August 2012

Unmanned Systems Innovation to Watch

Jack Byers, CEO and Laura Byers, VP

Reporting impression on AUVSI, Las Vegas, NV
August 6, 2012 – August 9, 2012
Vanguard Marketing International, Inc
www.e-vmi.com

2012 AUVSI Innovations to Watch

Monday, August 6 – Thursday, August 9, 2012
Manilay Bay, Las Vegas, Nevada

Friends and Colleagues,

Two years ago, our "2010 AUVSI Innovations to Watch" paper spoke about how the unmanned systems market was approaching what Silicon Valley's strategist Geoffrey Moore refers to as the "chasm" – a critical point in the widespread adoption of innovation, in which the market either succumbs to the status quo or meets challenges head on – by driving through seemingly impenetrable hurdles to create an early market mainstream. In the case of Unmanned Air Systems today, that critical factor in the industry's ultimate commercial adoption is actually making strides and clearing hurdles. We are seeing the FAA actively working on the integration of UAS into the national air space. By 2015, 45 lb. or less UAV's will be flying in our backyards and countryside. However, will the industry take off, as it was envisioned to?

We cannot allow ourselves to think that this factor alone will enable the industry to break into the prosperity afforded to technologies that reach the mainstream. It will not be an Apple-moment. With knowledge and maturity all markets move to open standards and commodity pricing. In the case of UAS, instead of another super advanced, expensive aircraft it is now going to be a bus with modular payload capability, the proprietary system is opening and will be made available to the competition, the discriminating software is to be re-used, and using small, agile vendors will be the norm. The value proposition will be in the actionable information not the platform. The adoption of UAS is unquestioned, but the industry's "UAS" category is being parlayed into multiple domains of intersecting capabilities, requirements, metrics, value propositions and acquisition priorities. There are many opportunities and challenges as represented by Moore's Law. One thing we know, autonomy is not automation; and it is not wholly vehicle centric. Autonomy begins with a human's quest to be aware and informed while maximizing the quality and speed of decision making at the lowest cost. At AUVSI today, we saw major advancements in sensors and sensor suites, including powerful processors with real-time operating systems, vast storage, complex analytics, and secure communications, all packed into ever smarter, smaller and more affordable footprints. Ultimately, the challenge that lies ahead will be the speed and complexity of invention and our ability to turn it into innovation.

The market for UAS is at a tipping point. Do we hold back and keep the man-forever-in-the-loop, or do we embrace the man-on-the-loop journey? In ten years the market will much different. Some of the many leading players today will fade into history while others… perhaps from other industries will emerge and be the powerhouses of tomorrow. It is an exciting time.

Hope you enjoy our findings.

Jack Byers,
Chief Executive Officer

Jack@e-vmi.com

CONTENTS

PLATFORMS: UGV-UNMANNED CARGO CONVOYS

- ➔ ***Trends: Kits, modularity and full range of autonomy options for any vehicle.***
- ➔ ***Observations: Many in industry believe that the technical challenges for unmanned ground are much greater than for unmanned air.***

Oshkosh Defense (Oshkosh, Wisconsin) www.oshkoshdefense.com

Contact: John Urias, President

Two years ago at AUVSI, Oshkosh said that they would have operational prototypes with the next five years….

Product: Oshkosh® TerraMax™ unmanned ground vehicle technology integrates high-power military computers, intelligence, drive-by-wire technology and state-of-the-art distributed sensing systems to make unmanned ground vehicles run with no driver and limited supervision. TerraMax technology is available in kit form, so the original utility of the vehicle, crew comfort and payload capacity remain unhindered. And, depending on strategic field objectives, TerraMax technology is capable of a full range of operability – manned, tele-op, leader-follower or full autonomy.

October 2012 Headlines: ***Icahn bids to take control of Oshkosh Truck***

GENERAL DYNAMICS: ROBOTICS SYSTEMS (STERLING HEIGHTS, MICHIGAN)
http://www.gdrs.com/20120801%20LFT%20Fact%20Sheet%20LRes.pdf

Contact: Aaron Jaques, Senior Software Engineer

Product: GD Robotic Kit (GDRK) - designed to quickly adapt existing manned vehicles into a tele-operated unmanned system to support a variety of hazardous missions. A simulation demonstrates the GDRK Soldier – Machine interface that has been readily integrated with and used to operate manned systems on HMMWVs, Strykers, IVMMDs, Huskys and commercial platforms. Since 2010, it has been operationally tested and deployed via OCONUS and today's GDRK consists of a modular set of components that provide a range of robotic capabilities from tele-operation through autonomous navigation.

DA: Low cost, reliable and safe approach to driverless convoying

UNMANNED AIRCRAFT PLATFORMS: UAVS

- ***Trends: Current platforms focusing on payload integration with increased attention to ramping up speed, survivability, and endurance constantly driving to the highly efficient, ever expanding missions, but…***
- ***Observations: On-board PED and actionable information is the opportunity, but will the value come from a 3rd party or from the platform maker? Who will provide the key discriminator?***

GENERAL ATOMICS: NEXT GEN MULTI-MISSION ISR (POWAY, CALIFORNIA)

http://www.ga-asi.com/index.php

Contact: Travis Lively, Strategic Development Officer

Product: Predator C Avenger- Speed and reduced signature increases its survivability in higher threat environments and provides potential customers with an expanded quick-response armed reconnaissance capability.

High-speed, multi-mission Avenger is a long-endurance, medium-to-high-altitude Unmanned Aircraft System (UAS) that can perform wide-area surveillance, time-sensitive strike missions over land or sea, and a host of other challenging military missions. The aircraft has much higher operational and transit speeds than current Predator-series aircraft, resulting in quick response and rapid repositioning for improved mission flexibility and survivability.

The jet-powered UAV is equipped with a Pratt and Whitney PW545B turbofan engine capable of producing 4,800 lb installed thrust.

DA: Can operate at speeds up to 400 KTAS, a maximum altitude of over 53,000 ft, and 20 hours endurance. Its payload capacity enables it to carry multiple sensors, while its internal weapons bay can house 3,000 lb of precision munitions.

Unmanned Carrier-Launched Airborne Surveillance and Strike Aircraft (UCLASS) Competition: General Atomics' SeaAvenger, a marinized version of the Predator C, will be competing against Northrop (X-47B), Boeing (Phantom Ray?), and Lockheed (Sea Ghost). In 2007, Northrop was awarded a six-year, $635.8 million demonstrator contract. Test activities are currently in progress. With successful at-sea trials in 2013, the stage will be set for the potential follow-on acquisition.

Other GA Product(s):

- Next Generation Ground Control Station- Intuitive touch-screen technology, superior ergonomic design, and wide-screen video presentations that dramatically expand all visual cues provided to the pilot and sensor operator.

