General Dynamics Moses Lake facility.

General Dynamics also signed in mid-2005 to provide air vehicle services for the University of New Mexico Technical Analysis and Applications Centre, and Aerostars were used by the US Air Force Research Laboratory in early 2006 to test a prototype optical sense-and-avoid system for the General Atomics Aeronautical Systems International MQ-1 Predator A. The Israeli police tested Aerostars in the law enforcement role in February 2006. Three systems have been ordered by Nigeria.

Dominator

This multimission flying-wing MALE UAV was unveiled at the Aero India exhibition in February 2005. Under development since at least 2003, it was originally designated Morpheus, with work continuing. Endurance is believed to be 35-40h, including the use of underwing drop tanks and a wet wing. Capable of simultaneous carriage of both SAR and IR/EO payloads, the vehicle has large winglets and an integrated anti-icing system for high-altitude operations, with a ceiling of 25,000ft (7,600m). A satellite datalink terminal is above the nose mounting.

Orbiter

A short-range, electrically powered flying wing unveiled in early 2005, Orbiter is aimed at homeland security, law enforcement and facilities protection markets. Deliveries were made to an unspecified European defence customer in April 2006.

AEROSONDE

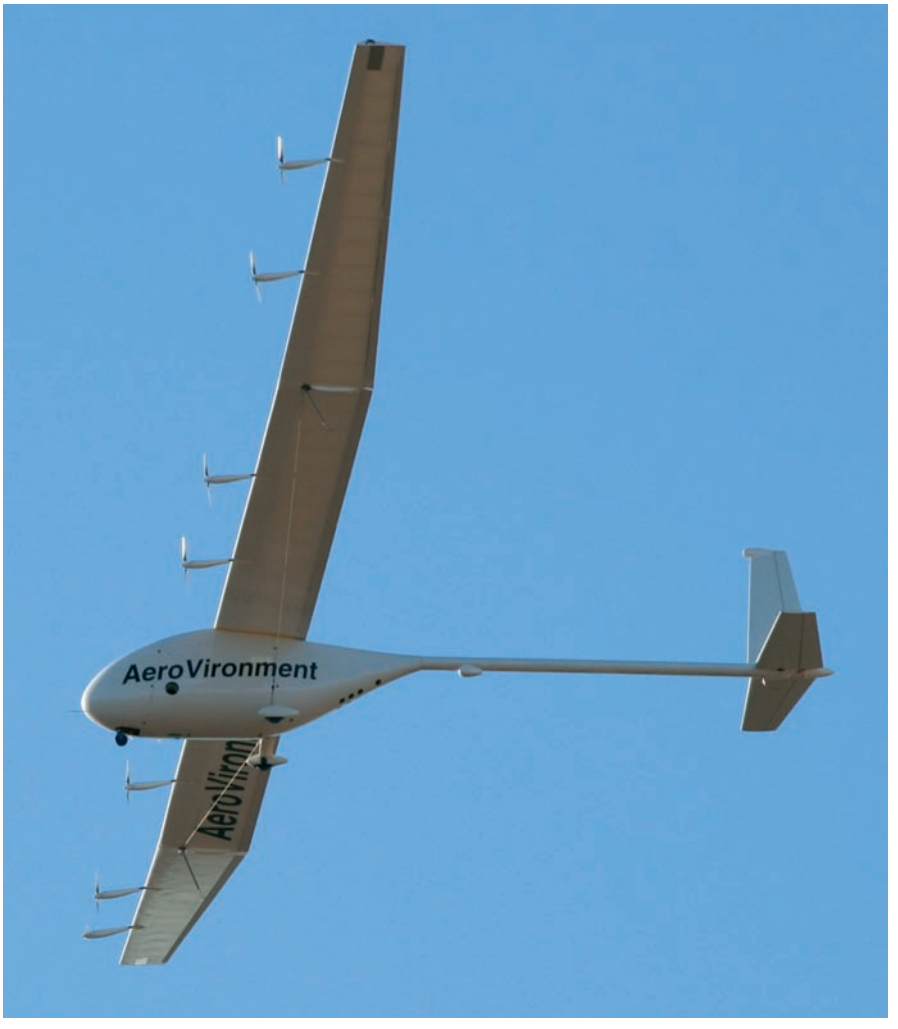
Aerosonde, Unit 1, 585 Blackburn Road, Notting Hill, Victoria 3168, Australia. Tel: +61 3 9544 0866; fax: +61 3 9544 0966; www.aerosonde.com

Aerosonde Mk1/2/3/3.1/4.1

The Mk3 standard production version superseded Mk1 and Mk2 versions developed between 1995 and 2000. Some Mk1 systems were sold to Taiwan for use in meteorological monitoring. The Mk3 version incorporates a fuel-injection system for the engine. A Mk3.1 version, featuring new avionics and a 75w electrical generator to enable increased flexibility in payload options, has been flying since early 2004 and will be standardised for future production series.

The major Mk3 application remains scientific monitoring, with standing contracts with NASA Goddard Space Flight Centre, Wallops, until 2006. Some Mk3s were sold to the Australian DSTO to support UAV battlefield experimentation with electronic warfare and EO-IR payloads with this continuing as at June 2006. A Mk2 Aeroguard configuration aircraft was used by the Australian Army in peacekeeping support work in the Solomons Islands in 2004. In 2004 follow-on Mk3 sales were made to Taiwan and a new sale was made to Singapore for civil applications. A Mk4.1 version was unveiled in February 2004, with key additions including a Cloud Cap Technology Piccolo guidance system, a distributed on-board data network, new power supply, increased payload weight and space, and increased endurance.

The changes were retrofitted in early 2005 into earlier versions owned by the US Office of Naval Research and Alion Science and Technology Corporation. A modified wing incorporating winglets was unveiled at the 2005



AeroVironment Global Observer testbed is intended to continue the quest for eternal aircraft

Paris air show. It was contracted by the US Air Force in September 2005 for the Weatherscout Foreign Comparative Test programmes. The type endurance record of 38h was set on 3 May 2006 and a 48h endurance target is being pursued through engine modifications. A revised Mk4 configuration, developed after the June 2006 acquisition of company by AAI, is due to be unveiled in August 2006.

It is on offer for the USMC Tier-2 TUAV competition with the existing ground control station replaced by the AAI One System to facilitate interoperability with the US Army AAI RQ-8B Shadow 200.

AEROVIRONMENT

Aerovironment, 4685-3H Industrial Street, Simi Valley, California 93065. Tel: +1 805 581 2187; fax: +1 805 581 4512; www.avinc.com

Dragon Eye/Swift

Designed by the US Naval Research Laboratory and Marine Corps Warfighting Laboratory as the air vehicle segment of the Navy Advanced Tactical Reconnaissance system. The first prototype flew in May 2000. A competition was launched in mid-2002 for the supply of up to 1,026 vehicles for the USMC, with this competed by BAI *(see separate entry)* and Aerovironment. Aerovironment was selected as preferred USMC supplier in November 2003 with a contract award worth up to $40 million over five years to supply around 300 fully autonomous air vehicle systems, each comprising one ground station and three air vehicles. A follow-on USMC award came in February 2006, worth $9.79 million, for 303 additional air vehicles and 101 ground control stations, with deliveries to be completed by December 2006. The Swift derivative has been developed to provide operators with a remote piloting option as well as full autonomous capabilities. Endurance data is based on a single-use battery.

FQM-151A Pointer

First flew in 1986, with initial deliveries to the USMC beginning in 1988, and follow-on orders coming from the US Army and USAF. Initial upgrades to the baseline payload system were implemented in 1990, followed by the addition of GPS-based auto-navigation systems and thermal-imaging cameras in 1995.

A new-generation thermal imager was added in 2000, along with a smaller, ruggedised control system. US Special Operations Command ordered 28 air vehicles and ground systems in early 2002 in response to identified capability deficiencies emerging from the war in Afghanistan. Deliveries were completed by August 2002.

The system was tested by the French army, with two systems delivered in 2001, with in-country support provided by CAC (later acquired by EADS). Total production since 1986 exceeds 700, with several hundred systems in the current US Army, SOCOM and USAF inventory.

Hawkeye

Unmanned logistics air vehicle under development since 2002 in conjunction with the US Special Forces Command, with the project managed by the US Naval Research Laboratories. Hawkeye has a folding tandem wing arrangement and is designed to be launched from the tail ramp of large cargo aircraft. Prototype systems were unveiled at the AUVSI Unmanned Systems North America exhibition in August 2004 with development continuing as at July 2006.

The larger version, designated X-Glider, has a 2.7m wingspan and was developed on behalf of the USN. X-Glider was flight tested from a USN Lockheed P-3 during 2002 as a potential delivery system for sonobuoys, but funding for that specific variant was discontinued in 2003. A range of miniature variants under development, called GLUAV – or Gun Launched UAV – are intended to either be fired from a ground-based ballistic system or tube-launched from the air.

Global Observer

Long-endurance hydrogen fuel cell-powered aircraft developed as company-funded initiative and drawing on lessons from crash of Helios eternal aircraft prototype in June 2003. The airframe is based on a traditional fuselage and wing configuration to better support fuel-cell weight distribution, as this directly contributed to the Helios accident. The debut flight in May 2005 at the US Army Yuma Proving Ground lasted 1h. A second flight took place in June 2005. Demonstration flights are planned for October 2006 over Arizona to test a prototype European Commission-funded Capanina project broadband communications payload.

Two Global Observer derivative versions were proposed in February 2006 for military use, with target customers including Australia, Japan and Saudi Arabia. The GO-1 configuration would have a 48.8m (160ft) span, a gross take-off weight of 1,800kg (3,960lb) and seven-day endurance. The limited rate production aircraft is forecast to cost $14.2 million, with a two-year lead time. GO-2 configuration would have an 80m span, 4,100kg gross take-off weight and eight-day endurance.

Directory: unmanned air vehicles

Pathfinder-Plus

Solar electric-powered eternal aircraft prototype developed as a stepping stone towards Helios aircraft, with funding provided from NASA's ERAST Earth sciences programme. The vehicle, which has a spanlifter airframe, was used to test atmospheric monitoring of coffee crops in September and October 2002. Pathfinder-Plus is also being used to support development testing of Aerovironment's Skytower commercial communications server concept based on using stratospheric aircraft as atmospheric satellites. The concept was demonstrated in trials over Hawaii in July 2002. NASA funding was awarded to Aerovironment in late 2003 to refurbish Pathfinder-Plus for flight operations, with this completed in early October 2004. Limited flights were conducted during the final quarter of 2004 to explore the impact of atmospheric turbulence on spanlifter airframes as part of the relaunch of NASA HALE UAV research after the loss of Helios. Follow-on final flights were conducted at Rogers Dry Lake at Edwards AFB on 31 August 2005 and 14 September 2005, again examining turbulence issues. The aircraft is now retired.

Puma

A new-generation close-range UAV proposed as a Pointer replacement, with an endurance of up to 4h on a single disposable battery and 3h on a rechargeable battery. US Army Soldier Systems Center acquired a system in September 2005 for evaluation. The water-landing Aqua Puma version was funded by US Special Operations Command in the US fiscal year 2006 budget, with total allocations of $3.5 million. The variant programme was made public in February 2006. Aqua Puma has a take-off weight of 5.5kg (18lb) with a single battery. Both versions are capable of carrying dual batteries, extending mission time. A basic version of the Puma was used to fly a broadband communications payload in an August 2003 demonstration of telesurgery capabilities jointly run by the US Army, University of Cincinnati and Aerovironment. Aqua Puma is being marketed internationally as an option for fitting small patrol craft with UAV capabilities, with target markets including Australia.

RQ-11A Raven

Lightweight close-range UAV making extensive reuse of Pointer subsystems, including same ground station. Designed to be transported by two people to reduce the weight load on individual soldiers, it first flew in 2003 and has been in service in Iraq with SOCOM units. The US Army placed a $20.7 million initial order for 170 vehicles in January 2004 and a second order in February for 59 air vehicles. The total USAF inventory at 1 February 2005 was 84 aircraft, while the SOCOM inventory was 225 aircraft.

A $7.9 million contract was announced in February 2005 for reset work on 170 air vehicles, with work scheduled for completion in October 2005. One air vehicle costs around $35,000 and a complete system, including ground control system and payloads, is roughly $250,000. A standard rechargeable battery pack provides 60-90min flight time, while a disposable battery gives 110min. It is on offer for the US Army small UAV competition, which was launched in February 2005.

Skytote

Tail-sitting, VTOL winged UAV being developed for US Air Force Research Laboratory using small business innovation research programme funding. The initial award, made in 1998, was worth $100,000. The vehicle uses counter-rotating propellers to lift off and then transitions into horizontal wing-borne flight. Transition weight loads are shared between wings and 2.3m cruciform tailplanes, which act as a landing platform in vertical flight mode. A half-scale demonstrator flew initial trials in the final quarter of 2003.

The vehicle completed all basic test flights, but then made a hard landing because of a software error. Repairs to the demonstrator were carried out in 2004-5, with flight testing resuming in early 2006 at the US Army Yuma Proving Grounds, Arizona, starting with initial autonomous hover tests. Follow-on testing, including exploration of transition modes, took place in the second quarter of 2006.

Wasp

Hand-launched micro-UAV downselected by DARPA for Micro Air Vehicle programme in 1997, with extensive development carried out since then focusing on potential applications in urban environments. Wasp is capable of both autonomous and remote flight modes and shares the same ground control station software as Raven and Puma. Can be landed in water with marinisation kit adding some 0.15kg to take-off weight. US Navy testing took place in April 2005. Production versions are expected to cost around $5,000 per unit. Development is continuing.

ALCORE TECHNOLOGIES

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Azimut

Hand-launched close-range military system similar to Aerovironment Pointer, with a high- wing pusher propeller configuration with V tail, it is a candidate for a future French army competition for a combined close-range/urban operations UAV system. Needs a two-person crew.

Biodrone

Close-range surveillance system with design features intended to mimic the aerodynamic attributes of birds to improve energy usage and increase endurance. A prototype has flown.

Chacal

Pusher-propeller powered delta wing surveillance UAV with canards to provide improved manoeuvrability. At least one prototype has flown with a GPS-based navigation system, autopilot and S-band datalink. Target drone variants have been proposed.

Futura

Jet-powered delta wing medium-range fast reconnaissance system that is rail launched. An attack configuration similar to that of the Rheinmetall Taifun has been proposed, but its development status is unclear. Target drone variants have been studied.

Maya

Short-range mini-VTOL system designed for use in urban and close-range reconnaissance operations. An integrated NBC detection payload is available, although the standard payload is one CCD camera. The current datalink uses analogue FM technology and a lithium polymer battery

ALENIA

Alenia Aeronautica, Via Campania, 45-00187 Roma, Italy. Tel: +39 06 420 881; fax +39 4282 4529; www.alenia-aeronautica.it

Sky-X

UCAV/URAV demonstrator being developed under a $32.1 million programme launched by Alenia in January 2003 following discussions with Italian air force about potential future requirements. The basic design is built around a requirement to carry and deliver two 225kg (500lb) J-series munitions from an internal weapons bay.

The first mock-up of the vehicle was unveiled in May 2003. The project schedule announced in June 2003 proposed an initial flight testing campaign to run in May-December 2004, followed by advanced testing from January 2005. A revised schedule and design concepts were announced in May 2004. Assembly of demonstrator began in October 2004 based on further design revisions and using an existing certificated weapons dispenser pod as the fuselage core. The guidance and control system was flight tested using a modified Aeromacchi SF-260 as a UCAV surrogate in early 2005.

The first flight of the demonstrator was in May 2005 at the Vidsel military test range in Sweden. Air vehicle take-off speed was 125kt (230km/h) and landing speed was 110kt.

A second flight campaign was carried out at Vidsel in the third quarter of 2005, comprising four sorties to assess the impact of software upgrades. A third flight campaign at Vidsel in April-May 2006 saw the vehicle attain an air speed of 230kt and an altitude of 10,000ft (3,000m). Campaign elements included autonomous navigation and a preliminary evaluation

of auto-approach modes for automatic take-off and landing, and datalink characteristics. A total of 11 flights was achieved by late June 2006, with a fourth flight campaign imminent as at 14 August 2006.

The project schedule calls for integration of autonomous flight-control systems with air traffic management systems to be completed by mid-2007 allowing the vehicle to operate in non-segregated airspace. A weapons delivery demonstration is proposed for 2006-2010. A new-generation Finmeccanica synthetic-aperture radar and hyperspectal imaging sensors is being considered for inclusion in the test programme. The development effort is contributing to Alenia involvement in the Dassault-led Neuron UCAV demonstrator programme *(see separate entry)*.

ATAIR

Atair Aerospace, Suite 3B, 499 Van Brunt Street, Brooklyn, New York 11231, USA. Tel: +1 718 923 1709; fax: +1 718 923 1733; www.atairaerospace.com

LEAPP

Long-endurance autonomous powered parasail (LEAPP)-based precision logistics UAV system planned to be developed for DARPA under a tactical technology project. Funding of $1.5 million has been incorporated into fiscal year 2007 forward DARPA budget plans released in February 2006. Atair plans initial test flights of demonstrator aircraft in September 2006. LEAPP is a derviative of the Onyx parasail logistics UAV initially developed in response to a development funding award worth $850,000 provided by the US Army in July 2003. Private launch investment was also provided by Festo.

Unpowered Onyx versions were used to demonstrate autonomous flocking and collision avoidance capabilities in December 2004 using two flights of five air vehicles. Autonomous guidance and control algorithms developed by Atair with variants are being considered for application to other UAV systems. Data is for the DARPA variant, but a 30.5m wingspan version capable of carrying 1,815kg was test flown during 2004. A micro LEAPP variant capable of flying for 4h with a 9kg payload was unveiled in June 2006.

