

Directory: unmanned air vehicles

AAI

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CLAW

Close Lightweight Airborne Warrior. Developmental close range, fully autonomous tactical UAV intended for small team operation. System intended to fold rather than dismantle for transport, with packed down system measuring 1.2m. V-tail arrangement. Primary sensors are miniature day-night cameras. 50kt dash speed. Pneumatic launcher with laptop computer-based ground control system. First unveiled at AUVSI Unmanned Systems North America exhibition in August 2004.

RQ-7A/RQ-7B Shadow 200

In production for US Army as standard TUAV system with modified RQ-7B configuration the current system baseline. Will act as interim Class III (battalion level) UAV under the Future Combat Systems programme. Each Shadow system made up of four air vehicles, two ground control stations, launcher and associated support equipment. Shadow 200A air vehicle first flew in 1998. Selected by US Army as standard TUAV in 1999 with LRIP contract signed that December. Initial Operational Test and Evaluation approvals from US Army granted in June 2002. Initial full rate production contract worth \$86 million signed January 2003, with nine systems to be delivered over 20 months. First full-rate production system delivered September 2003. US Army announced December 2003 that it was extending full rate production contracts for Shadow 200 systems. Second full-rate production order for 11 systems worth \$71.9 million announced March 2004. 100th RQ-7A air vehicle produced in July 2004. Deliveries of RQ-7B (also known as Shadow Plus) commenced August 2004 with air vehicles fitted for – but not with – Tactical Common Data

CLASSIFICATIONS

UAV classifications contained in this directory are largely based on manufacturers' designations but also take into account a variety of international classification standardisations. Close-range UAVs are generally those that 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 categories are also often referred to by the designations small-UAVs and mini-UAVs, as distinct from micro-UAVs, which tend to have a wingspan of less than 0.5m.

Tactical UAVs are generally classified as having an average endurance of around 6-10h, but with 10-15h becoming common. 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 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.

Link terminal. Third full-rate production order for eight systems awarded January 2005 worth \$71.9 million. Order worth \$14.4 million for one additional system and three mobile maintenance facilities announced 14 February 2005. Total US Army system orders between 1999 and February 2005 stands at 42. First deliveries to operational users in October 2002. Operational in Iraq since January 2004 with a total of 22,000 flying hours achieved in theatre by 13 systems to March 2005. Total number of aircraft remaining in the US Army inventory at 1 February 2005 was 96. Conceptual work carried out by US Army on weaponisation but no known flight tests, however. Work underway in

ACRONYMS

ACTD – advanced concept technology demonstration **CAPECON** - Civil UAVs applications and economic effectivity of potential configurations **DARPA** – US Defense Advanced Research Projects Agency **DSTO** – Australian Defence Science and Technology Organisation **HALE** – high-altitude long-endurance **IR/EO** infra red/electro-optical **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 **SIGINT** – signals intelligence **SOCOM** – US Special Operations Command **TUAV** – tactical unmanned air vehicle **UAV** – unmanned air vehicle **UCAR** – unmanned combat armed rotorcraft **UCAV** – unmanned combat 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.

both US Army and AAI on alternative sensor payload configurations. On offer to Australia to meet an army tactical UAV requirement, with acquisition decision due during third quarter 2005. RQ-7B version adds larger wet wing, modified tail assembly, and Athena Technologies GS-211e flight control computer in onboard avionics suite. Heavy fuel engine options being explored.

Shadow 400

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

AAI

Aircraft	CLAWS	Shadow 200A	Shadow 200B	Shadow 400	Shadow 600
Category	Close range	Tactical	Tactical	Tactical	Tactical
Airframe	Conventional	Conventional	Conventional	Conventional	Conventional
Span	1.44m	3.9m	4.29m	5.1m	6.8m
Length		3.4m	3.4m	3.82m	4.8m
Powerplant	Electric	UAV Engines AR741 rotary	UAV Engines AR741 rotary (interim)	UAV Engines AR741 rotary	UAV Engines 801 rotary
MTOW	4kg	149kg		200kg	265kg
Payload weight		25kg		30kg	40kg
Cruise speed	35kts	85kts		75kts	75kts
Endurance	1hr	5-6h	>7h	5h	12-14h
Range		125km (radius)		185km (radius)	200km (radius)

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ADI		
Aircraft	Cybird 2	Firefly 600
Category	Short range	Mini armed
Airframe	Conventional	Flying wing
Span	2.5m	0.6m
Length	3.2m	
Powerplant	TJT-3000 Eagle	Combustion
MTOW	?	?
Payload weight	?	?
Cruise speed	<227kt	?
Endurance	90min	20min
Range	?	10km (radius)

Shadow 600
 Evolved version of Shadow 200/400 family, incorporating semi-swept outboard wet wing. Export sales of at least one system to Turkey and two systems to Romania. Initial Romanian deal worth \$20 million sale announced May 1997.

ADI
ADI Limited, Cowper Wharf Road, Garden Island, New South Wales 2011, Australia.
Tel: +61 2 9562 3333; Fax: +61 2 9562 2390;
www.adi-limited.com

CYBIRD-2
 Jet powered UAV developed as testbed for researching new forms of air vehicle navigation and sensor system localisation and tracking algorithms derived from the study of insect cognition and flight behaviours. Airframe developed under subcontract by Turbo Jet Technologies. First flew early 2003 and publicly unveiled October 2003. Potential development of high-speed, short-range tactical UAV, loitering missile and target drone variants being studied. Being further developed under the Australian Defence Science and Technology Organisation's Project Air 5434 Bioseeker advanced concept technology demonstration project with initial funding awarded first quarter 2005.

FIREFLY 600w
 Attack micro-UAV intended for use as a precision engagement system against targets in complex environments. Developmental system first unveiled by ADI at the Australian Army's annual Land Warfare Conference in September 2004. High aspect-ratio delta-wing airframe made of Corflute, a plastic equivalent

of corrugated cardboard. Four air vehicles supplied to Australian Defence Science and Technology Organisation in early 2004 for tests. Unsuccessful bid to secure development funds under Australian Defence Concept Technology Demonstrator programme 2005 selections. Future development under review.

JANDU
 Jet-powered UAV under development as a high-speed platform to carry electronic intelligence gathering equipment. Larger than Cybird-2 and may have two engines. Proposed application is high-speed mapping of the electronic order of battle in threat areas. Payload capacity of 50Kg. Being further developed under the Australian Defence Science and Technology Organisation's Project Air 5436 JANDU advanced concept technology demonstration project with initial funding awarded first quarter 2005. No specification data released.

ADRO
ADRO UAV Systems, 1-4 Stephenson Road, Seaford, Victoria 3198, Australia.
Tel: +61 3 9775 0407; Fax: +61 3 9775 1546.
www.airbornedefence.com

Pelican Observer
 Developmental emergency services UAV. Single prototype made debut flight February 2005. Development programme intended to result in a highly stable air vehicle optimised for operations in severe micro-climates as created by wildfires. Larger 7.05m span version proposed for high-altitude operations. Short take-off and landing with parachute recovery option. L-3 Communications datalink in demonstration air vehicle. Extended operations up to 12h possible using twin drop tanks fitted to hard points on outboard wing.

ADVANCED CERAMICS RESEARCH
Advanced Ceramics Research, 3962 East Hemisphere Loop, Tuscon, Arizona, 85706, US of America. Tel: +1 520 573 6300; Fax: +1 520 573 2057; www.acrtucson.com

Manta
 Developmental convoy escort UAV developed

ADVANCED CERAMICS RESEARCH		
Aircraft	Manta	Silver Fox
Category	Short range	Short range
Airframe	Conventional	Conventional
Span	2.4m	2.4m
Length		1.47m
Powerplant	2.2ci Two stroke	91Ci Four stroke gasoline
MTOW	20.4kg	11.5kg
Payload weight	<6.8kg	5lb
Cruise speed	35-70kt	40-54kt
Endurance	<7h	<20h
Range	37km (datalink)	37km (datalink)

with the US Naval Research Laboratories based on operational lessons from US military operations in Iraq from 2003. Initial flights in early 2004. Prototype air vehicles first unveiled at AUVSI Unmanned Systems North America exhibition in August 2004.

Silver Fox
 Tactical UAV designed by USN Office of Naval Research (ONR) to support exploration of swarming UAV operations in the battlefield. Licensed production by Advanced Ceramics with air vehicles supplied to ONR deployed to Iraq in mid-2003 to assist in meeting surveillance requirements. First export sale worth \$649,000 to Canadian Defence Forces in April 2004 via Thales Systems Canada to support UAV experiments. Used by US Forest Service in October 2004 to monitor volcanic eruption of Mt St Helens in Washington, USA. Ground control system designed to simultaneously handle up to 10 air vehicles.

AERONAUTICAL DEVELOPMENT
Aeronautical Development Establishment, Defence Research and Development Organisation, Indian Ministry of Defence. New Thippasandra, Bangalore 560 075, India.
Tel: +91 80 2528 3188; Fax: +91 80 2505 7007.
www.drdo.org/labs/aero/ade

Nishant / Gagan
 Multimission tactical UAV with extended development history. Initial government funding in October 1991. First prototype flew in August 1996. Five additional prototypes built and tested up until 2002. Initial Indian army production order for 12 aircraft and ground systems placed mid-November 2004. Deal based on initial production and delivery four aircraft by the end of 2006, with payments to be released for remaining eight aircraft. Air vehicle unit cost is approximately \$3.5 million. Catapult launched with combined airbag and parachute recovery system
 Gagan is a proposed \$55.5 million development programme with Israel Aircraft Industries for an advanced version of Nishant capable

AERONAUTICS DEFENSE SYSTEMS					
Aircraft	Aerolight	Aerosky	Aerostar	Dominator	Orbiter
Category	Close range	Short range	Medium tactical	MALE	Short range
Airframe	Conventional	Conventional	Conventional	Flying wing	Flying wing
Span	4m	4.5m	6.5m	8m	2.2m
Length	2.56m	3.05m	4.4m	8m	1m
Powerplant	Combustion	Combustion	Combustion	160hp Lycoming	Electric
MTOW	40kg	70kg	200kg	800kg	6.5kg
Payload weight	8kg	18kg	50kg	400kg	1.2kg
Cruise speed				90-150kts	<75kts
Endurance	5h	5h	14h	>30h	90min
Range	150-200km	150-200km	150-200km		15km (datalink)

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ADRO	
Aircraft	Pelican Observer
Category	Short range
Airframe	Conventional
Span	5m
Length	2.3m
Powerplant	3W 17hp
MTOW	70kg
Payload weight	30kg
Cruise speed	95kt
Endurance	4h
Range	?

of carrying synthetic aperture radar as well as IR/EO optical sensors. Programme announced February 2005 with Indian Government funding approval scheduled for May, although as of 1 June no announcements had been made. Four prototype air vehicles proposed to be developed over a 42 month period.

Pawan

Proposed \$33.2 million development programme with Israel Aircraft Industries for a short-range, vehicle-launched tactical UAV announced in February 2005. Indian government funding approvals scheduled for April 2005 although as of 1 June no announcements had been made. Project expected to take 24 months and see assembly of four prototypes. Air vehicle projected to weigh 120kg, with an endurance of 24h and a 150km radius of operations.

Rustam

Proposed \$100 million development programme with Israel Aircraft Industries for a MALE UAV announced February 2005. Project start targeted for June, based on a 48-month development schedule leading to assembly of four prototypes. UAV would have an endurance of 24h, a 300km radius of operations, and weigh 1,100kg. Proposed payloads would include maritime surveillance radar, electronic warfare, and IR/EO sensors.

AERONAUTICS DEFENSE SYSTEMS

Aeronautics Defense Systems Ltd, 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 acquired by USN PMA-273 UAV

AEROSONDE	
Aircraft	Aerosonde Mk4.1
Category	LALE
Airframe	Conventional
Span	2.9m
Length	2.1m
Powerplant	EFI 24cc engine
MTOW	14kg
Payload weight	6kg
Cruise speed	40kt
Endurance	36h
Range	>4,000km

programmes office.

Aerosky

Twin tail-boom pusher-propeller configuration UAV. Used as baseline air vehicle for Aeronautics business model based on offering UAV services rather than for selling air vehicles. ADS was contracted in March 2002 by Israeli Defence Forces to provide "surveillance by the hour" service. Marketed internationally via a seven-year agreement with IAI signed in 2001. Foreign customers include USN PMA-263 UAV programmes office.

Aerostar

Based on Aerosky airframe, but with more capa-

ble engine and significantly increased payload capacity. Small number of aircraft and ground systems (along with Aerosky and Aerolight aircraft) acquired by USN PMA-273 office via June 2001 solicitation, with systems located at NAS Patuxent River, Maryland. Contract in 2003 from Israeli Defence Forces to provide routine security monitoring within Israeli borders. Two-year service contract announced May 2004 to provide security monitoring for Chevron Texaco-operated oilfields in Angola. Selected by Irkut in 2004 as UAV component of proposed emergency response system based on use of a UAV to cue firefighting missions by Beriev BE-200 seaplanes. Teaming arrangement with General Dynamics Ordnance and Tactical Systems announced September 2004 to pursue sales and service-based contracts in the USA and allied markets with Aerostars to be manufactured at GD's Moses Lake facility. Simultaneous announcement in September 2004 of six-month contract with options from Sentel Corp to provide UAV training support services to USN Air Warfare Center at NAS Fallon, Nevada.

Dominator

Multimission flying wing MALE UAV first



Aeronautics' Dominator is a multi-mission MALE UAV

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AEROVIRONMENT

Aircraft	Dragon Eye	Hawkeye	Helios	Pathfinder Plus	Pointer	Puma	Raven	Skytote
Category	Close range	ULAV	HALE+	HALE+	Close range	Close range	Close range	ULAV
Airframe	Conventional	Tandem wing	Flying wing	Flying wing	Conventional	Conventional	Conventional	Winged VTOL
Span	1.15m	84 in	75.28m	36.57m	2.7m	2.8m	1.37m	2.4m
Length	0.9m	46in	3.6m	3.6m	1.8m	1.8m	0.91m	
Powerplant	Electric	Glider	Electric/fuel cell	Electric	Electric	Electric	Electric	Wankel UEL AR801
MTOW	>2kg	76lbs	748.5kg	317.5kg	3.6kg	4.6kg	2.27kg	
Payload weight	225-450kg	22.6kg	>800kg	>11kg	0.9kg		0.18kg	23kg
Cruise speed	35kt	75kts	24kt	17kt	<45kts	30-50kt	25-50kt	
Endurance	50min		6 months	>14h	1.5h	4h	75min	
Range	10km (radius)	92km	Global		8km (radius)	10km (radius)	12km (radius)	

unveiled at Aero India exhibition in February 2005. Under development since at least 2003, originally under the designation Morpheus. Endurance is believed to be around 35-40h using underwing drop tanks and wet wing. Capable of simultaneous carriage of both SAR and IR/EO payloads. Large winglets. Integrated anti-icing system for high-altitude operations with ceiling of 25,000ft. Satellite datalink terminal in above nose mounting.

Orbiter

Short-range, electrically powered flying wing unveiled in early 2005. Aimed at homeland security, law enforcement and facilities protection markets.

AEROSONDE

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

Aerosonde Mk 1/2/3/1.4.1

Mk 3 standard production version superseding earlier Mk 1 and Mk 2 versions developed between 1995-2000. Some Mk 1 systems sold to Taiwan for meteorological monitoring. Mk 3 version incorporates engine fuel injection system. Mk 3.1 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. Major Mk 3 application remains scientific monitoring with standing contracts with NASA Goddard Space Flight Center, Wallops, until 2006. Some Mk 3 sales to Australian DSTO to support UAV battlefield experimentation with electronic warfare and EO/IR payloads with this ongoing.

Separate development programmes underway by Aerosonde and DSTO on larger fuselage to increase payload space. Radio relay role being explored under Australian DSTO-led Joint Project 2103 technology demonstration with initial funding award in 2004. Mk 2 "Aeroguard" configuration aircraft used operationally by Australian army in peacekeeping support role in Solomons Islands in 2004. Follow on Mk 3 sales during 2004 to Taiwan and new sale to Singapore for civil applications. New purpose-designed miniature gimballed camera mount developed for basic Aerosonde airframe by Tenix Defence Systems during 2003-4. Mk4.1 version unveiled February 2004 and forms new baseline standard for air vehicle production. Key changes include Cloud Cap Technology Piccolo guidance system, distributed onboard data network, new powertrain system facilitating 75W continuous electrical supply for payloads, increased payload weight and space, and increased endurance. Changes retrofitted in early 2005 into earlier versions owned by US Office of Naval Research and Alion Science and Technology. More than 100 air vehicles in all configurations built since 1995 with fleet recording more than 4000 flying hours at February 2005. Co-operation deal with Lockheed Martin Missile & Fire Control announced 28 April 2005 to pursue US homeland security market opportunities. Development of larger version with 15kg payload capacity being explored.

AEROVIRONMENT

Aerovirement Inc, 4685-3H Industrial Street, Simi Valley, California 93065. Tel: +1 805 581 2187; Fax: +1 805 581 4512;
www.aerovirement.com

Dragon Eye

Designed by the US Naval Research Laboratory and Marine Corps Warfighting Laboratory as air vehicle segment of the Navy Advanced Tactical Reconnaissance system. First prototype flew in May 2000. Competition launched in mid 2002 for the supply of up to 1,026 air vehicles for the USMC with this competed by BAI (*see separate*

entry) and Aerovirement. Aerovirement selected as preferred USMC supplier in November 2003 with a contract award worth up to \$40 million over five years to supply approximately 300 air vehicle systems, each comprising one ground station and three air vehicles. Total of 135 air vehicles in USMC inventory at 1 February 2005. Tested by USN as a potential force-protection asset for warships in port in 2002 using prototype air vehicles. Operationally deployed in Iraq in opening phases of the war using pre-production air vehicles supplied by Aerovirement and BAI for evaluation purposes prior to source selection. Some systems on loan to Australian Army units deployed in Iraq.

FQM-151A Pointer

First flew in 1986. Initial deliveries to USMC began in 1988. Follow on orders from US Army and USAF. Initial upgrades to baseline payload system implemented in 1990, followed by addition of GPS-based auto-navigation system and thermal-imaging camera in 1995. New generation thermal imager added in 2000, along with 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 completed by August 2002. System trialed by French Army with two systems delivered in 2001 with in-country support provided by CAC Systems (later acquired by EADS). Total production since 1986 exceeds 700 air vehicles. US Army inventory at 1 February 2005 was 555 aircraft. US SOCOM inventory on same date was 94 aircraft; USAF inventory was 32 aircraft.

