VMI's Best of the Best at 2016 XPONENTIAL

Drones, Systems and Technologies

VANGUARD MARKETING
INTERNATIONAL INC

www.e-vmi.com | 480-488-5707

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Section I: VMI Perspectives from AUVSI's XPONENTIAL 2016

VMI Viewpoint

VMI was in New Orleans from May 2-5 at XPONENTIAL 2016, which is the new name for the Association for Unmanned Vehicle Systems International's (AUVSI) annual trade show. Formerly referred to as "AUVSI Unmanned Systems" show, AUVSI rebranded its annual industry event to reflect the tremendous growth and innovation taking place in the unmanned systems industry globally.

In the post 9/11 era, AUVSI has helped promote the dramatic acceleration and acceptance of unmanned systems technology, predominantly with military and civil government users. In more recent years, the non-profit organization has witnessed an "***exponential*** emergence of commercial and consumer applications and demand" for cutting-edge strategies and technologies in intelligent robotics, automated vehicles and drones. Manufacturers are discovering new ways for these technologies to transform the way we do business, interact with one another and become part of our everyday lives. From farmers and first responders to the world's largest retailers, the number of end users of autonomous aerial systems are rapidly expanding.

To meet the needs of its broadening constituency, AUVSI revamped XPONENTIAL to appeal to the evolving trends and market requirements of this estimated $48 billion industry. While AUVSI quoted the same number of participants—8,000 attendees and 600 exhibitors—for both its 2015 and 2016 events, VMI noticed a marked difference in this year's trade show, which filled four halls at the Ernest N. Morial Convention Center. AUVSI succeeded in intersecting commercial and civil/defense applications at XPONENTIAL by creating an experience hub for business and investment among innovators, educators and end users from more than 55 countries.

In former years AUVSI focused more on the unmanned systems platform for the defense industry. At its 2016 event, we were able to experience new and emerging capabilities, detailed in this report, that are enabling end users in every industry to save time, money and lives. As further evidence of AUVSI's intent to increase awareness about the growing market for unmanned systems across all domains, the organization's line up of keynote speakers included representation from the commercial, civil and defense industries:

- Gur Kimchi, co-founder and vice president of Amazon Prime Air
- John Chambers, executive chairman of the board of Cisco Systems
- Michael P. Huerta, administrator of the Federal Aviation Administration
- Gen. David G. Perkins, commander of the United States Army Training and Doctrine Command

In the following section VMI provides an in-depth recap of the two speakers representing the commercial industries: Kimchi and Chambers.

XPONENTIAL Keynotes Set Tone for Innovation, Collaboration and Education

XPONENTIAL's first general session began with opening comments from AUVSI President and CEO, Brian Wynne and featured keynote addresses by industry leaders Gur Kimchi, Amazon Prime Air, and John T. Chambers, Cisco Systems. Both speakers shed light on the pressing needs for a safe and scalable

infrastructure, global protocols, collaboration with regulatory bodies and advocacy groups along with buy-in and support from national governments to support the booming demand for drones.

Amazon Prime Founder Builds Case for Drone Super Highway

Kimchi continued to spread awareness and seek buy-in for Amazon Prime's concept for integrating drones into airspace. For nearly a year Kimchi has been speaking at industry conferences, including a July 2015 event at NASA's Ames Research Center, where he unveiled Amazon Prime's "airspace design for small drone operations."

Amazon's proposal would essentially create a "drone superhighway" that would give a regulatory authority – the FAA – overarching control of the system, to ensure that the presence of manned aircraft takes top priority over all other aircraft in the vicinity. He described an air traffic management system with "automated, federated traffic controllers" who would share responsibilities for managing drone traffic across multiple overlapping traffic layers. The concept requires drones to have autonomous sense and avoid capability and controllers with smart phone-type connection to networks (cell towers) to work. Drones will communicate with their local airspace controller, controllers will communicate with each other (via the network); local controllers will manage local airspace, and federal regulators will have oversight and command over all controllers, again, via the network.

Kimchi helped the XPONENTIAL audience understand the controller concept by comparing it to how a mobile phone works with standard network interfaces and protocols enabling communication with each other – and now, drone operators can do the same – seamlessly over the Internet. The caveat – the industry must accept these standards and protocols now.

Promoting Safe Integration of Drones into Airspace

Contact VMI (480-488-5707) for the latest on Part 101 and Brexit effects on the FAA elements of airspace integration and drone developments.

Amazon Prime's recommendations for a heterogeneous airspace model, include:

- Enact a **no-fly zone for drones between 400 and 500 feet** to safeguard regulated airspace.
- Designate the **Low-Speed Localized Traffic area from ground up to 200 feet**, for non-transit, low-speed operations, used by photographers, surveyors, agriculturists and other lesser-equipped vehicles like those without sense and avoid.
- **Establish a band for High-Speed Transit, between 200 and 400 feet**, for well equipped vehicles that are exclusively under automatic control. This is the space that Amazon Prime has earmarked for its drones. To create a safe environment and minimize the risk of collisions, aviation authorities would set altitude and equipage restrictions. There would also need to be well established guidelines for sharing important information about location and flight path along with receiving and processing data from other drones.

The end result for Amazon Prime is that the largest online retailer would be able to employ drones to deliver goods at high speeds to the homes of their online shoppers in 30 minutes or less. Considering how Amazon has changed the way the world shops and consumers expect 24/7 access to goods and services, VMI believes that Amazon certainly has a track record of disrupting industries with leading-edge technological innovation and services. Amazon will also have significant support from a growing community of businesses that want to tap into the power of drones.

Drone Market to Triple by 2020

The number of drones circulating overhead is expected to triple in the next four years, according to the United States FAA's aerospace forecast for 2016 to 2036 released in March 2016. The FAA estimates hobbyist and commercial drones in the U.S. will increase from 2.5 million to 7 million by 2020.

Just as Amazon is giving Kimchi the resources and go-ahead to grow his team of aviation, robotics, hardware and software experts in the development of Prime Air vehicles, systems and operations, there are countless other commercial, civil and defense organizations eager to fully leverage the benefits of drones.

The FAA established a Drone Registration task force in October 2015 that includes individuals from Amazon, Wal-Mart, Google, BestBuy, Parrot and GoPro along with others involved in the creation and manufacturing of drones, hobbyist organizations, pilots and civil services to create a blueprint for a system that registers and classifies drones. The goal for the system is to provide the government and law enforcement with the tools they need to track drones that do not comply with FAA rules.

While maintaining safety in the skies is a top priority, the FAA has some huge adoption challenges to overcome. They will need to ensure the appropriate regulations, standardization and infrastructure requirements are established to accommodate the growing demand for drone delivery services. We at VMI are excited about the potential of drones. That said, we believe the unfortunate reality is that near-term innovation will continue to take place outside of the U.S. in countries such as France and Australia who have elevated drones as strategic Government initiatives in order to attract innovators from abroad so they can get a jump on the US in technology, industry application and visibility in global markets.