ATE

Advanced Technologies and Engineering, PO Box 632, Halfway House, 1685, South Africa. Tel: +27 11 266 7600; fax: +27 11 314 2151; www.ate-aerospace.com

Vulture

Developed in response to a South African Army requirement for artillery target location and spotting system, with initial contracts placed in 1994. First flight was in 1995, but the development and evaluation programme was extended. Qualification trials at the South African Gerotek test range were completed in mid-2004. The final integration of the ground control system with South African Army artillery command and control network took place in late 2004 and early 2005. Deliveries of more capable air vehicles to the South African Army to support operational qualification tests were made from early 2005 and completed in mid-2006. A production contract award was announced in August 2006.

Intelligence Vulture

Upgraded version to enter South African intelligence corps service in 2005-8 under South African government plans announced in 2003. May carry electronic intelligence payload.

Multi-Mission Vulture

Upgraded variant proposed to enter South African Army service in 2007-11 to support broader spectrum surveillance and reconnaissance missions.

The upgrade pathway is based on concepts for Super Vulture as offered to the United Arab Emirates between 1998 and 2002.

Ukhozi/Seagull

A Vulture derivative intended for use in civil and military maritime surveillance operations. The concept was unveiled in 2003, but development has been suspended.

AURORA FLIGHT SCIENCES

Aurora Flight Sciences, 3000 East Benedum Industrial Drive, Bridgeport, West Virginia 26330, USA. Tel: +1 304 842 8100; fax: +1 304 842 8116; www.aurora.aero

Excalibur

Vertical take-off and landing tactical UAV under development as a purpose-built, rapid-response strike platform for the US Army. Funding allocations totalled $20 million at mid-2005. The design is based on the turbine-powered flying wing, with tip-mounted vertical tails with VTOL lift attained by rotating the engine 90° into the vertical with augmentation stability provided by three electrically driven thrusters.

A sole-source contract was awarded by the US Army in March 2005, with an initial funding release of $5.01 million.

The prototype is scheduled to make its first flight in 2007.

Golden Eye 50

Shrouded fan short-range VTOL UAV for tactical application, with an optional free-wing configuration. Its development was made public in 2003 and its first free flight came in July 2004. Its first autonomous transition from hover to forward flight and back to hover was performed in April 2005 and a high-speed banked turn capability was demonstrated in October 2005. The 100th demonstrator flight was achieved in March 2006.

Aircraft weight is 7.2kg (15.8lb), with guidance and control architecture based on the Athena Technologies GS-111M system. At least one demonstration has been conducted for an unnamed second NATO member state.

Golden Eye OAV/Golden Eye 50 Block II

Shrouded-fan VTOL derivative of the Golden Eye 50 and 100 programmes. It was shortlisted in December 2004, alongside rival proposals by BAE Systems North America and Honeywell *(see separate entry)* for DARPA/US Army Future Combat System Phase 1 Class II Organic Air Vehicle (OAV) development programme. Aurora funding allocation for Phase 1 development totalled $2.39 million. The vehicle was downselected for the Phase II OAV Class II system in July 2005. The Golden Eye Block II designation was announced in March 2006, with this variant to include a new engine, increased endurance and improved imagery handling. The award of DARPA Phase III OAV Class II system funding worth $23.6 million was announced in June 2006. A candidate for the US Army FCS Class II requirement.

Golden Eye 100

Shrouded-fan VTOL with optional free-wings and heavy fuel engine. Its first flights in September 2003 included the demonstration of autonomous flight-control systems. An initial trials campaign ran from September 2003 to April 2004.

BAE SYSTEMS

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Directory: unmanned air vehicles

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Brumby Mk 3/4

Designed and developed by BAE Systems Australia as a stable, large payload capacity flying research platform. It is used to support research into real time observation and measurement techniques, coupled with distributed data processing between UAVs, to achieve precision autonomous navigation and targeting. Initial Brumby Mk1 and Mk2 designs were developed by the University of Sydney as a delta wing research programme.

The Mk3 was developed into canard wing configuration as a collaborative development, with at least five air vehicles built. BAE Systems Australia is the original equipment manufacturer for the Mk4 (also known as Kingfisher Mk1), which replaces the delta wing with a conventional airframe employing twin tailbooms.

Corax

URAV/UCAV demonstrator system was first flown in January 2005 at the Woomera test range in central Australia. The vehicle was made public in late 2005. The flying wing configuration has a shrouded, above-fuselage engine. Its modular flight-control systems were derived from the Raven demonstrator system with highly evolved air vehicle autonomous guidance and control capabilities. It is potentially the basis for a proposed UK Ministry of Defence UCAV demonstration programme under the Strategic UAV (Experiment) or SUAV(E) initiative established in July 2005.

Herti

UAV derivative of a glider airframe originally developed and produced by Polish firm J&AS Aeronew, Herti is an acronym for High Endurance Rapid Technology Insertion initiative. The first jet-powered Herti 1D prototype was built on a J5 glider airframe, with the UAV version built and readied for flights in a seven-month period. The first flight was at the Woomera test range in central Australia in January 2005.

A second version, designated Herti 1A, and built on a J6 glider airframe, replaced the jet engine with a pusher propeller and two-cylinder engine to improve endurance and became the first large UAV to fly autonomously in UK airspace in August 2005 with a flight at Campbeltown in Scotland. A limited manufacturing programme for the Herti 1A configuration is expected to result in 10 air vehicles by the end of 2006.

Concepts for a catapult launch have been studied in conjunction with Robonic of Finland. Weaponisation studies were revealed at the 2006 Farnborough air show. MALE derivatives are under study.

Kestrel

Blended wing body remotely piloted system developed in conjunction with Cranfield University with an airframe manufactured by Tasuma. It has a twinjet propulsion system and its one flight took place at Campbeltown, Scotland, in March 2003. The design was found to be highly unstable and the programme was suspended in favour of the Raven.

Kingfisher Mk II

Extensively modified derivative of the Brumby Mk4 airframe developed by BAE Systems Australia to provide significantly improved payload and endurance capabilities. The vehicle incorporates a new high-lift wing, larger box-form fuselage and a new engine. The avionics and the ground control station remain common to Brumby series. First flights took place in mid-2005. The Kingfisher is supporting the Australian DSTO's current Project Air 5435 Future UAV for Reconnaissance and Interdiction UCAV technologies advanced concept technology demonstration project.

OAV/IAV

Developmental shrouded fan VTOL close-range tactical UAV being developed by BAE Systems Platform Solutions, with at least three design iterations over the past three years. The initial OAV configuration was unveiled at AUVSI Unmanned Systems North America in August 2004 and is based on an augmented ring wing design with duct reducing to four venturi on the underside. Two side-mounted wings provide additional lift.

A derivative of this design was selected in December 2004 alongside rival proposals by Aurora Flight Sciences and Honeywell for the DARPA/US Army Future Combat System Phase 1 Class II Organic Air Vehicle (OAV) development programme.

BAE Systems funding allocation for Phase 1 development totalled $2.53 million. Around 100 tethered flights were made up to April 2005 using second configuration designs with duct lip-mounted sensor suite.

The first untethered flight of 7min duration using a third configuration air vehicle was announced in April 2005.

The company was advised by DARPA in June 2005 that it had failed to be selected for the Phase II OAV Class II concept maturation programme. The third configuration concept introduced the IAV name at AUVSI Unmanned Systems North America in July 2005. The IAV demonstrator has an external duct of 0.86m housing a 0.71m lift fan, with the sensor payload transferred to a pod mounted on a tripod pylon above the duct mouth. Removable wing and heavy fuel engine options have been proposed to be continued as part of that same revised development plan.

The first flight of the IAV demonstrator took place in southern California in August 2005. The first waypoint navigation demonstrations were announced in September 2005. The flight demonstrations for the US Army carrying SIGINT payloads took place in January 2006. Development is continuing. The data table details IAV 2 and IAV 3 production vehicle concepts as released in July 2005.

Phoenix

Current British Army tactical UAV system and first acquired for artillery spotting and observation roles, it was initially developed by the former GEC Avionics company, with a production award by the UK Ministry of Defence in 1985. There were extensive service entry difficulties, but these were largely resolved by the late 1990s. Operationally deployed to Kosovo in 1999-2001, it has served almost constantly in Iraq in 2003. It is to be replaced by the Watchkeeper system *(see Elbit entry)*, based on the Hermes 450.

Raven

UCAV/URAV demonstrator system developed over a nine-month timeframe in 2003, culminating in a first flight at the Woomera test range in Australia in December 2003. The second demonstrator was built and flown at Woomera in November 2004. The highly unstable flying wing airframe was used to explore development of advanced flight-control systems, with these subsequently ported to Corax and Herti systems.

Skyeye R4E 50/100

Current versions of long-standing Skyeye series, with the R4E first flying in 1980 and introducing a twin-boom configuration to the type. Sales to the US Army, Thai army, Morocco and Egypt were made during the 1980s.

Egypt remains the main operator, with systems upgrade contracts placed in 1999 for two operational squadrons.

Negotiations took place during mid-2005 for additional upgrades to existing fleet and the supply of enhanced capability air vehicles with improved avionics and sensor capabilities, but the outcome remains unknown. Proposed by BAE Systems North America as a potential platform for anticipated US Department of Homeland Security northern border surveillance requirement. Marketing in Middle East continues.

Skylynx II

Significantly scaled-up derivative of MiniFalcon designed by Innocon of Israel *(see separate entry)* with enhancements to provide a wider operational envelope. Design rights were acquired by BAE Systems to support evolution of the design to form the basis of BAE's bid for the current USMC Tier-2 tactical UAV competition. Two different demonstrators have been built with different powerplants.

The vehicle is catapult launched with a parafoil recovery system, but conventional take-off and landing is also possible. Initial Skylynx II flights took place in early 2006, with additional flights at the US Army Yuma proving ground in

early August 2006. The full system comprises three air vehicles, ground control station, launcher, remote receive terminal, and a crew of six.

BELL HELICOPTER

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Unmanned 407X

Concept revealed by Bell Helicopter in October 2005 for an unmanned conventional configuration helicopter being planned as alternative solution US Army Future Combat System architecture Class IV UAV requirement, for which the Northrop Grumman RQ-8B Firescout has been selected. No timeframes for development have been revealed.

Eagle Eye

Tiltrotor technology-based high-speed tactical UAV. TR-911X, a 7/8th scale technology demonstrator, first flew in March 1998 and achieved 100h flying until its retirement in 2000. Eagle Eye was evaluated by the US Navy for its VTUAV requirement but not selected, but it was chosen in February 2003 as preferred tactical UAV for the US Coast Guard's Deepwater programme. Construction of the full-scale TR-918 production prototype was announced in November 2003, with this originally planned to be flying by 1 November 2004.

TR918 ground testing was completed in December 2005. The first flight took place in January 2006 at Graford, Texas with two hover-only flights within 1h. FAA experimental certification for TR918 version was issued in early 2006. The TR918 demonstrator crashed in April 2006 after losing engine power in stable hover, causing suspension of flying programme.

The Deepwater programme acquisition plan is based on 45 air vehicles and 33 ground control stations, with the variant designated TR916. The original Deepwater plan called for deliveries from 2006 and the first variant flight is scheduled for December 2008. Funding pressures have forced initial entry into operational service to "approximately 2012", with delays caused by the lack of available funding within the Deepwater framework. The preliminary design review for the TR916 version was passed in the first quarter of 2004 and airframes will be produced by Aurora Flight Sciences. The Telephonics RDR 1700CG X-band multimode radar is to equip production systems and will also provide an air traffic sense-and-avoid function.

Discussions with Korea Aerospace Research Institute took place in 2003 on a variant to meet the South Korean government-funded "smart UAV" initiative, but no agreement has been reached. Concepts for possible armed and logistics derivatives were flagged by Bell Xworx in January 2005. The vehicle is being marketed to France and Germany to meet possible medium-term ship-launched VTUAV requirements.

An initial three-way teaming arrangement with Sagem of France and Rheinmetall of Germany was signed in June 2004 to pursue European requirements and formalised in December 2004. The teaming arrangement was predicated on Bell supplying modified air vehicles, and Sagem and RDE providing ground and shipborne control stations, datalinks, payloads and command and control system integration. A teaming arrangement was signed with Lockheed Martin and AAI in July 2004 to pursue additional US military and homeland security requirements.

A US Marine Corps budget allocation for a possible Eagle Eye purchase was incorporated into the USN budget plan for fiscal year 2006, but no orders were made. An order for three production air vehicles from Evergreen International Aviation for use in firespotting roles was signed in 2003, with deliveries planned for 2007

BLUE BIRD AERO SYSTEMS

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Blueye

Medium parafoil-based tactical reconnaissance system designed for land and maritime launched operations and unveiled in early 2005. The avionics suite incorporates MicroPilot navigation and guidance systems. Development partners include BES Systems, BKD Systems and Trudler.

Some systems were acquired by the USMC warfighting laboratory via a second-party deal in May 2005 for use in supporting trials of an airborne volumetric change detection system as a potential sensor to detect improvised explosive devices.

Boomerang

Hand-launched mini-surveillance system. Prototype systems have been built and development continues.

MicroB

Catapult-launched mini flying wing with tip-mounted tails unveiled in March 2006. Design draws extensively on larger Boomerang. Two hundred autonomous flights were made up to July 2006

Spy-Eye

Reduced-scale version of Blueye parafoil UAV for short-range reconnaissance missions.

BOEING INTEGRATED DEFENSE SYSTEMS

Boeing Integrated Defense Systems, PO Box 516 St. Louis, Missouri 63166. Tel: +1 314 232 0232; www.boeing.com

A160 Hummingbird

Jointly under development with DARPA since 1998 for potential US Army application. Initial development was begun by Frontier Systems, which was acquired by Boeing in May 2004. DARPA funding runs until September 2007.

The US Army is considering the vehicle as a long- term Class IV system under its Future Combat System architecture, with potential applications including gunship, psychological operations delivery, reconnaissance and surveillance, logistics delivery and special force insertion and recovery. Core endurance technology is based on use of a rigid rotor. The first of two prototypes flew in January 2002, with the initial version using a three-blade rotor. The first flight with a four-blade rotor and Subaru four-cylinder engine took place in November 2002. A DARPA contract worth up to $75 million for delivery of four more aircraft was announced in October 2003. Total Frontier Systems production comprised three aircraft, including the first two prototypes. Air vehicle one autorotated into the ground in an incident caused by software errors and bearing failure. Air vehicle three crashed after a tail-rotor failure.

Boeing resumed flight testing in September 2004 using air vehicle two. Four larger aircraft, incorporating new six-cylinder engines, improved airframes and subsystems are being built by Boeing, with the first flight taking place in November 2005. New aircraft will support Phase 1 demonstration continuation until 2007.

Sonex Research was contracted by DARPA in October 2002 to develop a diesel engine for the vehicle. Alternate turbocharged diesel engine development work is being carried out by Boeing and FEVEngine Technology with current plans calling for this to be fitted to air vehicle five. Proposals to fit air vehicles six and eight with Pratt & Whitney Canada PW207 turboshafts were proposed by DARPA in April 2006 for funding in US fiscal year 2007.

A turboshaft engine would extend endurance to beyond 24h. A US Army contract worth $10.3 million was awarded to Syracuse Research in May 2004 to develop and supply a purpose-developed A160 UHF foliage penetration radar payload.

Hydrogen-powered HALE

Concept for a 10-day endurance hydrogen- powered HALE system that would reuse elements of the former Boeing Condor HALE UAV programme, including that vehicle's 61m (200ft) wing. The concept was announced in July 2006 in parallel to the announcement of tests of prototype hydrogen-burning piston engine.

MD 530F Unmanned Little Bird

Unmanned version of US Special forces command MD Helicopters MD 530F/AH-6 Little Bird helicopter with one demonstrator flying. The manned MD 530F configuration aircraft was acquired from MD Helicopters in March 2004 and delivered one month later.

The project was made public at the AUVSI Unmanned Systems North America exhibition

in August 2004. Its control system is derived from unmanned mission control and autonomous flight systems developed for Boeing A160 helicopter and X-45A UCAV demonstrators. The aircraft first flew in an unmanned configuration, but with a safety pilot aboard in September 2004.

A contract worth $1.6 million from US Army Aviation Applied Technology Directorate was awarded in February 2005 to explore rotary-wing UAV weapons deployment using Lockheed Martin Hellfire missiles and the GAU-19A gun system. Little Bird participated in a Boeing networked urban operations demonstration in early December 2005, conducting live tracking of moving vehicles. Plans were announced in February 2006 for a demonstration of in-flight control from a US Army Sikorsky UH-60M late in 2006. The vehicle's potential fitout with Boeing software-enabled control (SEC) was flagged in March 2006, with this expected to allow autonomous nap-of-the-earth flight modes.

A demonstration of an AH-64 to control the Unmanned Little Bird weapons payload was made in April 2006. Little Bird had achieved 450 flying hours with a safety pilot aboard by July 2006. Its first fully autonomous flight with no safety pilot aboard took place at the US Army Yuma Proving Ground in June 2006. A new version based on the A/MH-6X airframe is to be unveiled in the third quarter of 2006 derived from the SOCOM mission-enhanced Little Bird.

X-45A/B

UCAV prototype. The initial X-45 variant (X-45A) was developed under the US Air Force/DARPA UCAV ACTD programme award in 1999, with the first flight of the Block 1 air vehicle in May 2002. The Block 1 trials programme was completed in March 2003, with 48 separate simulation, laboratory and actual flights performed to validate initial systems capability and performance.

Two X-45As were flying by November 2003 with the addition of Block 2 software. Final testing of Block 2 air vehicle and mission software was completed in March 2004. The Block 2-equipped air vehicle was used to demonstrate the first-ever air-to-ground mission by a purpose-developed UCAV in March 2004 with the dropping of a 250kg (550lb) inert Smart Small Bomb from an internal weapons bay on to a static target from 35,000ft (10,670m). The Block 2 campaign included air vehicles sharing data via Link 16 with an initial capability demonstration using one X-45A and a manned surrogate aircraft taking place in May 2004. Testing of Block 4 software started in April 2005, with the first flight of a modified X-45A in May.