Hawkeye

Unmanned logistics air vehicle under development since 2002 in conjunction with US Special Operations Command with project managed by US Naval Research Laboratories. Folding tandem wing arrangement with air vehicle designed to be launched off tail-ramp of large cargo aircraft. Prototype system first unveiled at AUVSI Unmanned Systems North America exhibition in August 2004. Larger version designated X-Glider features 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

ALCORE TECHNOLOGIES

Aircraft	Azimit	Biodrone	Futura
Category	Close range	Close range	Medium tactical
Airframe	Conventional	Conventional	Delta wing
Span	2.9m	3.4m	2m
Length	1.82m	1.8m	2m
Powerplant	Electric	Electric	Mini turboprop
MTOW	9kg	12kg	70kg
Payload weight	1.2-3.7kg	1.2-4.7kg	10-20kg
Cruise speed	30kt	40kt	185kt
Endurance	90-120min	100-130min	70min
Range	50km	50km	400km

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ALENIA			
Aircraft	Sky-x (May 03 configuration)	Sky-x (May 04 configuration)	Sky-X (May 05 configuration)
Category	UCAV	UCAV	UCAV
Airframe	Low observable	Low observable	Low observable
Span	5.74m	5.78m	5.74m
Length	6m	6.94m	6.84m
Powerplant	Turbojet	Turbojet	Microturbo TR 160-5/268
MTOW	1000kg	1100kg	1100kg
Payload weight	300kg	<200kg	200kg
Cruise speed	386kt	612kt	612kt
Endurance			
Range	100km (radius)		

for sonobuoys, but funding was discontinued in 2003.

Helios

Innovative high-altitude "eternal" flying wing aircraft developed for NASA and jointly powered by fuel cells and solar power. Originally constructed as the 61.8m-wingspan Centurion with solar-only propulsion system, flying for the first time in November 1998. Rebuilt as Helios with additional wingspan and engines. Achieved a world altitude record in August 2001 by remaining in stable flight for 40 minutes at above 96,000ft with power provided solely by 62,000 silicon solar cells embedded in the upper wing skin. Attempted first short flight on fuel cell power on 7 June 2003, but was not able to transition from solar power to fuel-cell system. Sole prototype crashed during follow-on check-out flight for fuel-cell powered operation on 26 June 2003. Interim accident report issued July 2003 indicated severe pitch oscillations in the wing structure at 3,000ft had caused partial break-up of airframe. Oscillation thesis confirmed in the final accident report released September 2004. Aeronvironment announced April 2005 that the Helios engine had been redeveloped into a 40kW ironless core electric engine under contract to Lockheed Martin in late 2004/early 2005 in support of US Missile Defense Agency High Altitude Airship programme.

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. Used to trial atmospheric monitoring of coffee crops in September and October 2002. Spanlifter airframe. Pathfinder-Plus also being used to support development testing of Aeronvironment's "Skytower" commercial communications server concept based on using stratospheric aircraft as atmospheric

satellites. Concept demonstrated in trials over Hawaii in July 2002. NASA contract award to Aeronvironment in late 2003 to refurbish Pathfinder-Plus for flight operation, with this completed in early October 2004. Limited flight series conducted during final quarter 2004 to explore impact of atmospheric turbulence on spanlifter airframes as part of re-launch of NASA HALE UAV research after the loss of Helios.

Puma

New-generation close range UAV proposed as a Pointer replacement with endurance of up to 3 hours. Under development.

RQ-11A Raven

Lightweight close-range UAV making extensive re-use of Pointer subsystems, including ground station. Designed to be transported by two people to reduce load on individual soldiers. First flew 2003. In service in Iraq with SOCOM units. US Army placed \$20.7 million initial order for 170 air vehicles in January 2004. Second order placed by US Army Robert Morris Acquisition Centre, Natick, Massachusetts in February for 59 air vehicles. Total USAF inventory at 1 February 2005 was 84 aircraft while SOCOM inventory was 225 aircraft. A \$7.9 million contract was announced on 10 February 2005 for reset work on 170 air vehicles with work to be completed October this year. Individual air vehicle costs approximately \$35,000 and a complete system, including ground control system and payloads, costs approximately \$250,000. On offer for the US Army small UAV competition launched February 2005.

Skytote

Tail-sitting, winged VTOL UAV being developed for US Air Force Research Laboratory using Small Business Innovation Research programme funding. Initial award made in 1998 worth \$100 million. Air vehicle uses counter-rotating propellers for take-off and transitions

into horizontal wing-borne flight. Transition weight loads shared between wings and 2.3m cruciform tailplane which acts as landing platform in vertical flight mode. Half scale demonstrator flew initial trials campaign in final quarter 2003. Air vehicle completed all basic test flights but then made a hard landing due to software error. Repairs to demonstrator carried out mid-2004 with flight testing initially expected to resume the fourth quarter of 2004. Current status unclear.

ALCORE TECHNOLOGIES

Alcore Technologies SA, Boîte Postale 7111, 95 054 Cergy Pontoise, Cedex, FRANCE. Tel: +33 (0)1 30 37 42 21; Fax: +33 (0)1 34 64 41 50; www.alcore-tech.com

Azimut

Hand-launched close-range military system. Being offered with Alcore's Maya micro-VTOL UAV for the looming French Army competition for a combined close-range/urban operations UAV system. Alcore is teamed with Thales for that requirement. Air vehicle has optional rail launcher subsystem. 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. Prototype flown.

Futura

Delta wing medium-range fast reconnaissance UAV. Rail launched. Attack configuration similar to Rheinmetall Taifun. Proposed but development status unclear. Target drone variants also studied.

Maya

Short-range mini VTOL UAV designed for use in urban and close range reconnaissance operations. Integrated NBC detection payload available. Standard payload is a single CCD camera. Current datalink uses analogue FM technology.

ALENIA

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

SKY-X

Unmanned combat air vehicle technology

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ATE			
Aircraft	Vulture	Intelligence Vulture	Multimission Vulture
Category	TUAV	TUAV	TUAV
Airframe	Conventional	Conventional	Conventional
Span	5.2m	5.2m	5.2m?
Length	3.1m	3.1m	3.1m
Powerplant	38hp fuel injected		Heavy fuel proposed
MTOW	100kg		
Payload weight	25kg	35kg	35kg
Cruise speed	65kt	65kt	65kt
Endurance	3-4hr	3-4hr	6-7hr
Range	<200km	200km	200km?

AURORA FLIGHT SCIENCE			
Aircraft	Excalibur	Golden Eye-50	Golden Eye-100
Category	Tactical	Close range	Short range
Airframe	Conventional	Shrouded fan VTOL	Shrouded fan VTOL
Span	6.4m	1.37m	3m (wings attached)
Length			1.7m (height)
Powerplant	Gas turbine	Electric	UAV Engines AR741
MTOW	1179kg	8.1kg	68kg
Payload weight	181kg	0.9kg	20kg (including fuel)
Cruise speed	460kt	100kt	<156kt
Endurance	3h	1hr	4h
Range			1,000km

demonstrator being developed under a \$32.1 million programme launched by Alenia in January 2003 following talks with Italian air force about future requirements. Basic design built around requirement to carry and deliver two 225kg J-series munitions from an internal weapons bay in first day of combat ground strike role. First mock-up of air vehicle unveiled May 2003. Project schedule announced June 2003 proposed initial flight testing campaign would run May-December 2004 followed by advanced testing from January 2005. Revised schedule and design concepts announced May 2004. Assembly of demonstrator commenced October 2004 based on further design revisions and using an existing certified weapons dispenser pod as the fuselage core. Guidance and control system flight tested using modified Aermacchi SF260 as UCAV surrogate in early 2005. First flight of demonstrator occurred late May 2005 at Vidsl military test range in Sweden. Air vehicle take off speed was 125kts and landing speed was 110kts. Further airframe development towards tailless configuration proposed, but implementation dependent upon flight trials outcomes and funding availability. Integration of sensor systems into fly-

ALLIED AEROSPACE	
Aircraft	iStar
Category	Close range
Airframe	Shrouded fan VTOL
Span	0.15-1.83m
Length	
Powerplant	Electric (0.15m version)
MTOW	~2kg (0.15m version)
Payload weight	
Cruise speed	<50kt (0.15m version)
Endurance	<1hr (0.15m version)
Range	<10km (0.15m version)

ing demonstrator will be complete mid-2005. In-flight opening of weapons bay door to be demonstrated in second quarter 2006. Integration of on-board processing systems to be completed late 2006, with automatic take-off and landing to be demonstrated by first quarter 2007. Integration of autonomous flight control systems with air traffic management systems to be completed by mid-2007, allowing air vehicle to operate in non-segregated airspace. Weapons delivery demonstration proposed for 2006-2010. Potential fit-out with new generation Finmeccanica synthetic aperture radar and hyperspectral imaging sensors being considered for inclusion in trials programme. Development effort contributing to Alenia involvement in the Dassault-led Neuron UCAV demonstrator programme (see separate entry).

ALLIED AEROSPACE
Allied Aerospace, 703 Middle Ground Boulevard, Newport News, Virginia 23606, USA.
Tel: +1 757 873 1344; Fax: +1 757 873 2183;
www.alliedaerospace.com

iStar
 Developmental shrouded-fan UAV programme launched in 1999 as a DARPA ACTD initiative supporting the US Army's Class II Organic Air Vehicle (OAV) requirement under the Future Combat Systems programme. Demonstrator successfully performed autonomous flight for the first time in March 2004. Ground control station developed by Northrop Grumman. Microelectro-mechanical systems (MEMS) technology based. Lightweight, integrated avionics system developed by Honeywell. Total avionics core system weighs 0.6kg and incorporates GPS, flight control processor and servo interfaces. Variant being offered by Honeywell (see separate entry) for FCS Class II competition.

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

Onyx
 Parasail-based precision logistics UAV system

ATAIR AEROSPACE	
Aircraft	Onyx
Category	ULAV
Airframe	Parasail
Span	19.8m
Length	
Powerplant	Combustion
MTOW	
Payload weight	998kg
Cruise speed	
Endurance	
Range	

with powered and unpowered variants under development. Initial development funding of \$850,000 provided by the US Army Soldier Systems Center in July 2003. Private investment also being provided by Festo. Unpowered versions 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 being considered for application to other UAV systems. Data is for baseline powered version. Larger version, with a 30m wingspan and capable of carrying 1,800kg flew in 2004. Concept for extended endurance powered version capable of 48h mission under development.

ATE
Advanced Technologies and Engineering Co (Pty) Ltd, PO Box 632, Halfway House, 1685, Republic of South Africa. Tel: +27 11 266 7600;
Fax: +27 11 314 2151; www.ate-aerospace.com

Vulture
 Developed in response to South African army requirement for artillery target location and spotting systems with initial contracts placed in 1994. First flight in 1995, but extended development and evaluation programme. Qualification trials at South African Gerotek test range completed mid-2004. Final integration of ground control system with South African army artillery command and control network in late 2004 and early 2005. Deliveries of more capable air vehicles to South African army from early 2005 to support operational qualification testing with this expected to complete second half 2005. Combined net and airbag recovery system. More efficient fuel injection engine planned to extend maximum endurance to 6h. Co-operation agreement with Tellumat signed May 2003 to develop new data link with this providing 200km radius of operations. Catapult launcher and combined net and airbag recovery system.

Intelligence Vulture
 Upgraded version to enter South African intelligence corps service in 2005-2008 under government plans announced 2003. May carry electronic intelligence payload.

Directory: unmanned air vehicles

BAI AEROSYSTEMS

Aircraft	Dragon Drone	Isis	Tern	Tern-P
Category	Close range	Medium tactical	Short range	Short range
Airframe	Delta wing	Conventional	Conventional	Conventional
Span	2.4m	7.3m	3.45m	4.26m
Length	1.5m	4.5m	2.71m	3.35m
Powerplant	Two stroke	38hp UAE Engines Rotary	100cc two stroke	150cc two stroke
MTOW	3kg	193kg	59kg	59kg
Payload weight ?		34kg	1.3kg (internal)	1.3kg (internal)
Cruise speed	50kt	70kt	45kt	45kt
Endurance	3h	12h	4h	4h
Range	80km	1,770km	320km	320km

Multi-Mission Vulture

Upgrade variant proposed to enter South African army service in 2007-11 to support broader spectrum surveillance and reconnaissance missions. Upgrade pathway based on concepts for Super Vulture as offered to United Arab Emirates between 1998-2002.

Ukhozi/Seagull

A Vulture derivative intended for use as in civil and military maritime surveillance operations. Concept unveiled in 2003 with development during 2004 / early 2005.

AURORA FLIGHT SCIENCES

Aurora Flight Sciences Corp, 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 strike platform for the US Army Aviation Applied Technology Directorate, with current funding totalling \$20 million. Design currently based on turbine powered traditional winged airframe with VTOL lift provided by electric thrusters. Sole-source contract awarded by US Army 31 March 2005 with initial funding release of \$5 million. Prototype scheduled to make first flight in 2007.

BAE SYSTEMS

Aircraft	Brumby Mk3	Brumby Mk4	Kingfisher Mk 2
Category	Short range	Short range	Tactical
Airframe	Canard wing	Conventional	Conventional
Span	2.82m	4.23m	4.13m
Length	2.19m	3.73m	4.2m
Powerplant	Desert Aircraft DA-150	Desert Aircraft DA-150	Motore-engine 3W-240 iB2hp
MTOW	45kg	60kg	115kg
Payload weight	9.2kg	10.7kg	29kg
Cruise speed	80kt	45kt	60kt
Endurance	50min	>1h	3h
Range			

Golden Eye 50

Shrouded fan short-range VTOL UAV for tactical application. Optional free-wing configuration. Development made public in 2003, with first free flight in July 2004. First autonomous transition from hover to forward flight and back to hover performed April 2005. At least 30 test flights conducted up until May 2005 using three air vehicles. Aircraft weighs 7.2kg with guidance and control architecture based on Athena Technologies GS-111M system.

Golden Eye-100

Shrouded fan VTOL UAV with optional free-wing. First flights in September 2003 included demonstration of autonomous flight control systems. Initial trials campaign ran September 2003 to April 2004.

Golden Eye OAV

Shrouded fan VTOL derivative of Golden Eye 50 and 100 UAV. 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. Downselection for Phase 2 OAV Class II system imminent. No performance data released.

Orion

Proposed variant of the EADS Euromale MALE UAV for potential US market requirements. See EADS entry for platform details.

BAE SYSTEMS

BAE Systems Platform Solutions Sector, 600 Main Street, Johnson City, New York 13790, USA. Tel: +1 607 770 2000; Fax: +1 607 770 3524. www.baesystems.com
BAE Systems Australia Pty Ltd, East Avenue, Edinburgh Parks, South Australia 5112, Australia. Tel: +61 8 8480 8888; fax: +61 8 8480 8800; www.baesystems.com

OAV

Developmental shrouded fan VTOL close range tactical UAV being developed by BAE Systems, with basic configuration unveiled at AUVSI Unmanned Systems North America in August 2004. Augmented ring wing design with duct reducing to four venturi on underside. Two side-mounted wings to provide additional lift. Derivative selected in December 2004 alongside rival proposals by Aurora Flight Sciences and Honeywell for the DARPA/US Army's Future Combat Systems 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 performed to April 2005. First untethered 7min flight announced 13 April 2005. Downselection for 24 month Phase II OAV Class II concept maturation programme imminent. No specification data released.

Brumby Mk 3/4

Designed and developed by BAE Systems Australia as a stable, large payload-capacity flying research platform. Used to support research into the use of real-time observation and measurement techniques, coupled with distributed data processing between UAVs, to achieve precision autonomous navigation and targeting. Initial Brumby Mk 1 and Mk 2 designs developed by the University of Sydney as a delta wing research programme. Mk 3 developed into canard wing configuration as a collaborative development with at least 5 air vehicles built. BAE Systems Australia original equipment manufacturer for Mk 4 (also known as Kingfisher Mk 1) with this replacing the delta wing with a conventional airframe employing twin tail-booms.

Kingfisher Mk 2

Extensively modified derivative of the Brumby Mk 4 airframe being developed to provide sig-

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Directory: unmanned air vehicles

BELL	
Aircraft	HV-911 Eagle Eye
Category	TUAV
Airframe	Tilt rotor
Span	7.37m
Length	5.57m
Powerplant	Pratt & Whitney PW200/55
MTOW	~1000kg
Payload weight	90kg
Cruise speed	200kt
Endurance	>6h
Range	1,500km

nificantly improved payload and endurance capabilities. Air vehicle incorporates new high-lift wing, larger box-form fuselage, and new engine. Avionics and ground control station remain common to Brumby series. Air vehicle to be used to support the Australian Defence Science and Technology Organisation's Project Air 5435 Future UAV for Reconnaissance and Interdiction (FURI) UCAV technologies advanced concept technology demonstration project with initial funding awarded in first quarter 2005.

BAI AEROSYSTEMS (L3 COMMUNICATIONS)

BAI Aerosystems Inc, 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 US Marine Corps and army, with extensive operational use. 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 series production. Dragon Drone selected by Bahrain, with deliveries taking place in late 1999. Evaluated under loan by Australian Army in 1999-2000, including deployment to East Timor. Marineised version designated Condor trialed by US Coast Guard in 2000. To be replaced in USMC service from 2005 with the US Naval Research Laboratory-developed Dragon Warrior.

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 Operations Command. Some 20 air vehicles built and used operationally in Afghanistan. Snake Eye is Dragon Eye modified for use by USN 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 in October 2004 with development continuing.

Isis

Medium tactical UAV in ongoing development. First unveiled at AUVSI Unmanned Systems exhibition August 2003. Intended to be able to take off and land from semi-prepared strips. Common avionics with Tern. Baseline system uses petrol 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. Combustion engine powered with 2h endurance. System being offered for both sale and short-term lease.

Tern

In service with US Special Operations Command and used operationally in Afghanistan in 2002 and Iraq in 2003. 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. Selected by US Army in December 03 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 tailhook 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 test-beds.

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.