Cisco Chairman: We are in a "Period of Disrupt or Be Disrupted"

While Amazon Prime's Kimchi urged everyone to get on the same page and "speak the same language" to advance the use of drones globally, John Chambers, executive chairman of Cisco Systems, encouraged more buy-in at the national level. Noting that in Q1 2016 France ranked the number one startup country in Europe for innovation focusing on drone applications such as aerial mapping, surveying and analytics. Chambers projected that due to a "massive wave of change coming from the *Internet of Things* – aka *Internet of Drones* – 40 percent of businesses today will be gone in a decade if they do not adapt."

The rapid growth in technology innovation over the past 20 years or so is indeed paving the way for increased opportunity for intelligent drones and autonomous systems. Factors such as the pervasive availability and low price point of smart sensors, high speed networks and connected mobile devices along with increased adoption of cloud computing are paving the way for double-digit growth in the IoT market.

While Cisco studies suggest the market potential for the "Internet of Everything" industry to be valued as a $19 trillion opportunity, other experts predict the IoT market size to grow from USD $157.05 billion in 2016 to USD $661.74 billion by 2021, at a Compound Annual Growth Rate (CAGR) of 33.3% from 2016 to 2021. Whatever the true market size, VMI clients need to take heed.

Embracing an Efficient, Proactive Digital Economy

Chambers encouraged XPONENTIAL 2016 participants to follow the path of such companies as AirBnb, which enables people to list, find, and rent lodging, and Uber, which has changed how people get affordable rides anywhere, anytime. These "sharing economy businesses" are empowering independent workers and contractors. They are also forcing firms with older business models to rethink not only their employment model, but also how they utilize technology with winners tapping into all the benefits of the digital economy.

Chambers is recommending the same pivot for the unmanned vehicle systems industry by ensuring that business leaders are building relationships with governments and regulatory agencies to promote - not inhibit - growth in the U.S. Many in industry support Chambers views on the need to establish an agile infrastructure that enables real-time, optimized and efficient operations. The time has also come for companies within the robotics and autonomous industry to focus more on the value of the systems' outcomes versus the technology itself. Farmers think about improving crop yield and fighting pests, not drone endurance.

An excellent example of a company doing just this is Zipline International, a Silicon Valley startup. Zipline is establishing a network of autonomous, fixed-wing drones in Rwanda to deliver blood, vaccines and medical supply to remote areas of the country. Zipline announced in April 2016 that it will be able to deliver packages to the country's 12 million citizens in 30 minutes once it begins rolling out its network in July 2016. The start-up is getting a helping hand from UPS, which is going to offer its shipping and logistics expertise to support Zipline's delivery of temperature-sensitive vaccines and blood to remote areas. UPS will also be using the opportunity to closely observe Zipline's approach to drone delivery.

"If we're successful in this pilot, we have a vision of taking this solution to save lives in other parts of the world," said UPS Foundation president Eduardo Martinez. "There are infrastructure challenges here in the US and a lot of other parts of the world. We're losing lives every day because of that. Our vision is to look beyond Rwanda."

This is just one of many examples that VMI can relay of how drones and other unmanned systems are providing unparalleled situational awareness, capabilities as well as saving money, time and lives. In the following section, we provide some of the innovations from XPONENTIAL 2016 that we believe are noteworthy. We will breakdown our reporting into the following sections:

- Platforms
- Countering Drones
- Gimbals, Cameras/Sensors & Solid State
- Control - Detect and Avoid
- Mapping, Surveys
- Wireless for HD
- Autonomy & Integration; Deep Learning

Section II: Commercial, Civil and Military Platforms

When we first encountered commercial drones at the 2015 Consumer Electronic Show a year and a half ago, they were on the whole quadcopter toys with a promise to enhance outdoor adventure, preserve vacation memories, and maybe enable some opportunities to make a buck. But the utility caught on – skyrocketing them into the film industry and offering news channels live aerial reports of crimes and rescues without the expense of large manned helicopters. Expert surveyors now can apply their craft utilizing drone-based precision mapping, while demonstrating huge value and time-savings to land development firms. Grape and nut growers, with years of field science from agronomists, can leverage space-age aerial multispectral imaging to more precisely care for their fields, further increasing yields and reducing costly overspray of pesticides. There are new profits to be made.

New York Gold Spot Price (24hrs) Jun 22, 2016 at 17:01 EST	
Gold Price Per Ounce	$ 1,268.86
Gold Price Per Gram	$ 40.79
Gold Price Per Kilo	$ 40,794.80

In the warfighter's world, Special Forces have been utilizing mini and micro drones for "overmatch" reconnaissance and situational awareness for the last couple of years in Afghanistan. Militaries from over sixteen countries are favoring one special micro drone weighing just 18 grams which has seen its price tag drop from $190K per unit in 2013 to a mere $50k per system in 2016 (the latter comprising 2 UAV's and a Ground Control Station weighing a total of ~1,320g). Soldiers say these micro drones are worth their weight in gold! That's the truth!

Industry Legend:
CO - Commercial
CI - Civil
MI - Military

While we stated earlier – *it's not about the platform but the results*, today's unmanned aerial systems' are lining up specific form factors and capabilities according to industry application, end-user needs, price points and ability to deliver outcomes.

- [CO-CI] **Precision-Hawk: Fixed-Wing** - work very large areas; offering end-to-end information solutions and leadership in Airspace Integration
- [CO-CI] **French-based Delta-Drone: Fixed Wing and Quads** - first to so many markets around the world with support of the French government; gaining huge experience in these domains
- [CO-CI] **DJI: Quadcopters**, world's leader in compact, easy to field quads; offering advanced stabilization and obstacle avoidance
- [CO-CI] **Autel: Tiltrotors** – **Best of Quad and Fixed Wing** – This hybrid platform promises flexible fielding, longer endurance and greater coverage area
- [CO-CI-MI] **Insitu & Textron Fixed Wing Hybrid Quad** – Hybrids are trending; Best in class
- [CI-MI] **Prox Dynamics: Micro Drone Copter** – The Black Hornet provides Soldier Borne Sensor (SBS) capability, pushing the envelope on future missions

Looking to further boost its surveillance and unattended dispatch capabilities, the Civil Sector and US military have begun testing tethered drone systems that hover in the air and stream continuous aerial views to security personnel or troops on the ground, while others lay in wait for the right time…

- [CO-CI-MI] **H3 Dynamic's Drone in a Box – unattended drones** – all-inclusive, 24/7 reactive monitoring with fuel-cell technology advancements
- [CI-MI] **AeroVironment – introduces Tether Eye** – persistent eyes and power for days
- [CI-MI] **Polarity – Tether *your* drone** – Add military grade strength; power & communications

PrecisionHawk (Raleigh, NC) www.precisionhawk.com

[CO-CI] FIXED WING / INFORMATION SOLUTION

Contact Brandon Eickhoff, Sr. Operations Engineer, 1-888-958-1451 x114

Products/Services

- **Fixed-wing drone maker** has lead the industry with its cost effective solutions; and is the leader in aerial data collection, analytics and safety platforms for drones with **primary industry being agriculture**
- **Provides end-to-end solution** using a wide range of UAVs (Lancaster, DJI, Matrice, and Inspire) for data collection
- **Proprietary analysis software platform**, **DataMapper inflight app**, to provide better business intelligence to clients across a wide range of civilian industries.