Twin X-45A ground taxiing trials controlled by a single operator were held in June 2004 as a prelude to airborne twin-ship trials. The first two-air-vehicle co-ordinated flight demonstration by a single pilot-operator took place in August 2004 at NASA Dryden Flight Research Centre at Edwards AFB.

Block 3 software testing began in August 2004 with ground and taxi tests, with a single ship first flight in October 2004. The first airborne test of an automated dynamic mission replanning function – allowing the vehicle to respond to pop-up targets – was conducted in October 2004. The first two ship flights with Block 3 software were conducted in November and December 2004 and the first demonstration of remote satellite control of the X-45 was in December 2004, with air vehicles launched from NASA Dryden then handed over to a pilot-operator in Seattle, Washington. The X-45A achieved its 50th sortie in February 2005 and ground trials of Block 4 software took place in April and early May 2005.

The first flight with Block 4 software was achieved in May 2005 and demonstration of autonomous SEAD capability was conducted at Edwards AFB during flight 52 in the second quarter of 2005. A two-ship co-operative SEAD capability demonstration was carried out in August 2005, and included simulated weapons release.

The X-45B was proposed as an initial operational capability variant, but was cancelled in February 2003 with the launch of the com-

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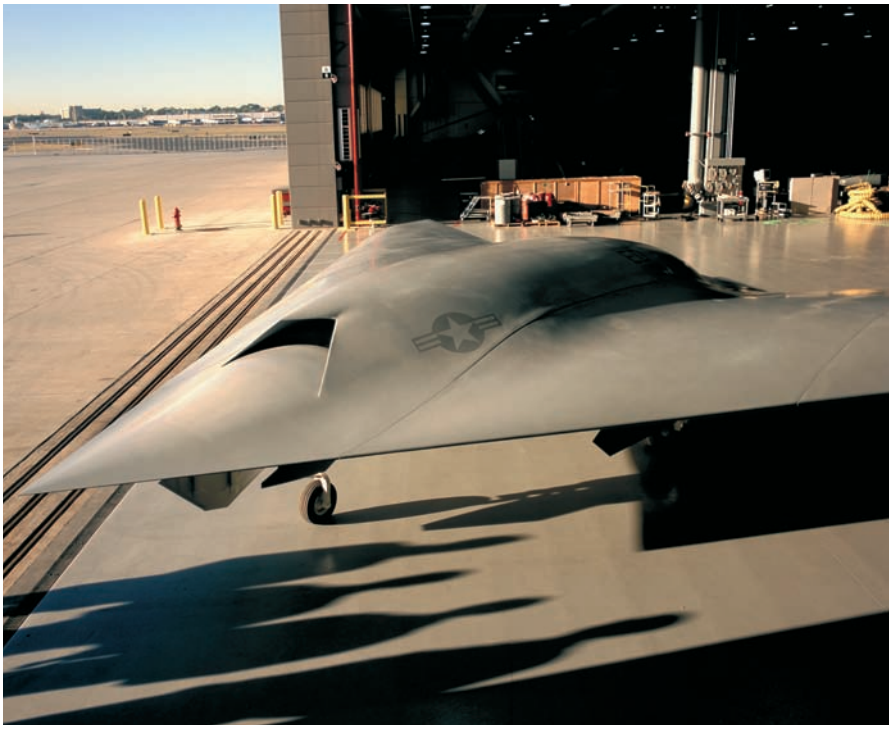

Boeing's X-45C is awaiting new directions with the launch of the N-UCAS programme

bined USAF/USN Joint Unmanned Combat Air System (J-UCAS) programme, itself since cancelled. X-45A air vehicle development is continuing despite the J-UCAS cancellation.

X-45C/D

The X-45C concept was unveiled in April 2003 as Boeing candidate for the former US Joint Unmanned Combat Air System (J-UCAS) capability demonstration programme. The X-45D was proposed by Boeing in early 2004 as a candidate for the US Air Force interim bomber requirement.

Initial assembly of the first of three X-45Cs began in June 2004 at Boeing's risk, with the lead aircraft to be completed in 2006. A $766 million contract award from DARPA was announced in October 2004 for three full- scale X-47C demonstrators and integrated into the J-UCAS Common Operating System being separately developed under the leadership of the Johns Hopkins University Physics Laboratory. First engines were delivered by General Electric in November 2004. A system requirements review with DARPA was completed in May 2005 and roll-out of the first X-45C was planned for March 2006, but halted after the J-UCAS programme was terminated in February 2006.

The first X-45C demonstrator was displayed at the 2006 Farnborough air show, but remains unflown. Preliminary planning for the replacement US Navy N-UCAS programme is expected to incclude a new tender process for demonstrations late 2006, with contract awards in April 2007, leading to a demonstration in 2012. Preliminary guidance from Boeing points to a modified X-45C design to meet new programme objectives, including carrier deck landing.

X-50A Dragonfly

Canard rotor-wing technology demonstrator being developed for potential application as a manned or unmanned high-speed VTOL platform. Technology is based on the transition of the wing from rotary mode to fixed mode during flight. The wing load is transferred to forward canard and tailplane surfaces during transition to prevent stall. The propulsion system uses direct thrust to exhaust nozzle for forward flight and diverted thrust to wingtip nozzles for rotary flight. A joint development programme between Boeing Phantom Works and DARPA with initial funding was agreed in June 1998. The prototype first flew in December 2003, but crashed in March 2004 on its second flight.

A second demonstrator began preparation for testing in third quarter 2004, with ground testing given initial precedence, including windtunnel testing to assist in identification of the causes of the lead demonstrator loss. That testing revealed a problem with a cross-coupling phenomenon in wind conditions and resulted in redevelopment work on flight-control software. A second prototype was transferred to the US Army Yuma Proving Grounds in early 2005, but flights did not take place until December 2005. Four further flights have been successful. A sixth flight in April 2006 resulted in a crash 18min into a sortie with the air vehicle in hover mode.

BOEING INTEGRATED DEFENSE SYSTEMS - INSITU

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Scan Eagle A15

Low-altitude long-endurance UAV, developed from the baseline Insitu Sea Eagle UAV *(see separate entry)*. An initial 15-month joint development programme with Boeing was announced in February 2002.

The first wholly autonomous Scan Eagle flight took place in June 2002. That same month the UAV was selected by the US Navy to support trials of co-ordinated operations between unmanned underwater vehicles with UAVs. These took place in February 2003 as part of the Giant Shadow experimentation programme in the Bahamas. The first long-distance autonomous flight was conducted in September 2003 and the vehicle demonstrated a 20h endurance in May 2004. A USMC contract was awarded in July 2004 for two systems, comprising multiple air vehicles and ground control and support infrastructure for use in Iraq from August 2004. That contract was renewed in July 2005 and a separate US Navy award in April 2005 worth $14.5 million was made for systems to provide offshore oil platform monitoring in the Persian Gulf.

Another USN contract award in September 2005 worth $13 million was to provide support for a floating staging base and high-speed theatre support vessels. Combined USMC and USN systems had achieved 10,000 flying hours by February 2006 with the loss of one air vehicle to hostile action and 15,000 flying hours by July 2006. A November 2004 contract was awarded for support of the UK Ministry of Defence's Joint Unmanned Experimentation Programme (JUEP) with flight operations during 2005.

Australia is considering a possible acquisition or lease as an interim tactical UAV. The proposed Scan Eagle B would have an endurance of 48h. A heavy fuel engine with increased payload capacity and 24h endurance is being explored under the designation Scan Eagle II. A proposed Scan Eagle XL version would have a 22.5kg (50lb) payload capability and 24h endurance. A Scan Eagle XS variant is proposed as a canister launched "daughter" UAV with an endurance of 12h.

CODARRA

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Avatar

Hand-launched, man-portable, close-range reconnaissance and surveillance system. Initial CX-1 versions were based on a kit model aircraft. Limited numbers of prototype CX-1 version were sold to the Australian Army Special

Air Service regiment and used operationally in East Timor during United Nations operations in 2000-1. Follow-on Avatar sales to the same customer were made in 2001 with a further contract worth A$345,000 signed in May 2002.

A digital image capture and compression system derived from a sniper rifle real-time command targeting system was fielded by the Australian SAS as part of Sydney Olympics security in 2000. A standard production P-1 Avatar introduced a purpose-built airframe and was used as a platform to support demonstrations of "Jack" autonomous guidance software developed by Agent Oriented Software at the Australian Army Graytown experimental weapons range in early July 2004. A P-2 configuration with up to 90min endurance was readied in 2004.

Alternate payloads being explored include a lightweight thermal imager, laser designator and radio relay. Avaar is a candidate for an Australian Army special forces mini-UAV acquisition project to be launched as part of a planned Joint Project 2097 re-equipment programme from late 2006.

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Eagle

Optionally piloted version of the Eagle 150B light sports aircraft with avionics and control systems sourced from BAE Systems North America. The development programme was launched in late 2001 and an $8.5 million production contract for three air vehicles was signed by CRTM with the Malaysian government in June 2001.

Prototype delivery to Malaysia's ministry of defence was made in April 2002 for operational test and evaluation. The remaining deliveries took place in the third quarter of 2002, but there have been no further orders for the vehicle. CRTM holds maintenance and in-service support contracts.

Tactical UAV

A co-operative effort by CRTM and Malaysian firms Ikramatic and Systems Consultancy Services was launched in December 2005 to develop a new tactical UAV for the Malaysian armed forces. The system is aimed at leveraging flight and mission systems from the Eagle into a 2h endurance tactical system with an expected airframe weight of 100kg (220lb) and a payload capacity of 25kg.

The vehicle is nominally a twin tail boom configuration airframe with pusher propeller. A sensor package would comprise a thermal imager and daylight camera as standard with a laser designator as an option. The production system would comprise four air vehicles, two half-tonne trucks and one towed catapult launcher. The vehicle would have a rugged undercarriage to support operations from unprepared strips. A demonstrator was planned to fly in mid-2006.

CYBAERO

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APID Mk 5

Development of the Autonomous Probe for Data Acquisition (APID) began in 1996, with the first prototype flights taking place in 1997. The Mk5 version was unveiled in June 2003 and the overall series had achieved more than 500 flying hours up to June 2005. Primary market focus is on homeland security and commercial aerial monitoring markets. A two-year contract was awarded by Mjosnett, a Norwegian electric utility, in January 2004 to undertake power transmission line inspection functions.

APID 55

New version of APID family unveiled at IDEX exhibition in Abu Dhabi in February 2005, it has a highly streamlined fairing over the modified air vehicle. The vehicle is the result of a co-operative development effort with the UAE armed forces UAV research and technology centre, with production systems testing for the UAE special forces expected to be completed in 2006. The vehicle is the basis of the Saab V150 Skeldar system unveiled in June 2006 *(see separate Saab entry)*.

CYBER DEFENSE SYSTEMS

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CyberScout

Developmental canard wing airframe with three ducted fan propulsors. One propulsor is located in the forward fuselage at the canard wing root. The remaining propulsors are at the rear of the fuselage on gimbals to enable rotation through at least 90°. Rear engines face downwards for vertical take-off and landing, but revert to horizontal for forward flight.

Construction of the first prototype began in late 2004 and the first transition flight from hover to horizontal flight was achieved in May 2005. Work was launched in mid-2005 to modify the design to accept a turbine powerplant to replace the existing gas- powered engine. An armed version is proposed. Cyber said in August 2005 that it had begun "shipping" air vehicles to "unnamed government entities", but no details were released.

DARA AVIATION

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D1

Under development as a small, long-range, low- to medium-altitude reconnaissance system using a joined wing to provide increased payload lift capability. It can use either rail or vehicle-roof mounted catapult launcher system. Several variants are flying using the same basic airframe, with the lead air vehicle making its debut flight in August 2000.

A joint trial with University Wing of Vancouver, British Columbia took place in June 2003 of the D-1D version equipped with a magnetometer to perform magnetic mapping. Funded trials of the D-1A version in an atmospheric monitoring role by Scripps Institute of Oceanography, San Diego, took place in June-November 2003.

A D1-E variant, based on the D-1D airframe with a 255mm (10in) fuselage plug, was developed to carry sensors for electromagnetic interference and geomagnetic survey work, with at least one demonstrator built. The D-1G version was unveiled in January 2004 to support atmospheric survey work, using the D-1A airframe with mid-span fins on the rear wing to improve airflow. More capable D2 and D3 variants are under development.

DASSAULT AVIATION

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AVE

UCAV and low-observable TUAV technol-

ogy demonstrator, it first flew July 2000. The demonstrator was made public in October 2000. A modified flight configuration variant designated Moyen Duc was revealed at the 2003 Paris air show, with this supporting the combined Dassault-Sagem Slow-Fast tactical UAV development programme *(see separate entry)*. The proposed Grand Duc variant has been superseded by the launch of the Neuron European UCAV technology demonstrator programme in 2004 *(see separate entry)*.

HALE/MALE

Concept for joined wing, high-altitude endurance UAV to meet proposed future French and other European air force requirements. The design was unveiled at the 2003 Paris air show as a potential MALE UAV development programme. Those plans were set aside following the launch of the EADS-led Euromale initiative in mid- 2004, but the collapse of that programme in mid-2006 has seen Dassault again flag interest in leadership of any revised European endurance UAV development effort.

DASSAULT/ALENIA/EADS/HELLENIC AEROSPACE/SAAB/RUAG

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Neuron

European UCAV collaborative technology demonstration programme unveiled by the French government at the 2003 Paris air show and formally launched at Eurosatory 2004 under the name of Neuron.

Dassault is the senior industrial partner and responsible for awarding 50% of workshare on the project to other participating nation companies. The French government funding commitment currently totals $183 million and the remainder of the development costs are to be shared between other participating nations.

Government-to-government preliminary agreements were signed between France and Sweden in December 2003, and between France and Greece in January 2004. Hellenic Aerospace Industry and Dassault signed an initial cooperation memorandum of understanding in March 2004 and a formal co-operation agreement in May 2005.

Initial government-to-government agreement was reached with Italy in January 2005 on financial investment worth around $100 million, with industrial involvement to be led by Alenia. Spain formally joined the programme on 18 May 2005 with EADS Casa to head Spanish industrial participation. The Spanish government contribution is expected to total $24-30 million, with EADS Casa already holding responsibility for design work on the Neuron wing structure.

A formal Swedish membership deal was announced in December 2005, with a total financial contribution of €76 million over a 10-year period. The formal contract award to Dassault from the French DGA was signed in February 2006 with the collaborative funding pool totalling €405 million. A three-year system definition and design phase is under way, with this to be followed by the development and assembly phase. First study deliverables were handed to the DGA in May 2006 and the first flight is targeted for mid-2011, three years later than originally proposed.

Workshare means Alenia has the lead on the internal weapon bay (Smart Weapon Bay), the bay doors and their mechanisms, electrical power and distribution systems, air data system, and ground and flight tests. Saab is second in charge of the programme and is responsible for general design, fuselage, avionics, fuel system and flight testing. Hellenic Aerospace Industries is responsible for the rear fuselage, engine exhaust and demonstrator test rig. EADS Casa is responsible for wings, ground station and datalink integration. Ruag is responsible for weapons interfaces and windtunnel testing. Dassault is the programme lead, responsible for design authority, flight-control systems, final assembly and ground and flight testing

DENEL AEROSPACE SYSTEMS

Denel, Aerospace Systems, PO Box 8322, Centurion 0046, South Africa. Tel: +27 12 671 2700; fax: +27 12 671 2793; www.denel.co.za

Seeker MK II/III

Tactical UAV developed from 1982 to meet South African Army requirements. The Seeker II variant has been in operational service with the South African military since 1991, with upgraded configurations nominally designated Seeker III, but later standardised as the Seeker IIE, introduced in late 1999-early 2000. The vehicle was certificated for use in South African civil airspace in 1994. At least two series of export sales to Algeria have been made since 1990, with second series air vehicles carrying Saab-Grintek electronic support measures payloads. Conceptual work on the more capable MKIII was carried out between 2000 and 2003, leading to a concept for a new development MALE UAV *(see below)*.

Bateleur

Developmental low-cost MALE system flagged at the 2003 Dubai air show, with mock-ups displayed at the African Aerospace exhibition in Pretoria in September 2004 and the 2005 Dubai air show. The vehicle is expected to fly in late 2006, with development pitched against expected South African maritime surveillance and Seeker UAV replacement requirements. The Subaru EA-82T is proposed as the engine, with a three-blade variable pitch pusher propeller. The vehicle is to have an all-composite airframe, with avionics derived from the Denel Skua aerial target system and Seeker tactical UAVs. The ground control system is derived from the Seeker.

DRAGONFLY PICTURES

Dragonfly Pictures, West Terminus of Second Street, Essington, Pennsylvania 19029, USA. Tel: +1 610 521 6115; fax: +1 610 521 3074; www.dragonflypictures.com

DP-4X

Medium-range and endurance helicopter UAV in development since 1994, with first flights taking place in mid-1996. The vehicle is based on modular airframe concepts that enable minor airframe changes to meet different operational requirements. It was selected in 2003 by Metal Storm as a testbed for flight trials of a 40mm rapid fire airborne gunnery system, with a revised agreement announced in June 2005 proposing demonstration by the end of 2006. The proposed DP-4XT version would link two DP-4X airframes to carry heavier payloads over an increased range.

DP-5X

Redevelopment of DP-4X airframe to support increased air vehicle modularity, with funding provided by DARPA. The airframe can be broken down for transport by a two-person team.

The first flight of the company demonstrator was believed to have taken place in early 2004. Funding worth $5.4 million was awarded by DARPA in July 2004 to support expansion of air vehicle functionality as its candidate for the US Army FCS Class III requirement. That funding ends in September 2006.