BELL HELICOPTER

Bell Helicopter Textron, Inc. PO Box 482, Fort Worth, Texas 76101, USA. Tel: +1 817 280 2011; Fax: +1 817 280 2321; www.bellhelicopter.com

Eagle Eye

Tilt-rotor high-speed tactical UAV. TR-911X, a

BLUE BIRD AERO SYSTEMS

Aircraft	Blueye	Boomerang	Spy-Eye
Category	Medium tactical	Close range	Short range
Airframe	Parafoil	Flying wing	Parafoil
Span	4-5m (parafoil)	2.4m	2.5-4m (parafoil)
Length	1.75m (fuselage)	1m?	1m
Powerplant	Combustion	Electric	Combustion
MTOW	55kg	5kg	25kg
Payload weight	15kg	0.5kg	5kg
Cruise speed	15-40kt	30-55kt	15-40kt
Endurance	8h	2h	3h
Range	50km (radius)	10km	30km

seven-eighths scale technology demonstrator, first flew in March 1998. Evaluated by USN for VTUAV requirement but not selected. Selected in February 2003 as preferred tactical UAV for the US Coast Guard's Deepwater programme. Construction of full scale HV-911 production prototype announced November 2003, with this planned to be flying by 1 November 2004. However schedule revised to support first flight in late 2005/early 2006. Preliminary design review for Deepwater variant passed first quarter 2004.

Deliveries to US Coast Guard due to start 2006, with total order expected to exceed \$1 billion over programme. Armaments options being studied. Being offered to France and Germany to meet looming ship-launched VTUAV requirements. Initial three-way teaming arrangement with Sagem of France and Rheinmetall of Germany signed June 2004 to pursue European requirements, with this formalised December 2004. Bell supplying modified air vehicles, Sagem and RDE providing ground and shipborne control stations, datalinks, payloads and command and control system integration.

Sagem proposed bid leader for emerging joint French Army-Navy VTUAV requirement. Teaming arrangement signed with Lockheed Martin and AAI in July 2004 to pursue additional US military and homeland security requirements. US Marine Corps budget allocation for Eagle Eye purchase incorporated into USN budget plan for Fiscal Year 2006, released February 2005.

BLUE BIRD AERO SYSTEMS

Blue Bird Aero Systems Ltd, 30 Hazait Street, Tel-Mond 40600, Israel. Tel: +972 5 8509 580; Fax: +972 9 8999 335; www.bluebird-uav.com

Blueye

New-generation medium tactical reconnaissance UAV designed for land and maritime launched operations. Avionics suite incorporates MicroPilot navigation and guidance systems. Development partners include BES Systems, BKD Systems and Trudler.

Boomerang

Hand-launched mini-surveillance system. Prototype systems built, with development continuing.

Directory: unmanned air vehicles

BOEING					
Aircraft	A160	Unmanned Little Bird	X-45A	X-45C	X-50A Dragonfly
Category	MALE	Medium tactical	UCAV	UCAV	Medium tactical
Airframe	Helicopter	Helicopter	Flying wing	Flying wing	Canard rotor wing
Span	>10.2m (rotor)	8.33m (rotor)	10.3m	14.94m	3.66m
Length	11.3m	8.97m	8m	11.89m	5.39m
Powerplant	Supercharged combustion	Rolls-Royce 250-C30R	Honeywell F124-100	General Electric F404-102D	Williams International F112
MTOW	2,270kg	1,610kg	5,530kg	16,500kg	645kg
Payload weight	130-180kg	360kg (internal)	~700kg	2041kg (ordnance)	90kg
Cruise speed	140kt		550kt	550kt	<160kt
Endurance	30-40h	8-10h	3h		
Range	>4,500km		2,400km	2,222km (radius)	

Spy-Eye

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

BOEING

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 commenced by Frontier Systems with that firm acquired by Boeing in May 2004. DARPA funding runs until September 2007. US Army considering air vehicle as a long-term Class IV UAV under its Future Combat Systems architecture with potential applications including gunship, psychological operations, reconnaissance and surveillance, logistics, and special forces insertion and recovery. Long endurance based on use of rigid rotor. First of two prototypes flew January 2002 with initial version using three-blade rotor. First flight with a four-blade rotor and Subaru four-cylinder engine in November 2002. DARPA contract worth up to \$75 million for delivery of four more aircraft announced October 2003. Total Frontier Systems production comprised three aircraft, including first two prototypes. Air vehicle 1 auto-rotated into the ground in an incident caused by software errors and bearing failure. Air vehicle 3 crashed after tail rotor failure. Flight testing resumed by Boeing in September 2004 using air vehicle 2. Four larger aircraft, incorporating new six-cylinder engines, improved airframes and subsystems being built by Boeing with first flights due to take place third quarter 2005. New aircraft will support Phase 1 demonstration continuation through until 2007. Sonex Research contracted by DARPA in October 2002 to develop diesel engine. Alternate turbocharged diesel engine development work being carried out by Boeing

and FEV Engine Technology. US Army contract worth \$10.3 million to Syracuse Research in May 2004 to develop and supply purpose-developed A160 UHF foliage penetration radar payload.

MD530F Unmanned Little Bird

Unmanned version of US Special Operations Command MD Helicopters MD530F/AH-6 Little Bird helicopter, with one demonstrator flying. Manned MD530F acquired from MD Helicopters in March 2004 and delivered one month later. Project made public at AUVSI Unmanned Systems North America exhibition in August 2004. Control system derived from unmanned mission control and autonomous flight systems developed for Boeing A160 helicopter and X-45A UCAV demonstrators. Aircraft first flew in unmanned configuration 8 September 2004. Forty flight hours logged by October 2004 and a total of 100 flying hours by January 2005. Contract worth \$1.6 million from US Army Aviation Applied Technology Directorate in February 2005 to explore rotary-wing UAV weapons deployment using Lockheed Martin Hellfire missiles and the GAU-19A gun system. Flight trials and systems development continuing.

X-45A/B

UCAV prototype. Initial X-45 variant (X-45A) developed under USAF/DARPA UCAV ACTD programme award in 1999 with first flight of Block 1 air vehicle in May 2002. Block 1 trials programme completed March 2003 with 48 separate simulation, laboratory and actual flights performed to validate initial systems capability and performance. Two X-45A air vehicles flying by November 2003 with addition of Block 2 software. Final testing of Block 2 air vehicle and mission software completed March 2004. Block 2 equipped air vehicle used to demonstrate first-ever air-to-ground mission by a purpose-developed UCAV in March 2004 with dropping of a 250kg inert smart small bomb from an internal weapons bay onto a

static target from 35,000ft. 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 in May 2004.

Testing of Block 4 software commenced April 2005, with first flight of modified X-45A 13 May. Twin X-45A ground taxing trials controlled by a single operator conducted June 2004 as a prelude to airborne twin-ship trials. First two air-vehicle co-ordinated flight demonstration by a single pilot-operator 1 August 2004 at NASA Dryden Flight Research Center at Edwards Air Force base. Block 3 software testing commenced August 2004 with ground and taxi tests with single-ship first flight 21 October 2004. First airborne test of automated dynamic mission replanning function – allowing air vehicle to respond to pop-up targets – conducted 28 October 2004. First two-ship flights with Block 3 software conducted 12 November and 3 December 2004. First demonstration of remote satellite control of X-45 occurred 9 December 2004 with air vehicles launched from NASA Dryden then handed over to pilot-operator located in Seattle, Washington.

X-45A achieved 50th sortie on 4 February 2005. Ground trials of Block 4 software in April and early May 2005. First flight with Block 4 software achieved 13 May 2005. Development continuing to support X-45C and J-UCAS development programmes. X-45B was proposed initial operational variant but cancelled in February 2003 with the launch of the combined USAF/USN Joint Unmanned Combat Air System (J-UCAS) programme.

X-45C/D

X-47C concept unveiled April 2003 as Boeing candidate for US Joint Unmanned Combat Air System (J-UCAS) capability demonstration programme. X-45D proposed by Boeing in early 2004 as candidate for USAF interim bomber requirement. Initial assembly of first of three X-45C aircraft commenced June 2004 at Boeing risk with lead aircraft to complete in 2006.

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Directory: unmanned air vehicles

BOEING - INSITU

Aircraft	ScanEagle A15
Category	LALE
Airframe	Flying wing
Span	3.1m
Length	1.2m
Powerplant	Motore-engine 3W series
MTOW	18kg
Payload weight	6kg (including fuel)
Cruise speed	49kts
Endurance	15h
Range	100km (datalink)

\$766 million contract award from DARPA announced 12 October 2004 to build three full-scale X-47C demonstrators and integrate into the J-UCAS common operating system being separately developed under the leadership of John Hopkins University Physics Laboratory. First engines delivered by General Electric 10 November 2004. System requirements review with DARPA completed May 2005. X-45C flight testing to commence early 2007, followed by operational assessment by USAF, USN and DARPA. DARPA funding ends in 2010.

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 transition of wing from rotary mode to fixed mode during flight. Wing load is transferred to forward canard and tailplane surfaces during transition to prevent stall. Propulsion system directs thrust to exhaust nozzle for forward flight and diverts thrust to wingtip nozzles for rotary flight. Joint development programme between Boeing Phantom Works and DARPA, with initial funding agreed June 1998. Prototype first flew 4 December 2003, but crashed in March 2004 on second flight. A second demonstrator commenced preparation for testing in the third quarter 2004, with ground testing given initial precedence, including wind-tunnel testing to assist in identification of causes of the lead demonstrator loss. Those tests revealed a problem with cross-coupling phenomenon in wind conditions and resulted in re-development work on flight control software. Second prototype transferred to US Army Yuma Proving Grounds in early 2005.

BOEING INTEGRATED DEFENSE SYSTEMS

CODARRA

Aircraft	Avatar P-1
Category	Close range
Airframe	Conventional
Span	2.51m
Length	1.3m
Powerplant	Electric
MTOW	3.5-5kg
Payload weight	<2kg
Cruise speed	
Endurance	1hr
Range	10km (datalink)

- INSITU

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

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

Scan Eagle A15

Low-altitude long-endurance UAV, developed from the baseline Insitu Sea Eagle UAV (*see separate entry*). Initial 15-month joint development programme with Boeing announced February 2002. First wholly autonomous Scan Eagle flight in June 2002. That month the UAV was selected by the USN to support trials of co-ordinated operations between UAVs and unmanned underwater vehicles, held in February 2003 as part of the Giant Shadow experimentation programme in the Bahamas. First long-distance autonomous flight conducted in September 2003. Used as a test-bed to demonstrate Boeing Phantom Works open control system software in February 2004. Demonstrated 20h endurance in May 2004. Supported US Joint Forces Command exercise Long Look in June 2004, which included exploration of increased interoperability and improved sensor data fusion between multiple air vehicles. Contract award by the USMC in July 2004 to supply two systems, comprising multiple air vehicles and ground control and support infrastructure for use in Iraq from August 2004. Those systems had achieved 1,000 operational flying hours by November 2004 and 3,000h by May 2005 with the loss of one air vehicle to hostile action. Contracted in November 2004 to support UK Ministry of Defence's Joint Unmanned Experimentation Programme (JUEP) with flight operations in first quarter 2005. USN contract worth \$14.5 million awarded in April 2005 to provide security surveillance services for oil rigs in the Persian Gulf. New software-based autonomy augmentation system demonstrated March 2005, allowing UAV to map its own flight path to an assigned area of operations and locate and track targets in that area without user input. The existing guidance system is based on pre-defined waypoint navigation. Scan Eagle B under development will have endurance of 48h. Heavy fuel engine with increased payload capacity and 24h endurance under development under the designation Scan Eagle II. Proposed Scan Eagle XL version would have 22.5kg pound payload capability and 24h endurance. Scan Eagle XS variant proposed as a canister launched "daughter" UAV with an endurance of 12h.

CATIC

China National Aero Technology Import and Export Corporation, 18 Beichen Road East, Beijing, China 100101. Tel: +86 10 6494 0353;

Fax: +86 10 6494 1024; www.catic.com.cn

ASN-15

Hand-launched close-range system, similar in concept to Aerovironment Pointer, but vehicle transported. In People's Liberation Army service. System offered for export sale comprises 3 air vehicles, remote-control-based control and navigation system, video cassette recording system. Payloads comprise CCD camera and real-time video datalink or film camera. Rail launcher available, along with parachute recovery option.

ASN 105B

Medium tactical UAV capable of multiple payload carriage. ASN-105B is the standard export model. A and B models in operational service with the People's Liberation Army with ASN-105A also sold to Pakistan in late 1990s. ASN-105B may have undergone some fuselage redesign and engine changes over past two years, with models on display at Asian Aerospace 2004 featuring a squarer fuselage, increased wing chord, and modified exhaust arrangements.

ASN206-207

Medium tactical UAV in Peoples Liberation Army service. ASN-206 exported to Pakistan and offered to Turkey in 1999. ASN-207 is upgraded version. However, CATIC officials at the 2003 Korean Airshow in Busan, South Korea advised that upgrade work on the ASN-206 was continuing with this including integration of an ESM capability to assist with air vehicle self-protection.

Wu Zhen (WZ) -5 / Chang Hong (CH) -1

High subsonic reconnaissance UAV based on early series Northrop Grumman Firebee system. Upgraded versions continue to be developed and fielded by People's Liberation Army Air Force. Export versions designated CH.

CODARRA

Codarra Advanced Systems Pty Ltd, Dunlop Court, Fernhill Park, Bruce ACT 2617, Australia. Tel: +61 2 6264 0100; Fax: +61 2 6264 0199; www.codarra.com.au

Avatar

Hand-launched, manportable close-range reconnaissance and surveillance system. Initial CX-1 versions based on model aeroplane. Limited numbers of prototype CX-1 version sold to Australian Army Special Air Service regiment and used operationally in East Timor during UN operations in 2000-2001. Follow on Avatar sales to same customer in 2001 with further contract worth A\$343,001 (\$262,500) signed 24 May 2002. Digital image capture and compression system derived from sniper rifle real-time command targeting system fielded by Australian SAS as part of Sydney Olympics security mission in 2000. Standard production

Directory: unmanned air vehicles

Avatar uses purpose-built airframe. Used as platform to support demonstrations of "Jack" autonomous guidance software, developed by Agent Oriented Software, at Australian Army Graytown experimental weapons range in early July 2004. Multiple air-vehicle flight operations planned across the course of 2005. Air vehicle development continuing, with this including expansion of air vehicle endurance to 90mins. Alternate payloads being explored include lightweight thermal imager, laser designator and radio relay. Candidate for Australian Army special forces mini-UAV acquisition project to be launched during second half of 2005.

COMPOSITES TECHNOLOGY RESEARCH MALAYSIA - EXCELNET

Composites Technology Research Malaysia Sdn Bhd, No T-02 Third Floor, 2310 Century Square, Jalan Usahawan, 63000 Cyberjaya, Selangor Darul Ehsan, Malaysia. Tel: +60 3 8313 5100; Fax: +60 3 8313 5111; www.ctrm.com.my

Eagle

Optionally piloted version of the Eagle 150B light sport aircraft with avionics and control systems sourced from BAE Systems North America. Development programme launched in late 2001. A \$8.5 million production contract for at least three air vehicles signed with Malaysian government in June 2001. Prototype delivery to Malaysia Ministry of Defence in April 2002 for operational test and evaluation. Remaining deliveries in third quarter 2002. No other customers.

CYBER DEFENSE SYSTEMS

Cyber Defense Systems Inc, 10901 Roosevelt Blvd. Suite 100D, St. Petersburg FL. 33716, USA. Tel: +1 703-753-3429; www.cyberdefense systems.com

CyberScout

Developmental canard-wing airframe with

COMPOSITES TECHNOLOGY RESEARCH

Aircraft	Eagle ARV
Category	Optionally piloted medium tactical
Airframe	Canard wing
Span	7.1m
Length	6.4m
Powerplant	Combustion
MTOW	648kg
Payload weight	60kg
Cruise speed	130kt
Endurance	10hr
Range	200km (datalink)

three ducted fan propulsors. One propulsor is located in the forward fuselage at canard-wing root, the others are located at rear of fuselage on gimbals to enable rotation through at least 90°. Rear engines face downwards for vertical take-off and landing, but revert to horizontal position for forward flight. Construction of first prototype began in late 2004. First transition flight from hover to horizontal flight announced 13 May 2005. Work underway on modifying design to accept turbine power plant to replace existing gasoline-fuelled engine. Armed version proposed by manufacturer.

Modified flight-configuration variant designated Moyen Duc revealed at Paris air show June 2003, with this supporting the combined Dassault-Sagem Slow-Fast tactical UAV development programme (*see separate entry*). Proposed "Grand Duc" variant superseded by launch of Neuron European UCAV technology demonstrator programme in 2004 (*see separate entry*)

DARA AVIATION

Dara Aviation, 19501 144th avenue. NE Suite C-600, Woodinville, Washington State 98072, USA. Tel: +1 425 415 6052; Fax: +1 425 984 1751; www.daraaviation.com

D1

Under development as a small long-range, low-to-medium-altitude reconnaissance UAV, using a joined wing to provide increased payload lift capability. Can use either rail or vehicle roof-mounted catapult launcher. Several variants using same basic airframe with lead air vehicle making debut sortie August 2000. Joint trial with University Wing of Vancouver, British Columbia in June 2003 of D-1D version equipped with magnetometer for mapping role. Funded trials of D-1A version in atmospheric monitoring role by Scripps Institute of Oceanography, San Diego, in June-November 2003. More capable Dr and D3 variants under development but no details released as at 1 June 2005.

DASSAULT AVIATION

Dassault Aviation, 78 quai Marcel Dassault, Cedex 300 92 552 Saint-Cloud Cedex, France. Tel : +33 1 4711 4400 ; Fax : +33 1 4711 5660 ; www.dassault-aviation.fr

AVE

UCAV and low-observable TUAV technology demonstrator. First flew July 2000. Demonstrator revealed in October 2000.

CATIC	ASN-15	ASN-105B	ASN-206	WZ-5
Aircraft	ASN-15	ASN-105B	ASN-206	WZ-5
Category	Short range	TUAV	TUAV	Medium tactical
Airframe	Conventional	Conventional	Conventional	Conventional
Span	1.8m	3.75m	3.8m	8.97m
Length	3m	5m	6m	9.76m
Powerplant	Combustion	Combustion	Combustion	Turbojet
MTOW	6.5kg	170kg	222kg	1,700kg
Payload weight		40kg	50kg	65kg
Cruise speed	<50kt	<110kt	<115kt	430kt
Endurance	1hr	7h	8h	0.5hr
Range	10km	150km	150km	

Modified flight-configuration variant designated Moyen Duc revealed at Paris air show June 2003, with this supporting the combined Dassault-Sagem Slow-Fast tactical UAV development programme (*see separate entry*). Proposed "Grand Duc" variant superseded by launch of Neuron European UCAV technology demonstrator programme in 2004 (*see separate entry*)

HALE

Concept for joined-wing high-altitude endurance UAV to meet proposed future French and other European air force requirements. Design initially unveiled at Paris air show in June 2003 as a potential MALE UAV development programme however Dassault has set aside plans for its own MALE system following its joining the Euromale initiative in mid 2004.