XPONENTIAL Announcements

1. Expanded its previously announced **partnership with Harris Corporation** to provide the industry with technology tools that will enhance the operational and situational awareness of drone pilots. The two companies are also moving toward the deployment of a UAS airspace management system using technologies like PrecisionHawk's LATAS platform. PrecisionHawk and Harris presented their strategic plan for airspace integration to move the industry to more advanced drone operations sooner, such as beyond visual line of site (VLOS) flight. **Download the white paper** here**.**
2. **Joining forces (software):** PrecisionHawk and DJI, a leader in multi-prop hovering UAVs, are coming together to provide an easy-to-use "drone and data" package for use by farmers. This new partnership enables anyone to get a UAV up and flying to capture information. Called the "Smarter Farming" package, it will include the DJI Matrice drone (M100 or M600), the new DataMapper Inflight app for data collection and a one-year subscription to DataMapper for data management analysis.
3. **Announced strategic alliance with Insitu**, a provider of information and UAS' for commercial, civil and military operations, to provide aerial solutions that help commercial enterprises achieve safe unmanned flight for extended and beyond-visual-line-of-sight (BVLOS) operations. Emphasis of the U.S.-based alliance is on providing business intelligence support for commercial operations, including asset protection, property preservation, safety enhancement and environmental monitoring. Alliance is designed to encourage more businesses to explore what unmanned technology can offer.

Differential Advantage Tyler Collins, VP LATAS at PrecisionHawk, said the team is working this summer to **test its extended visual line of sight (EVLOS) flight concept**. The EVLOS process would include a visual observer that would allow a drone operator to fly as UAV out to roughly two to three nautical miles. Testing of the concept will take place this summer

(www.FlyLatas.com)

The company also presented the **Lancaster 5, a five-band multispectral sensor**, which is reported to be **180% more robust than its predecessor**. Built for the field, Lancaster 5 is fully autonomous and easy to use with smart flight controls that adjust to various payloads and unpredictable environmental conditions to get the data needed.

Suited for agriculture, energy and mining, insurance and emergency response, and environmental monitoring.

http://www.precisionhawk.com

Delta Drone (Dardilly, Rhone, France)

www.deltadrone.com

INFORMATION SOLUTION –

Contact Alexandre Chardon, Commercial BD, +33 4 27 46 51 54

Products/Services

- Worldwide integrator of civilian drone services for professional use; Designs and manufactures the Delta Y (fixed wings) and Delta X (multi rotor) systems; Has five operating drone pilot training centers.
- **Wholly owned subsidiary, MTSA Hyrdogeosphere was founded in 2001** with two branches specializing in: Mining Topographic Survey and Imaging; and Hydromorphology water-related applications.

XPONENTIAL Announcement

1. Unveiled its new helicopter drone, the Delta X, at show with **tagline "from aerial acquisition to data valorization,"** (the increase value of capital assets).
2. Announced on April 25th an **alliance with Geodis**, a France-based supply chain leader in transportation and logistics, to jointly develop an automated inventory solution in warehouses based on the use of drones with testing concluding in May. The solution will be made available to 300 retail Geodis stores worldwide

Differential Advantage

3. Delta Drone offers to its customers a complete solution of aerial analysis collecting the automated processing of acquired data, relying on its proprietary cloud solution.

Targeted markets are Topographic Surveying & Imaging for Mines and Quarries, Agriculture, Industrial Inspection, and Hydrology.

THE FUTURE OF POSSIBLE

DJI (Shenzhen, China; US - San Mateo, CA) www.dji.com

QUAD COPTER / INFORMATION SOLUTION

Contact North America sales: sales@dji.com; +1 818-235-0789

Products/Services

- Shenzhen-based market leader in easy-to-fly drones and aerial photography systems. Products include the DJI quadcopters, such as the Phantom, that represent **the standard in consumer drone technology.**
- Develop and market flying and **camera stabilization** systems that are **redefining camera placement and motion** with its ability to capture high quality photos, video, professional imagery.

XPONENTIAL Announcement

1. Announced on May 4th the release of Osmo RAW firmware for Zenmuse X5R gimbal and camera, as well as the Single Shot, Multiple Shot, Interval Shot, Video and Audio Recording features. New release improves camera stabilization and includes reverse joystick control function for tilt and pan axis.
2. Post XPONENTIAL announced the launch of new mobile apps built on the DJI SDK: COMMANDER by Skycatch that enables pilots to easily create high-resolution maps and 3D models by planning and safely flying autonomous missions in just a few simple steps. Data can be automatically uploaded for automated cloud processing and accessed via the Skycatch Dashboard to view, analyze, and share with clients and company personnel.

Differential Advantage

A range of industry reviewers believe that **DJI's Phantom 4 (2016)** easily beats the competition as an accessible yet advanced prosumer-level (person who consumes and produces media) drone. It offers user-friendly intelligent features, **4K camera with slow-motion recording, and a speed of 45 mph.** It looks similar to its predecessor, Phantom 3, and has a price point **starting at $1,399 in the U.S.**

Intelligent features include **advanced obstacle-avoidance** system that DJI calls OSS that helps to prevent accidental collisions. OSS is a set of optical sensors that help to navigate the drone around obstacles within 2.3 to 49 feet away or it will simply stop and hover until the user pilots the drone away. Another smart feature is ActiveTrack, in which the drone automatically follows an on-screen object, such as a person, and enables even first-time users to capture steady tracking footage, and even pan 360 degrees around a moving object.

Serves the needs of Agriculture, Mapping/Surveying, Photography (Real Estate, Publications, etc.), Research and Development

Autel Robotics (Greater Seattle, Washington) www.autelrobotics.com

TILTROTOR – FIX WING HYBRID QUAD LIFT

Contact 844-692-8835; Arvid Elias, Autel Robotics Senior Director of Technology (with two decades as senior program engineer (mobile devices) at Microsoft and CSC.

Products/Services

- Best of both worlds – Kestrel is a tiltrotor platform – **a quad and fixed wing platform combined; Solves the "no runway" issue.** Kestrel is easy to field and has longer endurance and coverage area, with excellent stabilization.
- Also, manufacturer of the easy-to-use X-Star (X-Star Premium and X-Star) series of 4K camera drones for aerial photography/filming and imaging along with new handheld camera stabilizer prototype and the Kestrel project.

XPONENTIAL Announcement

1. The Autel Robotics team continued to preview the "Kestrel" prototype, designed for long-range, high speed missions. Autel initially revealed the Kestrel drone at the CES 2016 Technology show in Las Vegas and again at NAB 2016, and plans to see the platform **available sometime March 2017 for $10,000-$15,000 (not including sensor package).**

"We keep seeing new and amazing uses for the platform and have chosen to embrace that," Autel Robotics Senior Director of Technology Arvid Elias said. **"The same kind of modularity you see with our X-Star series, you will see on the Kestrel, but on a much larger scale."**

Kestrel's First Flight: https://www.youtube.com/watch?v=jidHDXH5GeA
Transition Vertical to Forward: https://www.youtube.com/watch?v=Je66mlK_XIg

Differential Advantage

Autel Robotics is positioning Kestrel as an "unprecedented," first-of-its-kind, vertical takeoff and landing, fixed-wing drone. The Kestrel transitions into a fixed-wing flight mode once in the air.