Contract award by US Army Communications and Electronics Command worth $6.6 million to Harris was announced in June 2005 to integrate the MIT-Lincoln Laboratories-developed Jigsaw Laser Radar on to the DP-5X on behalf of DARPA and support test campaigns over an unspecified period. The Pentagon Unmanned Air System Roadmap released in August 2005 advised that development and test milestones had been completed and the UAV was being prepared to enter initial flight demonstrations, but there have been no subsequent announcements. A proposed DP-5XT variant would link two DP-5X airframes to create a twin rotor air vehicle capable of carrying payloads of up to 70kg (154lb) over distances of 1,200km (650nm).

DRS TECHNOLOGIES

DRS Unmanned Technologies, 6300 Columbia Street, Municipal Airport, Mineral Wells, 76067 Texas, USA. Tel: +1 817 850 3894; fax: +1 817 850 3880; www.drs.com

Neptune

Water-landing UAV using Sentry flight control and navigation systems, it made its first flight in January 2002. A pneumatic launcher is built into the transport container.

Ground landing is possible using a belly skid. Initial orders for five systems were placed by the US Navy in March 2002 and initial deliveries began in February 2004. The Pentagon

unmanned air systems roadmap released in August 2005 says 15 systems had been delivered out of 27 planned.

Sentry/Sentry HP

Short-range tactical UAV. Some air vehicles have been used by the US Air Force to support a battlefield experimentation programme. The Sentry HP has greater payload capability, including the ability to carry external stores. The Sentry can be distinguished by a horizontal stabiliser joining twin tails, while a SentryHP has a V-shaped tail. The SentryHP was used to deploy Textron BLU-108 submunitions in small UAV weaponisation trials conducted at Eglin AFB base in Florida in 2004.

EADS DEFENSE AND SECURITY SYSTEMS

EADS Deutschland, 81663, Munich, Germany. www.eads.com

AOLOS-289/CL-289

High-speed, low-altitude surveillance system jointly developed between France, Germany and Canada, the vehicles have been in operational service with the French and German armies since 1991 and deployed in Bosnian and Kosovo campaigns.

CL-289 is the basic variant, AOLOS-289 is the upgraded version with the first unit rolled out in March 2003.

The AOLOS upgrade focused on avionics and mission software. The total upgrade programme will cover 160 air vehicles for France and Germany. The first German army units were handed over in April 2003, with final deliveries to both users in 2006.

Barracuda

URAV demonstrator publicly unveiled in May 2006 after launch of the develoment programme in 2003. Its first flight, at San Javier air force base in southern Spain in April 2006, lasted 20min. It has an all-composite airframe, but excludes low observability features.

The fuselage is built by EADS Germany and the wing at EADS Casa in Spain. Its large internal payload bay is being flight tested to include simultaneous carriage of synthetic-aperture radar and electro-optic sensors.

A weapons trial is possible, but there are no plans to use the demonstrator in direct UCAV-type roles. Future derivatives may include a UCAV, but the next likely development is a jet-powered MALE class system. An extensive flight-trial programme planned for the second half of 2006 will extend into 2007. The vehicle is expected to participate in Germany's Project Agile demonstration of UAV operations in networked environments between 2007 and 2010.

Carapas

Concept demonstrator funded by the French DGA to explore potential use of a LADP UAV to map the electronic order of battle and use signal returns to perform real-time cueing of an IR/EO payload carried by the same air vehicle to provide positive target identification.

The testbed UAV is the Galileo Avionica Nibbio *(see separate entry)*. The flight programme was carried out in 2005 and demonstration is complete.

Euromale

Former development programme for a common European MALE UAV initiated by the French government in October 2002 to meet common French and Royal Netherlands Air Force requirements for a second-generation MALE system that would enter service in 2010-2013. The design concept is based on the EADS-IAI Eagle, but the programme ran into trouble in 2004-5, with all work ceasing by mid-2006. European-wide negotiations are under way on its successor programme, with this expected to be dominated by French, German and Spanish military requirements.

Orka-1200

Unmanned derivative of the Helicopteres Guimbal-produced Cabri two-seater helicopter. The concept was flagged at the 2002 Farnborough air show as a potential replacement for the cancelled EADS SEAMOS VTOL shipborne UAV programme. A mock-up was unveiled at the 2003 Paris air show as a potential candidate for the French navy VTOL UAV requirement.

An agreement was signed at the 2005 Paris air show with Helicoptres Guinbal to establish a joint venture industrial vehicle called Vertivision to further progress development. The army variant was flagged at the 2006 Eurosatory exhibition as a potential solution for a possible combined French army and navy tactical UAV requirement. Development is continuing.

Scorpio

Lightweight VTOL UAV for urban or close- range maritime surveillance, the vehicle has been evaluated by the French army. Work is under way on integration of communications relay and ELINT payloads. One air vehicle has been sold to the UK Ministry of Defence for trials and evaluation under the Joint UAV Experimentation Programme. Some sales have been made to undisclosed South American customers.

Surveyor 600

Full-capability LADP UAV based on the Galileo Avionica Nibbio/Mirach 100.5 target drone proposed by EADS as the "fast" segment of a possible French army multi-mission, multi-sensor requirement to replace its AOLOS-289. The Carapas demonstrator represents the baseline capability version. Air vehicle capability was refined in 2003-4, with MTOW decreased from 450kg (990lb) to 350kg. Development is on hold pending decisions by the French ministry of defence on forward capability requirements.

Surveyor 2500

DynAero MCR S4 light aeroplane conversion into a medium endurance TUAV proposed by EADS as contender for former French army multi-mission, multi-sensor UAV programme. The concept was unveiled at the 2003 Paris air show, but most work is now channelled into development of optionally piloted MCR S4 surveillance aircraft after a proposed French programme was cancelled. A manned demonstrator aircraft, but without the autonomous flight control system, has been flying with an EO/IR sensor suite under the designation Fire Surveyor.

Tracker

Close-range, hand-launched mini-UAV first unveiled at the Unmanned Systems Europe conference in Berlin May 2004. A €30 million award for 160 systems for use as a close-range reconnaissance system was announced by the French army in January 2005, with each system to comprise two air vehicles, interchangeable payloads, and a portable ground control station. Tracker was demonstrated to the UK Ministry for Defence in early 2004.

At least one sale, believed to be to the French national police, has been made. The vehicle has a twin fuselage configuration, with electric propulsion, with the payload bay carried between fuselages and above the main wing to protect sensors on landing.

EADS - ISRAEL AIRCRAFT INDUSTRIES

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Israel Aircraft Industries, Malat Division, Ben Gurion International Airport, 70100 Israel. Tel: +972 3 935 7349; fax: +972 3 935 4175; www.iai.com.il

Eagle

Interim medium-altitude, long-endurance, UAV ordered for the French and Royal Netherlands air forces. Based on the IAI Malat Heron airframe, the prototype air vehicle first flew in 1998, and demonstrated a range of 4,000km (2,160nm) in trials the same year. The prototype has flown demonstration missions in the USA, Canada and Sweden and has been selected by the UK to support its ongoing JUAP battlefield experimentation programme. First production systems were delivered to a combined French air force/Dutch air force unit in late 2004 for operational qualification testing. Eagle II has been proposed as the basis of an EADS-led Euromale development programme, but all development work on that ceased in mid-2006.

ELBIT SYSTEMS

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Directory: unmanned air vehicles

Hermes 180

Unveiled at Asian Aerospace 2002 in Singapore, it is designed to perform reconnaissance and surveillance missions at brigade level. It made its debut flight in May 2002 and was offered by Thales UK as part of the UK's Project Watchkeeper. However, the Hermes 180 component of the bid was set aside in favour of Hermes 450 in February 2005. Hermes 180 has no known customers, but international marketing continues.

Hermes 450S

The vehicle entered initial operational service with the Israeli defence force in 2000 following purchase initiated in July 1997 and is now the main operational tactical UAV system. It was used extensivly in the 2006 Israeli military operations in Lebanon.

Hermes 450

Twin-engined version of 450S. Contracted by the US Armed Forces Joint UAV joint test and evaluation programme in July 2003 to enable extended evaluation after initial trials flights conducted in May-June of that same year. Two vehicles were leased by the US Department of Homeland Security in mid-2004 under a $10 million deal to perform monitoring trials of the US-Mexico border, with services starting in August 2004.

Undeclared sales were made to Botswana, with systems now operational. It was selected by the UK in July 2004 as the basis of the Watchkeeper joint services ISTAR programme. The primary acquisition contract from the UK MoD worth £700 million was signed in August 2005. An eight-year subcontract worth £317 million was awarded by Thales UK to a UK based joint venture between Thales UK and Elbit, with the first systems to enter operational service in 2010.

Thales is also offering the UK variant to France as a potential solution to an emerging joint services UAV requirement. Catapult launch capability was demonstrated in April 2005 and a demonstration was made to the Israeli police in September-October 2005. Demonstration flights were made at the 2006 Asian Aerospace air show in Singapore. A Hermes 450 with a Tadiran advanced capability ELINT payload to support detection of frequency hopping mobile emitters was displayed at the 2006 Farnborough air show.

Hermes 1500

First flew in June 1998. Its development was jointly sponsored by the Israeli ministry of defence as a concept technology demonstrator for large mission payloads. A $47 million turnkey services contract based on the Hermes 1500 was awarded to Elbit by the Israeli MoD in June 2003. A maritime patrol configuration aircraft ws unveiled at the 2005 Paris air show, incorporating wing-mounted fuel tanks to extend endurance to 50h. This variant would carry an underbelly maritime surveillance radar and an EO/IR and ELINT payload, with maximum take-off weight rising to 1,750kg (3,850lb).

Skylark I

Close-range, hand-launched electrically powered UAV unveiled at the 2003 Paris air show. A Skylark IV variant has been promoted since early 2005. Skylark was selected in February 2004 to equip Israeli army units, with deliveries in May 2005. It is in service with Australia, which acquired four systems in September 2005 with a follow-on purchase of six systems in November 2005 for use in Afghanistan and Iraq. Additional purchases by Australia were made in mid-2006. The system set an unofficial world altitude record for small UAVs with hand launch from an altitude of 13,785ft (4,200m). Flight operations to 15,000ft were carried out in west Asia in May 2005. It is a candidate for a current Israeli army platoon level requirement with downselect due in late 2006.

Skylark II

Enlarged version of Skylark 1 with larger airframe and increased endurance, but the same basic configuration, it is intended for use at brigade level. Unveiled at the 2006 Eurosatory exhibition, it uses the same ground control station as Skylark 1, enabling combined operations of both air vehicle types. First flight was in mid-2005, with the development programme initiated in 2003. Five systems were sold to Canada in June 2006 to equip units deploying to Afghanistan.

EMIT AVIATION

EMIT Aviation Consultants, 8 Bergman Zvi Street, Petah Tivka 49277, Israel. Tel: +972 3 934 8758; fax: +972 3 934 8757. www.emituav.com

Blue Horizon

Medium-endurance tactical system designed and manufactured by EMIT, it has a canard wing with twin outboard tails. It takes off and lands on runways, but catapult launch capability is available. It requires a three-person crew. Licensed variants have been developed by Singapore Technologies, under a 1998 commercial agreement, and by US-based EDO. A probable sale was made by Singapore Technologies to the Philippines armed forces in 2001 to provide counter-terrorism reconnaissance and surveillance.

Sparrow

Catapult launched UAV intended for extended short-range tactical missions, it has a combined parachute and airbag recovery system nd a three-person crew. it uses a waypoint-based autonomous guidance system and its standard payload comprises a day-night camera. The loitering missile derivative was shortlisted for a UK MoD requirement in July 2006 with EMIT teamed with Ultra UK. The derivative would retain the existing Sparrow sensor payload and use the same ground control station.

EMT

EMT Ingeneieurgesellschaft Dipl. Ing Hartmut Euer. Grube 29, D-82377 Penzberg, Germany. Tel: +49 8856 9225; fax: +49 8856 2055. www.EMT-Penzberg.de

Aladin

Short-range, electrically powered UAV in production for the German army, it was designed to operate in conjunction with Fennek reconnaissance vehicle units. An LRIP version was ordered in August 2002 and has been used in Afghanistan since 2003. A modified "robust" version was developed in response to lessons from Afghanistan operations.

A German army order worth $32 million for 115 aircraft was made in April 2005 with deliveries starting in August 2005. Five systems were acquired by the Netherlands ministry of defence under a deal announced in April 2006, with systems to support operations in Afghanistan, with the German army providing training support.

Fancopter

Developmental lightweight "open" ducted fan VTOL UAV designed for use in urban terrain, including indoor flying operations. A remote-piloted prototype incorporating twin counter-rotating propellers and veins located within the frame to allow for guidance was first flown in late 2003.

A revised configuration was unveiled in May 2006, introducing three mini-steering rotors to provide improved directional control. The revised version participated in German ministry of defence VTOL UAV demonstration in July 2006. All-composite construction.

Luna

Short-range tactical UAV, with pre-production systems in operational service with the German army since March 2000 and first deployed operationally in Kosovo in April that year. LRIP systems, comprising 12 ground control stations and 28 air vehicles, were ordered in August 2002 with deliveries in 2003. Luna was deployed with the German army in Afghanistan and used as a testbed to demonstrate an EADS miniature synthetic-aperture radar in February 2004. German army use had exceeded 1,800 missions by March 2006.

X-13

Flying wing UAV under development as a possible maritime TUAV to be carried by small warships. A prototype was built in early 2004 but flight testing and further development was suspended by late 2004.

FUJI HEAVY INDUSTRIES

Fuji Heavy Industries, 1-7-2 Nishishinjuku, Shinjuku-ku, Tokyo 160-8316, Japan. Tel: + 3 3347 2111; www.fhi.co.jp

RPH-2

Upgraded version of earlier RPH-1 agricultural helicopter initially developed against expected Japanese Ground Self-Defence Force requirement for a forward flying observation system. Basic RPH-2 in limited series production with at least 17 systems built since 1998.

GALILEO AVIONICA

Galileo Avionica, Via Albert Einstein 35, 50013 Campi Bisenzio, Italy. Tel: +39 5 589 501; fax: +39 5 589 506; www.galileoavionica.it

Falco

New-generation medium tactical UAV developed in expectation of a generational change in existing tactical UAV marketplace. It was designed and developed to be rapidly certificated for operations in non-segregated airspace. It has a short take-off and landing capability, hardpoints for carriage of external stores. The vehicle was unveiled at the 2002 Eurosatory exhibition and first flew in December 2003. Proposed by Galileo as replacement for the Italian army Mirach 26 system, the basic system development was largely complete by late 2004. Proposals for aircraft carrier-based version were revealed in June 2006 with the basic maritime configuration aircraft planned to be rolled out by mid-2007. Plans to base two aircraft at Parc Aberporth in theUK were announced in July 2006, with these to be used to conduct payload clearance for the mature Falco system. Studies of catapult launch options in conjunction with Robonic of Finland were announced in August 2006.

Nibbio

High-speed battlefield reconnaissance and surveillance system derived from Galileo Avionica Mirach 100.5 target drone, it has close conceptual parallels with the EADS CL-299 series and an integrated electronic warfare self-protection capability with winglet-mounted pylons carrying chaff and flare dispensing system.

Recovery is via parachute and airbag system from Mirach 100/5. Nibbio II is proposed as an enhanced version using more powerful engine.

GENERAL ATOMICS AERONAUTICAL SYSTEMS

General Atomics Aeronautical Systems, 16761 Via Del Campo Court, San Diego, California, USA 92127. Tel: +1 858 455 2810; fax: +1 858 455 4247. www.uav.com

Altair

Extended-range variant of the Predator B developed on behalf of NASA as a high-altitude scientific research platform. A contract with NASA was signed in January 2000 and the vehicle first flew in June 2003. The UAV incorporates multiple redundancy systems to support certification for operation in US national airspace. The prototype made its maiden flight in June 2003 and being used as a surrogate for General Atomics' Mariner (Predator B-ER) system, with a series of trial flights taking place in 2004. Sole-source solicitation by NASA for extension of UAV demonstration system services was issued in September 2004. Demonstrations in support of the US National Oceanic and Atmospheric Administration were flown in April and May 2005. One-year FAA experimental certification was awarded in August 2005 allowing less restrictive operations in non-segregated airspace. The UAV was used by the US National Oceanic and Atmospheric Administration for science research flights in late 2005. This deployment saw a new endurance record set for the type with an 18.4h flight conducted in November 2005. Aircraft are supporting firewatch operations in southern California.

Altus I/II

A derivative of the Predator A developed to support NASA and US Department of Energy atmospheric research missions, the Altus II first flew June 1998. Being marketed as a potential commercial communications relay platform. Altus I has a ceiling of 45,000ft (13,700m); Altus II has a ceiling of 65,000ft.

Gnat 750

First-generation MALE system has been in operational service since at least 1989, with launch orders from the US intelligence community. Export sales have been made to to Turkey and possibly one other country. Rotax 912 engine and variable pitch propeller options available.

Ignat/Ignat ER

Advanced version of GNAT-750 unveiled in 1998. Has a 113kg (250lb) external payload capability in addition to nose payload. A turbocharged Rotax 914 engine option is available. Has been in service with the US intelligence community since at least 1997. The US Army ordered three air vehicles and ground control systems in May 2003 to support force transformation experimentation, but those aircraft were subsequently deployed to Iraq in March 2004 and and had achieved 4,000 flying hours in theatre to March 2005. Follow-on Army contract worth $4.21 million was announced in February 2005 for two additional air vehicles to be built in extended-range configuration. The order also supported production of upgrade kits for existing three air vehicles and integration of the tactical automatic landing system into all five aircraft by February 2006. Satellite communications equipment was integrated into the US Army in early 2006 and army aircraft had flown 858 missions and totalled 10,000 flying hours by 10 May 2006. The company was awarded a $21 million support contract in June 2006.