Maritime Surveillance UAV

Concept for a fixed-wing, high-end tactical UAV for operation from French Navy aircraft carriers developed under a French Armaments Directorate funded study awarded to Dassault in late 2003. Design based on the SC2A Ameur Aviation Altania light-turboprop airframe. Projected endurance of 12h at a range of 60nm (110km), with an all-up weight of 450-500kg. Design partners on the project include Thales and Elbit Systems. Initial study funding ended

CYBER DEFENSE SYSTEMS

Aircraft	CyberScout
Category	Small VTOL
Airframe	Canard wing
Span	1.5m
Length	1.5m
Powerplant	Miniature gas turbine
MTOW	5.4kg
Payload weight	0.45kg
Cruise speed	87kt
Endurance	45min
Range	

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DARA AVIATION	
Aircraft	D1
Category	LALE
Airframe	Joined wing
Span	3.2m
Length	1.7m
Powerplant	Combustion
MTOW	25kg
Payload weight	4kg
Cruise speed	60kt
Endurance	18.5h
Range	2,056km

DASSAULT		
Aircraft	AVE	Neuron
Category	UCAV demonstrator	UCAV demonstrator
Airframe	Delta wing body	Flying wing
Span	2.4m	~10m
Length	2.4m	~10m
Powerplant	2x AMT Turbojets	
MTOW	60kg	~5000kg
Payload weight		
Cruise speed	>270kt	
Endurance		
Range	~150km	

December 2004.

DASSAULT - ALENIA - EADS - HAL - SAAB RUAG
Dassault Aviation, 78 quai Marcel Dassault,
Cedex 300 92 552 Saint-Cloud Cedex, France.
Tel : +33 1 4711 4400 ; Fax : +33 1 4711 5660 ;
www.dassault-avation.fr

Neuron

European UCAV collaborative technology demonstration programme unveiled by French government at the June 2003 Paris air show and formally launched at Eurosatory 2004 under the name Neuron. Dassault is senior industrial partner and responsible for awarding 50% of workshare to other participating nation companies. French government funding commitment currently totals \$183 million, with remainder of development costs to be shared between other participating nations. Government-to-government preliminary agreements signed between France and Sweden 22 December 2003, and between France and Greece 19 January 2004.

Hellenic Aerospace Industry and Dassault signed initial co-operation memorandum of understanding 5 March 2004 and formal co-operation agreement 18 May 2005. Initial government-to-government agreement reached with Italy in January 2005 on financial investment worth around \$100 million with industrial involvement to be led by Alenia Aeronautica. Saab Aerospace negotiating formal co-operation agreement worth \$390-520 million as of February 2005. Announcements on both Alenia and Saab deals expected during 2005 Paris air show. Spain formally joined the programme on 18 May 2005 with EADS-Casa to head Spanish industrial participation. Spanish government contribution expected to total \$24-30 million with EADS-Casa already responsible for design work on Neuron wing structure. Negotiations with Ruag continuing. Proposed Belgian involvement unlikely to proceed due to domestic political disagreements.

At least four different flying wing design con-

figurations studied, with current layout having strong parallels to Boeing X-45, including mid-fuselage mounted engine inlet. Modular payload integration concept. First demonstrator air vehicle to fly 2008. Formal handover of demonstrator to proposed joint-nation executive agency for collaborative trials in 2009. Specification data based on guidance released at Farnborough 2004 air show and remains approximate.

DASSAULT-SAGEM

Dassault Aviation, 78 quai Marcel Dassault,
Cedex 300 92 552 Saint-Cloud Cedex, France.
Tel : +33 1 4711 4400 ; Fax : +33 1 4711 5660 ;
www.dassault-avation.com

Slow-fast

Joint development programme for a new generation high-speed, deep penetration, low-altitude reconnaissance UAV that would normally operate at 1,000ft. UAV was proposed in 2003 as the basis of a combined Dassault-Sagem bid for the French Army's former multimission, multi sensor (MCM) requirement. However MCM programme was subsequently cancelled late in 2004. Design evolved from Dassault AVE subscale UCAV demonstrator. Preliminary technical information points to a 3h endurance air vehicle that would fly at 216km/h in slow flight profile and 720km/h in fast profile. Payload capacity is around 50kg. Development continuing.

DENEL AEROSPACE SYSTEMS (KENTRON)

Denel (Pty) Ltd, Aerospace Systems, PO
Box 7412, Centurion 0046, South Africa.
Tel: +27 12 671 1911; Fax: +27 12 671 1779;
www.kentron.co.za

DENEL KENTRON

Aircraft	Seeker IIE	Bataleur
Category	Medium tactical	MALE
Airframe	Conventional	Conventional
Span	7m	15m
Length	4.4m	
Powerplant	Limbach L550E two stroke	Rotax 914 Turbocharged
MTOW	240kg	
Payload weight	40kg	200kg
Cruise speed	70kt	135kt
Endurance	15h	18-24h
Range	250km (radius)	750km (radius)

Seeker Mk II/III

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

Bataleur

Developmental low-cost MALE system first announced at Dubai air show in November 2003 and mock-up first displayed at African Aerospace exhibition in Pretoria in September 2004. Expected to fly in 2006. Subaru EA-82T considered as alternate engine. Has three blade variable-pitch pusher propeller and all-composite airframe. Avionics derived from Denel Skua aerial target system and Seeker series tactical UAVs. Ground control system derived from Seeker.

DRAGONFLY PICTURES

Dragonfly Pictures Inc, 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 in mid-1996. Based on modular airframe concepts with this enabling minor airframe changes to meet different operational requirements. Selected in 2003 by Metal Storm as a testbed for flight trials of a 40mm rapid fire airborne gunnery system, due to occur in second half of 2005, one year later than originally planned. Proposed DP-4XT version would link two DP-4X airframes together to carry heavier payloads over increased range.

DP-5X

Development of DP-4X airframe to support increased air vehicle modularity with funding provided by DARPA. Introduces streamlined air vehicle skin. First flight believed to have been in early 2004. Additional funding award worth \$5.4 million by DARPA in July 2004 to support expansion of air vehicle functionality and capability with this to be completed by September 2006. DARPA sponsored candidate for US Army FCS Class III requirement. Contract award by US Army Communications and Electronics Command worth \$6.6 million to Harris Corp announced 2 June 2005 to integrate MIT-Lincoln Laboratories developed Jigsaw Laser

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DRAGONFLY PICTURES

Aircraft	DP-4X	DP-5X
Category	Tactical VTOL	Tactical VTO
Airframe	Helicopter	Helicopter
Span	3m (rotor)	7.7h
Length	2.1m	
Powerplant	Two stroke	
MTOW	65kg	
Payload weight	>16kg	15.9kg
Cruise speed		
Endurance	8h	7.7h
Range	800km	1,60km

laser radar onto DP-5X on behalf of DAPRA and support test campaigns over an unspecified period. Proposed DP-5XT variant would link two DP-5X airframes together to create a twin rotor air vehicle capable of carrying payloads of up to 70kg distances of 1200km.

DRS TECHNOLOGIES

DRS Unmanned Technologies Inc, 6300 Columbia Street, Municipal Airport, Mineral Wells, 76067 Texas, USA. Tel: +1 940 328 1197: Fax: +1 940 328 0753: www.drs.com

Neptune

Unique water landing derivative of the Sentry UAV, with orders for five systems from the USN in March 2002. Initial USN deliveries commenced February 2004, with those air vehicles believed to carry an electronic warfare payload.

Sentry/ Sentry HP-

Short-range tactical UAV. Some air vehicles used by USAF to support battlefield experimentation programme. Sentry HP has greater payload capability, with this including ability to carry external stores. Sentry can be distinguished by tailplane joining twin tails. Sentry HP has V-shaped tail with no tailplane surface. Sentry HP was used to deploy Textron BLU-108 submunition in small UAV weaponisation trials conducted at Eglin Air Force Base in third quarter 2004.

EADS

EADS Deutschland GmbH, Defence and Electronic Systems, 81663, Munich, Germany. Tel: +49 ; Fax: +49 : www.eads.com

AOLOS-289 / CL-289

High-speed low-altitude surveillance UAV jointly developed by Canada, France and Germany. In operational service with the French and German armies since 1991. Deployed in Bosnian and Kosovo campaigns. CL-289 is basic variant. AOLOS-289 is upgraded version, with first unit

DRS TECHNOLOGIES

Aircraft	Neptune	Sentry	Sentry HP
Category	TUAV	TUAV	TUAV
Airframe	Delta wing-body	Delta wing	Delta wing
Span	2.13m	3.35m	3.9m
Length	1.82m	2.42m	2.56m
Powerplant	LAE 150	Herbrandson 290	Herbrandson 290
MTOW	36.29kg	113.4kg	147.4kg
Payload weight	9kg	27.22kg	34kg (internal)
Cruise speed	85kt	70kt	75kt
Endurance	4h	4h	4h
Range	<40nm	100km (radius)	100km (radius)

Carapas

Concept demonstrator funded by the French DGA to explore potential use of a LADP UAV to map the electronic order of battle-use Electronic Support Measures (ESM) sensors to facilitate real-time cueing of IR/EO payload carried by same air vehicle to provide positive identification of low probability of detection emitters. Testbed UAV is a modified Galileo Avionica Nibbio (see separate entry), with proposed production version designated Surveyor 600 (see below). DGA confirmed June 2005 that demonstrator would fly late in 2005

Euromale

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. Design based on EADS-IAI Eagle 1. EADS negotiated sole ownership of all Euromale intellectual property rights in early 2005, with IAI's role limited to manufacture of first air vehicle airframe. Development programme formally launched under EADS leadership by French government at Eurosatory in June 2004. The development programme is expected to cost \$360 million, with direct French government funding to total €75 million (\$90 million). EADS will contribute €100 million. The remaining €125 million is expected to come from other partner nations and industries.

Industrial participation is being discussed with Finmeccanica, Patria, Saab Aerospace and Stork Aerospace. Formal government

participation being discussed with Finland, Greece, Italy, the Netherlands and Spain. Sweden expressed strong initial interest, but has deferred formal programme membership until at least 2007 due to budget problems. First Euromale air vehicle flight is targeted for 2008. EADS estimates a market for up to 59 Euromale-class platforms in Europe in the medium

term, including a common NATO system with a tender for that requirement expected in 2006. Project expected to be transferred from French armaments directorate control to administration by European Defence Agency in mid-2005. Block 0 air vehicle construction already underway by IAI and is expected to make first flight in European airspace in 2007 ahead of launch of capability demonstration flights in 2008.

Fox-AT/AT-3

Short-range, catapult launched tactical UAV. Earlier version ordered by Indonesia. AT-3, a fundamentally different air vehicle design, was unveiled at 2001 Paris air show and features significantly larger wing, with endurance of around 6h. Data for basic AT variant.

Orka-1200

Unmanned derivative of the Helicopteres Guimbal-produced Cabri two-seat helicopter. Concept first flagged at Farnborough air show in 2002 as a potential replacement for the cancelled EADS VTOL shipborne UAV programme. Mock-up unveiled at the 2003 Paris air show. Being advanced as a joint-service candidate for emerging French army and navy VTOL UAV requirement. EADS candidate for proposed demonstration of VTOL operations from a French navy warship planned for 2007-9. Development continuing.

Scorpio

Lightweight VTOL UAV for urban or close-range maritime surveillance. Evaluated by French army. Work underway on integration of communications relay and ELINT payloads. One air vehicle sold to UK Ministry of Defence for trials and evaluation under the Joint UAV Experimentation Programme (JUEP). Some sales to undisclosed South American customers.

Surveyor 600

Full capability LADP UAV based on the Galileo Avionica Nibbio/Mirach 100.5 target drone,

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EADS						
Aircraft	CL-289	Euromale	FOX-AT	Orka-1200	Scorpio	Surveyor 600
Category	LADP	MALE+	Short range	VTOL Tactical	Close range	LADP
Airframe	Missile	Conventional	Conventional	Helicopter	Helicopter	Missile
Span	1.32m	26m	3.6m	7.2m (rotor)	1.8m (rotor)	2.3m
Length	3.48m	13m	2.75m	6.22m (airframe)	1.7m (airframe)	4.06m
Powerplant	Rolls Royce BMW T117	Pratt and Whitney PT6A	Limbach 22hp	Combustion	Combustion	MicroTurbo TMS 18
MTOW	240kg	3,600kg	90kg	680kg	13kg	350kg
Payload weight	30kg	450kg	15kg	180kg	6kg	65kg
Cruise speed	400kt	230kt	50-95kt	<105kt	20kt	260-450kt
Endurance	<1h	>24h	3h	8h	1hr	1-3.5h
Range	>400km	2,900km (radius)	100km (radius)	>185km (radius)	10Km (radius)	>150km (datalink)

proposed by EADS for the French army's former multi-mission, multi sensor (MCMM) requirement. Carapas demonstrator represents baseline capability version.

Surveyor 2500

DynAero MCR S4 light aeroplane conversion into a medium endurance TUAV, proposed by EADS for the French army's former multi-mission, multi sensor (MCMM) UAV programme. Concept first unveiled at 2003 Paris air show. Conversion work on a demonstrator aircraft underway in June 2004 but appears to be suspended following cancellation of MCMM.

Tracker

Close-range, hand-launched mini-UAV first unveiled at Unmanned Systems Europe conference in Berlin, May 2004. A €30 million award for 160 systems by French army as close-range reconnaissance system in December 2004. Each system to comprise two air vehicles, interchangeable payloads, and portable ground control station. Demonstrated to the UK MoD in early 2004. At least one initial sale, with customer believed to be branch of the French national police. Twin-fuselage configuration air vehicle with electric propulsion. Payload bay carried between fuselages and above main wing to protect sensors on landing.

EADS - ISRAEL AIRCRAFT INDUSTRIES

EADS Defence and Electronic Systems, 6 rue Dewoitine BP 14, F-78142 Velizy Villacoublay Cedex, France. Tel: +33 1 3463 7000; Fax: +33 1 3463 7070; www.eads.com

Israeli Aircraft Industries Ltd, 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 Netherlands air forces. Based on IAI Malat Heron airframe. Prototype air vehicle first flew in 1998, and demonstrated a range of 4,000km in trials later same year. Prototype has flown demonstration missions in Canada, Sweden and the USA and was used by the UK to support its ongoing JUEAP battlefield experimentation programme. First production systems to com-

mence acceptance testing with French DGA in August 2005 prior to deliveries to a combined French air force-RNAF operational unit in late 2005. Planning for proposed Eagle 2 variant subsumed into Euromale development programme in late 2003.

ELBIT SILVER ARROW

Elbit Silver Arrow L.P. 10 Roujansky Street, Rushin-Le-Zion, 75706, Israel. Tel: +972 3 963 2111; +972 3 963 2112; www.elbit.co.il

Hermes 180

First unveiled at Asian Aerospace 2002 exhibition in Singapore. Designed to perform reconnaissance and surveillance mission at the brigade level. Made debut flight in May 2002. Successfully offered by Thales UK as part of UK's Project Watchkeeper with downselection announced 20 July 2004. However, the Hermes 180 component of the bid was set aside in favour of Hermes 450 in February 2005. Teaming arrangement in place with Thales and Thales subsidiary ADI for Australian Department of Defence's Joint Project 129 tactical UAV requirement, with a source selection imminent.

Hermes 450S

The 450S entered initial operational service with the Israeli Defence Force in 2000 following purchase initiated in July 1997 and is now main operational tactical UAV system.

Hermes 450

Twin-engine version of 450S. Contracted (for service) by US armed forces joint UAV test and evaluation programme in July 2003 to enable extended evaluation after initial trials flights in May-June that year. Offered by Thales UK along with the Hermes 180 as the

basis for its successful bid for the UK Project Watchkeeper, with downselect announced 20 July 2004. UK MoD announced £6 million (\$10.85 million) risk-reduction contract award to Thales in January 2005 to progress acquisition. UK MoD revealed in March 2005 that Watchkeeper would proceed as a Hermes 450-only acquisition with systems to enter operational service in 2009. Two air vehicles leased by US Department of Homeland Security in mid-2004 under a \$10 million deal to perform monitoring trials of the US-Mexico border August-October 2004.

Hermes 1500

First flew in June 1998. Development jointly sponsored by Israeli ministry of defence as a concept technology demonstrator for large mission payloads. Turnkey services contract based on Hermes 1500 awarded to Elbit by Israeli ministry of defence in June 2003. Contract valued at \$47 million and runs until mid-2006.

Seagull

Close-range, hand-launched flying wing UAV first unveiled at the Paris air show 2003.

Skylark

Close-range, hand-launched electrically-powered UAV first unveiled at Paris air show 2003. Skylark IV variant promoted since early 2005. Selected in February 2004 to equip Israeli Army units. On offer to Australia by ADI as candidate for looming special forces mini-UAV competition.

EMIT AVIATION

EMIT Aviation Consultants Ltd, 8 Bergman Zvi Street, Petah Tivka 49277, Israel. Tel: +972 3 934 8758; FAX: +972 3 934 8757. No web site.

Blue Horizon 2

Medium-endurance tactical UAV designed and manufactured by EMIT. Licensed variants developed by Singapore Technologies under a 1998 commercial agreement and separately by EDO of the USA. Probable sale by Singapore Technologies to the Philippines armed forces in 2001 to provide counter-terrorism reconnaissance and surveillance. Table data based on EDO Blue Horizon 2 configuration.