The Kestrel, with max takeoff weight of 31 lbs., and design payload of 4.4 lbs., it is slated to be able to efficiently use its battery for flights from 1.2 to 2 hours with a range of up to 62 miles and top speed of 40 m/h.

Serving the needs of Agriculture, Cinematography, Construction/Mining, Consumer, Mapping/Surveying, Photography (Real Estate, Publications, etc.), Public Safety (firefighting, law enforcement, search and rescue, etc.); additionally, announced resource management, inspection, security, and imaging.

INSITU (Bingen, Washington), www.insitu.com

FIXED WING HYBRID QUAD LIFT

FLARE quad lift of Scan Eagle; Microsoft Hololens HMI for Insitu's Inexa Control Software (photo courtesy of Insitu)

Contact

Andrew Hayes, Director of Advanced Development 509-637-6196

Products/Services

- Unmanned Systems innovation company with end-to-end solution for commercial, civil, and defense industries
- FLARES – a quadcopter that can launch Insitu's ScanEagle

XPONENTIAL Announcement

1. Announced the Flying Launch and Recovery Systems (FLARE) launcher
2. Insitu showcased its new Inexa Control Software integrated with HOLOLENS – ***clearly one of the top innovations of the show***
3. Partnership with PrecisionHawk to bring best-in-class Drone Services to Commercial Market – safe flight for extended and BVOS operations

Differential Advantage

With a wingspan of 3m (10ft) and maximum gross take-off weight of 22kg (49lb), the ScanEagle is normally launched from Insitu's trailer-mounted Mark 4 catapult launcher and recovered via the SkyHook system, which uses differential GPS navigation to guide the aircraft into a trapping cable.

That equipment is not always suitable for launching UAVs from inside walled military bases, jungle canopies, or cramped spaces. The FLARES unit starts autonomously, flies up to its release altitude, flies forward to a certain speed and releases the ScanEagle so that it autonomously takes off and goes into an orbit. The FLARES unit returns back to where it took off and hovers waiting for the operator to give the all-clear. ***Should be ready for production by late 2017.***

Textron Systems (Huntsville, MD) www.textronsystems.com

Alternative approach: April 2016 - Textron completed hybrid quadrotor integration on its Aersonde, a small UAV adapted with a multi-rotor system lift off and land vertically, as opposed to being catapult-launched *and* recovered via a catch net. With the addition of VTOL capabilities, the system retains service-proven capability within a smaller, more portable footprint.

A flight test in which a transition to forward fight is scheduled for the first quarter in 2017.

TEXTRON's Aerosonde –

Hybrid with partners Latitude Engineering and Cloud Cap Technology.

(Fix Wing Hybrid with VTOL lift)

Proof of Concept

Prox Dynamics USA Inc. (HQ in Alexandria, VA)

www.proxdynamics.com

MICRO DRONE COPTER / PERSONAL RECONNAISSANCE SYSTEM (PRS)

Contact 1-703-212-8960 or salesUSA@proxdynamics.com; Prox Dynamics AS, (HQ in Norway)

Products/Services The PD-100 is the **first airborne and commercially available Personal Reconnaissance System.** It provides end users with a highly mobile sensor system providing an immediate Intelligence, Surveillance, and Reconnaissance capability.

- Over 4000 units have been sold to 16 countries
- Rotor span 120 mm; Mass 18 g including cameras
- Maximum speed 5 m/s; Endurance up to 25 minutes
- Digital data link beyond 1600 m line-of-sight GPS nav or visual nav through video

YouTube Black Hornet PRS

XPONENTIAL Announcement

1. Prox Dynamics pre-announced that a new CONOPS *would be announced at Eurosatory* - A little anti-climactic, except…
2. Eurosatory (June 13-17, 2016): BAE announces it was looking into potential integration of the Black Hornet into their CV90 armored vehicle as it continues to refine the BattleView 360 digital mapping system. For BAE, the birds-eye perspective has been important for missions. Teaming UAVs with the CV90 would enable it to approach [a site] faster because you already know what is in the area. An additional area of interest includes bringing augmented reality into the CV90 gunner view site; this would align with what the commander and crew member are looking at, reducing the risk for error.
3. In other news: South Korea's Hanwha Techwin and Prox Dynamics signs an MOU, June 15, 2016.

BAE's CV90 + Black Hornet PRS

Differential Advantage **May 2012** saw the PD-100 Black Hornet PRS become the world's **first operational** Personal Reconnaissance System with its **deployed with UK Forces in Afghanistan**. This deployment demonstrated the system as combat proven and the only true PRS; thus introducing a brand new, game changing capability to the modern warfighter.

Newest PRS based on modern microelectronics, new sensor technology, creative mechanical design, and efficient low-cost production techniques; the system price has gone down several orders of magnitude – ***Black Hornet 2 system now runs $50,000 (includes 2 UAVs and 1 GCS).***

Serves the needs of Law Enforcement, Search and Rescue, Military and Special Forces

H3 Dynamics

H3 Dynamics: DroneBox (Singapore)

www.h3dynamics.com

UNATTENDED DRONE (IN A BOX) / LONG ENDURANGE ENERGY STORAGE SYSTEM

Drone in a Box – Unattended; Long Endurance with Energy Storage

Contact Additional locations in Austin, Texas, and Paris, France. tel: +65 6250 3949; **taras**@h3dynamics.com

Products/Services

- High performance solutions across the UAV value chain:
  - **Fuel cells with hydrogen on demand**
  - **Unmanned vehicles (Hycopter) with integrated fuel cell**
  - **Unattended UAV Dronebox systems**
  - **Real-time sensor data processing capability**
  - **GPS denied navigation**
  - **Long range field communications**

XPONENTIAL Announcement

1. Served as the North America launch of DRONEBOX, a revolutionary system that converges professional drone-enabled services with the Industrial Internet of Things. This all-inclusive, self-powered system can be deployed anywhere, including in remote areas where industrial assets, borders, or sensitive installations require constant monitoring.

Differential Advantage

- Designed as an evolution over today's many unattended sensors and CCTV cameras installed in cities, borders, or large industrial estates; end-users can now deploy flying sensor systems at different locations, and measure just about anything, anywhere, anytime. They offer 24/7 reaction, providing critical information to operators – even to those located thousands of miles away.
- *How it works:* The unattended base station that contains the drone, waits for a signal; Upon receipt of signal, the box opens and releases a quad copter. The quad performs its mission and then returns to its box. The base station performs inspection of the drone upon return and recharges it from solar panel.
- These Droneboxes will connect to other drone boxes, and eventually back to a central control system. This means they can be networked, short-flying drones communicating with other stations in an "internet of drones."
- http://www.popsci.com/dronebox-is-nest-for-drones

H3 Dynamics services a range of industries including agriculture, automated vehicle applications, cinematography, construction/mining, defense and security, energy, power, utilities, industrial, mapping/surveying, natural resource management/environmental, oil and gas, photography (real estate, publications, etc.), public safety (firefighting, law enforcement, search and rescue, etc.), research and development, and more.