Mariner

Extended-range version of the Predator B and originally designated Predator B-ER. The concept was unveiled in April 2003 and is similar to the Altair, including reuse of the Altair wing. Addition of conformal tanks on fuselage above wing root makes room for an additional 272kg (600lb) of fuel. Maximum external stores load is 907kg. It is on offer to the US Navy as a solution for its persistent unmanned maritime aircraft requirement in a teaming arrangement with Lockheed Martin. A modified Altair has flown as a Mariner demonstrator since March 2004 with a large sensor pod beneath its fuselage to accommodate maritime surveillance radar. The Mariner demonstrator became the first UAV to fly above the Arctic Circle with over the horizon control in August 2004 as part of a Canadian Atlantic littoral intelligence, surveillance and reconnaissance experiment. Variant is on offer to Australian Coastwatch

organisation in joint teaming arrangement with National Jet Support of Adelaide.

MQ-1 Predator / RQ-1 Predator A

Developed from 1994 in conjunction with the US Defence Advanced Research Projects Agency as an advanced concept technology demonstrator programme. Transitioned to a US Air Force programme in 1997. Has been used operationally in all major conflicts since 1995, including Bosnia, Kosovo, Afghanistan and Iraq and is operated by the US Air Force, US Navy and US intelligence agencies. Produced since 1998, the 100th air vehicle was manufactured in February 2004. There are more than 120 systems in USAF inventory. Initial operational capability was declared by the USAF in March 2005. The first export sale to Italy in August 2001 involved five air vehicles, with four assembled by Galileo Avionica. Four aircraft remain after one was lost in a mishap in the USA. Italian aircraft deployed operationally to Iraq in January 2005.

A weaponised MQ-1 version was developed in 2000 and tested in 20001 using a combination of integrated laser designator and Hellfire missile. Variant has larger wing and increased endurance. The MQ-1 was used to support anti-terrorist strikes in Sudan and in the war in Afghanistan in 2002, and in Iraq. Its ability to carry and deploy "daughter" UAVs was demonstated in a trials programme with US Naval Research Laboratory Finder UAVs *(see separate entry)* in August 2002. Some older RQ-1s were used as sacrificial radar decoys during opening phases of Operation Iraqi Freedom. Heavy fuel engined version, using Thielert Centurion as a replacement for Rotax 914T, was flown in October 2004.

Total GAASI production Predator fleet reached 100,000 flight hours on 27 September 2004; 150,000h by August 2005, and broke 200,000h (10,961 combat missions flown) on 22 July 2006. Specification data is for MQ-1.

MQM-9 Predator B

Enhanced capability version of MQ-1/RQ-1 air vehicle. First flights of turbojet-powered version was in February 2001 using a Williams FJ-44-2A turbojet, but the demonstrator was converted to a turboprop. A USAF initial order was placed in December 2002 for two air vehicles and these were delivered for operational testing in 2005. The first pre-production turboprop version flew in October 2003.

GA-ASI was awarded a $17 million contract in March 2004 to further develop specifications for a weaponised production MQ-9 variant. Maximum external stores load is 1,360kg (3,000lb). Flight tests of carriage and clearance requirements for Boeing Joint Direct Attack Munition (JDAM), Lockheed Martin Hellfire missile and Small Diameter Bomb began in 2004. The Predator B prototype demonstrated an ability to drop a GBU-12 Paveway II laser-guided bomb in trials in August 2004. JDAM integation and clearance is expected in 2006. Potential armament options include the Raytheon AIM-120 AMRAAM and AIM-9X Sidewinder. Combat configuration air vehicle has an endurance of 16h.

The US Department of Homeland Security tested the vehicle for border surveillance in 2004 and sined a $14.1 million, two aircraft acquisition deal in September 2005. The first DHS aircraft was unveiled in September 2005 and achieved 1,000h surveillance time on US-Mexico border before a vehicle was lost in an operator induced crash in April 2006. Second DHS aircraft is due for handover in October 2006. Plans for purchase of two additional aircraft were flagged by the DHS in June 2006.

A USAF system development and demonstration phase contract award worth $68.2 million was announced in March 2005, and included additional weapons carriage and targeting capability development, and retrofit of four MQM-9 airframes to the revised SDD configuration. Total USAF inventory at August 2005 was planned to total 60 aircraft with six air vehicles delivered by then. One aircraft is deployed in Iraq. Flights with prototype electronic attack suite were carried out by the US DoD and the CIA in the final quarter of 2005. A contract worth $5.2 million for the upgrade of five USAF aircraft to incorporate improved landing gear to support weapons and special mission payloads was announced in June 2006 with work to be completed by June 2007. A maritime demonstration carrying Elta 2022 Seawatch radar was made as part of a US Navy Trident Warrior 2006 experiment off southern California in July 2006. A US Navy launch order worth $8.29 million was announced in August 2006, with a system to support ongoing experimentation in the use of endurance UAVs in performing broad area maritime surveillance. One aircraft is to deploy to Australia to support contracted demonstration of maritime surveillance applications. On offer to Netherlands as a candidate for anticipated MALE competition in early 2007.

Predator C

Jet-powered evolution of Predator B airframe with enhanced low observable features. Demonstrator initially expected to be make debut flight late 2005, but development slowed to allow existing Predator A and B and Warrior delivery schedules to be met. Likely first flights in late 2006 or early 2007 were announced in June 2006.

Warrior

MQ-1 Predator hybrid able to carry four AGM-114 Hellfire missiles, compared with basic Predator ability to carry only two. Successful contender for the US Army Extended Range Multipurpose (ERMP) programme, with selection announced 8 August 2005. Initial award was worth $214.4 million and structured as a cost-plus-incentive-fee contract covering research, development, test and evaluation, Initial system development and demonstration phase runs until August 2009. An army order is expected to comprise 11 systems. Developed by GAASI under quick reaction prototyping programme initiated in July 2004, it first flew in October 2004. Follow-on funding increment award worth $67 million was announced in March 2006. Subsystem preliminary design review for production systems was completed in May 2006.

GENEVA AEROSPACE

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Dakota

Originally developed by Daedalus Research for the US Naval Research Laboratories as a rugged UAV testbed. Rights were acquired by Geneva Aerospace in July 2001. UAV was used to support demonstration of multiple air vehicle control by a single operator on behalf of the Office of Naval Research and US Air Force Research Laboratory in January 2003 as part of ONR's autonomous operations future naval capability programme. A new-generation autonomous guidance system, designated flightTEK, announced in November 2004. Limited production of aircraft got under way in January 2005 for unspecified customers. Plans for modified aircraft to be fitted with pontoons to support Vought *(see separate entry)* seaplane UAV concept demonstrations for DARPA was announced in April 2005. Dakota was used to support demonstration of autoland suite at the US Army Yuma proving ground in February-March 2006 for US Naval Air Systems Command.

HONEYWELL

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Organic Air Vehicle

Selected as the US Army's Class I Organic Air Vehicle (OAV) requirement under the Future Combat Systems programme in May 2006 with initial funding award worth $61 million. Shortlisted in June against Aurora Flight Sciences Golden Eye OAV for FCS Class II OAV requirement with current phase – Phase III – running until February 2009.

Both Class I and Class II designs are based on scaleable VTOL lift-augmented ducted fan airframe technology with development under way since 1999. This same airframe type is also known as a ring wing, with the duct acting as lift surface during horizontal flight

Initial development was carried out in co-operation with Allied Aerospace as a DARPA ACTD initiative. Selected in June 2001 by DARPA to progress as prototype Class II sys-

tem for demonstration purposes with 250 test flights completed by Kestrel variant up until July 2002. A modified version, developed in co-operation with Allied Aerospace and known as iStar successfully performing autonomous flight for the first time in March 2004.

Honeywell derivative of iStar was shortlisted in December 2004 for the first phase of the DARPA FCS Class II Organic Air Vehicle (OAV) development programme. Honeywell funding allocation for Phase 1 development totalled $3.99 million. Honeywell team members include AAI, which is responsible for airframe manufacture, AVID LCC, and Techsburg.

FCS Class 1 system based on a 333mm (13in) diameter micro air vehicle (MAV) version was unveiled by Honeywell at the 2004 AUVSI Unmanned Systems North America exhibition. A version was developed via $40 million DARPA MAV advanced concept technology demonstration contract, with the demonstrator starting a three0month flight-test programme in December 2004. MAV is distinguishable by twin outboard fuel and payload capsules and its four-leg sprung undercarriage. Initial prototypes built for DARPA to transfer to US Army for operational use during fiscal year 2007, with first Honeywell FCS programme production units to be delivered in December 2008. MAV development and manufacture team is the same as for the Class II OAV variant.

INNOCON

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ASIS

Optional piloted Aerial Surveillance and Intelligence System (ASIS) is derived from the P-92 Echo Super two-seat light aircraft. A demonstrator has been built. Payload is controlled by mission control station in manned mode. Conversion kit is also available for other aircraft types.

Mini Falcon

Lightweight catapult-launched tactical UAV with parafoil recovery system and a POP200 surveillance payload. Range can be extended up to 8h by fitting additional 15 litre fuel tank. Production rights for larger derivatives sold to BAE Systems North America to provide basis of its Skylynx II tactical UAV system.

INSITU

The Insitu Group, 118 East Columbia River Way, Bingen, Washington 98605, USA. Tel: +1 509 493 8600; +1 509 493 8601; www.insitu.com

A20/GeoRanger/SeaScan

Low-altitude, long-endurance UAV initially developed under the designation SeaScan with first prototypes unveiled in 2001. A20 is the basic civilian market configuration. Vehicle has flying wing with winglets and suspended central fuselage carrying sensors and pusher propeller system. Catapult launch system has recovery using vertical wire, which is caught by a wingtip-mounted grapple. Plans for trans-pacific flight were announced in August 2001, but has never fulfilled. A teaming arrangement with Boeing *(see separate entry)* was announced in February 2002 to develop a military version known as A15 Scan Eagle with the prototype making its first wholly autonomous flight in June 2002. GeoRanger derivative of basic A20, carrying magnetic anomally detectors, developed between 2002 and 2004 in conjunction with Fugro Airborne Survey and introduced into service with that company in October 2004. Forest fire monitoring capability with A20 model demonstrated for NASA in June 2006 in conjunction with Evergreen Aviation. Sale of a single A20 system, comprising one air vehicle, was made to the University of Alaska Geophysical Institute in August 2006.

INTA

Instituto Nacional de Technica Aeroespacial Ctra. De Ajalvir, km4, Torrejon de Ardoz 28850, Madrid, Spain. Tel : +34 91 520 13 09; fax: +34 91 520 16 32; www.inta.es

ALO

The Avion Ligero de Observacion (or ALO) is a lightweight, short-range tactical surveillance system intended for use in homeland security missions and small military unit reconnaissance roles. The system has been under development since the early 1990s. INTA is offering extended-range variant in its international marketing since mid-2003.

INTEGRATED DYNAMICS

Integrated Dynamics, 250/1 NC-24, Korangi Creek Road, Karachi, Pakistan. Tel: +92 21 509 1881; fax: +92 21 509 1883

Border Eagle

Twin tail boom pusher-propeller configuration short-range system unveiled at 2005 Dubai air show. Has all-composite wing with reinforced tricyle undercarriage to support rough field operation. Intended for use in border surveillance roles by civil authorities.

Desert Hawk

Hand-launched all-composite system intended for use by both civil and military authorities. Similar in design to L3 BAI Aerosystems Javelin with engine mounted above forward fuselage on elevated pylon to allow for forward-facing EO payload.

The initial development began in 2003 in response to Pakistani army requirement for close-range system, with prototype making its debut flight in early 2004. Communications relay capability using two air vehicles demonstrated in early 2005. Unveiled at the 2005 Dubai air show.

Hawk Mk V

Robust conventional configuration UAV derived from target drone design. Has all-composite wing. Has steel composite undercarriage to allow for rough field operations, but with option of parachute recovery.

Shadow Mk-1

Twin tail pusher propeller configuration air vehicle with close visual parallels to Pioneer RQ-2C Pioneer. Has two-piece all-composite wings. Detachable all composite tail structures. Options for extended endurance by fitting of additional internal tank in fuselage.

Vision Mk-1/Vision Mk-11

Conventional airframe design with pusher propeller at back of main fuselage. Mk-11 is extended-range version. Low-slung, carbon-fibre reinforced tail boom support T-tailplane is on both versions. Mk-1 has two-piece all-composite wing. Mk-11 has two-piece hollow composite wing. Vehicles have steel composite undercarriage. Runway or parachute recovery,

ISRAEL AIRCRAFT INDUSTRIES

Israel Aircraft Industries, Malat Division, Ben Gurion International Airport, 70100 Israel. Tel: +972 3 935 7349; fax: +972 3 935 4175; www.iai.co.il

Bird Eye 100

Hand-launched, mini surveillance system intended for military and paramilitary market. Released onto international market early 2004.

Bird Eye 400

Flying wing UAV with development completed early 2005. Unveiled at Aero India in February 2005. Pusher propeller. Uses deep stall landing system with upper wing surface incorporating shock absorbers for upside down touchdown. Night sensor suite qualified during 2005.

Bird Eye 500

Hand-launched mini surveillance UAV. Common avionics and control system with Bird Eye 100 but in a completely different airframe. Under evaluation by civilian police in the Netherlands and flown in low-level demonstration flights over Amsterdam in June 2004. Two concepts for dedicated civilian derivatives developed under European Commission-funded UAVNET thematic project and unveiled in June 2005. Bird Eye 500M would have 2.4m (7.8ft) wing and parachute landing system, with maximum take-off weight rising to 5.6kg (12.3lb). Bird Eye 500D would have 2.4m wing but use deep stall landing techniques, with maximum take off weight capped at 4.9kg.

Ei-Tan (Strength)

Prototype HALE system with possibly two demonstrators built and flying with the Israeli air force. Take-off weight reported to be 4t. Span reported to be 26m.

Directory: unmanned air vehicles

Heron

Medium-altitude long-range surveillance system. In operational service with Israeli defence forces, with variants including highly modified electronic intelligence gathering aircraft. Forms baseline air vehicle for joint France-Netherlands Eagle MALE programme *(see separate entry under EADS-IAI)*. Autonomous take-off and landing system developed in conjunction with EADS. Heavy fuel version, designated Heron ERMP, was flight tested in January 2005. Acquired by India in 2003 and operated by Indian air force, with operations included supporting 2005 Indian Ocean tsunami surviver relief operations using thermal imaging payloads. Potential follow-on Indian order for up to 50 aircraft was flagged early in 2005, but there have been no eported sales. A $180 million order for 10 aircraft and ground systems was placed by Turkey in April 2005 with deliveries believed to be under way. Israeli air force order for multiple systems to replace Searcher was signed in September 2005, with the order worth $50 million. Air force aircraft are known as Mahatz 1 with initial deliveries from late that same year. Some aircraft may have weapons capabilities with that service using armed UAVs as part of forces deployed against Hezbollah forces in sSouthern Lebanon and Palestinian forces in the Gaza Strip during July-August 2006.

Hunter

Currently in operational service with armies of Belgian, French and the USA. Single Hunter system acquired by France in 1998, with this to be replaced by 2010 with Euromale. Belgian aircraft designated B-Hunter to reflect assembly by Belgian Eagle Consortium. System selected by Belgium in December 1998 with initial deliveries in 2001. B-Hunter is based on standard Hunter configuration, but has 8.9m wingspan. At least two Belgian aircraft lost during 2006, one in an accident and the second to ground fire in the Democratic Republic of Congo during support operations for European peace keeping force. Extended-range Endurance Hunter (E-Hunter) is capable of 30h endurance and replaces existing wing, boom and tail assembly with modules from Heron. US Army Hunter designated RQ-5A with Northrop Grumman programme prime contractor *(see separate Northrop Grumman – IAI entry)*.

I - See

Hand-launched mini-UAV unveiled at DEFEXPO 2004 in India. Close range, pusher propeller above glider type airframe. Initially developed as candidate for Israeli army interim close-range UAV requirement in 2004-5, but unsuccessful.

I-View

Catapult-launched tactical UAV family built around common core flight control system and scaled airframe configuration with guided parafoil recovery. Robust airframe structure intended for use in frontline military operations, including high load absorbing undercarriage. Basic version is designated I-View 50 with this evaluated by Israeli army in March 2006 as candidate for platoon level system with source selection decision due late 2006. I-View 150 made debut flight in early 2005. I-View 250 is largest version reusing wing from Searcher II. Successfully offered by IAI in conjunction with Boeing Australia for Australian Army JP129 tactical UAV requirement with source selection announced December 2005. Protracted contract negotiations expected to be finalised during August-September 2006 for two-system purchase. K50 and K125 are proposed civil derivatives based on concepts developed by European Commission-funded UAVNET thematic project. Fuel cell powered versions also studied.

Searcher II

Basic Searcher operational with Israeli air force since 1992 with some air vehicles equipped with electronic warfare payloads, but now being progressively replaced by Heron. Ordered by India in 1996 and used operationally during border clashes with Pakistan. In operational service with Singapore with Singaporean navy having ground control systems installed in larger ships. Searcher II selected by Israeli minister of defence in August 2003 to undertake special surveillance missions as a turnkey service based on payment per flight hour with operations starting in September 2003. Unknown number of aircraft sold to India in follow-on deal negotiated in late 2003 and early 2004. Indian aircraft used operationally in January 2005 to support search for survivors of Indian Ocean tsunami. Technical data is for Searcher II.

Swallow

Hand launched mini-UAV under development as a low-cost/expendable surveillance system. Large nose mounted sensor pod.

JARS

Jordan Advanced Remote Systems, PO Box 815570, Amman 11180, Jordan. Tel: +962 6 556 0511; fax: +962 6 5560 0514; www.jars.jo

Arrow/Trans Arrow

Basic Arrow developed as a target drone for training short range air defence units with Trans Arrow concept was unveiled in 2005 as a "mother ship" to carry and deploy smaller electric powered "leave behind" mini UAVs – these were designated "I-Wing". Each Trans Arrow would carry two I-Wings, one on each wing. Nominal mission range for Trans Arrow mission is 50km (27nm). Basic Arrow target drone has crew of five. Nominal range for I-Wing is 10km.