AAI –TEXTRON SYSTEMS: UNMANNED SYSTEMS (HUNT VALLEY, MARYLAND)

http://www.aaicorp.com/products/uas/air_vehicles.html

Contact: Steve Reid, VP of Unmanned Aircraft Systems

Product: **RQ-7B Shadow Tactical UAS**, in service with both the U.S. Army and Marine Corps. Shadow systems have amassed a record number of operational hours, including vital support of warfighters in Operation Iraqi Freedom and Operation Enduring Freedom.

DA: Ability to provide high-quality, experienced UAS support, including analyzing customer requirements, conducting modeling and simulation studies, developing specifications, and managing suppliers. Moore's Law is delivering smaller and smaller, more advanced payloads, this workhorse will provide greater situational awareness to a broader market.

Other product(s)

- Aerosonde small UAV is manufactured by wholly owned subsidiary and the lightweight UAV can be launched using a catapult system or from the top of a fast-moving ground vehicle. AAI also can convert vessels from a manned to an unmanned configuration and is STANAG compliant.
- Unified Ground Control Station (UGCS) that has harnessed expertise to deliver a maritime command and control solution, is now offered with Common Unmanned Surface Vessel, or CUSV. Point and click functionality, uploading the mission plan allows for seamless operation and streaming of video to phone, tablet, or laptop platforms. Supported by iCommand, an application server and network guard.

Interesting: Much of this activity is coming out of their Huntsville office, demonstrating value of proximity to customer.

MLB COMPANY (SANTA CLARA, CALIFORNIA)

http://spyplanes.com

Contact: Dr. Stephen Morris, President

Product: V-Bat UAV, long endurance VTOL design under development at MLB. The aircraft is launched and recovered in a 20 x 20 ft area and can fly for up to 10 hours with a 5 lb payload. Versions as large as 10 ft in span/70 lb and as small as 6 ft in span/12 lb have been tested to date.

DA: Autonomous vertical take-off, 20 x 20 ft area; enclosed propeller structure provides safer operation (in comparison to its rival, the Flexrotor).

CHANDLERMAY – (HUNTSVILLE, ALABAMA) http://www.chandlermay.com/index.asp

Contact: John Purvis, President

ChandlerMay specializes in designing, developing, integrating, and manufacturing C4ISR and UAS systems that are tactically survivable, open architecture, modular, expandable, and user friendly. ChandlerMay and AME Unmanned Air Systems, (a ChandlerMay company) work closely to understand the full requirements.

Product: Fury- Provides the long endurance and largest payload capability of any runway independent small or small-tactical UAS available today. The Fury is also an affordable package, easily deployable, and heavy-fuel capable. Originally designed for electronic warfare missions, Fury's multiple variants are able to withstand high electronic emissions environments while delivering more than 400 Watts to the payload during sustained flight. With its low signature, Fury can support missions where radar, visual, infrared, and acoustic detection is to be avoided.

DA: Electronic Warfare (EW) -- Large and modular payload bay and plug-and-play architecture simplifies payload integration while its STANAG 4586 control design enables quick implementation across multiple mission sets.

Other product(s):

- **Tactical Air Vehicle Control System**- Shelters use a wide range of products and capabilities, including high-end embedded workstations, video processing, communications products as well as rugged systems packaging, cable fabrication and the latest in manufacturing processes.

- **SharkFin**- Provides navigation control, video display, and payload control in one integrated, commercial software package. It includes a sophisticated toolset of decision aids, optimization algorithms, and situational awareness displays, as well as STANAG 4586 Control. Best of all, SharkFin is meant for extension — its modular architecture allows for customization, integration, and expansion, all done as plug-ins to the core.

AUTOPILOTS & LOITERING UAVS

- ➔ ***Trends: Continued miniaturizing of autopilots***
- ➔ ***Ominous Implications: Anticipating a growing market -- turning ever smaller UAVs into loitering UAVs… aka flying IEDs***

CLOUD CAP TECHNOLOGY, FORMERLY A GOODRICH COMPANY, NOW PART OF UTC (HOOD RIVER, OREGON)
http://www.cloudcaptech.com/
Contact: Matt Lendway, Customer Support Manager, Applications Engineer
Matt.Lendway@goodrich.com

Cloud Cap Technology is a provider of UAV autopilots, Stabilized Camera Systems (TASE Product line) including a video processing systems, and Inertial Sensors.

Product: Piccolo- UAV Autopilot that allows for precision navigation with GPS / INS accuracy and support for complex missions with various waypoints and multiple launch and land modes. Comes with a complete integrated Flight Management System (over 4,000 systems sold on 50 different aircraft).
What's new: **4th Quarter 2012 they will be bringing out the Piccolo Nano,** designed to meet the requirements of the smallest UAVS where the vehicle structure provides enclosure and the autopilot components need to be distrusted within the airframe's available space.

DA: "Nano" Size - how small, not known, but will be "very small" and maintain the "Piccolo-ness"
Next developments: SAASM GPS, Transponder / ADSB, Piccolo III with redundant controls and better sensors

Other Products:
TASE product line includes: EO, LWIR, SWIR
Inertial Sensors: Latest MEMS technology

AEROVIRONMENT – (MONROVIA, CA; SIMI VALLEY, CA) http://www.avinc.com/uas/adc/switchblade/
Contact: Roy Minson, SVP & GM, Unmanned Systems

Product: Switchblade- Designed to provide the warfighter with a man-portable, rapidly deployable, loitering munition for use against beyond-line-of-sight (BLOS) targets. A small, remotely-piloted and autonomous platform can either glide or propel itself via quiet electric propulsion, providing real-time GPS coordinates and video for information gathering, targeting, or feature/object recognition. The vehicle's small size and quiet motor make it difficult to detect, recognize, and track.

Designed to provide the warfighter with a back-packable, non-line-of-sight precision strike solution with minimal collateral effects.

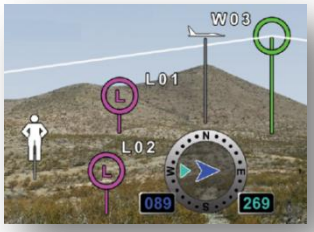
DA: Miniature UAV with ISR and strike capabilities that can be quickly launched from diverse battlespace conditions.

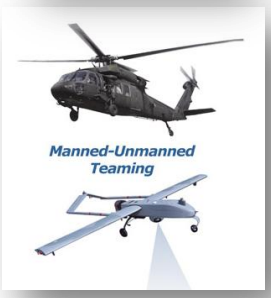
COMMON CONTROL STATION (CCS) SUPPLIERS

➔ ***Trends: Continued pursuit of a truly modular, open architected system for controlling multi-vehicle, multi-unique platforms – man-on-the-loop***

➔ ***Implications: While there have been many attempts to rid Unmanned Systems of closed, proprietary systems, we see the US Navy's efforts for CCS as admirable – will the 6th go-around be the charm?***

KUTTA TECHNOLOGIES (PHOENIX, ARIZONA) www.KuttaTech.com





Contact: Douglas V. Limbaugh, CEO dlimbaugh@KuttaTech.com

Products: **Unified Ground Control Station (UGCS)** software system capable of interfacing with a multitude of different Unmanned Aerial System (UAS) platforms based on STANAG 4586 protocol. This innovative software can be tailored to unique vehicle specifications and delivered in a variety of hardware platforms.