AeroVironment, Inc. (Simi Valley, CA) www.aerovironment.com

UNATTENDED & TETHERED DRONE

Contact	Kirk Flittie, VP & GM AeroVironment UAS Business segment
Products/Services	• Tether Eye™ – a new unmanned aircraft system designed to provide continuous, 24-hours-a-day surveillance at up to 150 feet above its launch point. YouTube Tether Eye
Announced at the Special Op Forces Industry Conf. May 23, 2016	1. Announced the US Combatting Terrorism Technical Support Office (CTTSO) is evaluating Tether Eye for ISR and security applications. 2. CTTSO funded the development program under a US government contract.
Differential Advantage	Tether Eye deploys automatically from a small, weather-sealed, self-contained base station and ascends to a pre-determined hover altitude from where viewers of its video feed take advantage of its 360-degree field of view. The specially designed and ruggedized tether connecting Tether Eye to its base station provides continuous power.

Polarity, Inc. (Rancho Cordova, CA) www.polarity.net

TETHERING SYSTEMS

Contact	Call or email technical sales at 916-635-3050 x221 sales@polarity.net.
Products/Services	• Polarity provides tethered power solutions for a wide range of industries including military, commercial, and industrial.
XPONENTIAL Announcement	1. Polarity is now offering tethers systems for small to medium UAVs that require an electrical tether. The tethers are designed for altitudes up to 1000 feet. The combined weight of the 1000ft tether and 2kW down converter is 5.5lbs. 2. Offers several light weight down converters ranging from 500W to 10KW; 1500ft tether—optional optic link; Optional Winching System.
Differential Advantage	Industry leader in Military Grade Electrical Tether System - that require several kilowatts of power delivered over several 100 feet of electrical cable, 1000 feet nominal. Built to withstand harsh environments for shipboard, ground mobile, and fixed ground applications. **Applications include: shipboard, airborne, ground-based military systems, industrial high test machines, commercial electric vehicles, and high voltage medical systems.**

Section III: Countering-Drones

CES2016

VMI's Best of the Best: **Highlights**

https://e-vmi.com/

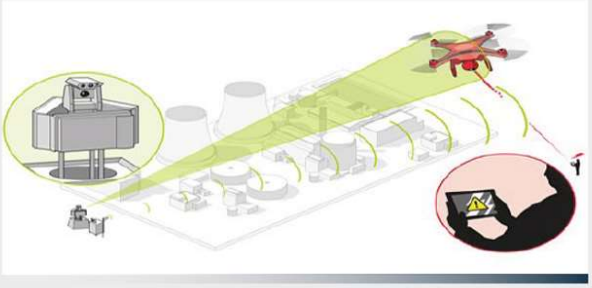
MARKET TREND

Defense Companies in Commercial Sector

Airbus Defense and Space

"We bring it down."

Counter UAV System protects large installations and events from illicit intrusion by targeting their datalinks in order to disrupt their navigation and control; and if that doesn't work, by putting some energy on target.

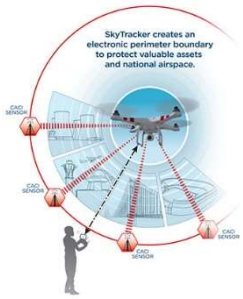


- It uses operational radars, infrared cameras and direction finders from Airbus Defence and Space's portfolio to identify the drone and assess its threat potential at ranges between 3.1 and 6.2 miles (5 and 10 kilometers) (VPJ-R6 Jammer and optional Laser Hard Kill)
- There are dozens of news outlets that published Airbus' as the go to experts in drone defense

In January at the 2016 Consumer Electronics Show in Las Vegas, drones took over a large portion of the South Hall exhibition. Situated next to the FAA booth was Airbus Defense and Systems -- with a slogan "We Bring it Down" in reference to UAV's that get too close to sensitive infrastructure (download your copy at https://e-vmi.com).

In just a few months, numerous defense companies are lining up, recognizing the opportunities to detect, locate, and mitigate aerial threats for defense, industrial, and consumer markets. These players include L-3 Communications-East, ADSYS Controls Inc., Lockheed Martin, Raytheon (Laser & High Power Microwave (HPM)), and a host of others, but the one that had the caught our eye was CACI, SkyTracker UAS.

Initial solutions are focused on the single, small quadcopter or fixed wing vehicle. Yet, in time, especially in the defense sectors, the real need will be to counter swarms of small tactical UAVs like the Blackjack and Shadow. This is where pulsed HPM solutions like Raytheon's will have an advantage.



CACI (Arlington, VA) www.caci.com

DRONE-DECTECTION

Contact Ronald Schneider, Executive VP, Business Development, 703-841-7901 rschneider@caci.com

Products/Services

- CACI's SkyTracker™ unmanned aircraft system (UAS), a new, precision system to protect high-value assets and support public safety against the escalating threat posed by the inadvertent or unlawful misuse of UAS.

White Paper

XPONENTIAL Announcement CACI showcased SkyTracker, which was released in November 2015. SkyTracker's UAS detection, identification, and tracking system uses the drone's radio links to **precisely identify and locate UAS flying in banned or protected airspace, and has the unique capability to locate UAS ground operators.**

Differential Advantage

1. Demonstrated to address a variety of UAS threat scenarios: protecting airports, safeguarding critical infrastructure, stadiums, or events - anywhere UAS pose a potential risk to people or assets.
2. Offers cyber hardening and cyber electronic warfare (EW) use signal intelligence (SIGINT) - air Radio Frequency (RF) to identify drones in the air as well as the ground control station location.
3. Counter-UAS tech testing: CACI's team gave an update on why it was added to the FAA's list of pathfinders and what it has learned about testing counter-UAS near airports. According to CACI, the tests were better than expected.
4. The results aren't out yet, but this technology could be placed at all major airports.

Section IV: Gimbals, Cameras, Sensors, & Solid State

As one aviation writer put it… "If you don't have a sensor package on your drone, well, what's the point? All you'll have is an annoying noisy RC!" At this year's XPONENTIAL we saw Laser, LiDAR, and all sorts of cameras. Many were tied to inertial navigation systems which will provide useful, if not huge amounts of information for mapping and surveilling.

AeroVironment, Inc. (Simi Valley, CA)
www.aerovironment.com

EO/IR CAMERAS AND GIMBAL

Contact Dave Sharpin, vice president of BD, UAS at AeroVironment.

Products/Services

- Designs, develops, produces, and supports an advanced portfolio of UAS for both military (WASP, RAVEN, PUMA & SWITCHBLADE) and civilian (PUMA) applications:
- **Mantis i45 electro-optical/infrared (EO/IR) gimbal payload**

XPONENTIAL Announcements

1. **Unveiled its new Mantis i45 EO gimbal payload** designed for AeroVironment Puma™ AE (All Environment) small UAS – for both commercial and military applications, which will be available to order in September 2016.
2. Announced that the company – in **partnership with SmartC2,** a leading provider of flight business management systems – will team with NASA on its Unmanned Traffic Management (UTM) Technology Capability Levels (TCL) 2 flight demonstration slated for October 2016.

Differential Advantage

Mantis i45 - The new payload **integrates five subsystems with EO/IR cameras** operating at 15 megapixels so that when integrated onto the company's Puma AE platform, it offers pixels on target that customers usually can only obtain with much larger platforms.

NASA, AeroVironment (RQ-20A PUMA) & SmartC2 (VirtualAirBoss™) Partnership - Meets requirements for a small UAS platform with beyond-visual line-of-sight (BVLOS) capabilities and UTM communications interface.