Falcon

Short-range tactical UAV was unveiled in early 2004. Has all-composite airframe with pusher propeller and detachable joined tail. Catapult launcher and parachute recovery options are available. The option of increased size fuel tank is available to increase endurance. Twin fixed field of view cameras mounted on common gimbal chassis. Ground crew of 3-4.

Silent Eye

Hand-launched, backpackable system unveiled in 2005. All-electric, with waypoint based navigation. Has daylight and low-light cameras in nose- mounted ball. Flight simulator built into ground control station. Crew of two.

KALEBAYKAR

Kale Holding, Sefakoy, Tevfik Bey Mah, Istiklal Cad, No 1334295, Kucukcekmece, Isanbul, Turkey. Tel: +90 212 624 0670; fax: +90 212 579 5529; www.kaleaero.com

Bayraktar

Hand-launched close-range UAV powered by twin wing mounted electric engines. First flight was in October 2005. Autonomous guidance system has been under development since 2002. Has a firm order for 19 systems from Turkish army, with deliveries from mid- 2007. Ordered systems will each comprise four air vehicles, plus ground control station and support equipment. Demonstrator prototype was made public at the 2006 Farnborough air show, with production air vehicles to incorporate optional parachute recovery system. Kalebaykar is jointly run by the Ankara-headquartered Baykar Machine and Kalekalip Aerospace companies.

KAMAN

Kaman Aerospace, Helicopters Division, Old Windsor Road, Bloomfield, Connecticut 06002, USA. Tel: +1 860 242 4461; www.kamanaero..com

Burro/Burro+

Development unmanned version of the K-Max heavylift helicopter. Name is an acronym emerging from US Marine Corps requirements in the late 1990s for broad area unmanned responsive resupply operations. Initial development was supported by a $4.2 million USMC contract award in 1999 to build an optionally piloted demonstrator with follow-on funding worth $2.7 million in May 2000. Debut flight was made in early 2000. Demonstrations conducted by the USMC during 2001 to support exploration of autonomous over-the-shore deployment of weapons systems and logistics supplies. Separate demonstrations for US Army Aviation Applied Technology Directorate took place at Fort Eustis, Virginia, in 2003. Follow-on demonstration for US Army in November 2005 in the form of a "robots moving robots" experiment. New generation Burro+ developed in early 2006 and incorporates large underbelly fuel tank to increase endurance. Demonstrator conducted 12h endurance flight in April

2006 from Kaman airfield at Bloomfield, Connecticut. A $3.1 million contract from US Army Material Research Development and Engineering Command announced 17 July 2006 with this supporting development of more advanced autonomous flight control system before five-week flying demonstration at Fort Benning, Georgia, in October and November 2006.

KOREA AEROSPACE INDUSTRIES

Korea Aerospace Industries, Seosomun-dong, Jung-gu, Seoul 100-737, South Korea. Tel: +82 2 2001 3114; fax: +82 2 2001 3011; www.koreaaero.com

Night Intruder 300

Initial development started in 1991, with the full-scale production version ready from 2000. Production contract from South Korea defence ministry came in September 2001. Initial operational capability achieved with South Korean army in November 2003. Production ended in 2004, but concepts have been proposed for maritime surveillance version. Extensively marketed since 2004, but no follow-on orders as at August 2006.

L3 BAI AEROSYSTEMS

L3 BAI Aerosystems, 9040 Glebe Park Drive, Easton, MD 21601, USA. Tel: +1 410 820 7500; fax: +1 410 820 8500; www.baiaerosystems.com

BQM-147A Exodrone/Dragon Drone.

Originally developed by Johns Hopkins University as an expendable electronic warfare jamming drone. In series production since mid 1980s for the United States Marine Corps and Army with extensive operational usage in a variety of conflicts. USMC variants include electronic warfare jammer. Development of Dragon Drone version funded by USMC in 1997 with 30 Exodrones converted to this configuration ahead of standard series production. Dragon Drone selected by Bahrain with deliveries taking place in late 1999. Evaluated under loan by Australian Army in 1999-2000, with this including deployment to East Timor. Marinised version designated Condor was tested by US Coast Guard in 2000. Replaced in USMC service by Aerovironment Dragon Eye.

Evolution/Evolution XT/Snake Eye

Evolution is a modified version of the US Office of Naval Research's Dragon Eye close-range UAV supplied to US Special Forces Command. Some 20 air vehicles were built and used operationally in Afghanistan. Snake Eye is a Dragon Eye modified for use by US Navy SEALS. Snake Eye uses the Dragon Eye airframe, but incorporates new flight-control systems from MicroPilot and Northrop Grumman and carries an infrared nose camera. See Aerovironment for main entry on Dragon Eye. Evolution XT (Extended Time) demonstrated 90min flight for the first time in October 2004 with development continuing.

Isis

Medium tactical UAV with ongoing development. Was unveiled at the 2003 AUVSI Unmanned Systems exhibition. Intended to be able to take off and land from semi-prepared strips. Common avionics with Tern. Baseline system uses gasoline engine. Heavy fuel engine option extends range to 3,200km with endurance of 24h.

Javelin

Lightweight close-range UAV intended for commercial and paramilitary application. Remotely operated rather than autonomous, it is combustion engine powered with a 2h endurance. System is being offered for both sale and short term lease.

Tern

Air vehicle optimised for rough field operation with engine mounted above wing to ensure propeller remains free, and high set tricycle undercarriage with large main wheels. Height also enables fitting of slung payloads of up to 10kg, with precision dispensing identified as a mission option. Undercarriage incorporates disc brakes to reduce landing footprint. Additional fuel tank can be fitted externally to increase endurance. In service with US Special Forces Command and used operationally in Afghanistan in 2002 to support distribution of unattended ground sensors and achieved 225 operational hours in that theatre. Selected by US Army in December 2003 to support trials of beyond line of sight combat identification system as a surrogate for the Organic Air Vehicle still being developed. Catapult launch capability intended for small field or shipborne deployment demonstrated in March 2004 using Dragon Drone launcher. Version equipped with skids and tail-hook in place of tricycle undercarriage for shipboard landings demonstrated in April 2004. Small number of systems operated by US Naval Air Systems Command as experimentation testbeds. Total SOCOM inventory at August 2005 was 65 systems.

Tern-P

Evolved version of basic Tern system unveiled in August 2004 at AUVSI Unmanned Systems North America exhibition. Twin tail boom with pusher propeller integrated into rear fuselage, rather than overwing engine mount as with basic Tern. Retains high undercarriage to support slung loads.

LOCKHEED MARTIN

Lockheed Martin Aeronautics, PO Box 748, Fort Worth, Texas 76101, USA. Tel: +1 817 777 2000; www.lmaeronautics.com
Lockheed Martin Systems Integration, 1801 State Route 17C, Owego, New York , 13827-3998, USA. Tel: +1 607 751 2000; www.lockheedmartin.com

Desert Hawk/Desert Hawk III

Original air vehicle system developed by the US Air Force Electronic Systems Centre and manufactured under licence by Lockheed Martin. System briefly known as Sentry Owl with this a brand name assigned by Lockheed Martin. Systems produced for the USAF as operational Force Protection Airborne Surveillance System from late 2001 with initial deliveries starting in 2002. The system was deployed to both Iraq and Afghanistan. Total USAF acquisition order by August 2005 stood at 21 systems, each comprising six air vehicles. Acquisition of 60 air vehicles, 10 ground control stations and five remote viewing terminals approved by UK Ministry of Defence in late 2003/early 2004 with those systems deployed in Afghanistan as at August 2006. Desert Hawk III configuration is for larger, more robust air vehicle with larger fuselage supporting modular payload bay. Three standard payload modules as at July 2006 – comprising low light black and white, low light colour and infrared cameras; wide field of view and narrow field of view low light black and white cameras and non-visible illuminator; and colour wide and narrow field of view cameras. All sensors have fixed focal length. Table data is for basic Desert Hawk aircraft.

Morphing Wing technology demonstrator

Subscale demonstrator for testing of morphing wing concepts with at least two air vehicles built. The design is based on a flying wing with two stream-wise folding joints located in wing structure on each side of central body. This allows wings to be raised vertically to act as a tail surface, as well as fully fold in against the body to reduce the overall air vehicle profile. A development contract award from US Air Force

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Research Laboratories was made in January 2003 worth $9.3 billion following open solicitation in September 2001. Project funding ends November 2006. Air vehicle prototype was unveiled at the 2004 AUVSI Unmanned Systems North America exhibition. Windtunnel testing was carried out between August and November 2005. Two vehicles crashed during take-off attempts in the first half of 2006 because of flight control issues. DARPA funding is continuing.

Multipurpose UAV

Submarine-launched and recovered UAV concept being jointly advanced by Lockheed and DARPA. The vehicle would be carried and deployed from standard ICBM missile launch tubes on Ohio-class submarines converted to carry cruise missiles.

Its primary role would be surveillance and reconnaissance for cruise missile strikes, but UAV arming concepts flagged by Lockheed include the Boeing Small Diameter Bomb and the Lockheed Martin LOCAAS loitering missile. Has potential technology links with the Lockheed Martin morphing wing UAV demonstrator programme. Water landing would be either by stall manoeuvre or parachute. Submarine would recover UAV underwater with the assistance of a remotely operated vehicle.

Powerplant options being considered include modified Honeywell AS903. Initial DAPRA funding approvals came in April 2003. DARPA announced a two-year, $7.87 million risk-reduction demonstration contract to Lockheed Martin in May 2005, with initial allocation worth $4.22 million and funding ending in March 2007. Testing from November 2006 to January 2007 will see full-scale, non-folding model dropped into the water to simulate parachute recovery. Underwater recovery is to be tested seperately

P-175 Polecat

High-altitude long-endurance flying wing UAV technology demonstrator with basic low observable features. It was developed and flown by Lockheed Martin Skunkworks over an 18 month period at a total cost of $27 million. First flight in late 2005.

The system was made public at the 2006 Farnborough air show. Follow-on flight programme is planned for September 2006 to study contrail suppression.

Sky Spirit /Sky Spirit ER

Developmental LALE system under development by Lockheed Martin MS2 Tactical Systems division in conjunction with the University of Minnesota for at least two years with demonstrators flying. Has pusher propeller configuration, with airframe having close visual similarities to the US NRL/Advanced Ceramics Manta system, but with central fuselage flattened to operate as a lifting surface. Development is continuing.

MLB

MLB, Suite B 2551 Casey Avenue, Mountain View, California 94043, USA. Tel: +1 650 966 1022; www.spyplanes.com

BAT 3

Short-range UAV being promoted for small unit surveillance, urban surveillance and force protection missions. Also being offered for agricultural monitoring and wildlife mapping missions. Uses vehicle-roof mounted catapult launcher.

MMIST

MMIST, Unit 4B, 190 Colonnade Road South, Ottawa, Ontario K2E 7J5, Canada. Tel: +1 613 723 0403; fax: + 1 613 723 8925; www.mmist.ca

CQ-10A Snowgoose

Parafoil-based logistics UAV. Ground launched, but demonstrated to be air launchable in trains of four from a single Lockheed Martin C-130 during trials by US Special Forces command in April 2002. Production contract award made by US SOCOM in early 2005. Total SOCOM inventory as at August 2005 was 15 systems. Larger systems are being proposed, including capability for a 455kg (1,000lb) payload and endurance of more than 30h. Derivatives of basic system also being proposed for use as surveillance platform. Performance and payload data is for ground-launched system.

NAVMAR

Navmar Applied Sciences, Suite 220, 1450 Edgemont Avenue, Chester, Pennsylvania 19013, USA. Tel: +1 610 619 7440; www.navmar.com

Mako

Low-cost, modular tactical UAV designed to be expendable depending on mission requirements. Developed under contract to USN Air Systems Command for US Special Operations Command. Development supported by L-3 BAI Aerosystems, with air vehicle unveiled at AUVSI Unmanned Systems North America exhibition August 2004. Total SOCOM inventory at August 2005 was 30 aircraft. System used operationally during Operation Iraqi Freedom.

Tiger Shark

Tactical UAV with close design parallels to Mako. At least one prototype has been built under contract to USN Air Systems Command. First unveiled at AUVSI Unmanned Systems North America exhibition August 2004.

NEANY

Neany, Suite A 44010 Commerce Avenue, Hollywood, Maryland 20636, USA. Tel: +1 301 373 8700; fax: +1 301 373 6405. www.neanyinc.com

Arrow

Developed for USN Air Systems Command on behalf of US Special Operation Command (SOCOM) as a candidate for production as a testbed for trials of mission payloads and concepts. Air vehicle was unveiled at AUVSI Unmanned Systems North America exhibition August 2004. The airframe is derived from the Titan Aircraft Tornado 912 kitplane. Prototype first flew April 2004. Initial development contract award was made in early 2003, with additional $9.25 million funding awarded in June 2004 to allow further work on enhancing the basic system capabilities. Two full production standard aircraft were scheduled to be delivered to SOCOM in June 2006, but current status is unclear. A fourth prototype air vehicle was in assembly at June 2005. Concepts for ambulance version, incorporating satellite datalink and telemedicine system with 5h endurance, and gunship version equipped with twin 0.5 calibre machine guns with 16h endurance were revealed in June 2005.

NORTHROP GRUMMAN

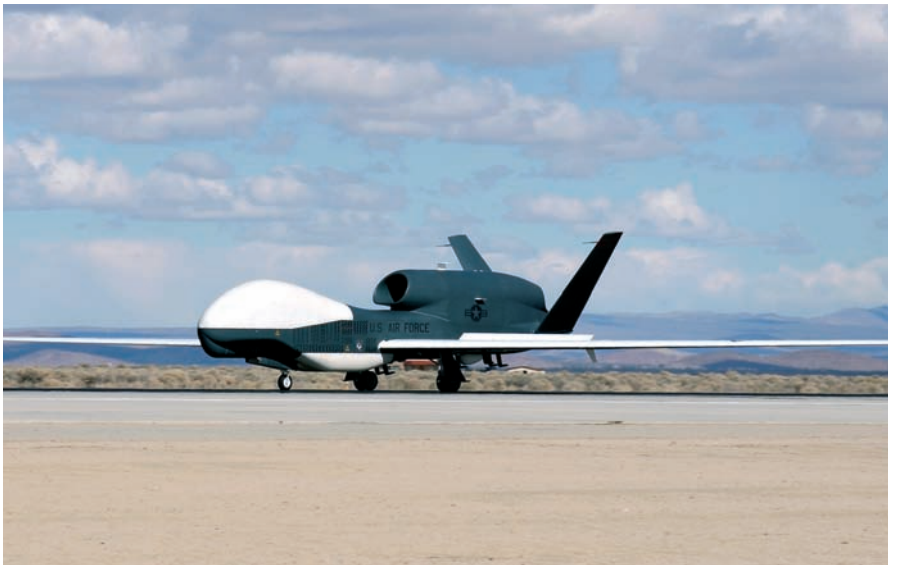
Northrop Grumman Integrated Systems, Unmanned Systems, PO Box 509066, San Diego, California 92150-9066, USA. Tel: +1 858 618 4355; www.is.northropgrumman.com

BQM-34 Firebee

In production since the mid-1960s with a wide variety of variants flown operationally, including weaponised and target drone types. Employed in radar decoy roles against Iraqi air defences during Operation Iraqi Freedom in 2003. Rapid prototyping project was launched at the request of US Special Forces Command in third quarter 2002 to modify BQM-34S Firebees to carry modular payload canisters for airborne delivery mission. Canisters manufactured by Grove Aircraft, California. Unknown number of air vehicles upgraded with new fully autonomous navigation system. Test flights began in December 2002 and the programme was made public in January 2003. Payload canisters unveiled by Northrop at AUVSI-USN UAV demonstration at Webster Field in August 2003. A $48.2 million order was placed by the USN in April 2005 for 60 aircraft and logistics support with deliveries to be completed in 2006. Order contains options for 60 further aircraft in 2007.

RQ-4A Global Hawk/Block 10

High-altitude long-endurance system developed out of DARPA Advanced Concept Technology Demonstration project launched in 1995. Initial order was placed with Teledyne Ryan for seven air vehicle demonstrators, with the company later acquired by Northrop Grumman. First air vehicle was rolled out in February 1997 and it made its first flight late that same year. Military utility trials began in 1999. First crossing of the Atlantic Ocean was made in April 2000, with this including the first demonstration of air vehicle control being performed from another continent. Entered



Northrop Grumman RQ-4A Global Hawk has flown 10,500h

engineering, manufacturing and development phase of programme in March 2001. First UAV to cross Pacific Ocean on deployment to Australia in April 2001. Used operationally in Afghanistan and Iraq conflicts. Air vehicle 1 was refurbished by Northrop Grumman in early 2003 for use as trials aircraft and deployed to Germany in October-November for joint German air force/USAF demonstration of proposed German Eurohawk SIGINT version. Final prototype RQ-4A was built under Advanced Concept Technology Demonstration programme delivered to USAF February 2003. First LRIP production contract worth $101 million was awarded by USAF in February 2002 to supply two air vehicles. A $307 million contract award was made in January 2003 for LOT 2 LRIP of four RQ-4As. A $185 million contract was awarded in February 2003 to build two RQ-4As for the USN to support maritime surveillance experimentation.

The first production standard RQ-4A (LRIP LOT 1 air vehicle) was delivered to the USAF in August 2003. The US FAA granted national certificate of authorisation for the RQ-4 system in August 2003 enabling routine operation of system in US national airspace. First flight of USAF Lot 2 air vehicle was made on 1 July 2004 and delivered to Beale AFB in October 2004. First flight of USN aircraft – designated N1 – occurred in October 2004.