EADS-IAI

Aircraft	Eagle 1
Category	MALE
Airframe	Conventional
Span	16.3m
Length	8.94m
Powerplant	Rotax 914
MTOW	1,150kg
Payload weight	250kg
Cruise speed	115kt
Endurance	30h
Range	1,700km (radius)

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ELBIT SILVER ARROW

Aircraft	Hermes 180	Hermes 450	Hermes 450S	Hermes 1500	Seagull	Skylark
Category	Tactical	Medium tactical	Medium tactical	MALE	Close range	Close range
Airframe	Conventional	Conventional	Conventional	Conventional	Flying wing	Conventional
Span	6m	10m	10.5m	10m		2.4m
Length	3.47m	6.2m	6.1m	8.6m		2.2m
Powerplant	AR741 rotary	TAR801010 rotary	AR801010 rotary	Twin rotax 914	Electric	Electric
MTOW	200kg	550kg	450kg	1,500kg		5.5kg
Payload weight	32kg	150kg	150kg	400kg		
Cruise speed	70-100kt	80kts	79kt	80-130kt	20-40kts	20-40kts
Endurance	>10h	24h	20h	>40h	4h	2h
Range	150km (radius)	200km (radius)	200km (radius)		10Km (radius)	10Km (radius)

EMT

EMT Ingenieurgesellschaft, 82377 Penzberg, Germany. Tel: +49 8856 92250; Fax: +49 8856 2055. www.EMT-Penzberg.de

Aladin

Short-range, electrically powered UAV in production for the German army. Designed to operate with Fennek reconnaissance vehicle units. LRIP version ordered August 2002 and operationally deployed to Afghanistan in 2003. Modified robust version developed in response to lessons from Afghanistan operations. German army order worth \$32 million for 115 aircraft announced 16 April 2005.

Fancopter

Developmental lightweight "open" ducted fan VTOL UAV designed for use in urban terrain, including indoor flying operations. Remotely piloted version flying since late 2003. All-composite construction.

Luna

Short-range tactical UAV. Pre-production systems in service with German army since March 2000 and first deployed operationally in Kosovo in April the same year. LRIP systems, comprising 12 ground control stations and 28 air vehicles, ordered August 2002, with deliveries in 2003. Deployed with German army in Afghanistan. Used as a testbed to demonstrate

EMIT AVIATION

Aircraft	Blue Horizon II
Category	Medium tactical
Airframe	Canard wing
Span	6m
Length	3.2m
Powerplant	Rotary
MTOW	180kg
Payload weight	37kg
Cruise speed	70kts
Endurance	17h
Range	150km (radius)

EADS miniature synthetic aperture radar in February 2004, with negotiations underway as at May 2005 on acquisition by German army as a retrofit to LRIP aircraft.

X-13

Flying wing UAV under development as a possible maritime TUAV carried by small warships. Prototype built in early 2004, but flight testing and further development suspended by late 2004.

Excelnet

Excelnet Sdn Bhd, Suite S06, 2nd Floor, 2310 Century Square, Jalan Usahawan, 63000 Cyberjaya, Selangor Darul Ehsan, Malaysia. Tel: +60 3 8313 5000; Fax: +60 3 8313 5001; www.excelnet.com.my

Mini UAV

Development programme for an unnamed ship-launched mini UAV unveiled at Malaysia's Langkawi Airshow October 2003. Excelnet says an air vehicle demonstrator first flew in early 2003. System proposed for monitoring oil and gas pipelines, customs patrols and fisheries stock detection and tracking. Air vehicle will have an 8ft wingspan and weigh 6.5kg. No other technical details have been released. Development launched early 2003 and expected to be completed by October 2005.

EMT

Aircraft	Aladin	Fancopter	Luna	X-13
Category	Short range	Close range	TUAV	TUAV
Airframe	Conventional	Ducted fan	Conventional	Flying wing
Span	1.46m	0.5m	4.17m	5.1m
Length	1.5m	n/a	2.28m?	
Powerplant	Electric	Electric	Two stroke, 8hp	Heavy fuel
MTOW	3kg	0.75kg	30kg	130kg
Payload weight				
Cruise speed	25-50kts		11kt	55-100kts
Endurance	1hr	>15min	4hrs	6hrs
Range	10Km (radius)	>500m (radius)	80km (radius)	200km (radius)

Tactical UAV

Development programme for an unnamed tactical UAV unveiled at Malaysia's Langkawi airshow in October 2003. Excelnet says system will be available from 2005 with oil and gas pipeline inspection targeted as primary market. Air vehicle will have a 13ft wingspan. No other technical details have been released.

FUJI HEAVY INDUSTRIES

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

RPH-2

Upgraded version of RPH-1 agricultural helicopter initially developed to meet expected Japanese Ground Self Defence Force requirement for the Forward Flying Observation System. Basic RPH-2 in limited series production with at least 17 systems built since 1998.

GALILEO AVIONICA

Galileo Avionica Spa, Via Albert Einstein 35, 50013 Campi Bisenzio (FI), 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 tactical UAV marketplace. Designed and developed to be able to be rapidly certified for

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operations in non-segregated airspace. Short take-off and landing capability. Hard-points for carriage of external stores. Air vehicle first unveiled at Eurosatory 2002 exhibition. Air vehicle first flew December 2003. Proposed by Galileo as replacement for Italian army Mirach 26 system. System development largely complete by late 2004.

Nibbio

High speed battlefield reconnaissance and surveillance UAV derived from Galileo Avionica Mirach 100.5 target drone. Close conceptual parallels with EADS CL-289 series. Integrated electronic warfare self-protection capability with winglet-mounted pylons carrying chaff and flare dispensing system. Recovery via parachute and airbag system from Mirach 100/5. Nibbio II proposed as an enhanced version using more powerful engine.

GENERAL ATOMICS AERONAUTICAL SYSTEMS

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

Altair

Extended range variant of Predator B developed for NASA as a high-altitude scientific research platform. Contract with NASA signed January 2000, with air vehicle first flying in June 2003. UAV has multiple-redundancy systems to support certification for operation in US national airspace. Prototype made maiden flight in June 2003. Prototype currently being used by GA-ASI as a surrogate for its Mariner (Predator B-ER) system, with a series of trial flights in that role occurring throughout 2004. Sole-source solicitation by NASA for extension of UAV demonstration system services issued September 2004. Demonstration flights in support of the US National Oceanic and Atmospheric Administration in April and May 2005.

Altus I/II

Derivative of Predator A developed to support NASA and US Department of Energy atmospheric research missions. Altus II first flew June 1998. Being marketed by GA-ASI as a potential commercial communications relay platform. Altus I has a ceiling of 45,000ft, Altus II has a ceiling of 65,000ft. Technical data refers to Altus II.

GALILEO AVIONICA

Aircraft	Falco	Nibbio	Nibbio II
Category	Medium tactical	LADP	LADP
Airframe	Conventional	Missile	Missile
Span	7.2m (rotor)	2.3m	
Length	5.25m	4.1m	
Powerplant	75hp turboprop	Microturbo TRS 18-1 turbojet	Turbojet
MTOW	240-320kg	330kg	400kg
Payload weight	70kg	70kg	100kg
Cruise speed	<125kt		
Endurance	8-14h		
Range	150km (datalink)	380km	

FUJI HEAVY INDUSTRIES

Aircraft	RPH-2
Category	Short range
Airframe	Helicopter
Span	4.8m (rotor)
Length	4.4m
Powerplant	Fuji Robin Two stroke
MTOW	325kg
Payload weight	80kg
Cruise speed	<65kts
Endurance	3.5h
Range	150km

GNAT 750

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

IGNAT / IGNAT ER

Advanced version of Gnat-750 unveiled in 1998. Has 113kg external payload capability in addition to nose payload. Turbocharged Rotax 914 engine option available. In service with US intelligence community since at least 1997. US Army ordered three air vehicles and ground control systems in May 2003 to support force transformation experimentation. Those aircraft were subsequently deployed to Iraq and had achieved 4,000 flying hours in theatre to March 2005. Follow-on army contract worth \$4.21 million announced 3 February 2005 for two additional air vehicles to be built in extended range (ER) configuration. Order also supported production of upgrade kits for existing three air vehicles and integration of the tactical automatic landing system into all five aircraft, to be completed by February 2006. Technical data is for ER variant.

Mariner

Extended-range version of the Predator B, originally designed Predator B-ER. Concept first unveiled April 2003. Similar to Altair, including re-use of Altair wing design. Addition of conformal tanks on fuselage above wing root to accept an additional 272kg of fuel. Maximum external stores load is 907kg. On offer to the USN as a solution for its Persistent Unmanned Maritime Aircraft requirement in a teaming arrangement with Lockheed Martin. Modified Altair platform flying as Mariner demonstrator since March 2004 with addition of large sensor pod beneath fuselage to accommodate maritime surveillance radar. Mariner demonstrator was first UAV to fly above the Arctic Circle in August 2004, with over-the-horizon

control, as part of Canadian Atlantic littoral intelligence, surveillance and reconnaissance experiment. 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 USAF programme in 1997. Used operationally in all major conflicts since 1995, including Afghanistan, Bosnia, Iraq and Kosovo. In operational service with USAF, USN and US intelligence agencies. Multiple production orders since 1998, with manufacture of 100th air vehicle in February 2004. First export sale to Italy in August 2001 involving five air vehicles, with four assembled by Galileo Avionica. Four aircraft remaining after one lost in mishap in the USA. Italian aircraft deployed operationally to Iraq in January 2005. Potential follow-on Italian order under discussion as at 1 June 2005.

Weaponised MQ-1 version developed in 2000 and trialled 2000-2001 using combination of integrated laser designator and Hellfire missile. Variant has larger wing and increased endurance over basic RQ-1. MQ-1 used to support anti-terrorist strikes in Sudan, the war in Afghanistan in 2002 and during ongoing campaign in Iraq. First demonstrated ability to carry and deploy "daughter" UAVs in a trials programme with US Naval Research Laboratory Finder UAVs (see separate entry) in August 2002. Some older RQ-1s used as sacrificial radar decoys during opening phases of Operation Iraqi Freedom. Heavy-fuel-engined version, using Thielert Centurion as replacement for existing Rotax 914T, flown 25 October 2004.

Total General Atomics production Predator fleet reached 100,000 flight hours on 27 September 2004. Total USAF inventory at 1 February 2005 totalled 59 aircraft. USAF budget request for FY2006 released February 2005 sought \$125 for acquisition of seven additional aircraft. USAF announced MQ-1 had attained initial operating capability as at 1 March 2005. Planning for the increase of the overall USAF MQ-1 fleet to 15 squadrons, each comprising 12 aircraft, announced 18 March 2005. USAF aircraft had attained more than 80,000 flying hours in west Asian theatre as at March 2005. Specification data for MQ-1

MQM-9 Predator B

Enhanced capability version of MQ-1/RQ-1 air vehicle. First flights of turbojet powered version in February 2001 using Williams FJ44-2A turbojet engine, but demonstrator converted to turboprop. USAF initial order placed in December 2002 for two air vehicles, with these delivered for operational testing in 2005. First pre-production turboprop version flew in October 2003.

General Atomics awarded \$17 million con-

Directory: unmanned air vehicles

GENERAL ATOMICS AERONAUTICAL SYSTEMS

Aircraft	Altair	Altus II	GNAT 750	IGNAT ER	Mariner	MQM-1 Predator A
Category	HALE	HALE	Medium tactical	Medium tactical	MALE+	MALE
Airframe	Conventional	Conventional	Conventional	Conventional	Conventional	Conventional
Span	26.21m	16.76m	10.75m	17m	26.23m	17m
Length	10.97m	6.71m	5m	8m	10.98m	8m
Powerplant	Honeywell TPE331-10T	Rotax turbocharged	Rotax 582	Rotax 914 Turbocharged	Honeywell TPE331-10	Rotax 914 Turbocharged
MTOW	3266kg	734kg	513kg	1043kg	4,990kg	1043kg
Payload weight	300kg (internal)	148.5kg	64kg	204kg (internal)	522kg (internal)	204kg (internal)
Cruise speed	150kt	100kts	<120kt	<125kts	170kts	70-120kts
Endurance	<40hrs	24hrs	>40hrs	40hr	49hrs	40hr
Range	9,575km (ferry)	5,556km	~2,800km (radius)	~2,800km (radius)	7,600km	3,700km

tract in March 2004 to further develop specifications for weaponised production MQ-9 variant. Maximum external stores load is 1,361kg. Flight tests of carriage and clearance requirements for Boeing Joint Direct Attack Munition (JDAM) small diameter bomb and Lockheed Martin Hellfire missile commenced third quarter 2004. Predator B prototype demonstrated ability to drop GBU-12 Paveway II laser guided bomb in trials in August 2004, with full clearance planned for mid-2005. JDAM integration and clearance expected to complete in second quarter 2006. Potential armament options also include Raytheon AIM-120 AMRAAM and AIM-9X Sidewinder. Combat configuration air vehicle has endurance of 16h.

Trialled as a border surveillance system by US Department of Homeland in first quarter 2004. System development and demonstration (SDD) phase contract award worth \$68 million announced 30 March 2005, to include additional weapons carriage and targeting capability development, and retrofit of four MQ-9 airframes to the revised SDD configuration. Funding for two additional aircraft contained in USAF FY2006 budget request released February 2005. Total USAF orders at June 2005 were for 20 aircraft, with seven air vehicles delivered. USAF aircraft to be fitted with 1760 databus to facilitate easier weapons integration. One aircraft deployed to Iraq theatre of operations as at June 2005. Potential change of platform name under consideration by USAF since February 2005.

Predator C

Jet-powered HALE UAV based on significantly evolved Predator B airframe. Demonstrator in assembly as of June 2005 and expected to be make debut flight late 2005.

Warrior

MQ-1 Predator hybrid. **Successful/ unsuccessful** contender for the US Army Extended Range Multipurpose (ERMP) pro-

gramme with selection imminent. Developed by General Atomics from MQ-1 Predator under quick reaction prototyping programme initiated July 2004, with first flight 25 October 2004. Key changes include larger forward fuselage, to accommodate additional payload requirements, and extended wing. Shortlisted for ERMP system capabilities demonstration on 3 January 2005. First flight under the control of the AAI-developed One System ground control station announced 14 February 2005. Completed system capabilities demonstration 11 March 2005 with announcement revealing that two prototype air vehicles had been produced and participated in the phase, however only one aircraft carried a heavy fuel engine.

GENEVA AEROSPACE

Geneva Aerospace, Inc. 4240 International Parkway, Suite 100, Carrollton, Texas 75007, USA. Tel: +1 469 568 2376; Fax: +1 469 568 2101; www.genaero.com

Dakota

Originally developed by Daedalus Research for the US Naval Research Laboratories as a rugged UAV testbed. Rights acquired by Geneva Aerospace in July 2001. UAV 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

GENEVA AEROSPACE

Aircraft	Dakota
Category	Short range
Airframe	Conventional
Span	
Length	
Powerplant	4.9m
MTOW	100kg
Payload weight	36.3kg (includes fuel)
Cruise speed	<100kt
Endurance	6h
Range	Combustion

autonomous operations future naval capability programme. New-generation autonomous guidance system, designated FlightTEK, announced on 15 November 2004. Limited production of aircraft underway on January 18 for unspecified customers. Plans for modified aircraft to be fitted with pontoons to support Vought (*see separate entry*) seaplane UAV concept demonstrations for DARPA announced 13 April 2005.

GULFSTREAM AEROSPACE

Gulfstream Aerospace, 500 Gulfstream Road, Savannah, Georgia 31402-2206, USA. Tel: +1 912 965 5555; Fax: +1 912 965 3084; www.gulfstream.com

RQ-37

Proposed high-altitude endurance UAV version of the Gulfstream G550 business jet. Concept first unveiled at AUVSI-USN UAV flight demonstration at Webster Field, Maryland in August 2003. Initially proposed as a candidate for the former USN Broad Area Maritime Surveillance (BAMS) requirement. Demonstrator air vehicle under development initially meant to fly by early 2004, although there has been no announcement to date of when first flight will take place. Talks underway with Israel on possible development of fully autonomous or remotely controlled configuration for new Israeli air force maritime patrol and special mis-

GULFSTREAM AEROSPACE

Aircraft	RQ-37
Category	HALE
Airframe	Conventional
Span	28.5m
Length	29.4m
Powerplant	2XBR710 turbojets
MTOW	21,909kg
Payload weight	2,700-3,600kg
Cruise speed	515kt
Endurance	15.5hrs
Range	12,501km

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Directory: unmanned air vehicles

HONEYWELL	
Aircraft	OAV Class II
Category	Small VTOL
Airframe	Ducted fan
Span	0.73m
Length	
Powerplant	Diesel
MTOW	<50kg (target)
Payload weight	
Cruise speed	>30kts
Endurance	2hrs (target)
Range	10Km (radius)

sion aircraft revealed in June 2004. Israel has four G550s on order for use as airborne early warning and signals intelligence platform, to enter operational service in manned configuration in 2005.

Studied during 2004 by Royal Australian Air Force as potential contender for Project Air 7000 multimission endurance UAV requirement, but set aside after USN BAMS programme suspended. Potential candidate for revised USN Persistent Unmanned Maritime Aircraft (PUMA) project established in second quarter 2005, but no announcements by Gulfstream. RQ-37 technical data as for manned G550 except payload data, which based on estimates released by Gulfstream August 2003.

HONEYWELL
Honeywell International Inc. 101 Columbia Road, Morristown, New Jersey 07962, USA.
Tel: +1 973 455-2000; Fax: +1 973 455-4807.
www.honeywell.com

Organic Air Vehicle

Under development since 1999, initially in co-operation with Allied Aerospace, as a DARPA ACTD initiative supporting the US Army's Class II Organic Air Vehicle requirement under the Future Combat Systems programme. Based on scaleable VTOL lift-augmented ducted fan airframe technology. The approach is also known as ring wing airframe, with the duct acting as lifting surface during horizontal flight. Technology could support variants with airframe as large as 2m in diameter. Selected in June 2001 by DARPA to progress as prototype Class II system for demonstration purposes, with 250 test flights completed by Kestrel variant up until July 2002. Modified version developed in co-operation with Allied Aerospace known as iStar (*see separate entry*), with this

successfully performing autonomous flight for the first time in March 2004. Additional iStar variant testing by Honeywell conducted in mid-2004 at the US Army Soldier Battlelab at Fort Benning, Georgia and at Honeywell facilities. Honeywell developed derivative of iStar selected in December 2004 alongside rival proposals by BAE Systems North America and Aurora Flight Sciences for the first phase of the DARPA/US Army Future Combat Systems 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 and Techsburg. Downselection for 24-month Phase II OAV Class II concept maturation programme imminent as at 1 June 2005.

Honeywell unveiled a 33cm-diameter micro air vehicle (MAV) version at AUUSI Unmanned Systems North America exhibition in August 2004. MAV version developed under \$40 million DARPA advanced concept technology demonstration contract, with demonstrator commencing three-month flight test programme in late December 2004. Version features twin outboard fuel and payload capsules and four-leg sprung undercarriage. Current powerplant is a two-cylinder engine designed for model aircraft. System engineering contract award by FCS prime contractors Boeing and SAIC announced 16 March 2005 to compare MAV as developed for DARPA with US Army FCS OAV Class I requirements awarded. DARPA contract requires production of 50 heavy fuel engine powered prototypes for US Army testing. That version expected to fly in 2006. MAV development and manufacture team same as for Class II OAV variant.