DA: - Streamlines development costs for emerging unmanned vehicle programs, and bolsters operational effectiveness for manned / unmanned teaming. Very intuitive GUI; allow user to focus on the ISR and not the way-points (system automatically accounts for optimal way-points).

Bi-Directional Remote Video Transceiver (BDRVT) affords an operator the ability to control the sensor payload on an air vehicle. Includes image planning, mission processing and payload command processing software.

MUM-Teaming Kit - One of the first products of its kind available to help facilitate the teaming of both manned and unmanned assets, and represents a significant step forward in how aviators utilize the growing number of UAV platforms. Payload/Vehicle Operator utilizes Kutta kneeboard controller; a resistive multi-touch pad with sealed industrial membrane switches and weighs less than 0.5 lbs.

DA: BDRVT and MUMT provide Interoperability Level 3 (IOL3+) for payload and vehicle control (no Take Off/Landing); **Focus is on the sensor in the sky, not the aircraft. offers the next-gen Human Machine Interface** for payload control – A mobile device with zero force touch pad to allow payload or mission operator to control cameras and vehicle with various swipe commands -- intuitively.

Interesting: Kutta has long history of consulting to the FAA.

INSITU (BINGEN, WASHINGTON) www.insitu.com

Contact: Andrew Hayes, Program Manager – Advanced Ground Architectures

Product: ICOMC2 (Insitu Common Open-Mission Management Command & Control) is based upon the combat-proven ScanEagle C2 system, with over 600,000 combat flight hours

A platform agnostic C2 system, fully interoperable with all Stanag 4586-compliant UASs, offers plug-in applications, moving map display, automated landing, takeoff, status and control of vehicle, payload, weapons, systems' health, and is interoperable with current/future C2 systems.

DA: Cooperative dissimilar unmanned aircraft can now create a common picture for improved mission effectiveness. Streamlined capabilities to assist vehicle operator in responding quickly to emergency or catastrophic vehicle failure via customizable tables and powerful recommender tools. Many 3D features provide the viewer with frames of reference in relation to the vehicle. An advanced video overlay system (AVOS) places ISR imagery within the context of the larger battlefield

http://www.insitu.com/documents/Collateral/ICOMC2%20Product%20Card.pdf

More DA's: The **Software is FREE!** (at this time); Users to pay for annual maintenance fee where fixes will be quickly turned; Updates and modifications, however, may or may not be included in the free offer.

What's New: 3rd Party push… Plug-in interface definition and software developer's kit (SDK) allowing the flexibility of third parties to develop ICOMC2 applications. Provide HMI guidelines and control management. 2012, ICOMC2 first flew its Integrator UAS during a one-hour, 20-minute flight

RAYTHEON INTELLIGENCE AND INFORMATION SYSTEMS (DULLES, VIRGINIA)

Contact: Katie Hughes, Software Engineer **klhughes@raytheon.com**

Product: Tactical Control System (TCS) is an open common ground control station for all branches of the US and NATO armed services, designed to address UAS operations issues by enhancing the performance and effectiveness of the operator. Basic UAV command and control, mission planning, sensor control, and sensor feeds. Based on the FireScout (RQ-8B) TCS, R-IIS spent additional IRAD money to implement portions of UCS to make TCS more of a plug and play, and extremely modular, Interoperability Levels (IOL) 1-5 capable. www.raytheon.com/capabilities/products/cgcs/

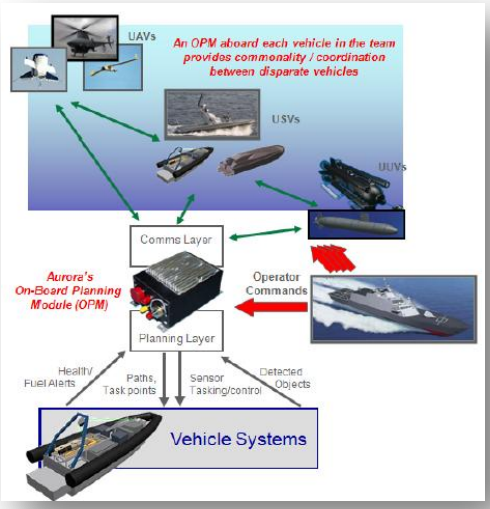
DA: Now, Linux-based and able to support multiple, dissimilar UAVs via translator modules.

AUTONOMY

- ***ONR AACUS Program Officer and MIT Professor, Missy Cummings warns the industry against the overuse of the label autonomous. "Predator doesn't have the ability to reason on its own, and any aircraft that relies on waypoint navigation is merely automated."*** ***Source: Unmanned Systems – September 2012 Issue***
- ***Trends:***
  - ***Pursuit of Autonomy – moving man from in-the-loop to on-the-loop, actionable information when human involvement is called for.***
  - ***On-board PED to find that needle in the haystack … and to reduce manpower requirements on the back-end***

ONR/AURORA (CAMBRIDGE, MASSACHUSETTS) **www.aurora.aero**

Contact: Karl Kulling, GNC Engineer, Aurora Flight Sciences Corporation kkulling@auroa.aero



Demonstration (TRL 5): Human-Supervised Control of Multi-Vehicle Unmanned Systems; Aurora's program is transitioning multi-vehicle coordination algorithms (MIT-developed, Aurora-vetted) from the laboratory into realistic environments. This system addresses what is needed in the next generation systems: Multiple USVs, UAVs, and other UVs working together; One operator supervising ~10 Unmanned Vehicles; Autonomous response to detected threats, changing conditions, and operator directives.

Solution/Product: On-Board Planning Module (OPM) is a multi-vehicle coordination and control system which is an auction-oriented, decentralized (aerial mesh network) cooperative UAV mission decision and execution process (high-level coordination). This system makes disparate vehicles into a coordinated team.

DA: Essentially, once a "search" profile has been established by the human supervisor mode (perhaps initiated by a ground troop's iPhone picture of a target), the air vehicles' OPM negotiates with each other to determine how they will collectively go about the mission. Depending upon the characteristics of each vehicle (some are better suited for comms relay versus others having particular sensors suites, etc.) the algorithms determine to optimum tasking allocation of vehicles. During flight, other aspects factor in to the real-time, dynamic algorithmic processing such as fuel consumption, vehicle health and performance, etc. STANAG 4586 and JAUS compliance plan in place

Opportunity: Aurora is looking for potential partners to transition and integrate their work with existing or future unmanned systems. They can provide a standalone Onboard Planning Module, specific algorithms, and/or integration support.