Both USN aircraft were delivered to US NAS Patuxent River, Maryland in August 2005 with trials to run until fiscal year 2009. RQ-4A became the first US military UAV to achieve USAF military airworthiness certification in January 2006. The start of flight tests of High Band System Production Configuration Uni signals intelligence system were announced in January 2006, with these continuing across 2006. Final Block 10 production air vehicle was handed over to the USAF in June 2006 with all current and future production aircraft to be RQ-4B/ Block 20+ series. USAF RQ-4A fleet had achieved 10,500 flying hours up until August 2006.

RQ-4B Global Hawk/Block 20+

Standardised production version of Global Hawk. Key external changes to RQ-4A comprise extension of forward and rear fuselages through the introduction of plugs; larger tail fin surfaces; and relocation of undercarriage to retract into conformal pods on the inboard wing to provide increased internal fuselage space.

USAF awarded a $147 million contract in March 2003 to launch a spiral development programme leading to RQ-4B configuration. Funding worth $30.1 million for long lead LRIP items for four LOT 3 air vehicles was awarded in June 2003 with this supporting finalisation of RQ-4B design configuration and construction of three out of the four air vehicles to that standard.

Funding worth $50.6 million for long lead LRIP items for four LOT 4 RQ-4B air vehicles was awarded by the USAF in March 2004. An additional $143 million was awarded in April 2005 to compensate for cost overruns in EMB phase. A LOT 5 funding award of $60.2 million in August 2005 was based on five RQ-4Bs, four with advanced sensor suite and one with basic sensor suite. A funding award of $22.5 million in June 2006 was made for interoperability standardisation to support the beginning of Initial Operational Test and Evaluation (IOT&E) in November 2008. Total USAF production to 2009 baselined on 51 air vehicles, including a number of SIGINT variants. Flight test of production RQ-4B deliveries from LOT 3 order is scheduled to start in November 2006.

The RQ-4B was selected as the preferred platform for the unmanned segment of the NATO Alliance Ground Surveillance programme in April 2004. A German air force order for RQ-4Bs is expected in late 2006 with those air vehicles to be converted to Eurohawk SIGINT configuration by EADS. Candidate for planned USN Broad Area Maritime Surveillance system requirement.

RQ-8A/RQ-8B Firescout

Derivative of Schweizer Aircraft Model 333 manned helicopter. Selected as the winner of the US Navy's VTUAV competition, the first fully autonomous flight was made by the Model 379 VTUAV prototype in January 2000. Northrop Grumman was awarded a $93.7 million contract in February 2000 to perform Model 379 engineering and development work and produce three initial systems. Model 379 was named Firescout and given the designation of RQ-8A. USN dissatisfaction with the programme in 2001 led to cancellation of planned production contracts and the ending of the programme from July 2003. The prototype RQ-8A made its first flight in May 2002, with the first engineering and development variant making its debut flight in November 2002.

RQ-8B concept was publicly released in November 2002 and the following month the USN revealed it was exploring funding development of a more robust version tentatively designated RQ-8B Sea Scout. Four-blade rotor test was flown on a manned Schweizer Model 333 test-bed aircraft in March-April 2003. Programme funding restored by US Congressional committee in July 2003. The USN announced in January 2003 that Firescout would be developed to support the Littoral Combat Ship programme.

The RQ-8B was selected as the preferred Class IV UAV for the US Army's Future Combat Systems (FCS) programme in September 2003. An eight-year, $115 million contract was awarded to Northrop Grumman by FCS prime contractors Boeing-SAIC in January 2004 to build seven RQ-8B Firescout air vehicles and ground systems to support FCS programme development and testing up to 2008. Test firing of the RQ-8A with Hydra folding fin rockets was carried out in February 2004 as part of continuing weaponisation experiments.

A US Navy contract award worth $49 million was made in March 2004 to supply two RQ-8B configuration systems by October 2005 to support continued test and development of naval variant. First shipboard landing demonstration was carried out with USS *Denver* in January 2006. Follow-on USN funding award worth $135 million was announced in July 2006, with this supporting development until August 2008.

A revised fuselage configuration for army aircraft, designated MQ-8B and featuring large sponsons, was unveiled in late 2004. A contract worth $11.74 million, covering eight air vehicles and support equipment for US Army requirements, was awarded by the USN in April 2005. The first MQ-8B airframe was delivered by Schweizer Aircraft to Northrop Grumman in January 2006. The first two MQ-8Bs are

scheduled for delivery in November 2006. Full rate production orders for US Army aircraft are expected in 2008, with initial operational capability aircraft to be fielded from 2010.

Range and endurance information in technical data supplied by Northrop Grumman compares maximum effective 272kg payload being carried on same mission by three blade RQ-8A and four blade RQ-8B versions.

Killer Bee

Developmental flying wing system first unveiled June 2005 based on initial air vehicle design from Swift Engineering of California. It is being developed as a multi-mission, joint-service family of scalable size UAVs, and was designed to provide surveillance and force protection for military bases, shipping lanes, borders or convoys. The vehicles were intended to incorporate networking and swarming capabilities to allow for more sophisticated tactical level operations. The variant is currently being offered for US Marine Corps Tier-2 UAV requirement with downselect for that requirement imminent. A demonstration was carried out for the US Air Force Battlelab at Creech AFB, Nevada, in March 2006 using 2.74m (8.9ft) wingspan aircraft. Data is for KB-2 mid-sized variant.

X-47

UCAV demonstrator and prototype operational UCAV programme. The X-47A, also designated Pegasus, was developed under former US Navy DAPRA maritime UCAV feasibility demonstration programme. An X-47A demonstrator was first rolled out in February 2001 and made its maiden flight in February 2003.

The X-47B was developed as the Northrop Grumman candidate for the former US Joint-Unmanned Combat Air System (J-UCAS) programme, now cancelled pending launch of the N-UCAS successor programme. The X-47B development was launched in May 2003 with a $160 million contract awarded from DARPA to build and demonstrate two X-47B configuration air vehicles. A full-scale mock-up unveiled for the first time at the 2004 Farnborough air show. A DARPA follow-on contract award worth $1 billion was announced in August 2006 to design and develop three X-47B demonstrators, mission control stations and common operating system components to meet USAF and USN requirements by September 2009.

Low-speed windtunnel testing involving 750 test runs using a high-fidelity model was completed in September 2004. An X-47B system integration laboratory opened at Northrop Grumman's San Diego facility on 15 October 2004. Manufacture of the forward fuselage by GKN Aerospace began in June 2005 and the final assembly of lead aircraft under way at Northrop Grumman's Palmdale, California facility when the programme was terminated in February 2006. Preliminary planning for the replacement US Navy N-UCAS programme is expected to see new tender process for demonstrations late this year with contract awards in April 2007, leading to a demonstration in 2012.

NORTHROP GRUMMAN - IAI

Northrop Grumman Integrated Systems, Unmanned Systems, PO Box 509066, San Diego, California 92150-9066, USA. Tel: +1 858 618 4355; www.is.northropgrumman.com
Israel Aircraft Industries, Malat Division, Ben Gurion International Airport, 70100 Israel. Tel: +972 3 935 7349; fax: +972 3 935 4175; www.iai.com.il

Hunter/E-Hunter

Interim US joint tactical UAV that has gone on to boast an impressive operational history in service with the US Army. The vehicle first flew in 1991. An automatic take-off and landing system was retrofitted into US Army aircraft in 2002 and a number of air vehicles were deployed to Iraq in support of Operation Iraqi Freedom and upgraded in theatre in mid-2003 to partial E-Hunter standard to provide endurance of above 15h.

RQ-5A test flights with a heavy fuel engine were completed in July 2004 with implementation on 40 air vehicles from October 2004. A standard Hunter was used to support border surveillance demonstrations by US Department of Homeland Security between November 2004 and January 2005. The aircraft deployed to Iraq had recorded 8,000 operational flying hours up until March 2005 and the first flight of US Army aircraft modified to full E-Hunter standard took place in March 2005. The total number of aircraft delivered to the US Army through all orders was 62, with 35 remaining in service as at August 2005. Planned to be withdrawn from operational service in 2009.

OERLIKON CONTRAVES - RUAG AEROSPACE - ISRAEL AIRCRAFT INDUSTRIES

Oerlikon Contraves, Defence, Birchstrasse 155, CH-8050 Zurich, Switzerland. Tel: +41 44 316 2211; fax: +41 44 311 3154; www.rheinmetall-detec.de
Ruag Aerospace, PO Box 301, CH-6032 Emmen, Switzerland. Tel: +41 412 684 121; fax: +41 412 682 024; www.ruag.com

Ranger

Enhanced version of original Ranger tactical system developed by IAI for Israeli defence force use. Ordered by the Swiss armed forces in December 1995 with the prime contract awarded to a consortium headed by Oerlikon Contraves. Twenty-eight air vehicles were produced by IAI, but modified and integrated by Ruag. The system entered initial operational service with the Swiss air force in June 1999 and was formally accepted into service in December 2001. Oerlikon Contraves was selected to supply Ranger to the Finnish army in September 1999. A follow-on Finnish army order was awarded to Oerlikon Contraves in September 2003 with deliveries made in the third quarter of 2005. Version incorporates larger fuel tanks to provide increased range.

PATRIA

Patria Systems, Naulakatu 3, FI-33100, Tampere, Finland. Tel: +358 20 4691; fax: +358 20 469 2690. www.patria.fi

Modular Airborne Sensor System

Small hand-launched UAV with design parallels with Lockheed Martin Desert Hawk, it was unveiled in June 2006 at the Eurosatory exhibition in Paris. It has a foam airframe with electric pusher propeller. Payload options include minaturised NBC detectors and sampling systems. The system comprises one to three air vehicles. The vehicle dismantles into eight primary modules for transport and storage.

PIASECKI

Piasecki Aircraft, PO Box 360, Second Street West, Essington, Pennsylvania 19029, USA. Tel: +1 610 521 5700; fax: +1 610 521 5935; www.piasecki.com

Air Scout

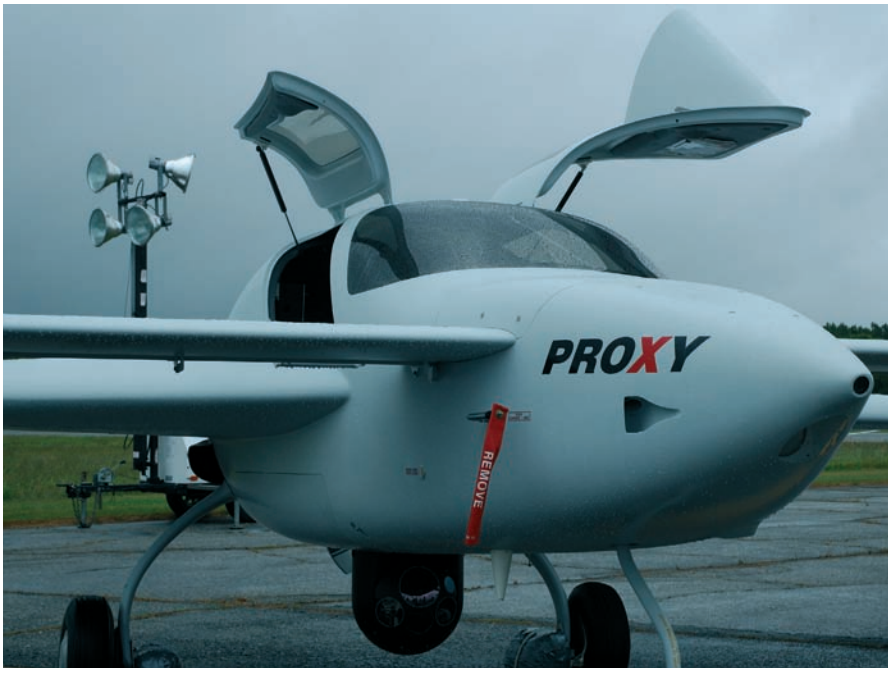
Tandem shrouded rotor short-range tactical UAV. The vehicle has a "filled" figure of eight configuration with a sensor turret mounted on a pylon rising vertically from the right hand side of the vehicle (as seen from top down).

The vehicle flight profile is based on the constant hover mode design of the Piasecki PA-59KAir Geep. Development team members include Lockheed Martin System Integration Owego, Georgia Tech and Geneva Aerospace. Collision avoidance sensors are being developed by Drexel University. Sole system shortlisted by Boeing and SAIC for US Army Future Combat System Class II UAV requirement in July 2005, with system now in funded development phases. Final selection for FCS remains dependent on comparative evaluation by US Army against DARPA funded candidates with this to occur by 2008. No specification data has yet been released.

Air Guardian

Autogyro UAV with demonstrator aircraft making first fully autonomous flight, with Level 4 control, on 12 July 2006. The flight-control system was jointly developed by Lockheed Martin System Integration Owego, Georgia Tech, and Geneva Aerospace.

The system was shortlisted for the US Army Future Combat System Class III tactical UAV requirement by Boeing and SAIC in July 2005 as one of three designs to receive 10-month risk-reduction studies pending final downselect of one system to evaluate against DARPA candidate for acquisition phase system selection. Current development and trials plans are based on near-term demonstration of Level 5 autonomous take-off and landing. No specifi-



Proxy Aviation plans a new future for the Velocity Aircraft Velocity XL as a UAV

cation data has yet been released. FCS Class III downselect was imminent as at August 2006.

PIONEER UAV

9 Schilling Road, Hunt Valley, Maryland 21030, USA. Tel: +1 301 862 7707; www.puav.com

RQ-2C Pioneer

Standard US Marine Corps surveillance system for 17 years. Formerly in USN and US Army service but now withdrawn. Pioneer UAV is a joint venture between AAI and Israel Aircraft Industries. USMC air vehicles were progressively upgraded over their service lives, with designation evolving through RQ-2A, 2B and current 2C version.

Upgrades have included fitting with automatic take-off and landing systems after an initial capability demonstration in January 1997 and re-engine programme from March 1997. A Pioneer improvement programme was funded in 2003 to sustain the system for the remainder of the life of the type in USMC service up until 2010.

A contract worth $6.8 million for production of replacement ground control stations and new modular avionics systems was placed by the Pentagon in August 2005, with deliveries to be completed by July 2007.

A total of 35 aircraft remain in the USMC/USN inventory as at August 2005 from total orders of 175, with the type expected to be withdrawn from service in 2010.

PROXY

Proxy Aviation Systems, Suite 250, 12850 Middlebrook Road, Germantown, 20874 Maryland, USA. Tel: +301 515 2799; fax: +301 540 9356. www.proxyaviation.com

Skywatcher

Development effort unveiled in June 2005 for a multiple UAV surveillance system based on the Velocity Aircraft Velocity XL canard wing kitplane rebuilt as an optionally piloted aircraft.

The core concept is for up to 12 aircraft to operate in a self-co-ordinating consetallation providing airborne intelligence to a network of up to 20 ground nodes.

The programme is a self-funded development effort with at least three UAVs built during 2006. A sponsored demonstration was carried out for the US Air Force Battlelab in November 2005 using two air vehicles. Development is continuing.

QINETIQ

Qinetiq, Cody Technology Park, Ively Road Farnborough, Hampshire GU14 OLX, UK. Tel: +44 8700 100 942; www.Qinetiq.com

Zephyr

Development solar and electrically powered high altitude long endurance UAV. It was originally developed between 2001 and 2003 as an orbiting camera system to record a proposed balloon-based manned altitude record attempt by Qinetiq. The vehicle secured UK Ministry of Defence interest with funding from 2004 to develop a demonstrator. The first flight of the ground-launched HALE version took place at the Woomera test range in central Australia during 2004. Between seven and nine different configurations have been built to date, with the average wingspan measuring 16m (52ft) and an all-up air vehicle weight of below 30kg (66lb). A civil version, dubbed Mercator, was ordered by the Flemish Institute for Technological Research in June 2005 and the vehicle was ready for delivery as at July 2006. Two demonstrator flights took place at the US White Sands missile test range in New Mexico in December 2005. A follow-on flight of three aircraft at White Sands at the end of July 2006 set a type endurance record, with one UAV achieving 18h. The demonstration also included tests of the UAV in communication relay roles. Development work is continuing, with plans to stage a three-month flight demonstration in 2008.

RAFAEL

Rafael Armament Development Authority, Missile Division, PO Box 2250 / 37 Haifa, 31021 Israel. Tel: +972 4 9908 558; fax: +972 4 9908 811; www.rafael.co.il

SkyLite/Skylite B

Reuseable mini-UAV derived from design by Bluebird UAV. The original design was based on launch from a shoulder-mounted canister using a small booster rocket with pop-out wings activated once airborne. It was originally released in July 2003 as the Skylark, but was renamed Skylite in April 2004 due to marketplace confusion. It is designed for use in urban warfare environments and complex terrain with severe restrictions on launch space.

The vehicle was offered for an Israeli army interim close-range UAV requirement in 2003, but not selected. The Skylite B configuration was unveiled in November 2005 and introduced a lightweight catapult launcher, parachute recovery, improved ground control system and advanced imagery processing tools. Air and canister launch concepts remain under consideration as potential future evolutions.

It is a candidate for a current Israeli army platoon level requirement, with source selection due in late 2006.

Directory: unmanned air vehicles

RHEINMETALL DEFENCE ELECTRONICS

Rheinmetall Defence Electronics, Brueggeweg 54, Bremen D-28309, Germany. Tel: +49 421 457 3670; fax: +49 421 457 4752; www.rheinmetall-de.com

Carolo P70/T140

Mini UAV under development as part of a family that also includes two micro-UAVs. It was unveiled in February 2004 at the Asian Aerospace exhibition in Singapore. The P70 was flying as a remote system during the first half of 2004, with the development of a fully autonomous guidance system under way.

KZO

German army tactical surveillance UAV now in series production and in operational service since late 2004. It has an extensive development history, with the initial design jointly developed as a French-German co-operative acquisition programme. However this was later terminated. The baseline version vehicle was previously known as both Brevel and Tucan, with development jointly undertaken by Rheinmetall and the former Matra company.