INNOCON
Innovative Control Solutions Ltd, 5 Zvi Bergman Street, Petach-Tikkva 49297 Israel.
Tel: +972 3 934 7470; Fax: +972 3 934 6992.
www.innoconltd.com

ASIS

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

ISRAEL AIRCRAFT INDUSTRIES						
Aircraft	Bird Eye 100	Bird Eye 400	Bird Eye 500A	Bird Eye 500M	Heron	Hunter
Category	Close range	Close range	Short range	Short range	MALE	Medium tactical
Airframe	Conventional	Flying wing	Conventional	Conventional	Conventional	Conventional
Span	0.85m	2m	1.998m	1.961m	16.6m	8.9m
Length	0.80m	0.8m	1.560m	1.623m	8.5m	6.9m
Powerplant	Electric	Electric	Electric	Electric	Rotax 914 Turbocharged	Dual 68hp 4 stroke
MTOW	1.3kg	4.1kg	5.5kg	7.5kg	1,100kg	727kg
Payload weight	0.3kg		0.85kg		250kg	114kg
Cruise speed	20-80kt		20-60kt			
Endurance	1h	80min	100min	1hr	<51h	12h
Range	5km (radius)	15km (radius)	10km (radius)	10Km (radius)	1,00km (radius)	<300km (radius)

INNOCON		
Aircraft	ASIS	Mini Falcon
Category	Medium tactical	TUAV
Airframe	Conventional	Conventional
Span	8.7m	4.6m
Length	6.4m	3.2m
Powerplant	Combustion	3W 200cc
MTOW	550kg	90kg
Payload weight	150kg	16kg
Cruise speed	55kt	60-70kt
Endurance	5-20h	5h
Range	>100km (radius)	

Mini Falcon

Lightweight catapult-launched tactical UAV with parafoil recovery system. POP200 surveillance payload. Range can be extended up to 8h by fitting additional 15 litre fuel tank.

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 UAV intended for use in homeland security missions and small military unit reconnaissance roles. System has been under development since early 1990s. INTA offering extended-range variant in its international marketing since mid 2003, but has not released specific data on this option.

SIVA

Tactical UAV under development since early 1990s and first unveiled at Paris air show in 1993. Intended for Spanish armed forces though no known orders.

ISRAEL AIRCRAFT INDUSTRIES
Israeli Aircraft Industries Ltd, 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, surveillance mini-UAV intended for military and paramilitary market. Released onto international market early 2004.

Bird Eye 400

Flying wing UAV, with development completed early 2005. First 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 being qualified as at June 2005.

Directory: unmanned air vehicles

INTA		
Aircraft	ALO	SIVA
Category	Short range	TUAV
Airframe	Conventional	Conventional
Span	3.03m	6h
Length	1.75m	4.025m
Powerplant	9hp two stroke	50hp Rotax two stroke
MTOW	20kg	300kg
Payload weight	6kg	40kg
Cruise speed	30-110kt	<92kt
Endurance	2h	6h
Range	50km	

Bird Eye 500

Hand-launched surveillance mini-UAV. Common avionics and control system with Bird Eye 100, but in a completely different airframe. Under evaluation by Dutch police force and flown in low-level demonstration flights over Amsterdam in June 2004. Multiple variants at preliminary stage of design.

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.

HA 50

Concept for a modular HALE UAV for commercial applications. Initial development work commenced under the European Commission CAPECON project in 2002, but development as a stand-alone IAI project being considered. Co-operative development proposal made to EADS during first half of 2004 was not accepted. Relationship to the Ei-Tan system remains unclear.

Heron

Medium-altitude long-range surveillance system. In operational service with Israeli Defence Forces, with variants including highly modified electronic intelligence gathering aircraft. Ordered by India. 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 ERMF, first flight tested 20 January 2005. In operational service with Indian air force and used operationally to support 2005 Indian Ocean tsunami survivor relief operations using thermal imaging payloads. Potential follow-on Indian order for up to 50 aircraft under negotiation as of March 2005. A \$180 million order for 10 aircraft and ground systems placed by Turkey

KOREAN AEROSPACE INDUSTRIES	
Aircraft	Night Intruder 300
Category	TUAV
Airframe	Conventional
Span	6.4m
Length	4.7m
Powerplant	50hp rotary
MTOW	290kg
Payload weight	50kg
Cruise speed	65-80kt
Endurance	6h
Range	>120km (radius)

18 April 2005, with deliveries to commence late 2005. Israeli air force order for eight aircraft under negotiation as of 1 June 2005.

Hunter

Currently in operational service with Belgian and US armies. Single Hunter system acquired by France in 1998 but retired in early 2005. Belgian aircraft designated B-Hunter to reflect assembly by Belgian Eagle consortium. System selected in December 1998, with initial deliveries in 2001. B-Hunter based on standard Hunter configuration, but has 8.9m wingspan. Extended range Endurance Hunter (E-Hunter) 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*). Technical data is for basic Hunter.

I - See

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

I-View

Short-range, catapult-launched UAV with guided parafoil recovery. Robust airframe intended for use in frontline military operations. Basic version is designated K50. K125 is civil application version, with aircraft making first flight in March 2005. K250 is heavier version re-using wing from Searcher II and is baseline for IAI bid for Australian army tactical UAV requirement, a source selection for which is imminent.

Searcher II

Basic Searcher operational with Israeli air force since 1992 with some air vehicles equipped with electronic warfare payloads. Ordered by

LEW AEROSPACE		
Aircraft	Inventus E	S-1
Category	Small	LALE
Airframe	Flying wing	Flying wing
Span	6ft 4 inch	12ft
Length	2.7kg (dry)	11.3kg (dry)
Powerplant	Electric	15hp combustion
MTOW	2.7kg (dry)	11.3kg (dry)
Payload weight	5.4kg	22.6kg
Cruise speed	38kt	60kt
Endurance	2h	30h
Range	Electric	3,200km

India in 1996 and used operationally during border clashes with Pakistan. In operational service with Singapore, with navy having ground control systems installed in larger ships. Searcher II selected by Israeli defence ministry in August 2003 for special surveillance missions as a turnkey service based on payment per flight hour with operations commencing in September 2003. Unknown number of aircraft sold to India and used operationally in January 2005 to support search for survivors of Indian Ocean tsunami. Technical data for Searcher II.

Swallow

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

KOREA AEROSPACE INDUSTRIES

Korea Aerospace Industries, Seosomun-dong, Jung-gu, Seoul 100-737, Republic of Korea.
Tel: +82 2 2001 3114; Fax: +82 2 2001 3011;
www.koreaero.com

Night Intruder 300

Initial development commenced 1991, with full scale production version ready from 2000. Production contract from South Korea ministry for defence in September 2001. Initial operational capability achieved in November 2003 with production continuing.

LEW AEROSPACE

Lew Aerospace, Suite 3-891, 1930 Village Centre Circuit, Las Vegas, Nevada 89144, USA.
Tel: +1 702 735 2224; Fax: +1 702 735 2225
www.inventus-uav.com

Inventus E / Inventus S-1.

Low-cost, low-altitude, long-endurance UAV. All-composite monocoque construction. Inventus-E is electrically powered version. Three E series flown in close formation by a single operator in May 2005 using Cloud Cap Technology's Piccolo Plus autopilot system. E

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Directory: unmanned air vehicles

LOCKHEED MARTIN

Aircraft	Desert Hawk	Multipurpose UAV
Category	Mini	Tactical
Airframe	Conventional	Folding wing
Span	1.3m	
Length	0.81m	5.8m
Powerplant	Electric	Turbofan
MTOW	3.2kg	4082kg
Payload weight	0.45kg	450kg
Cruise speed	<54kt	
Endurance	1h	
Range	5km (radius)	1300km (radius)

series has recorded 300h of autonomous flight up to May 2005 with 20 air vehicles built. Parachute recovery with optional catapult launch. S-1 version made first flight in October 2002 with development continuing.

LOCKHEED MARTIN

Lockheed Martin Aeronautics Company, 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 State, 13827-3998, USA. Tel: +1 607 751 2000; www.lockheedmartin.com

Sentry Owl / Desert Hawk

Sentry Owl is Lockheed Martin Aeronautics' generic name for a family of mini-UAV systems, with Desert Hawk in production as the USAF's Force Protection Airborne Surveillance System. Original air vehicle developed by the USAF Electronic Systems Center and manufactured under licence by Lockheed Martin. Desert Hawk deliveries began in 2002, with system operational in Iraq as of June 2004. Total USAF inventory at 1 February 2005 was 126 aircraft.

MAUV morphing wing technology demonstrator

Subscale demonstrator for testing of morphing wing concepts with at least two air vehicles built. Design based on flying wing with two stream-wise folding joints located in wing structure on each side of central body. This allows wings to be raised vertical to act as a tail surface, as well as fully fold in against the body to reduce overall air vehicle profile. Development contract award from USAF Research Laboratories 24 January 2003 worth \$9.3 million following open solicitation in September 2001. Project funding

MLB

Aircraft	BAT 3
Category	Short range
Airframe	Conventional
Span	1.82m
Length	1.43m
Powerplant	Zenoah G-26 two stroke
MTOW	<8.6kg
Payload weight	<1.81kg
Cruise speed	<45kts
Endurance	2.5-6h
Range	320km

ends November 2006. Air vehicle prototype unveiled at AUVSI Unmanned Systems North America exhibition in August 2004. Air vehicles expected to make first flight mid-2005 at NASA Dryden, 9 months later than originally planned.

Multipurpose UAV

Submarine launched and recovered UAV concept being jointly advanced by Lockheed Martin and DARPA. UAV would be carried and deployed from standard ballistic missile launch tubes on Ohio-class submarines converted to carry cruise missiles. Primary role would be surveillance and reconnaissance for cruise missile strikes. However, UAV arming concepts flagged by Lockheed include the Boeing Small Diameter Bomb and the Lockheed Martin LOCAAS loitering missile. Potential technology links with the Lockheed Martin morphing wing UAV demonstrator programme. Water landing either by stall manoeuvre or parachute. Submarine would recover UAV underwater using a remotely operated vehicle. Powerplant options being considered include modified Honeywell AS903. Initial DAPRA funding approvals April 2003. DARPA announced two-year, \$7.87 million risk reduction demonstration contract to Lockheed Martin 10 May 2005. Initial allocation worth \$4.22 million, with funding ending March 2007.

MLB

MLB Company, 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. Demonstrated at the AUVSI-USN Webster Field UAV field day in August 2003. 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,

MMIST

Aircraft	CQ-10A Snowgoose
Category	ULAV
Airframe	Parasail
Span	2.8m (cargo vehicle)
Length	2.8m (cargo vehicle)
Powerplant	Combustion
MTOW	
Payload weight	34kg
Cruise speed	34kt
Endurance	>14h
Range	>300km (radius)

NAVMAR

Aircraft	Mako	Tiger Shark
Category	TUAV	TUAV
Airframe	Conventional	Conventional
Span	3.9m	5.2m
Length	2.77m	4.75m
Powerplant	10.5hp two stroke	30hp combustion
MTOW	63.5kg	150kg
Payload weight	13.61kg	27.22kg
Cruise speed	55kt	65k
Endurance	8h	12h
Range		

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. Low rate of initial production order for 2+2 systems from SOCOM in July 2003. Full rate of production contract for 18 systems with options for 200 in August 2004. Two systems being mobilised for operational deployment to Iraq as at June 2005. Performance and payload data is for ground-launched system. Larger systems being proposed, including capability for 450kg payload and endurance of more than 30h. Basic system also being proposed for use as surveillance platform.

NAVMAR

Navmar Applied Sciences Corporation, 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 from USN Air Systems Command. First unveiled at AUVSI Unmanned Systems North America exhibition August 2004, with several prototypes built and flying before that date.

Tiger Shark

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

NEANY

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

Arrow

Developed under contract to US Naval Air Systems Command on behalf of US Special Operations Command (SOCOM) as a test-bed for trials of new guidance technologies and payloads. Air vehicle first unveiled at AUVSI Unmanned Systems North America exhibition August 2004. Airframe derived from Titan Aircraft Tornado 912 kitplane. Prototype flying since April 2004. Initial development contract

Directory: unmanned air vehicles

NEANY	
Aircraft	Arrow
Category	TUAV
Airframe	Conventional
Span	7m
Length	5.8m
Powerplant	Rotax 100hp
MTOW	680kg
Payload weight	124kg
Cruise speed	55kts
Endurance	

award in early 2003 with additional \$9.25 million funding awarded 14 June 2004 to allow further work on enhancing basic system capabilities through until June 2006. Total orders could reach 16 UAVs over a three-year period.

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 range 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 launched at request of US Special Operations Command in third quarter 2002 to modify BQM-34S Firebees to carry modular payload canisters, manufactured by Grove Aircraft, California, for airborne delivery mission. Unknown number of air vehicles upgraded with new fully autonomous navigation system. Test flights commenced December 2002. Payload canisters unveiled by Northrop at AUVSI-USN UAV demonstration at Webster Field in August 2003. A \$48.2 million order placed by USN in April 2005 for 60 aircraft and logistics support, with deliveries to complete in 2006. Order contains options for 60 further aircraft in 2007.

Model 295

Concept for a special-mission MALE UAV derivative of the Scaled Composite-developed Proteus optionally piloted endurance air vehicle that would operate in the 30,000ft to 50,000ft altitude envelope. Company-funded research and development initiative with activities including use of Northrop Grumman-owned Proteus aircraft to perform weapons release demonstration on 24 February 2005 at Nellis Air Force Base using inert 500lb bombs. Model 295 is expected to be jet powered, hunter-killer platform with multiple sensor types and large ordnance payload capacity. Internal stores capacity expected to be 450kg. External stores capacity of up to 3,250kg. Follow-on demonstration flights using Proteus to resume in second half of 2005.

RQ-4A Global Hawk

Advanced HALE UAV. Advanced concept technology demonstration launched by DARPA in 1995 with seven air vehicle demonstrators ordered. First air vehicle rolled out February 1997 and made first flight late that same year. Military utility trials commenced in 1999. First crossing of the Atlantic Ocean in April 2000, including first demonstration of air vehicle being controlled from another continent. Programme entered engineering and manufacturing development phase 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 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 built under advanced concept technology demonstration programme delivered to USAF February 2003. First LRIP production contract worth \$101 million awarded by USAF February 2002 to supply two air vehicles. A \$307 million contract was

awarded in January 2003 for Lot 2 LRIP of four RQ-4As. A \$185 million contract to build two RQ-4As for USN to support maritime surveillance experimentation awarded February 2003. First production-standard RQ-4A (LRIP Lot 1 air vehicle) delivered to USAF in August 2003. FAA granted national certificate of authorisation for RQ-4 in August 2003 enabling routine operation of UAV in US national airspace. RQ-4As deployed to west Asia surpassed 2,000 operational flying hours in July 2004 and 4,000 by March 2005. First flight of USAF Lot 2 air vehicle on 1 July 2004 and delivered to Beale air force base 28 October 2004. First flight of USN aircraft – designated N1 – in October 2004. Both USN aircraft to be delivered to US Naval Air Station Patuxent River, Maryland in August 2005 with trials to run until FY2009.

RQ-4B Global Hawk

Standardised production version of Global Hawk. Key external changes to RQ-4A comprise extension of forward and rear fuselage through the introduction of plugs; larger tail surfaces; and relocation of undercarriage to retract into conformal pods on the inboard wing to provide increased internal fuselage space. USAF awarded \$147 million contract in March 2003 to launch spiral development programme leading to RQ-4B configuration. Funding of \$30.1 million for long-lead LRIP items for four Lot 3 air vehicles 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 of \$50.6 million for long lead LRIP items for four Lot 4 RQ-4B air vehicles awarded by USAF to Northrop Grumman in March 2004, guaranteeing funding to January 2005. Lot 5 order in 2005 based on four RQ-4Bs with a further six in Lot 6 in 2006. Total USAF production to 2009 baselined on 33 air vehicles, including SIGINT variants. USAF FY06 budget request released February 2005 sought \$327 million to procure five additional aircraft. Additional \$143 million

NORTHROP GRUMMAN						
Aircraft	Hunter II	RQ-4A	RQ-4B	RQ-8A	RQ-7B	X-47A
Category	MALE	HALE	HALE	VTUAV	VTUAV	UCAV
Airframe	Twin tail boom	Conventional	Conventional	Helicopter	Helicopter	Diamond flying wing
Span	16.6m	35.42m	39.89m	8.38m	8.4m	8.47m
Length	9.3m	13.53m	14.5m	6.97m (folded)	7m (folded)	8.5m
Powerplant	Rotax 914 baseline	Rolls Royce AE3007H	Rolls Royce AE3007H	Rolls Royce M250-C20W	Rolls Royce M250-C20W	JT 15D-5C turbojet
MTOW	1225kg	11,612kg	14,630kg	1,156kg	1,428kg	2,500kg
Payload weight	227kg	907kg	1,361kg	272kg	272kg	
Cruise speed	70kts	>345kt		125kt	125kt	
Endurance	<44h	30h	>30h	<3h	5h	
Range	3000km	25,015km?		200km	200km	

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awarded 22 April 2005 for EMB phase. Aurora Flight Sciences is major airframe subcontractor and delivered first RQ-4B aft fuselage in April 2005. Vought Aircraft Industries is primary contractor for wing design and manufacture with testing of three prototypes completed 31 May 2005. First RQ-4B deliveries from Lot 3 order to occur in 2006.

RQ-4B selected as preferred platform for unmanned segment of NATO Alliance Ground Surveillance programme in April 2004 with integration to be studied as part of €20 million preliminary integration study contract awarded 28 April 2005. Production contract expected in 2006. Schedule proposes initial delivery of three RQ-4Bs in NATO configuration by 2010 with a further four air vehicles to enter service by 2012. German air force order for RQ-4Bs expected late 2005 with those air vehicles to be converted to Eurohawk SIGINT configuration by EADS. German air force requirement for an additional five aircraft in IMINT configuration now being scoped. Royal Australian Air Force order for five IMINT aircraft expected 2006, but remains dependant on budget funding. Teaming arrangement with Tenix Defence Systems and Saab Systems Australia for Australian requirement announced March 2005. Interest expressed by US Missile Defense Agency in December 2004 for possible use of RQ-4 to monitor missile defence system tests.