JOHNS HOPKINS UNIVERSITY (BALTIMORE, MD)

Contact: Dr. Matthew Johannes, Senior Engineer Matthew.Johnannes@jhuapl.edu

June 2012: Boeing and the Johns Hopkins University Applied Physics Laboratory (JHU/APL) demonstrated that an operator on the ground, using just a laptop and a military radio, can command an unmanned aerial vehicle (UAV) "swarm." With only limited flight training, the operator is able to connect with autonomous UAVs, task them and obtain information without using a ground control station. The team conducted flight tests in Oregon for several days in June, using two ScanEagle UAVs manufactured by Boeing subsidiary, Insitu, and swarm technology developed by the JHU/APL. The technology allows UAVs to perform similarly to a swarm of insects, completing tasks by communicating and acting together.

Technology/Algorithms: At AUVSI, JHU/APL spoke about their advanced autonomy algorithms that enable **operational swarming capabilities, cooperative behaviors, and mission level solutions.** Capabilities include command and control, autonomous perception, control algorithms, disruption-tolerant communications for autonomous collaboration, cooperative search, chemo-bio plume detection, classification, and mapping.

DA: Conducted organic persistent ISR mission using heterogeneous team of 16 UAVs in air, ground, sea surface, and undersea vehicles.

GROUND-BASED TACTICAL AUTOMATIC LANDING SYSTEMS

SIERRA NEVADA CORPORATION (SPARKS, NEVADA)

www.sncorp.com/snc_cnsatm.php

Contact: Rick Osmun, Director Business Development

Product: Tactical Automatic Landing System, tailored for land based UAV operations in confined areas. TALS provides all weather, day-night; ruggedized performance that meets the Army's field requirements for automatic recovery, high mobility by HMMWV, two-man transportability, and a 15 minute set-up time by soldiers in the field. ***Currently working on UCLASS demo and teaming with Northrop Grumman on autonomous refueling and landing platforms.***

DA: Successful recovery rate exceeding 99.95%.

Other product(s):

- **AN/MSQ-135 MOTS-Mobile Tower System-**The modular MOTS includes the controllers' shelter, portable 30kW power generator trailer, airfield lighting system, and meteorological sensors

- **T2 Transport Telemedicine-** system solution that captures and communicates critical patient care/condition information through the transport phase of patient care beginning at the Point of Injury (POI) until disposition to a definitive care medical facility.
- **HALS Helicopter Autonomous Landing System-** provides visual situational awareness/wire and obstacle avoidance in degraded visual conditions.

AUTOLANDING/ VISION CONTROL

➔ ***Trends: Technology is increasing in scope and size year over year with autonomous landing on the forefront of engineering designs. However redundant capability (loss link or jammed GPS signal) still pose threat to future advancements.***

L3 – AIRBORNE TECHNOLOGIES DIVISION (ATI) (ASHBURN, VIRGINIA)

www.airborne-tech.com

Contact: Ralph Alderson, VP Programs (also First Vice Chairman of the Board, AUVSI)

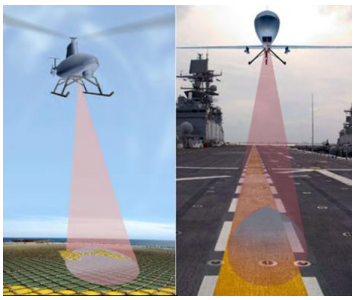
Product: Ground Control Station for multiple and dissimilar UAVs, including Viking and Mobius, considered Man-on-the-loop.

DA: Fully autonomous takeoff and landing capabilities with LIDAR once the GPS coordinates of the start and end of the landing strip have been determined. No radar tracking or other sensors required on the airfield to assist in takeoff and landing. The small footprint benefits expeditionary forces.

Other products:

- Predator Mission Aircrew Training System (PMAT) – a full spectrum Predator training center solutions for the U.S. Air Force
- Video Scout
- The Mobius aircraft is designed to fulfill a wide range of unmanned ISR and RSTA missions. The aircraft can also be flown in a manned configuration for flexibility operations, training, and R&D.

ROKE MANOR RESEARCH LTD. A SIEMENS COMPANY, (HAMPSHIRE, UK)



Contact: Robert Whitehouse, Business Sector Consultant, Unmanned Systems www.roke.co.uk/unmanned-systems

Featured on the cover of our 2010 AUVSI Highlights, Roke continues its work…

Product: Autoland – low cost, self contained landing capability which utilizes an on-board camera and processing to enable a UAV to land automatically, even **when the desired landing platform is in motion** (ships, trucks)

DA: Redundant capability; eliminates the need for complex communications systems. Enables covert operation and night landing; Can operate at Level 5 Sea State.

Other Product(s):

- Miniature radar altimeter (world's smallest for UAS and Aerial targets)
- Epsilon – Radar Cross Section Prediction Software
- Resolve – Tactical EW Manpack
- QuadTac – Direction Finding Antenna; Surveillance Sensor; Electronic Attack; Wireless Networking
- Commercial Sector: Hawkeye - US Open Contested Line Calls

BAE SYSTEMS (SAN DIEGO, CA AND AUSTRALIA)

Contact: Geoff Butler, Engineering Director, Intel & Security
Kevin Beaulne, Strategy & BD Aerospace

As early as 2002, BAE has been advancing the field of Simultaneous Localization and Mapping algorithms without the aid of GPS for years. Today, they are applying this work to autonomous landing of UAVs.

This capability will enable the UAV to locate and land…

Technology: Simultaneous Location and Mapping (SLAM) - Autonomous capabilities based on platform that conducts sensor recon and entails navigation filter improvements. Structured to minimize impact of critical flight areas of navigation and comms links to ground. ***Autonomous landing that operates independently of GPS and builds map as it scans the area for a potential landing zone, a technology that possibly will be leveraged into carrier landings.*** Target detection and tracking considered strength of the platform, which is software neutral and integrated with EO/IR LIDAR optics.

DA: Autonomous landing in GPS denied areas via imaging LIDAR to identify landing strips as well as scouting out the area for IEDs before landing. Target detection and tracking tested by advanced algorithms.

Interesting: Northrop is their customer – Could SLAM be applied on X-47B? The X-47B is equipped with an avionics suite supplied by BAE Systems Platform Solutions of Johnson

City, New York. The avionics and vehicle management computer performs flight control processing, autopilot control, engine control processing, mission command and control, navigation and other functions.