The initial flight trials of the German army air vehicle took place in 1994. Pre-production systems were delivered to the German army in 1998 to support evaluation campaign. The first flight of the production standard version took place in March 2004. A current production order is based on six systems, each comprising 10 air vehicles, two ground control stations, two launchers and associated support equipment. One system is being delivered every six months up until mid-2007.

Variants developed for potential German army service include the Mucke, fitted with an electronic countermeasures payload, and the Fledermaus, carrying electronic support measures, but development has been suspended due to difficulties with the EW payload capabilities. The baseline KZO is on offer to Norway for its army tactical UAV requirement and was flight tested on Norwegian ranges in late 2003/early 2004.

Prospector

Modified version of the KZO, with a heavy fuel engine, is currently on offer by Teledyne Brown Engineering for the US Army Future Combat System Class III. The bid plan was announced in November 2004. The system was shortlisted for the US Army Future Combat System Class III tactical UAV requirement by Boeing and SAIC in July 2005 as one of three designs to receive 10-month risk-reduction studies pending the final downselect of one system to evaluate against the DARPA candidate for acquisition phase system selection. FCS Class III downselect is imminent as at August 2006.

TARES

Attack version of the KZO guided by an advanced millimetric wave radar seeker head developed by EADS. The airframe details are the same as for the KZO. Full-scale development began in 1997, but the programme slowed due to the re-evaluation of the technical requirement after the collapse of the former Soviet Union.

The development programme was suspended by mutual agreement between the German defence procurement agency BWB in August 2003 to enable additional technical development activities to take place, based on slaving a pencil beam infrared imaging system to the millimetric seeker and modifications to the datalink to allow real-time operator involvement in terminal mission phases.

The programme was originally known as Taifun, but was renamed Tares in 2005 to reflect a changed operational concept. The technical development programme and trials for a revised seeker head are continuing until late 2006. German army user trials are planned for 2007 and depending on the outcome, production is planned to begin in 2008 for an initial operational capability in 2009.

The vehicle was offered for the UK Ministry of Defence loitering munitions demonstration requirement in September 2005 in a teaming arrangement with Thales UK, but failed to be shortlisted. It is on offer for the US Army FCS Class III requirement by Teledyne Brown Engineering under the designation of Thunder.

SAAB AEROSYSTEMS

Saab, Aerosystems, SE-581 88 Linkoping, Sweden. Tel: +46 13 18 00 00; www.saabaer-osystems.com

FILUR

The Flying Innovative Low-observable Unmanned Research (FILUR) air vehicle is a reduced scale demonstrator to support development of next-generation Swedish manned and unmanned combat air vehicles.

Funding of $6.2 million was awarded in September 2003 to facilitate development. Initial development work was launched in 2001 with feasibility studies completed early 2003. One flying wing demonstrator has been built to date, with initial demonstrator radar cross section testing completed in February 2005.

The first flight was carried out at Sweden's Vidsel test range on 10 October 2005, with a sortie lasting for 10min and with a demonstrator-carrying vertical tail. A second flight campaign is in preparation with this to explore how low-observable air vehicles can operate against a networked surveillance environment, and how such an environment can defend against new-generation strike platforms. Three follow-on flight campaigns are planned as development proceeds, with the tail to be removed in the more advanced stages of the programme.

SHARC

Development of the Swedish Highly Advanced Research Configuration (SHARC) concept technology demonstrator for future Swedish unmanned combat air vehicle and high speed-low observable tactical UAVs was launched in 1998.

Funding has been provided via the Swedish National Aeronautics Research Programme. Low-speed windtunnel testing of the basic design began in March 1999 and the exisence of the programme was announced in September 2000. The vehicle was developed to commercial certification standards to assist development of a certification regime that would enable UAVs to operate in non-segregated airspace.

First flights of a 1/8th scale SHARC demonstrator took place in early 2002 in the USA, with the air vehicle remotely controlled. The vehicle was publicly revealed in July 2002. Three flight campaigns were conducted in total, with a second occurring in August 2004. This included the first fully autonomous flight, including take-off and landing. The final campaign took place in late 2004 and the air vehicle was then retired. Development work on autonomous navigation and flight control system was transferred to the Filur programme.

Tactical UAV

Proposed new-generation, multi-role tactical UAV. Development plans were unveiled at the Eurosatory exhibition in June 2004, with initial concepts suggesting a new platform development effort. A formal project office to oversee development was raised within Saab in early 2004. Saab officials confirmed at the 2006 Farnborough air show that discussions were taking place with a variety of existing UAV manufacturers about co-operation options that would allow air vehicle development to be fast tracked by evolving an existing system. The first demonstration flight of a new demonstrator is proposed for 2007.

The system is expected to form the basis of a Saab bid to replace the Swedish defence force's existing Sagem Ugglan (Sperwer) tactical UAV system from 2010.

V-150 Skeldar

Short-range VTOL UAV system unveiled at the Eurosatory exhibition in Paris in June 2006. it is based on the CybAero Apid 55 airframe with the addition of streamlined fairing to improve air handling, with new avionics derived from existing Saab autonomous systems development efforts and reuse of existing Saab UAV ground station designs.

The basic system would comprise two air vehicles and one ground control station. The forecast cost of a production system is €3 million per air vehicle. It is a candidate for an anticipated Swedish army VTOL UAV requirement in the medium term. Sensor suite development includes plans for SIGINT capability. This is expected to be explored from mid-2007. Civil market applications are being pursued in parallel to military sector.

Directory: unmanned air vehicles

SAIC

Science Applications International Corporation, 10260 Campus Point Drive, San Diego, California 92121, USA. Tel: +1 858 826 6000. www.saic.com

Vigilante

Tactical VTOL UAV initially developed as a candidate for the USN's VTUAV requirement (later won by Northrop Grumman). The airframe is based on the UltraSport 496 sports helicopter. An initial development contract award from the US Navy's Joint Programme Office for Unmanned Aerial Vehicles worth $4.8 million was announced in January 1998 to support demonstrations for VTUAV competition. Two versions are available – Model 496, an optionally piloted air vehicle, and the Model 502. It was used as a testbed for two live-fire demonstrations of a 2.75in folding fin rocket launch from a hovering UAV at the US Army Yuma Proving Ground in December 2004. Payload control for demonstrations is provided by operator aboard a Bell UH-1N helicopter flying in loose formation with the UAV.

SAGEM DEFENCE

Sagem Défense Sécurité Division, Le Ponant de Paris, 27 rue Leblanc, 75015 Paris, France Tel: + 33 1 40 70 63 63; fax: + 33 1 40 70 66 40. www.sagem-ds.com

Busard

Optionally piloted MALE demonstrator based on the Stemme S10 glider airframe. A prototype system is being developed in conjunction with the French research agency Onera under a French regional government-funded programme to explore potential civil UAV applications of MALE technology and airspace integration issues. At least one demonstrator has been built and was rolled out at the 2005 Paris air show. This incorporated a surveillance sensor suite derived from the Sagem Sperwer UAV and mounted in a large underwing pod. The vehicle would have an endurance of 20h in a UAV configuration.

Merlin

Close-range, hand-launched system unveiled at the Eurosatory exhibition in June 2004. It was developed as a candidate for a French army close- range competition (later won by EADS). It is a twin fuselage, twin wing airframe in forward and rear layout. The rear wing is semi-swept. A pusher propeller is located between the wings and fuselage with the engine on the forward wing.

Sperwer

Most successful European-developed tactical UAV in market penetration terms with six users. Its launch order came from the Netherlands army in November 1995 and it was ordered by Sweden in June 1997 under the designation Ugglan, by Denmark in February 1999, and by the French army in August 2001 as its interim tactical UAV system (SDTI) to replace the Crecerelle systems in service since 1995.

Initial trial flights of the SDTI system were conducted in December 2002 and continued through 2003. SDTI deliveries to the French army were completed in the second half of 2004 and it was declared fully operational in the first half of 2006 after initial problems with software.

It was ordered by Greece in October 2001. Sperwer long endurance (LE) and high velocity (HV) variants were unveiled mid-2001, with the LE version making its first flight in December 2001. The Netherlands awarded its air vehicles airworthiness certification in December 2002, enabling operation in non-segregated airspace. Studies of armed Sperwer variants were launched in early 2003 with weapon options including modified GIAT Bonus 155mm anti-armour artillery rounds and Javelin anti-tank missiles.

A Canadian Army order worth C$27.5 million was placed via Oerlikon-Contraves of Canada in September 2003 with four air vehicles, ground control systems and support infrastructure delivered directly to Canadian operational units in Afghanistan. A second Canadian order came in late 2003 for two additional air vehicles. A Greek order for two additional systems was announced June 2003. Canada negotiating the acquisition of Danish army ground control stations as at August 2006 as part of that nation's retirement of its systems.

Sperwer B

Evolved version of the Sperwer, originally designated Sperwer-LE, but now designated Sperwer B. The demonstrator made its first flight in February 2004, and a revised configuration was unveiled at the Eurosatory exhibition in Paris in June 2006. The airframe now incorporates a double delta wing and canards, with satellite communications antenna on the roof of the forward fuselage. An extensive flight testing campaign was conducted in Finland in June 2006 to qualify system on a Robonic pneumatic launcher, with further flights planned, again in Finland, in October 2006.

SCHIEBEL

Schiebel Elektronische Geraete GmbH, Margaretenstrasse112, Vienna, A-1050, Austria. Tel: +43 1 546 2611; fax: +43 1 545 2339; www.schiebel.net

Camcopter

Short-range purpose-built UAV helicopter. It was extensively trialled by the US Air Force in 1998 as an airfield perimeter surveillance system. It was tested by the US Army and German Federal Office of Defence Technology and Procurement (BWB) as an airborne mine detection platform. A maritime demonstration for the US Coast Guard was performed in 2000. It was ordered by the Egyptian navy to perform maritime surveillance roles, with deliveries completed in 2002.

S-100

Substantially upgraded version of Camcopter unveiled at IDEX 2005 and developed in a two-year co-operative programme funded by the UAE Armed Forces UAV Research and Technology Centre. A revised configuration supports highly a streamlined skin with dash speed of 100kt. The UAE version is known as Al Sber. First deliveries of demonstrator systems to the UAE Army were made in October 2005 for acceptance trials, with full-rate production of a 40-system, 80 air vehicle fleet expected to start in mid-2006 with composite aircraft skins and final assembly to occur in the UAE. A demonstration by the European NATO navy is planned for September 2006.

SINGAPORE TECHNOLOGIES AEROSPACE

Singapore Technologies Aerospace Ltd, 540 Airport Road, Paya Lebar – HQ, Singapore 539938. Tel: +65 6287 1111; fax: +65 6280 9713; www.staero.aero

Fantail 3000/5000

Mini-tail sitter UAV with centrally mounted lift-fan in short depth duct. It is an evolution of the Lutronix MAV-3AS/GF and XQ-138 Helispy systems. The initial variant was launched on to the market in early 2004, but suffered from noise and endurance problems. The larger, revised Fantail 5000 version was unveiled at the 2006 Asian Aerospace exhibition.

MAV -1

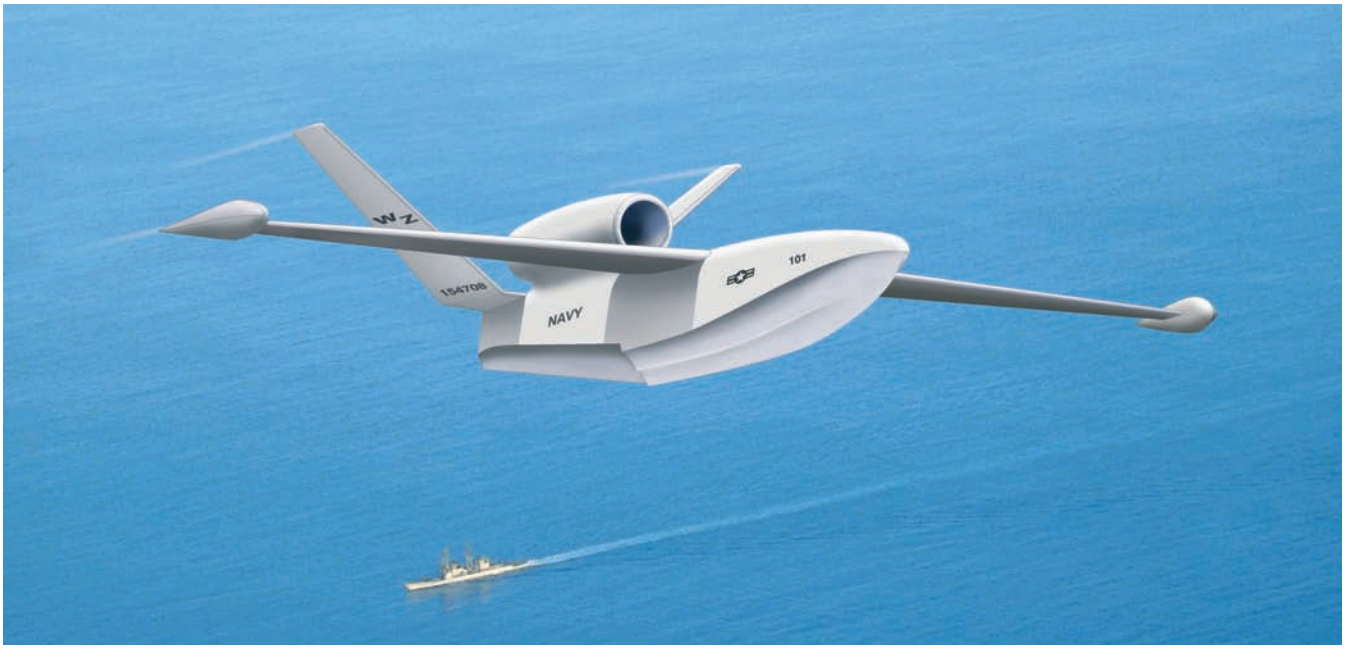
One-third scale low-observable, high-speed short-endurance surveillance UAV demonstrator. It was unveiled at the 2004 Asian Aerospace air show with development work under way for some two years. It is intended for use in exploring parameters of low-observable technologies in UAV design, with the potential to evolve into a small unmanned combat air vehicle acknowledged by the development team as a factor driving the programme. The first flight is expected during the second quarter of 2004, but development was suspended after a failure to secure international development partners.

Skyblade series

Close/short range system under development for the Singaporean army. Its existence was made public by the Singaporean ministry of defence in April 2004. The prototype Skyblade system was of conventional monoplane design with electric propulsion.

The Skyblade II hand-launched close-range system was unveiled in April 2005 and the Singaporean army ordered four systems. Initial deliveries began in January 2006. A variant included significant airframe redesign and is gasoline powered with a large underslung sensor pod.

The Skyblade III is an all-electric system and



Vought continues to develop its Kingfisher II concept

was unveiled at the Asian Aerospace air show in Singapore in February 2006. The shift in propulsion systems has allowed for extensive redesign of the fuselage, including removal of the large underslung sensor pod.

The Skyblade IV, also unveiled at Asian Aerospace 2006, is a significantly larger air vehicle in the short-range tactical class with a maximum take-off weight of 50kg, including a 12kg payload. The airframe is conceptually similar to the EMIT Aviation Sparrow UAV and like that system, uses catapult launch and a combined parachute and airbag recovery system. Full air vehicle development is planned to be completed by the end of 2006.

VOUGHT

Vought Aircraft Industries, 9314 West Jefferson Boulevard, Dallas, Texas 75211, USA. Tel: +1 972-946-2011; www.voughtaircraft.com

Kingfisher II

Seaplane configuration tactical UAV concept made public at the Unmanned Systems North America exhibition in August 2004 along with proposals for a conventional wheeled undercarriage version designated Desert Owl.

Initial discussions with Lockheed Martin about co-operative development took place in mid-2004. The Kingfisher II is currently being proposed by Vought in conjunction with Geneva Aerospace as a future technology candidate for the USN Littoral Combat Ship programme. Potential applications include surveillance and reconnaissance, sensor placement, special operations support, and deployment platform for autonomous underwater vehicles. A DARPA funding award of $497,000 in March 2005 was made to demonstrate autonomous water take-off and landings over a nine-month period using Geneva Aerospace Dakota UAV modified with pontoons as a surrogate.

YAMAHA

Yamaha Motor Company, Aeronautic Operations, 2500 Shingai, Iwata-shi, Shizuoka-ken, 438-8501, Japan. Tel: +81 538 32 1170; fax: +81 538 37 4259; www.yamaha-motor.co.jp

RMX Type II/Type II G

Third-generation agricultural UAVs in large-scale series production. The RMAX Type II G was introduced into the marketplace in March 2003 with the air vehicle incorporating GPS navigation and improved ground control station designed to reduce operator workload. Type IIG has a minor payload increase.

Japanese domestic farmers form the main market, but emphasis is increasing on the development of exports with the establishment of subsidiary operations in the USA and the launch of a marketing campaign in South-East Asia and Australia.

Some sales into academic research sector for use in other UAV development programmes have been made.

The RMAX Type II is used as testbed for autonomous navigation research by the University of Linkoping, Sweden, as part of the Saab SHARC UCAV development programme. Northrop Grumman had acquired at least one RMAX as a testbed for helicopter UAV concept research with that aircraft flying at least 60 missions up until November 2004 in support of the former US Army Unmanned Combat Armed Rotorcraft project.

The Georgia Institute of Technology announced in February 2005 that it had flown a modified RMAX fitted with an integrated autonomous navigation suite that included flight-control fault identification, adaptive control and agile manoeuvring capabilities. The Georgia Tech team includes Draper Laboratories, Honeywell and Boeing with funding from DARPA. Research into co-operative UAV and unmanned land and maritime systems was announced by Yamaha in June 2005 but no subsequent statements have been made.

FOR MORE DETAILED TECHNICAL DATA ON ALL OF THE UAVS IN THIS DIRECTORY, VISIT FLIGHTGLOBAL.COM/UAVDIRECTORY