RQ-8A/RQ-8B Firescout

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

RQ-8B concept publicly released November 2002 and the following month the USN revealed it was exploring funding development of more robust version tentatively designated RQ-8B Sea Scout. Four-blade rotor test-flown on manned Schweizer Model 333 testbed aircraft in March-April 2003. Programme funding restored by US Congressional committee in July 2003. USN announced in January 2003 that Firescout will be developed to support the Littoral Combat Ship programme. Northrop Grumman shortlisted for UK Watchkeeper programme in February 2003 with mix of Firescout and RuAG Ranger UAVs but unsuccessful. Flight trials of modified RQ-8A with nose-mounted Lynx synthetic aperture radar in July-August 2003. RQ-8B selected as preferred

Class IV UAV for the US Army's Future Combat Systems (FCS) programme in September 2003. Eight-year, \$115 million contract 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 out to 2008. Test firing of RQ-8A with Hydra folding-fin rockets carried out in February 2004 as part of continuing weaponisation experiments. USN contract award worth \$49 million in March 2004 to supply two RQ-8B systems by October 2005 to support continued test and development of naval variant. Revised fuselage configuration featuring large sponsons, unveiled late 2004. Contract worth \$11.74 million, covering eight air vehicles and support equipment for US Army requirements, awarded by USN 5 in April 2005 with deliveries to be complete November 2006. Continuation funding for USN acquisition contained in USN Fiscal year 2006 budget request released in February 2005. Full rate production orders for US Army aircraft expected in 2008 with initial operational capability aircraft to be fielded from 2010. Range and endurance data compares maximum effective 272kg payload being carried on same mission by three-blade RQ-8A and four-blade RQ-8B versions.

Small UAVs

At least two small tactical UAVs under development as at June 2005. The first system is a 20.5kg air vehicle with a maximum speed of 60kt. The second system is a 40.8kg air vehicle with a maximum speed of 80kt. Development is possibly linked to USAF's HURT programme for co-ordinated unmanned system operations in urban terrain with Northrop Grumman receiving an \$11.64 million contract 9 December 2004 to develop enabling UAV mission technologies for the HURT programme.

X-47

UCAV demonstrator and prototype operational UCAV programme. X-47A, also designated Pegasus, developed under former USN DAPRA naval UCAV feasibility demonstration programme. X-47A demonstrator first rolled out in February 2001 and made its sole flight in February 2003.

X-47B is Northrop Grumman's design for US Joint-Unmanned Combat Air System (J-UCAS) programme being developed alongside Boeing. Northrop teaming partners include GKN Aerospace, Lockheed Martin and Pratt & Whitney. \$160 million contract awarded by DARPA on 1 May 2003 to build and demonstrate two X-47B configuration air vehicles. Demonstration of X-47B shipboard mission control system on board USN aircraft carrier in February 2004 using modified manned Beechcraft King Air as X-47B surrogate aircraft. Full-scale mock-up unveiled at Farnborough air show in July 2004. DARPA contract award worth \$1.04 billion announced 18 August 2004

to design and develop three X-47B demonstrators, mission control stations and common operating system components to meet USAF and USN requirements. Initial funding was \$30 million, with total funds running until September 2009. Low-speed wind-tunnel testing involving 750 test runs using high-fidelity model completed 22 September 2004. X-47B system integration laboratory opened at Northrop Grumman San Diego facility October 2004. Manufacture of forward fuselage by GKN Aerospace commenced June 2005, with final assembly of lead aircraft to take place at Northrop Grumman Palmdale, California facility. First X-47B flight planned for early 2007. Derivative of X-47B proposed by Northrop Grumman in early 2004 as an option for USAF's interim bomber requirement. Northrop announced May 2005 it will conduct J-UCAS advanced engine study in conjunction with the USAF Research Laboratory's Versatile Affordable Advanced Turbine Engine programme.

NORTHROP GRUMMAN - IAI

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Israeli Aircraft Industries Ltd, 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 as RQ-5A. First flew in 1991. Automatic take-off and landing system retrofitted into US Army aircraft in 2002. Several air vehicles deployed to Iraq in support of Operation Iraqi Freedom upgraded in theatre in mid-2003 to partial E-Hunter standard to provide endurance of above 15h. RQ-5A test flights with heavy fuel engine completed July 2004, with implementation on 40 air vehicles from October 2004 onwards. Standard Hunter used to support border surveillance demonstrations by US Department of Homeland Security between November 2004 and January 2005. Aircraft deployed to Iraq recorded 8,000 operational flying hours up to March 2005. Total number of aircraft in US Army inventory at 1 February 2005 was 32. First flight of US Army aircraft modified to full E-Hunter standard occurred March 2005. US Army and Northrop Grumman began talks in April 2005 on modifying remainder of fleet to full E-Hunter specification and upgrade of ground stations to common One Station configuration prior to introduction into operational service of proposed ERMP MALE UAV.

Hunter II

Successful/unsuccessful contender for the US Army Extended Range Multipurpose (ERMP) programme with selection imminent. Air

Directory: unmanned air vehicles

OERLIKON CONTRAVES - RUAG - IAI	
Aircraft	Ranger
Category	TUAV
Airframe	Conventional
Span	5.71m
Length	4.61m
Powerplant	Goebler-Hirth 42hp
MTOW	275kg
Payload weight	45kg
Cruise speed	
Endurance	8h
Range	<150km (radius)

PIONEER UAV	
Aircraft	RQ-2C Pioneer
Category	TUAV
Airframe	Conventional
Span	5.15m
Length	4.26m
Powerplant	UEL AR-741 rotary
MTOW	204kg
Payload weight	
Cruise speed	80kt
Endurance	5.5h
Range	185Km (datalink)

RAFAEL	
Aircraft	Skylite
Category	Close range
Airframe	Conventional
Span	1.7m
Length	1.15m
Powerplant	Electric
MTOW	6kg
Payload weight	
Cruise speed	
Endurance	~1h
Range	10km (radius)

vehicle based on IAI Heron MALE design. Northrop-led team comprises Aurora Flight Sciences (which has negotiated licences to produce Heron and Eagle 1/Euromale airframes from IAI) and IAI. Northrop-funded demonstration flights at Chochise College Air Field, Arizona during December 2004 and January 2005. Team shortlisted for ERMP system capability demonstration (SCD) 19 January 2005. Hunter II demonstrator performed 14 separate flights totalling more than 50h up until 16 February 2005, including flights of heavy fuel engine powered version. SCD flights also saw demonstration of Northrop Grumman-developed Advanced Information Architecture operations from Hunter II. One demonstrator Hunter II configuration aircraft being built by Aurora after order placed by Northrop in April 2005. Intended to carry combined IR/EO, SAR and weapons payloads. Some minor specification changes compared to baseline Heron, particularly airframe length and maximum takeoff weight.

OERLIKON CONTRAVES - RUAG AEROSPACE - ISRAELI AIRCRAFT INDUSTRIES
Oerlikon Contraves AG, 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 UAV developed by IAI for Israeli Defence Force use. Ordered by Swiss armed forces in December 1995, with prime contract awarded to consortium headed by Oerlikon Contraves. A total of 28 air vehicles produced by IAI, but modified and integrated by RUAG. System entered initial operational service with Swiss air force in June 1999 and formally accepted into service in December 2001. Oerlikon Contraves

selected to supply Ranger to Finnish army in September 1999. Follow-on Finnish order awarded in September 2003, with deliveries to complete in third quarter 2005. That version will incorporate larger fuel tanks to provide increased range. Support for Swiss and Finnish Rangers transferred from Oerlikon Contraves to parent company Rheinmetall-Detec in Bremen, Germany, under corporate restructuring in 2004. Variant with new generation control system proposed by Northrop Grumman in conjunction with RUAG as part of unsuccessful bid for UK Ministry of Defence's Project Watchkeeper.

PIONEER UAV
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. Was in US Navy and Army service but now withdrawn. Pioneer UAV is a joint venture between AAI and Israeli Aircraft Industries. USMC air vehicles progressively upgraded over service life, with designation evolving through RQ-2A, -2B and current -2C version. Upgrades included automatic take-off and landing systems after initial capability demonstration in January 1997 and re-engine programme from March 1997. Pioneer improvement

RAYTHEON	
Aircraft	Silent Eyes
Category	Mini
Airframe	Tandem wing
Span	0.7m
Length	0.5m
Powerplant	Glider
MTOW	80-100kts
Payload weight	
Cruise speed	80-100kts
Endurance	Mini
Range	167km (from 60,000ft launch)

programme funded in 2003 to sustain system for remainder of life of type in USMC service to 2010. Continued operational demands on system in Afghanistan and Iraq may lead to its earlier withdrawal however, possibly as early as 2006, due to lack of serviceable air vehicles. USMC sought \$6.7 million in FY2006 budget to enable acquisition of 12 additional engines and 12 modular avionics integrated systems to enable aircraft to remain operational. Total of 35 aircraft remaining in USMC/USN inventory at 1 February 2005. Contract for common RQ-7/RQ-2 ground control station awarded to AAI June 2004.

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
 Reuseable mini-UAV designed for shoulder-mounted canister launch. Small booster rocket used to deploy air vehicle with pop-out wings activated once airborne. Originally released in July 2003 as Skylark, but renamed Skylite in April 2004 due to marketplace confusion. Designed for use in urban warfare environments and complex terrain with severe restrictions on launch space. Offered for Israeli Army close-range UAV requirement in 2003, but not selected.

RAYTHEON
Raytheon Missile Systems, 1151 East Hermans Road, Tucson, Arizona 85706 USA. Tel: +1 520 545 9842; Fax: +1 520 545 9770. www.raytheon.com

Silent Eyes
 Expendable gliding UAV under development since late 1990s. First flew September 1999 at Nellis Air Force Base as part of JEFX99 exercise and again in October 2000. Initial configura-

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RHEINMETALL DEFENCE ELECTRONICS

Aircraft	Carolo P70	Carolo T140	KZO
Category	Mini	Mini	TUAV
Airframe	Conventional	Conventional	Delta wing
Span	0.7m	1.4m	3.42m
Length	0.46m	1m	2.28m
Powerplant	Electric	Electric	Two stroke
MTOW	0.55kg	1.85kg	161kg
Payload weight	0.1kg	0.3kg	35kg
Cruise speed			110kt
Endurance	20min	30min	>4h
Range			>120km (radius)

SAAB AEROSPACE

Aircraft	FILUR	SHARC	TUAV
Category	UCAV demonstrator	UCAV demonstrator	
Airframe	Flying wing	Conventional	
Span	2.5m	2.1m	
Length	2.2m	2.5m	
Powerplant	AMT HP Olympus	AMT Olympus	
MTOW	55kg	60kg	
Payload weight			
Cruise speed	190kt	<175kt	
Endurance	20min		
Range	Saab Aerospace		

tion based on cylindrical airframe. Revised configuration, based on "flying shoebox" with pop-out wings intended for carriage in Raytheon ALE-50 towed decoy launcher, was revealed at 2004 Farnborough air show. Shoebox version demonstrated as leave-behind sensor deployed from General Atomics Aeronautical Systems MQ-9 Predator B in May and June 2004 under \$3.5 million funding award in late 2003. Unsolicited proposal made by Raytheon to USAF in June 2004 for production funding as part of MQ-9 programme, but no subsequent announcements. Armed version studied as part of ongoing Raytheon planning for development of foothold in UAV sector. Guidance suite based on Cloud Cap Technology Piccolo Plus system. Production cost estimated by Raytheon at \$15,000 per unit.

Whirl

Innovative long-endurance winged flying saucer design developed in early 2004 as a potential battlefield surveillance UAV carrying synthetic aperture radar. Air vehicle would comprise low-speed rotating central hub with four wings to provide lift. At least one subscale demonstrator air vehicle built under company funded research and development programme, with this flying for the first time in August 2004. Full capability version would fly at approximately 53,000ft altitude and remain on station in stable position for four days at a time. Production version estimated by Raytheon to cost \$1 million per air vehicle.

RHEINMETALL DEFENCE ELECTRONICS

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

Carolo P70 / T140

Mini UAVs under development as part of a family that includes two micro-UAVs. First unveiled in February 2004 at Asian Aerospace exhibition in Singapore. P70 flew as remote system during first half of 2004 with development of a fully autonomous guidance system underway.

KZO

German army tactical surveillance UAV in series production and entering operational service in late 2004. Extended development history, with initial design jointly developed as a French-German co-operative acquisition programme, later terminated. Baseline version air vehicle previously known as both Brevet and Tucan, with development jointly undertaken by Rheinmetall and the former Matra company. Initial flight trials of German army air vehicle

in 1994. Pre-production systems delivered to army in 1998 to support evaluation campaign. First flight of production standard version in March 2004. Production systems include new ground control systems. Delivery schedule will see a total of six systems, each comprising 10 air vehicles, two ground control stations, two launchers and associated support equipment. One system to be delivered every six months through until mid-2007. Variants developed for potential German army service include Mucke, fitted with an electronic countermeasures payload, and Fledermaus, carrying electronic support measures, but development suspended due to difficulties with EW payload capabilities. Baseline KZO evaluated by Norway for army tactical UAV requirement and flight tested on Norwegian ranges in late 2003/early 2004. Teaming arrangement with Teledyne Brown Engineering announced November 2004 to offer system under designation Prospector for US Army FCS Class III requirement. Teledyne Brown also examining potential conversion to heavy fuel engine.

Taifun

Attack version of KZO guided by advanced millimetric wave radar seeker head developed by EADS. Airframe details same as KZO. Full-scale development commenced 1997, but programme slowed due to re-evaluation of technical requirement after collapse of former Soviet Union. Development programme suspended by mutual agreement between German Defence Procurement Agency BWB in August 2003 to enable additional technical development 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

RNR PRODUCTS

Aircraft	APV-3
Category	Short range
Airframe	Conventional
Span	12ft
Length	
Powerplant	31cc Honda
MTOW	22.6kg
Payload weight	10kg
Cruise speed	39kts
Endurance	8h
Range	

phases. Technical development programme for revised seeker head planned for completion in mid-2005 with demonstrations to be held until late 2006. German army user trials planned for 2007 and depending on outcome, production planned to commence in 2008 for an initial operational capability in 2009. Teaming arrangement with Teledyne Brown Engineering announced November 2004 to offer system under the designation Thunder for the US Army FCS Class III requirement.

RNR PRODUCTS

RnR Products, Inc. 1120 Wrigley Way Milpitas, California 95035 USA. Tel: +1 408-946-4751; Fax: +1 408-946-4999. www.rnrproducts.com

APV-3

Low-cost, high-wing UAV primarily used for sciences applications. Carries MLB-developed autopilot system. Large underslung payload bay. Used by NASA UAV Applications Center since 2003 as air vehicle component of vineyard monitoring demonstration project. Two aircraft used by NASA Dryden in early 2005 as testbed for demonstration of autonomous swarming and obstacle evasion software under development via the NASA AMES networked UAV teaming experiment.

SAAB AEROSYSTEMS

Saab AB, Aerosystems, SE-581 88 Linköping, Sweden. Tel: +46 13 18 00 00; www.saabaerosystems.com

FILUR

The Flying Innovative Low-observable Unmanned Research (FILUR) air vehicle is a reduced-scale demonstrator to support proposed development of an indigenous Swedish unmanned combat air vehicle. Development funding of \$6.2 million awarded in September 2003. Initial development work launched in 2001 with feasibility studies completed early 2003. One demonstrator built to date with initial radar cross-section testing completed February 2005. First flight campaign proposed for third quarter 2005, to be conducted at Vidsel test range in northern Sweden. Possible extension of initial flight campaign into 2006 dependent upon whether test objectives can be met before northern Winter.

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SCHIEBEL	
Aircraft	Camcompter 5.1
Category	Short range
Airframe	Helicopter
Span	3.09m (rotor)
Length	2.68m (fuselage)
Powerplant	Two stroke
MTOW	68kg
Payload weight	25kg
Cruise speed	50kt
Endurance	6h
Range	100km (radius)

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, but not revealed until September 2000. Funding provided via the Swedish National Aeronautics Research Programme. Low-speed windtunnel testing of basic design commenced March 1999. First flights of 1/8th scale SHARC demonstrator took place in early 2002 in the USA with air vehicle remotely controlled. Air vehicle publicly revealed July 2002. Development work on autonomous navigation and flight control system ongoing. Follow-on test campaign in August 2004 included first fully autonomous flight, take-off and landing. Air vehicle developed to commercial certification standards to assist development of certification regime that would enable UAVs to operate in non-segregated airspace. Development ceased late 2004.

Tactical UAV

Proposed new-generation, canard-wing high-speed, low-observable multirole tactical UAV with both jet and turboprop variants under consideration. Concepts unveiled at Eurosatory exhibition in June 2004. Formal project office to oversee development raised within Saab in early 2004. First demonstration flight planned

SAGEM			
Crececelle	Merlin	Sperwer	Sperwer B
TUAV	Close range	TUAV	Medium tactical
Delta wing	Tandem wing	Delta wing	Canard delta wing
3.3m	1.6m	4.2m	6.2m
2.7m	1m	3m	3m
Combustion	Electric	Two stroke	70hp two stroke
150kg	6kg	330kg	
35kg	0.8kg	45kg	100kg
70-130kt	30-40kt	<130kt	
3-5h	>1hr	6h	12hrs
60-90km (radius)	>7km (radius)	200km (radius)	

for 2007. The system is expected to form basis of Saab bid for replacement of Swedish Defence Force's existing Ugglan (Sperwer) tactical UAV system.

SAFRAN (FORMERLY SAGEM)

SAFRAN SA, 2 Boulevard du General Martial Valin, 75015 Paris, France. Tel: + 33 1 40 60 80 80; Fax: +33 1 40 60 81 02. www.safran-group.com
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

Crececelle

Short-range tactical system. In operational service with French army since 1995, but to be replaced initially by the Sperwer SDTI system (see below) before full fleet replacement under proposed multimission, multi sensor (MCM) programme. Deployed operationally with French forces in the Balkans in 1998. Additional systems equipped with electronic warfare payload ordered by French army in June 1999.

Merlin

Close-range, hand-launched system first unveiled at Eurosatory exhibition in June 2004. Developed as candidate for French Army close range competition (won by EADS). Twin fuselage, twin-wing airframe with rear wing semi-swept. Pusher propeller located between wings and fuselage with engine on forward wing.