SENSOR PAYLOADS

- ***Trends: Increased performance and pixel resolution allowing for lightweight and effective integration into smaller and smaller UAV platforms. With 3D, real time imaging, and foliage penetration capabilities, sensors are escalating the amount of data and actionable intelligence collected by the end-user***
- ***Note: Sensors, analytics/autonomy (on-board PED processing) are tied to one-another. Success of one will enable (or drive) the success of the other. The challenges inherent in datalinks (compression, bandwidth) must be diminished.***

FLIR: LONGWAVE INFRARED THERMAL CORE CAMERA

http://www.flir.com/cvs/cores/view/?id=51266&collectionid=549&col=51275

Contact: Kurt Heidner, LWIR Cores Manager

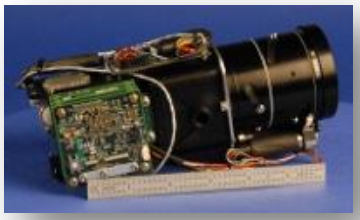
Product: Quark- provides leading-edge imaging performance and reliability in a compact, lightweight package with an innovative design that is enabled by wafer-level packaging of the microbolometer sensor. Available in 336 and 640 resolution: Both with 17-micron pixels and totes an ultra-small volume & low mass, which enables new applications in smaller packages.

DA: **The world's smallest and lightest VGA format thermal imager** for thermal imaging applications that require minimum volume and weight. Enables new applications in smaller packages. Offers low power consumption, high shock and vibration tolerance, and affordability. **Size (w/o lens): 17 x 22 x 22 mm; Weight (body & lens): 23 g (13mm lens) <-> 28g (35mm lens)**

SENSORS: SWIR

NOVA SENSORS (SOLVANG, CALIFORNIA) HTTP://WWW.NOVASENSORS.COM/HOME.HTM

Contact: Mark Massie, President



Product: Eagle MWIR 640A, 40x480 pixel format SWIR integral Stirling cooled, high performance camera system. The camera system development was derived from the 640x512 SWIR electronics developed by Nova and took only three months from concept to camera operation

DA: Designed to be a payload onboard the Scan Eagle UAV but can be modified for other air vehicles – both manned and unmanned, and ground stationary and vehicle based

SENSORS: SAR

SPACE DYNAMICS LABORATORY (NORTH LOGAN, UTAH)

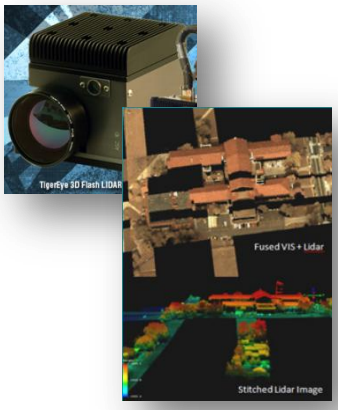
http://www.sdl.usu.edu/downloads/rasar.pdf

Contact: Neil Holt, Director

Product: Real-Time Autonomous, Synthetic Aperture Radar (RASAR), quad-polarization, linear chirp pulsed, frequency-modulated SAR designed to be SWAP compatible with deployment on the Shadow-200 UAS. Self-contained system that can be flown in an external pod mounted under the wing of the Shadow or other UAS, minimizing any impact on current ISR Payloads.

DA: Day-night all-weather imaging with direct, single pass, thin target detection capability. Demonstrated performance in counter IED mission and provides moderate foliage penetration capabilities.

SENSORS: LIDAR



ADVANCED SCIENTIFIC CONCEPTS – (SANTA BARBARA, CALIFORNIA)

http://www.advancedscientificconcepts.com/

Contact: Thomas Laux, VP of Business Development- tlaux@asc3d.com

Product: 3D FLASH LIDAR TigerEye- Incorporates 3D focal plan arrays that have rows and columns of pixels similar to 3d cameras but with the additional capability of capturing the 3D depth. Each pixel records the time the camera's laser flash pulse takes to travel into the scene and reflect back to the camera's focal plan.

This product is ideal for applications that require high-speed capture from land-based or airborne for moving-vehicles in automotive, aviation, autonomous navigation,

collision avoidance, situational awareness, fast moving object capture, identification and mapping applications.

DA: Solid State LIDAR designed for real-time 3D video stream acquisition and allows for 1 to 20 frames per second. **It is smaller, lighter and more rugged (no moving parts) than current 3D cameras. Wide range: 5cm to 3km blur-free images;** No motion distortion, Currently working on Space X Dragon Vehicle and is being ***resold by Ball Aerospace.***

DYNAMIC AIRSPACE

- ***Trends: The technology is here, the maturity levels are coming along***
- ***Issues: Trust and the willingness to make it happen***

ITT EXELIS (VAN NUYS, CALIFORNIA) **www.exelisinc.com**

Contact: Kevin B. Davis, VP, Director Business Development Kevin.davis@exelisinc.com

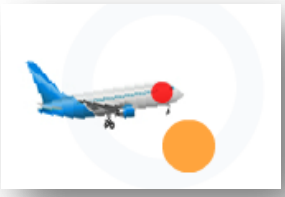
Product: SkySense sense and avoid systems with advanced active array 3D radar. The *SkySense-2020H is the air to air radar currently deployed on BAMS. It's the first program of record for due regard. There is 270 degrees of coverage and the individual* panels can be placed on the wings. The SkySense-2020G is the ground based version and can see 10km of distance.

DA: Proprietary Thin Tile Array technology is the key to smaller packaging, minimized cost and results in the thinnest AESA radar currently available. Open systems architecture, delivers low SWaP which is required by UAS platforms. Scalable and modular solution.

YouTube: http://www.youtube.com/watch?v=spRBNErA8sc

AEROSPY (LINZ, AUSTRALIA) http://www.aerospy.at/

Contact: Mag Ganglberger, R&D Program Manager v.ganglberger@aerospy.at



Product: Sense and Avoidance System - Used as a pilot assistant and a tracking enhancement system for manned aviation while also being leveraged into platform. Algorithms are developed in Matlab/Simulink and the code is generated automatically while changes in the code can be made quickly. Currently being tested on small UAVs and manned aircraft with six 5-megapixel cameras which replicate the human eye.

DA: The complexity of the system is reflected e. g. by the ability to calculate 3D trajectories of intruder aircrafts using only monocular cameras and with no assumptions on the intruder aircraft.

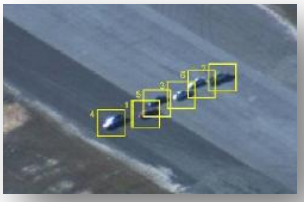
Aerospy's sense and avoid technology is used in Switzerland where UAVs are already integrated into commercial airspace.

IMAGE DETECTION / MOVING TARGET DETECTION/TRACKING

➔ ***Trend: Analyst and decision maker dealing with actionable information as opposed to operators staring at imagery trying to find an anomaly.***

TOYON (SANTA BARBARA, CALIFORNIA)

www.toyon.com



Contact: Gaemus Collins, Ph.D, Senior Analyst, gcollins@toyon.com

Product: VIDTRACC provides predictive planning path of moving targets. It's a fully autonomous system with human-on-the-loop. One month TAT for modifications of system for modularity; and many parameters for adjustment.