- This capability will help NASA provide technologies that support the development and approval of FAA requirements for safe flight and integration of small UAS into the National Airspace.

ICI (Beaumont, TX)

www.infraredcamerasinc.com

THERMAL AND MULTISPECTRAL IR

Contact **Gary Forister, Sr. Design Engineer, 409-861-0788**

Products/Services

- ICI's thermal and multi-spectral infrared camera solutions include: Visible, NIR, SWIR, MWIR, LWIR sensors with USB interfaces; provides remote management capabilities via ICI Sensor Control Module.
- Manufactures, repairs, calibrates and rents infrared sensor packages for a broad spectrum of industries.
- Offers thermal training, inspection and custom designed systems.

XPONENTIAL Announcement

1. Tweeted during XPONENTIAL about "Sensor Control Module," which was formerly called IR UAV CPU module. See below for more details.

2. USB products include 7000, 8000, 9000 and SWIR Series. The 7320 USB Thermal Infrared Camera offers unmatched image sensitivity and accuracy in a 320 x 240 radiometric imager.

Differential Advantage

Sensor Control Module:

- **USB plug and play**
- It provides remote management of the ICI 9320, 9640,SWIR320, SWIR640, Visible and NIR cameras.
- Manages image storage and data transfer for the images needed to create very highly detailed mosaics, offering exact temperature data for analysis.
- This unit was designed to provide detailed data in the field of Precision Agriculture and many other applications including UAV/UAS integration, robotics, search and rescue, building and roof inspections, archeologic mapping, industrial inspection systems, and alternative energy inspections.

1xiQ USB3 Vision Cameras (photo courtesy of Ximea)

Ximea GmbH (Germany) www.ximea.com

HYPERSPECTRAL

Contact Jürgen Hillmann, COO, juergen.hillmann@ximea.com +49 (2501) 964-555-11

Products/Services

- Manufacturer and supplier of the USB3 Vision camera series and High-end CCD camera series along with high-speed PCIe cameras.

XPONENTIAL Announcement

Presented the newest in UAVs:

1. xiQ - Smallest Hyperspectral Imaging Camera - **USB3 Vision** compatible camera family is especially suitable for use with drones/UAV due to its SWAP - Size (26x26x26mm), Weight (26g) and Power consumption (1Watt). Availability of board level versions or OEM options with angled connectors and NIR (Near Infrared) choices enhances the attractiveness.

Youtube: https://www.youtube.com/watch?v=dPoszgpC6tE

2. xiSpec - Big hit with attendees are usually the mini **Hyperspectral** cameras based on USB 3.0 platform, providing a vast variety of application opportunities.

3. Among other camera lines XIMEA will present established products and newcomers like:
   - **Thunderbolt™** enabled cameras with CMOSIS sensors and new Sony CMOS family with Pregius™ technology
   - **PCI Express** cameras offering 12 and 20 Mpix with incredible speed utilizing its 20 Gbit/sec bandwidth
   - **Subminiature** cameras (15x15x8mm) with 5 Mpix and others

Differential Advantage

- Considered a premier manufacturer of cameras for UAV, XIMEA has been developing, producing, and selling digital cameras for over 20 years. European design and manufacturing, a focus on quality and performance, and a penchant for design have made XIMEA one of the premier sources for scientific and industrial cameras worldwide.

2HperCore is the size and weight of a Rubik's cube

Headwall Photonics (Fitchburg, MA) www.headwallphotonics.com

HYPERSPECTRAL and PROCESSOR STORAGE

Contact Sales in the U.S. by calling (978) 353-4100 or email: info@headwallphotonics.com

Products/Services

- Privately-held designer & manufacturer of spectral imaging instrumentation (Hyperspectral and Raman technologies) for use across quality/industrial inspection, defense/security government, remote sensing, biotechnology/ medical and other commercial applications.
- Spectral regions: UV, VIS, VNIR, Extended VNIR, NIR, SWIR, MWIR, and LWIR. All instruments utilize Headwall's high efficiency diffractive optics that deliver high efficiency (>90%), high spatial and spectral resolution, and a wide field of view.

XPONENTIAL Announcement

1. Most recent news announcement occurred in February 2016 introducing HyperCore, Headwall's new, powerful data processing unit specifically designed for UAV airborne applications requiring sensor fusion.
2. The small size and weight of HyperCore combined with its powerful data processing and high capacity storage connections offers the industry's only processing platform for fusing hyperspectral sensing data with many other sensor payloads on the aircraft.

Differential Advantage

Headwall's CEO David Bannon stated that the **convergence of small UAVs and the need for different but complementary instruments such as LiDAR, GPS, thermal**, and others **led us to develop a single point of fusion for the data streams** from each instrument. HyperCore puts a focus on managing and synthesizing the data streams that are so crucial for developing imagery in remote sensing applications.

"A precision agriculturalist wants to know if there is an invasive disease posing a threat to his crops. HyperCore gives the user community a processing solution for managing those data streams in a small and light UAV-friendly package," said Bannon.

The product weighs only 1.4 pounds (0.64 kg), measures 3.5" x 3.0" x 3.0", and draws only 12W. It is designed to work with Headwall's Hyperspec® family of sensors, plus a wide range of instruments by notable third-party vendors.

HyperCore is the size and weight of a Rubik's cube yet stores 500GB of incoming airborne data and features two Gigabit Ethernet connections, one base CameraLink connection and a multi-purpose I/O port to handle GPS/INS, sensor commands, etc. (credit: Headwall)

ImSAR (Springville, UT) www.imsar.com

NANOSAR

Contact Dr. Michael Duersch, VP Operations, 801.798.8440, michaeld@imsar.com

Dr. Britton Quist, CTO

Products/Services

- Privately-held, world leader in miniature synthetic aperture radar (SAR) technology for manned and unmanned aircraft. The company's flagship product is the NanoSAR multi-mode radar system, which weighs two pounds and includes the navigation system, antennas, cabling, real-time processor, and RF front end.
- *Definition: Synthetic Aperture Radar is a coherent, mostly airborne or spaceborne, side-looking radar system which utilizes the motion of the vehicle carrying it to simulate a system having an extremely large antenna area, or aperture electronically, and that generates high-resolution remote sensing images of a surface.*

XPONENTIAL Announcement

1. ImSAR's announced Fortem Technologies as its new commercial channel partner. Refer to Fortem for details of ImSAR's announcement of its sale of UAV detect-and-avoid radar technology.

Differential Advantage

- World's smallest SAR (1 lb; entire assembly only 2lbs, consumes < 25 W)
- **It is integrated with the Piccolo autopilot and fulfills FAA's requirements for Sense and Avoid, as well as flying Beyond Line of Sight (BLOS).**
- NanoSAR C enables cost-effective detection, location, and classification of targets in rain, snow, fog, dust, smoke, and darkness, where other sensors fail.
- Designed with open standards so that it operates across a variety of unmanned and manned platforms.
- **ImSAR is on board the Shadow and the Integrator (Tactical UAVs).** Their smallest radar is 1 lb and is **on the PUMA (Type 1 UAV).**

Velodyne Lidar, Inc. (Morgan Hill, CA) www.velodynelidar.com

Puck LITE is Velodyne's lightest 3D LiDAR

LIDAR

Contact 408-465-2800 or LiDAR Sales at 408.465.2899 or lidar@velodyne.com

Products/Services
- Developer, manufacturer, and supplier of real-time LiDAR sensor technology used in a variety of applications including autonomous vehicles, vehicle safety systems, 3D mobile mapping, 3D aerial mapping, security and defense.