Sperwer

Most successful European-developed tactical UAV in market penetration terms with six users. Launch order by the Netherlands army in November 1995. Ordered by Sweden in June 1997 under the designation Ugglan. Ordered by Denmark in February 1999. Ordered by French army in August 2001 as SDTI interim tactical UAV system to replace Crececelle systems in service since 1995. Initial trial flights of SDTI system conducted December 2002 and continued through 2003. SDTI deliveries initially planned for mid-2003 but progressively delivered to army during second half of 2004. Ordered by Greece in October 2001. Sperwer-Long Endurance (LE) and High Velocity (HV) variants unveiled mid-2001 with LE version making

SAIC	
Aircraft	Vigilante Model 502
Category	TUAV
Airframe	Helicopter
Span	7m (rotor)
Length	7.9m
Powerplant	Rotax 914 Turbocharged
MTOW	499kg
Payload weight	68kg
Cruise speed	<117kts
Endurance	<9hrs
Range	

first flight in December 2001. Netherlands awarded its air vehicles airworthiness certification in December 2002 enabling operation in non-segregated airspace. Co-operation agreement signed with Rheinmetall Defence Electronics of Germany in July 2003 to explore increased interoperability between Sperwer and KZO (see separate entry) systems, including control of either air vehicle type from either company's ground control stations. Studies of armed Sperwer variants launched early 2003 with weapon options including modified Giat Bonus 155mm anti-armour artillery rounds and Javelin anti-tank missiles. Canadian Army order worth Canadian \$27.5 million placed via Oerlikon-Contrares of Canada in September 2003 with four air vehicles, ground control systems and support infrastructure delivered directly to Canadian operational units in Afghanistan. Second Canadian order in late 2003 for two additional air vehicles. Evolved version of Sperwer-LE, designated Sperwer B, made first flight in February 2004 and is now baseline Sperwer system configuration. Development of HV version suspended in favour of joint development of Slow-Fast with Dassault (see separate entry).

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). Airframe based on UltraSport 496 sports helicopter. Initial development contract award from USN's Joint Programme Office for Unmanned Aerial Vehicles worth \$4.8 million announced January 1998 to support demonstrations for VTUAV competition. Two versions available - Model 496, an optionally piloted air vehicle,

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SCANDICRAFT

Aircraft	APID Mk 5
Category	Short range
Airframe	Helicopter
Span	3.03m
Length	2.8m (cargo vehicle)
Powerplant	Petrol
MTOW	>100kg
Payload weight	42kg (includes fuel)
Cruise speed	>55kt
Endurance	4-6h
Range	>200km (radius)

and the Model 502 UAV. Undisclosed number of 502-configuration aircraft fitted with nuclear and chemical agent detection systems under US Army contract in late 2003 for use in low-altitude detection of weapons of mass destruction. Testing at army's Aberdeen proving ground in third quarter 2004 and scheduled for deployment to Iraq late in 2004. Current status unclear. Used as testbed for two live-fire demonstrations of 2.75in (70mm) folding-fin rocket launch from hovering UAV at US Army Yuma Proving Ground in December 2004. Payload control for those demonstrations provided by operator aboard Bell UH-1N helicopter.

SCANDICRAFT

Scandicraft AB, Westmanagatan 29, Se-582 Linköping, Sweden. Tel: +46 13 210 240; Fax: +46 13 250 998; www.scandicraft.com

APID Mk 5

The Autonomous Probe for Data Acquisition (APID) has been under development since 1996, with first prototype flights in 1997. The APID Mk 5 was unveiled in June 2003 with the overall series having in excess of 500 flying hours to June 2005. Primary market focus is homeland security and commercial aerial monitoring markets. Two-year contract awarded by Mjosnett, a Norwegian electric utility, in January 2004 to undertake power transmission line inspection functions.

APID 55

New highly streamlined, member of APID family unveiled at IDEX exhibition in Abu Dhabi in February 2005. Believed to be on order or near order for UAE Armed Forces however no confirmation as of June 2005.

SCHIEBEL

Schiebel Elektronische Geraete GmbH, Margaretenstrasse 112, Vienna, A-1050, Austria. Tel: +43 1 546 2611; Fax: +43 1 545 2339; www.schiebel.com

Camcopter

Short-range purpose-built UAV helicopter. Extensively trialled by USAF in 1998 as an airfield perimeter surveillance system. Tested by the US Army and German Federal Office of Defence Technology and Procurement as an airborne mine detection platform. Maritime

SINGAPORE TECHNOLOGIES AEROSPACE

Aircraft	Fantail	MAV -1	Skyblade
Category	Close range	TUAV	Short range
Airframe	Shrouded fan VTOL	Conventional	Conventional
Span	0.28m	3m	1.7m
Length	0.84m (with landing gear)		0.7m
Powerplant	Combustion	Microturbo	Electric
MTOW	2.9kg	80kg	5kg
Payload weight	0.8kg (includes fuel)	5kg	
Cruise speed	<70kt	85kt	30kts
Endurance	1h	30min	1h
Range	1km (radius)		8km (radius)

demonstration for the US Coast Guard in 2000. Ordered by Egyptian navy for maritime surveillance with deliveries completed in 2002. 100km mission radius requires enhanced data-link. Standard link limits operational radius to 10km.

S-100

Substantially upgraded version of Camcopter unveiled at IDEX 2005 provides increased payload capacity of up to 25kg and endurance of 6h. Streamlined airframe. Dash speed of 100kt. Ready for production from late 2005 with company planning to build up to 100 air vehicles by 2007. Potential sale to UAE armed forces reported May 2005, however, no official confirmation.

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

Tail sitter mini-UAV with centrally mounted lift-fan in short depth duct. Evolution of the Lutronix MAV-3AS/GF and XQ-138 Helispy systems. Expected to be ordered by Singaporean army as close-range and urban warfare reconnaissance support system. Work underway on reducing air vehicle noise signature. Co-operation talks with Rheinmetall Defence Electronics in early 2004 on possible joint bid for emerging Germany army VTOL urban warfare UAV. Teaming arrangement in place since at least early 2003 with Sagem of France for variants to pursue French army urban warfare requirement with modified versions. Cruise speed data is for horizontal flight mode.

SYSTEMS RESEARCH AND DESIGN

Aircraft	Archangel	Super Archangel	Wraith
Category	LALE	LALE	Medium tactical
Airframe	Flying wing	Flying wing	Flying wing
Span	3.04m	4.26m	2.75m
Length	1.58m	1.58m	
Powerplant	Combustion	Combustion	Combustion
MTOW	42.75kg	63kg	
Payload weight	2.25kg	15.75kg	
Cruise speed	65kts	60kt	
Endurance	~30hrs	16hrs	8.5hrs
Range	~3,700km	~2030km	930km

Skyblade/Skyblade II.

LALEE

Joint HALE UAV development programme involving Singapore Technologies, Singaporean defence and defence science ministries and technology agency. Concept first made public in 2001, but requirement dates back to at least 1998. Name stands for Low Altitude, Long Enduring Endurance. Low altitude refers to comparison with Singapore's space-based surveillance satellite project being developed with Israel. Long enduring refers to system's expected service life. Initial concept thought to have been based on an upgraded version of the EADS/IAI Eagle MALE UAV, however, artist's impressions released April 2004 indicate a single fuselage, conventional airframe design with large, underslung synthetic aperture radar array. System is intended to perform surveillance, communications relay and possibly airborne early warning and control missions. No technical data available.

MAV -1

One-third-scale low-observable, high-speed, short-endurance surveillance UAV demonstrator. First unveiled at Asian Aerospace 2004 with development work underway for around two years. Intended for use in exploring parameters of low-observable technologies in UAV design. Potential to evolve into a small unmanned combat air vehicle acknowledged by development team as a factor driving programme. First flight expected during second quarter 2004, but no announcements as of June 2005. International partners being sought to progress development.

Phantom Eye

A developmental hand-launched close-range reconnaissance system unveiled at Asian Aerospace 2002 in Singapore. Baseline system would weigh 2kg with 0.8m long fuselage and was scheduled to make first flight in mid- to third quarter 2002. Development ceased in favour of Skyblade system selected for the Singaporean army to meet close/short range mission requirement.

Directory: unmanned air vehicles

TECKNISOLAR			
Aircraft	Buteo	Coccinelle	DER / Bourdon
Category	Close range	Close range	Close range
Airframe	VTOL	Oval wing	Oval wing
Span	0.5m	1.3m	
Length	0.7m	1.4m	
Powerplant	Electric	Electric	Electric
MTOW		280-400g	3.5kg
Payload weight			1.5kg
Cruise speed		<45k	<55k
Endurance		0.5h	50min
Range		1.5km (radius)	10km (radius)

US NAVAL RESEARCH LABORATORY			
Aircraft	Duster	Finder	Spotlight
Category	Medium tactical	Medium tactical	Short range
Airframe	Conventional	Conventional	Flying wing
Span	6m	2.67m?	
Length	3.65m	1.6m	
Powerplant	Combustion	Combustion	
MTOW	136kg	27.5kg	5.5kg
Payload weight		5kg	1.35kg
Cruise speed	60kt	65kt	45kt
Endurance	22h	7.5h	
Range	1,220km (radius)	>750km	20km (radius)

models. Aircraft planned to enter production in late 2005. Expected to be commercially available from early 2006.

TECKNISOLAR-SENI
Tecknisolar-Seni Ltd, 21 rue cantin, Courbevoie 92400, France. Tel : +33 1 4789 5679; Fax : +33 1 4789 5731

Close/short-range system under development for the Singaporean army. Air vehicle first revealed by Singaporean defence ministry in April 2004. Prototype air vehicle flown. Conventional monoplane design. Electric and miniature petrol engine versions available. Specification data is for electric configuration.

SYSTEMS RESEARCH AND DESIGN CORP
Systems Research and Design Corporation, PO Box 32635 Palm Beach Gardens, Florida 33420-2635, USA. Tel: +1 561 625 7977; Fax: +1 561 625 8977; http://home.att.net/~aircraft.srdc/

Archangel/Super Archangel

Developmental low-cost, long-range reconnaissance and surveillance UAVs for expendable roles. Prototype Archangel flown. System draws heavily on commercial low-altitude, long-endurance UAV concepts, including adoption of Iridium global satellite communications as primary data and air vehicle control relay. Heavy fuel engine in development as at late 2003.

Wraith

Smaller scale version of the Archangel. Some units supplied to the USN for evaluation in special operations role.

TACTICAL AEROSPACE GROUP
Tactical Aerospace Group, 468 North Camden

TACTICAL AEROSPACE GROUP			
Aircraft	M65	M80	M2600
Category	Small VTOL	Small VTOL	VTOL
Airframe	Helicopter	Helicopter	Helicopter
Span	2.17m	2.55m	8.08m
Length	1.82m	2.12m	6.35m
Powerplant	63.88cc two stroke	76.8cc two stroke	2600cc combustion
MTOW	14kg	20kg	654kg
Payload weight			250kg
Cruise speed	54kts	54kts	89kt
Endurance	5hrs	8hrs	>2hrs
Range	500km	800km	350km

Drive, Beverly Hills, CA 90210 USA. Tel: +1 310 388 0234; Fax: +1 310 388 5886. www.tacticalaerospacegroup.com

M65/M80/M100

Remotely operated helicopter-configuration small UAVs designed for short-range tactical surveillance missions, with some versions believed to have been acquired by US Special Operations Command. Civil variants are the C65, C80 and C100. One C-series air vehicle, model unknown, used to provide security support for Oscar award ceremony in Hollywood in March 2005. Target version designated D50 and D100. Order from Rotor F/X, a US-based movie support company, announced in April 2005 for 14 baseline airframes derived from C65/80/100 series. Total value is \$2.8 million with deliverables comprising four piston, four turbine and six twin-turbine powered aircraft over two years with options on an additional 12 aircraft.

M2600

Fully autonomous short-range tactical helicopter UAV development programme being developed with some funding support from US Special Operations Command. Concept first unveiled at Eurosatory in June 2004. Intended to offer a more dynamically agile VTUAV compared to Northrop Grumman RQ-8 Fire Scout and Bell Eagle Eye VTOL systems (*see separate entries*) with high level of human intervention in air vehicle control. Airframe based on Robinson R22, with at least one prototype flying since early 2004. Main airframe modification appears to be an extended tailboom. Some subsystems re-use from M65/M80/M100 series

Buteo

Circular flying-wing mini-UAV supporting four ducted fans. Experimental system flying for at least two years. Designed to support low-speed precision flying in urban and other complex terrains.

Coccinelle

Backpackable mini-UAV under development for close-range surveillance missions. Air vehicle has similar oval wing arrangement to related Der/Bourdon system. Individual transport harness incorporates solar cells to recharge air vehicle batteries to extend deployment options.

Der / Bourdon

Oval-wing mini-UAV designed for close-range missions. Prototype armed version unveiled at Eurosatory 2004 featuring a Verney-Carron F101 Flash Ball gun. The weapon weighs 1.1kg with rounds including hardened rubber balls, tear gas and dye-ball markers. Weapon test fired during UAV flights in May 2004 to prove concepts. Possible sale of 60 units to United Arab Emirates Army reported in June 2002, but order status unknown.

Libellule

Long-endurance, high-altitude solar-powered mini-UAV with 4.2m wingspan. Altitude capability cited as 80,000-100,000ft. Proposed missions include radio relay, missile detection using infrared sensors and imagery intelligence.

US NAVAL RESEARCH LABORATORY

US Naval Research Laboratory, 4555 Overlook Avenue southwest, Washington DC 20375, USA. Tel: +1 202 767 2541; www.nrl.navy.mil

Duster

Design programme unveiled in late 2003 for an evolved version of Finder (*see below*) designed to be carried folded on a wing pylon and deployed from a large maritime patrol aircraft into high-

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Directory: unmanned air vehicles

VOUGHT	
Aircraft	Kingfisher II
Category	Tactical
Airframe	Seaplane
Span	12.5m
Length	11.5m
Powerplant	Pratt and Whitney PW528B
MTOW	4,308kg
Payload weight	1133kg
Cruise speed	250kt
Endurance	8-10h
Range	250km (radius)

threat areas. Folded state would occupy a space of 3.7x0.53x0.64m. Proposed stand-off range from mother aircraft is 300km. UAV would self-ferry back to pre-designated home base after completing surveillance mission.

FINDER

Flight-Inserted Detection Expendable for Reconnaissance (Finder) technology demonstration UAV jointly developed with US Defence Threat Reduction Agency. General Atomics Aeronautical Systems RQ-1 Predator used as parent aircraft with two Finders per Predator. Each Finder carries a chemical weapon point-detection payload with Predator carrying a stand-off chemical weapons detection payload. Eighteen deployments from Predator carried out between 2002 and third quarter 2003 demonstrating operational capability and military utility. Eight residual FINDER UAVs handed over to USAF in first quarter 2004.

SAIL-A-PLANE

Concept for a long-endurance catamaran fuselage air vehicle capable of taking off and landing using hydrofoils. Folding wings would act as rigid sails when craft is on water surface, enabling extended operations before returning to flight. Proposed application is SIGINT. Scale model boat version built and undergoing testing during first half of 2005. Construction of flying scale model underway during second quarter 2005 with scaled convertible sea-air demonstrator potentially to be built late in 2005/early 2006. Full size vehicle would have span of 10m and weigh up to 680kg.

Spotlight

Design programme unveiled in late 2003 for boxed short-range maritime surveillance UAV

YAMAHA MOTOR		
Aircraft	RMAX Type II	RMAX Type IIG
Category	Close range	Close range
Airframe	Helicopter	Helicopter
Span	3.11m (rotor)	3.11m (rotor)
Length	3.63m	3.63m
Powerplant	2 Cylinder	2 Cylinder
MTOW	94kg	94kg
Payload weight	28kg	31kg
Cruise speed		
Endurance	1hr	1hr
Range	150m (standard datalink radius)	150m (standard datalink radius)

V-TOL AEROSPACE			
Aircraft	i-Foil	Phantom	Seeker
Category	TUAV	Medium tactical	TUAV
Airframe	Parasail	Helicopter	Helicopter
Span	7-9m		
Length		5.75m	2.75m
Powerplant	20-30+HP Rotary Heavy Fuel	Aerospace Rotary 50HP - 90HP	2-Stage Gas Generator Turbine
MTOW	80-120kg	250kg	35kg
Payload weight	50kg	5-135 Kg	5kg
Cruise speed	<21kts	<65kts	43kts
Endurance	<12hr	<12hrs	100min
Range	20km (radius)	20km (radius)	20km (radius)

that could be carried, deployed and recovered from small coastguard-type vessels.

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 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 on co-operative development in mid-2004. Kingfisher II being proposed by Vought with Geneva Aerospace as a future technology candidate for the USN Littoral Combat Ship programme.

Potential applications including surveillance and reconnaissance, sensor placement, special operations support, and deployment platform for autonomous underwater vehicles. DARPA funding award of \$497,000 in March 2005 to demonstrate autonomous water takeoff and landings over nine months using Geneva Aerospace Dakota UAV modified with pontoons as a surrogate. Data is notional for Kingfisher II configuration as at April 2005.

V-TOL AEROSPACE

V-TOL Aerospace Pty Ltd, Unit 18, 1645 Ipswich Rd, Rocklea, Queensland 4108, Australia. Tel: +61 7 3275 2811; www.v-tol.com

i-Foil

Developmental low-cost paraglider-based UAV for use in surveillance and stores delivery roles. Prototypes flying since 2004 with basic system scaleable. Heavy-fuel-engine option being explored.

Phantom

Development of medium tactical helicopter UAV, with concept first unveiled early 2005. Dual payload capability using nose and under-fuselage mounts. Option of semi-autonomous or fully autonomous operations. Flight status unclear at 1 June 2005.

Seeker

Small VTUAV with prototype first unveiled at Australian Airshow in March 2005. All composite fuselage and sensor pod. Agricultural version available since June 2005.

Yamaha

Yamaha Motor Company Ltd, 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

RMAX Type II/ Type II G

Third-generation agricultural UAVs in large-scale series production. RMAX Type II G introduced into marketplace in March 2003 with air vehicle incorporating GPS navigation and improved ground control station designed to reduce operator workload. Type IIG has minor payload increase. Main market is Japanese domestic farming, but emphasis increasing on development of exports with establishment of subsidiary operations in the USA and launch of marketing campaign in Southeast Asia and Australia. Some sales into academic research sector for use in other UAV development programmes. RMAX Type II used as testbed for autonomous navigation research by Linköping University, Sweden as part of the Saab SHARC UCVA development programme. Georgia Institute of Technology announced 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. Georgia Tech team includes Draper Laboratories, Honeywell and Boeing with funding from DARPA. Northrop Grumman has acquired at least one RMAX as 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.