DA: Can track multiple UAVs simultaneously with a predictive window of 40 seconds into the future. ***Very few pixels on target***. The automatic target detection is based on motion, and continues to track based on identified features; can then track through obscurity. http://www.toyon.com/downloads/toyon_video_tracking_flyer.pdf

Interesting: Variant on Lockheed Martin's Samurai for image stabilization.

Other Products:

- Halbach Array Motors- High torque motor without the weight: 5+hp/lb. Rapid prototyping & quick delivery, however, in early stage of development, TRL 3/4.
- Goetrack Micro Digital Video Solution- All digital ISR quality video capture and compression for small assets. Modular designs that allows application across range of mechanical configurations. Standard Ethernet interface and Web interface and global shutter imaging system produces clear imagery in rapid motion scenes.

SENTIENT (MELBOURNE, AUSTRALIA)

http://www.sentientvision.com

Contact: Stewart Day, General Manager stewartd@sentientvision.com

Product: Kestrel Land MTI Automated Target Detection for Full Motion Video possess ability to detect moving targets, monitor activities and disseminate the information to the right parties involved in ISR process. Automatically detects and cues operators to small moving targets, such as vehicles or dismounts, by indicating them on the viewing screen. **COTS software that is proven in theatre on Heron, ScanEagle, and Shadow.**

DA: Ability to detect targets down to a 2x2 pixels, facilitating the efficient observation of larger surveillance areas

PED – Processing Exploitation and Dissemination

➔ ***Trends:***

- ***Increasingly more on-board PED (as processors, storage, sensors and algorithms continue to improve)***
- ***Quantity and quality of data being captured growing at staggering rates...***
- ***Off-board data fusion applied enabling the analyst to extract actionable intelligence, exercise direct control over assets and to more effectively collaborate among their peers***

CDL Systems (Calgary, Canada)

Contact: Scott Sobieraj, Systems Engineer; ssobieraj@cdlsystems.com

Product: Service-Oriented Information Fusion Software manages the huge volumes of data being received by placing fusion capabilities in the hands of the mission commanders, payload operators, and analysts, enabling increased production with fewer resources. New user interface based on Google Earth. It's a modular PMS/PED station on the path towards **the intel analyst having control of the vehicle**.

DA: Connects with any C4I system (enabling the intel/ISR analyst to control the vehicle) - intelligence databases, blue-force tracker, geospatial intelligence and imagery databases; provides ability to analyze and act on information as it is fused with full-motion video, a 3D world-view, and other visualization technologies; Advanced algorithms organize the volumes of information to present; Provides meta-tagging, categorization and search technology for intuitive archiving; Real-time intelligence communications through JChat. Uses forensic analytics to highlight areas of vulnerability along planned routes of allied conveys and logistical teams.

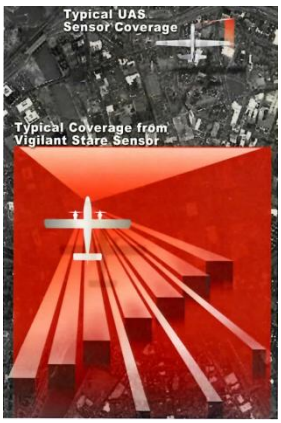
- **CDL said that they can deliver in two weeks, whether initial product or client requested modification; (two-week cycles)**

Other Products:

- **United Target Control Station (UTCS)** controls multiple vehicles (air and sea-surface) at one time and coordinates the attack
- **Manned Unmanned Systems Integration Capability (MUSIC)** interoperable MUM-T software, remote hands off system,

ITT EXELIS/SIERRA NEVADA CORP (ROCHESTER, NY)

www.exelisinc.com/solutions/VigilantStare/Pages/default.aspx



Contact: Rick Osmun, Director Business Development, (Centennial, CO)
rick.osmun@sncorp.com
Matt Pellechia, Director, Airborne ISR Strategy, (Rochester, NY)
airbornesolutions@exelis.com

Product: Vigilant Stare is an EO/IR day/night wide-area airborne persistent surveillance solution. SNC built the aircraft integration and systems while ITT built the sensors. There is motion imagery in three simultaneous product tiers.

DA: Has best resolution "chipouts" within the full field of regard as well as multiple sub views of the FFOR. Archive abilities – geo-location, time location.

2D3 SENSING (IRVINE, CALIFORNIA) www.2d3.com

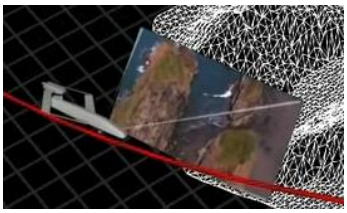
Contact: John Leipper, Sr. Solutions Engineer, Irvine, CA john.leipper@2d3sensing.com

Chad Partridge, VP Operations, San Mateo, CA chad.partridge@2d3sensing.com

"Generating Intelligence from Imagery"

Product: TacitView, and exceptional FMV exploitation tool, is built using the Tungsten Media Tool Kit (also by 2d3), a software development kit for development of real time media solutions. Tools for FMV editing, enhancement and exploitation.

DA: Standalone software can also be integrated into 2d3's Catalina server which supports many feeds and users simultaneously.



Other Products:

- Catalina: Media Server
- Tungsten: Media Toolkit
- AltiMap: Generates geo-located mosaics
- ADASII: Intelligently control the acquisition of imagery data

VIDEOBANK (NORTHVALE, NJ)

http://www.videobankdigital.com/

Contact: Joshua Vereb, Applications Engineer joshv@videobankdigital.com

VideoBank continues to be a powerful back-end PED solutions

Product: ISR System COTS turn-key solutions for military that collects and analyze reconnaissance, surveillance and intelligence information. Analysis tool that aggregates and organizes both content and data using a GUI, which reduces the time it takes for analysts to extract actionable intelligence. Metadata tags allow for isolating events for

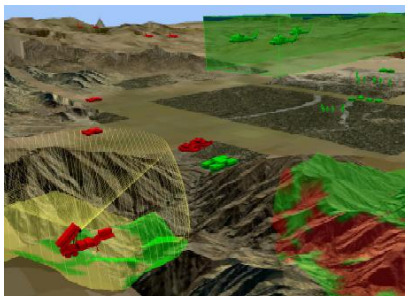
analysts' to mark areas of interest for review while offering chatting data based in the cloud.

DA: Offers playlist creation and processing applications & browse based tools for search and playback. Works with diverse client base including DoD, NASA, Navy, and Bureau of Land Management.

DISPLAYS, PROCESSORS

ULTRA ELECTRONICS (AUSTIN, TEXAS) http://ultra-ats.com/

Contact: John McAlonan, President



Product: TacViewC2, new standard for mission-oriented, **real-time tactical displays.** Designed for the most demanding real-world requirements, the TacViewC2 software provides flexibility and customization. Displays thousands of tracks at a time with the real-time responsiveness needed to visualize the battlefield.