XPONENTIAL Announcement
1. On May 1, 2016 Velodyne introduced new 3D LiDAR (Light Detection And Ranging) sensor, the Puck LITE, representing the lightest version of company's 3D LiDAR sensors.

Differential Advantage
- The leader in the global automotive LiDAR Sensor market.
- Velodyne LiDAR's Puck LITE is a lighter weight version of the VLP-16 PUCK for applications that demand a lower weight to meet their requirements. The Puck LITE has identical performance to VLP-16 with the only difference in weight of **590 g vs. 830 g** for the latter. No other changes have been made to Puck LITE as it retains its patented 360° surround view to capture real-time 3D LiDAR data that includes distance and calibrated reflectivity measurements. As a mainstay mid-level leader in LiDAR for 3-D mapping, Velodyne's LiDAR sensors offer full 360-degree coverage.

QUANERGY (Sunnyvale, CA) www.quanergy.com


Quanergy S2-Qi Solid State LiDAR

LIDAR, SECURITY, DETECTION

Contact Dr. Louay Eldada, Quanergy CEO; Privately held company. 408-245-9500

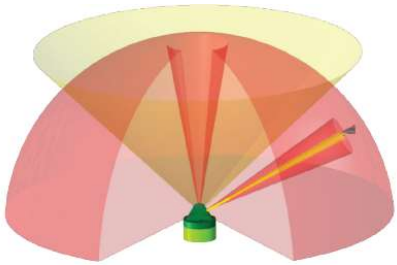
Products/Services
- SolidState high-performance LiDAR - Quanergy offers the world's leading LiDAR sensors and software for real-time capture and processing of 3D mapping data and object detection, tracking, and classification.

XPONENTIAL Announcement
1. Announced they had **revolutionized the LiDAR sensor space** with the development of the all-new S3-Qi, a **miniature solid state LiDAR sensor that is 15% the size of the previous solid state model (S3).**

Differential Advantage
- Newcomer (since 2014) - Well suited in multiple applications including drones, intelligent robotics, security, smart homes, and industrial automation.
- **Size: 1" x 1.5" footprint, weight at about 100 grams, and low power consumption; Price Points: $300 and $200; Mass production Q1 2017**
- **Global Partners: Mercedes-Benz, Hyundai, Renault-Nissan, Delphi, Samsung Ventures…**

Section V: CONTROL - Detect and Avoid

Systems integrators are integrated sensor into autopilots with the objective of enabling autonomous sense and avoid capability – a critical element in sharing airspace with other vehicles.



ADSYS Controls Inc. (Irvine, CA) www.adsyscontrols.com

DETECTION

Contact Karl Pendergast, 720-432-5430

Products and Services

- **SATS2 – Small Areal Threat Surveillance Systems**
- Develops optic systems, remote sensing payloads, test systems, and control systems for unmanned and laser platforms. Specialties include **Video Processing, ISR Payloads, Flight Control Simulators, Autopilots, and Laser Systems**.
- Products include the **Arrow gimballed sensors**, XSight Video Processor, Airborne Sense & Avoid Sensors, Razor Simulation & Test System, LARS Laser Navigation System, and FireFly Autopilot.
- Other solutions include free space optical communications, long-range RSTA payloads, IRST sensors, LIDAR sensors, and laser weapons.

XPONENTIAL Announcement

1. Brian Goldberg gave a talk on Adsys' Certification Platform for Commercial UAS Operations.

Differential Advantage

- The SATS2 system is designed to fill critical gaps in aerial surveillance. Blends optical and acoustic sensing technologies - SATS2 bridges the gap between RADAR and LIDAR to deliver fast and accurate detection of a variety of difficult low observable targets.
- A Whole New Type of LIDAR. Optimized for acquisition speed and accuracy, SATS2 combines fast optical scanning with acoustic cueing to provide detection of low **observable threats at ranges of up to 20km in a matter of seconds**.
- Detection is only the beginning. Once SATS2 has detected a threat, the system provides **precise threat location** with greater than one-meter accuracy. The threat ‘s position is continually updated as it moves, and the system is capable of providing precise location information for multiple threats simultaneously.
- Multiple Threats — One Solution. The SATS2 system provides reliable detection and tracking of a variety of larger traditional targets, including commercial, small, private and rotary wing aircraft; as well as untraditional low observable targets like UAVs, remote control airplanes, ultralights, para-gliders, and hang-gliders.

Echodyne's MESA-K-DEV self-contained radar, the size of a smartphone

Echodyne Corp (Bellevue, WA) www.echodyne.com

DETECT AND AVOID; UAS Detection

Contact

General Information: info@echodyne.com

Products and Services

- Breakthrough low SWaPC radar vision for a wide range of commercial applications including detect and avoid on small UAS and for drone detection.

XPONENTIAL Announcement

Released two news announcements timed with the show:

1. Announced availability of MESA-K-DEV, an ultra-low C-SWAP (cost, size, weight, and power), fast electronically scanning radar based on its patented Metamaterials Electronically Scanning Array (MESA™). Released as a developer's kit, MESA-K-DEV is designed to give integrators the ability to test the breakthrough C-SWAP characteristics and capabilities of MESA-based radar. It is designed for a wide variety of applications, including **drone guidance systems and security systems.**
2. Announced the development of MESA-DAA, **an Airborne Detect and Avoid (DAA) radar** for small to medium-sized unmanned aircraft systems (UAS), that will operate at K-band and be capable of rapidly scanning a broad field of view in azimuth and elevation at ranges out to 3km. Based largely on Echodyne's existing MESA-K-DEV radar, the MESA-DAA is scheduled for release at the end of 2016.

Differential Advantage

MESA-K-DEV

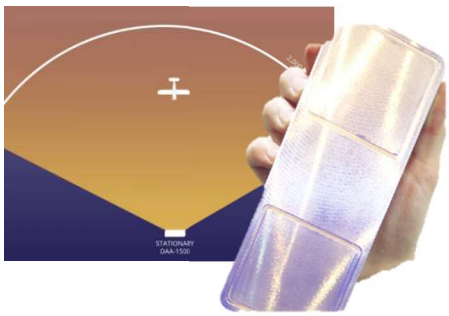
- Eben Frankenberg, founder and CEO of Echodyne claims that MESA-K-Dev is unlike other radar since its C-SWAP characteristics are completely unparalleled for a true electronically scanning radar.

MESA-DAA

- Detect and avoid is a significant technical hurdle to opening up the National Airspace System to UAS. The MESA-DAA technology, once delivered, has the potential to safely open up airspace for beyond visual line of sight operations. The market opportunity for UAS applications is high with FAA forecasting sales of commercial small UAS could exceed 600,000 for 2016 and grow to 2.7 million by 2020, according to the FAA Aerospace Forecast.