DA: No limit to monitor sizes and resolutions, and the display window is customizable. Operators can choose whether windows float or are docked to a specific area of the window or can use multiple monitors.

L-3 DISPLAY SYSTEMS (ALPHARETTA, GA)

Contact: Charlie Doerlich, Director, Business Development Charlie.doerlich@L-3com.com

Product: Bandit, Wearable Computer - Folding OLED Display (in partnership with UDC, AFRL, ARL, CERDEC, and the Flexible Display Center at ASU); Over the last ten years, L-3 DS has been on the forefront of the development of flexible wearable displays. Their latest, the Bandit, has greatly improved with a focus on size, weight and power

PHYSICAL OPTICS CORPORATION (TORRANCE, CALIFORNIA)

http://www.poc.com

Contact: Robert Waldo, Director of BD

Product: BRAVR, provides an essential blast - protected monitoring and recording system for avionics, ground combat vehicles, and security applications. The small (1.5" x 4.8" x 2.5"), lightweight system provides high quality HD video and CD quality audio recording, with up to 7 days of recorded content.

DA: 32GB Blast Survivable Memory Unit (BSMU) uses solid state memory and crash - survivable packaging to survive blast conditions.

Other product(s):

- **Robust Holographic Optical Memory System**- stores tens to hundreds of terabits worth of digital data in a compact & lightweight (500g) robust package.
- **Soldier Information Technology Assistant-** wearable, lightweight, compact display with PDA functionality. This day/night readable display is flexible and provides up to date tactical information and is covert, rugged, with low power requirements.
- **PASTOR- MULTISPECTRAL DETECTION OF EXPLOSIVES & CHEMICALS IN TRACE AMOUNTS,** passive detection systems that will identify trace amounts of explosives and dope. The modular system will operate in day/night conditions and will accurately identify chemical contraband at distances up to 1000 meters.

MERCURY COMPUTER SYSTEMS (CHELMSFORD, MASSACHUSETTS)

http://www.mc.com/company-information/who-we-are/

Contact: Gerald M Haines, SVP Corporate Division

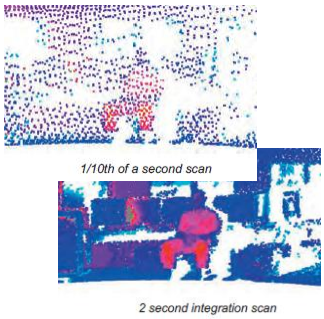
Product: EO/IR Application Ready Subsystem, installed aboard a medium altitude long endurance (MALE) UAV, advanced electro-optical/infrared sensors. The real-time and computationally intensive algorithms that comprise on-board exploitation are intended to derive actionable information from streaming sensor data, cross-cueing, reducing analyst processing time, mitigating bandwidth and storage requirements. The application called for processing power per Watt so enormous that an existing solution was not available through any vendor.

DA: 96 Terabyte storage unit development and image processing toolkit with onboard exploitation

HUMAN MACHINE INTERFACE – GESTURE RECOGNITION

GENERAL DYNAMICS ROBOTICS (WESTMINSTER, MARYLAND)

www.gdrs.com



Contact: Dr. Robert Mitchell, Manager Autonomous Perception Research

Product: Mind's Eye is a HMI System that can do stationary or mobile human recognition through a device capable of visible or IR imagery and can be fused with LADAR to improve human recognition of what is happening (i.e. meaningful actions)

DA: Uses **LADAR 3D** real time labeling, image pixel based, able to identify figures in a cluttered environment**. Able to identify body and legs, but ready to include arms and hands right now.**

Interesting: Consortium of Boston Dynamics (Big Dog technology), Carnegie Mellon University, University of Central Florida, University of Pennsylvania, Qinetics, Co57 Systems, Colorado State University, Jet Propulsion Lab/Caltech, the Massachusetts Institute of Technology, Purdue University, SRI International, SUNY at Buffalo, Netherlands Organization for Applied Scientific Research, University of Arizona, UC Berkeley, USC, General Dynamics Robotic Systems, iRobot, and Toyon Research.

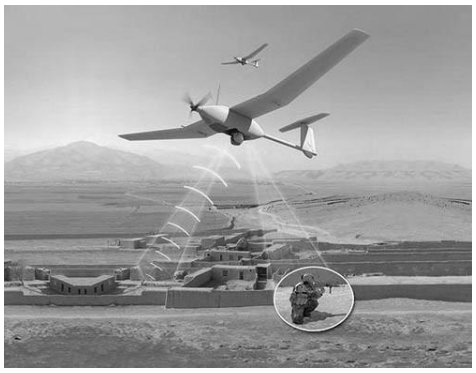
Read more at http://venturebeat.com/2012/04/09/darpa-wants-improvements-in-machine-vision-for-self-driving-vehicles/#hVQfzWFt1hQJ4Btm.99

POWER INNOVATIONS

➔ **Trends: Increased flight durations and drive to increase output of propulsion systems is seeing increasing R&D to enhance platform's energy efficiencies.**

LOCKHEED MARTIN & LASERMOTIVE INC – LASER POWER SYSTEM (BETHESDA, MARYLAND)
http://www.youtube.com/watch?v=07M7v_KeYUo&feature=player_embedded

Contact: Tom Koonce, Program Manager



Product: Stalker- A small, silent UAS used by Special Operations Forces since 2006 to perform intelligence, surveillance and reconnaissance missions. Newly developed **Innovative Laser Power System to extend the Stalker Unmanned Aerial System (UAS) flight time to more than 48 hours.** Modified for the indoor flight test to incorporate LaserMotive's proprietary system that makes it possible to wirelessly transfer energy over long distances using laser light to provide a continual source of power to the UAS. At the conclusion of the flight test, held in a wind tunnel, the battery on the Stalker UAS had more energy stored than it did at the beginning of the test.

DA: This increase in flight duration represents an improvement of 2,400 percent.

SERVICES: TRAINING SYSTEMS

CAMBER CORPORATION (HUNTSVILLE, ALABAMA) www.camber.com

Contact: Jim French, Program Manager, jfrench@camber.com

Product: Interactive Multi-Media Instruction (IMI) comprehensive electronic training system used by Northrop Grumman and General Atomics for MUMT (Apache Longbow MUMT-IOL2) and Gray Eagle Starlite SAR/GMT.

DA: Modular software uses flash. Reduces 20 hours of classroom instruction into a 2 hour online class. Takes just one month to build a single module – up to 12 months depending on customer needs.

Interesting: US Army is current customer (PMUAS-06). Will migrate the tool to the cloud on the Army's Knowledge Online.

Product: Tactical Trainer- Digital Battle Field using virtual space to provide a realistic environment for lesson centric scripted flight and full free flight models for UAV operators. Build and apply models to represent the larger physical and integrated systems environment in support of advanced concepts and research efforts in the UAV space.

DA: Developed in support of the Apache PMO, a detailed engineering-level test bed credited with delivering more than $313M in cost avoidance over its life-cycle.

DISTI (ORLANDO, FLORIDA)

www.disti.com

Contact: Ben Ellis, Solutions Engineer bellis@disti.com

Product: Replica8 to create own training materials/curriculum.

DA: 3D Virtual training software - can build training content in minutes; Java based; FAA Certified; Modular system (trial copy available for download)

Interesting: Boeing is a customer (F/A-18)

Other Product(s):

GL Studio- Enables developers to build high-fidelity graphics and fully interactive controls into software products, enhancing the level of realism and sophistication of development efforts. Creates reusable 2D or 3D graphical user interfaces for operating, maintaining, or replicating complex systems including military/civil aircraft cockpit displays, automotive dashboards, process/flow controls, medical displays, and communications equipment.

MIDDLEWARE, REAL-TIME OPERATING SYSTEMS, INFORMATION ASSURANCE

Trends: Open Architectures, Real Time Operating Systems, Information Assurance

RTI (SUNNYVALE, CA)

Contact: Jerry Schaefer, Director of BD for Gov't Programs jerry@rti.com

Product: Infrastructure Technology Network High-performance real-time messaging for distributed control systems and sensor data distribution. Developed and deploying reliable, highly available, fault tolerant, and zero-administration applications that operate over wireless links that can be unreliable, intermittent, high latency and low bandwidth. Reliably recording large volumes of high-throughput, real-time surveillance data for post-mission analysis

DA: Critically acclaimed middleware solutions for UAV platforms with TRL ranking of 9. Used by General Atomics, Cassidian and EADS company to enable the rapid development and integration of mission-critical sub-systems into next generation GCS's

GREEN HILLS SOFTWARE (COLUMBIA, MARYLAND)

www.ghs.com

Contact: John Warther, (NAVAIR-work) VP Government Programs, john.warther@ghs.com

Contact (St. Louis): Jason Stroud, Regional Sales Manager, Jason.stroud@ghs.com

Product: INTEGRITY -178B, complete time and memory-partitioned real time operating system designed for used in reliable, mission critical, safety critical and secure applications.

DA: Linux based high assurance platform, EAL6+ high robustness. Specifically built/purposed for Unmanned Systems.

Interesting: Company's products are mostly TRL 9.

LYNUXWORKS (SAN JOSE, CALIFORNIA)

www.lynuxworks.com

Contact: Robert Day, VP Marketing rday@lnxw.com

Product: RTOS Operating System multi domains on the same system. Partitioning – separation kernels. Peer-to-peer between domains – selectable one-way directional/bi-directional. Highly secure virtualization.

DA: EAL 6+. First and only embedded operating system to receive Advisory Circular AC-20-148 Approval (Reusable software components). Has real time scheduler – if there is a communications failure, the user can shut down one window and allow the other windows to run as scheduled/programmed.

WIND RIVER (ALAMEDA, CA)

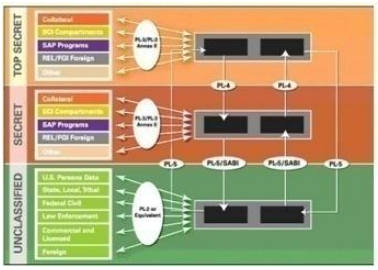
http://www.windriver.com/

Contact: Tim Skutt, Solutions Architect

Product: IPSec - Authentication, data integrity, and encryption of any network traffic on the IP layer, support both IPv4 and IPv6, a powerful management API, and flexible hardware interface for encryption acceleration.

DA: Secure Platform for use on tablets or phones running Android. Can open two windows at the same time on a table to run Android apps (Google map, UAV's flight path) simultaneously.

EXMERITUS http://www.exmeritus.com/



Contact: Jonathan Moneymaker, Intelligence Systems Group director for Information Solutions

Product: eXMerutus HardwareWall appliance – a COTS product that provides secure data transfer of different classification levels, from TOP SECRETT//SCI//SAP to Unclassified across domains where systems are interconnected. Ideally placed at all PED locations (incoming ISR and outgoing) to ensure complete information assurance.

DA: For file transfer and streaming data; high-speed data transfer. One of only a select number of technologies listed on the Unified Cross Domain Management Office Baseline, a list of validated solutions already certified and accredited by sponsoring agencies.

Interesting: May 2012, Boeing completed the first delivery of this tactical cross-domain technology to General Atomics-ASI. The system will be integrated into the GCS of the Predator/Reaper UAV to improve the ability of intelligence analysts and warfighters to securely access videos and imagery from the MQ-1Predator and MQ-9 Reapers. Includes IA and engineering support from Boeing.

OTHER INNOVATIONS

BOSTON DYNAMICS (WALTHAM, MASSACHUSETTS)

http://www.bostondynamics.com

Contact: Greg Klecker, Director of Domestic Sales

Product: RHex, is a six-legged robot with high mobility. Powerful, independently controlled legs produce specialized gaits that devour rough terrain with minimal operator input, climbing in rock fields, mud, sand, vegetation, railroad tracks, telephone poles and up slopes and stairways. Sealed body, making it fully operational in wet weather, muddy and swampy conditions.

DA: Controlled remotely from an operator control unit at distances up to 700 meters. Visible/IR cameras and illuminators provide front and rear views from the robot.

Other product(s)

- **SandFlea-** one pound robot that drives like an RC car on flat terrain, but can jump 30 ft into the air to overcome obstacles. High enough to jump over a compound wall, onto the roof of a house, up a set of stairs or into a second story window.

AIR FORCE RESEARCH LABORATORY (GREENE, OHIO)

http://www.wpafb.af.mil/AFRL/

Contact: Pam Pitchford, Liaison

Product: Hard and Deeply Buried Target Technology, focused on providing the Air Force munitions community with new capabilities that can better neutralize these increasingly hardened and below ground enemy facilities. Concepts support development of conventional ordnance packages tailored for the penetration and defeat of these difficult targets. These near- and mid-term approaches are characterized by an increase in target impact velocity over current inventory approaches.

DA: Intent of this transition is to reduce the design risk in future HDBT air-to-surface munitions concepts that will, themselves, eventually translate into the next generation of fielded HDBT weapons.

Other product(s):

- Close Controlled Strike Vision- 50lb, 25lb, and 1lb swarming munitions designed to rapidly deliver scalable kinetic effects to difficult targets.

Vanguard Marketing International, Inc.
See what's next, Being what's next®

As a follow-up, the reader is encouraged to review Vanguard Marketing's website and published white papers on selected topics related to Vanguard's core competencies at:

http://www.e-vmi.com/pgs/library.html

For more information or to contribute to this or other white papers: Call 480-488-5707