Fortem Technologies (Springville, UT) www.fortemtech.com/

DETECT AND AVOID RADAR FOR UAVs



Contact Timothy Bean, CEO, 385-375-3233

Adam Robertson, CTO, (9 years at ImSAR) 801-762-7263 adam@fortemtech.com

Products/Services

- Fortem Technologies is a privately held, venture-backed company that delivers ultra-small SWaP-C radar to enable, for the first time, beyond line of sight unmanned aircraft vehicle operations.
- YouTube: https://www.youtube.com/watch?v=0Uu-lra4_YY
- DAA-R10 provides the aircraft integrator with a radar to quickly and easily detect and avoid.
- Simplicity of integration: a serial connection, 12-28V input voltage, and a graphical web-page configuration over Ethernet. Mounting points allow flexibility to meet the needs of specific aircraft integrations. The DAA-R10 consists of a fully functional, bits-in and bits-out radar unit, communication and power cable, Quick Start Guide, and Interface Control Document (ICD).
- The DAA-R20 is designed for high volume, high reliability, mission critical detect and avoid operation. Meeting rigorous DO-178 and DO-254 standards, the DAA-R20 is designed specifically to meet FAA certifications.

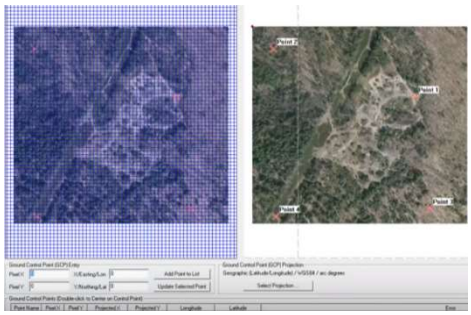
XPONENTIAL Announcement

1. Leading Defense NanoSAR provider IMSAR LLC announced on May 2, sale of the company's detect and avoid radar technology to Fortem Technologies. This technology powered IMSAR's previously announced family of collision avoidance radar designed for the commercial Unmanned Aerial Systems (UAS) market.
2. According to Ryan Smith, CEO of ImSAR, key development milestones have been met allowing the spin out of "sense and avoid" to Fortem Technologies.
3. IMSAR and Fortem Technologies presented at the same booth at XPONENTIAL.
4. Fortem Technologies announced product availability in July 2016.

Differential Advantage

- Traditionally, radar has been large, power hungry, and expensive. Fortem Technologies brings to the market a radar from a proven team that is low cost, with a very small power, weight, and size footprint for use on UAS. With ranges from 1500m to 3000m+ and effective 360-degree coverage, the beginning of true autonomy beyond human line of site is now commercially viable in over 45 countries.
- Dr. Britton Quist, ImSAR's CTO, says; "Radar is ideally suited because it operates effectively in darkness, cloud cover, fog, smoke, and precipitation."
- Timothy Bean, CEO of Fortem Technologies said, "Nothing like this exists in the UAS market today."

Section VI: Mapping, Surveys



Mapping capability for drones is where the rubber meets the road -- the democratization of information, enabling small ventures or individuals to take matters into their own hands instead of relying on big systems integrators with expensive platforms.

Blue Marble Geographics (Hallowell, ME) www.bluemarblegeo.com

Contact

Sales: U.S. and Canada Only: 1-800-616-2725; Global Mapper Sales: gmorders@bluemarblegeo.com

Products/Services

- Developer of geospatial data conversion and GIS software, including Geographic Calculator, GeoCalc SDK, Global Mapper, LiDAR Module, and Global Mapper SDK.

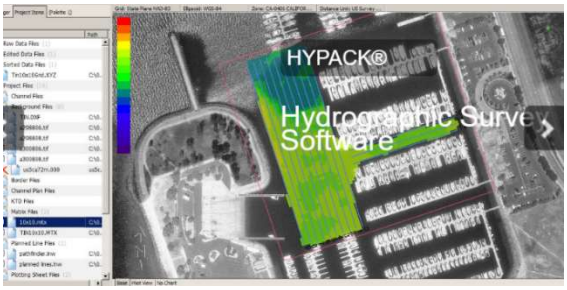
YouTube: https://www.youtube.com/watch?v=QKKjujltuq0

XPONENTIAL Announcement

1. Showcased Global Mapper's UAV Data Processing Capabilities, including GSA sensor-to-data translation

Differential Advantage

- Blue Marble's geospatial data manipulation, visualization, and conversion solutions are used worldwide by thousands of GIS analysts at software, energy, mining, civil engineering, surveying, and technology companies, as well as government agencies and academic institutions.
  - Capable of displaying, converting, and analyzing virtually any type of geospatial data; the application's format support is unequaled among comparable GIS applications allowing it to be uniquely interoperable across multiple platforms.
- Global Mapper is the GIS software of **choice for hundreds of UAV data collection companies throughout the world.**
  - Any remotely collected data can be quickly processed, analyzed, and delivered in virtually any format.
  - The innovative 3D display tools in Global Mapper enable users to create HD fly-through videos derived from UAV flight path data, and the software includes an embedded UAV Video Playback tool.
  - LiDAR Module's capabilities include automatic ground classification, feature detection, along with automatic and custom vector extraction.



Hypack a Xylem brand (Middletown, CT) www.hypack.com/new

Contact Vitad V. Pradith, Technical Support, vitad.pradith@xyleminc.com

Products/Services

- Manufacturer of HYPACK®, which is among the most widely used hydrographic survey and processing software packages in the world, and
- HYSWEEP®, an optional module that provides for the calibration, data collection and data processing of multibeam sonar data inside the HYPACK® package

XPONENTIAL

1. Demonstrated HYPACK® and HYSWEEP® solutions for unmanned systems -- **with a common operating picture above and below the water.**

Announcement Differential Advantage

- **ISR/Survey Column View: Surface and subsurface (on Kongsberg Hydroid Unmanned Underwater Vehicle (UUV)).**
- HYPACK's expertise in hydrographic survey data acquisition, processing, and visualization software will complement Xylem's capabilities in Ocean and Coastal analytics and applications. Uses Velodyne LiDAR.
- HYPACK® is one of the most widely used hydrographic surveying packages in the world, with more than 4,000 users.
- Users span the range from small vessel with just a GPS and single beam echosounder to large survey ships with networked sensors and systems.

Section VII: Wireless for HD

CONNEX real-time drone vision system

CONNEX by Amimon (HQ San Jose, CA)
www.connex.amimon.com

ZERO-LATENCY WIRELESS, HD VIDEO TRANSMISSION TECHNOLOGY

Contact	David Shefler, VP of worldwide sales and BD, 408-334-1927
Products/Services	• CONNEX by Amimon is zero-latency wireless, high-definition (HD) video transmission technology • Wiris 640 includes: a thermal camera, digital camera, and control unit; it's easily connected to the Connex system for even more viewing clarity in real time.
XPONENTIAL Announcement	1. Demonstrated its CONNEX real-time drone vision system, which enables users to perform efficient single flight inspections at 3,000 feet Line of Sight, as well as provides an integrated infrared capability for enhanced viewing clarity in all conditions. 2. Amimon also showed an integrated thermal imaging system from Workswell. The compact Wiris 640 system provides full remote control and allows the inspector to view and store fully radiometric image data (images and video); with the system, inspections can be performed day or night, and in fog, thick smoke, and partly through vegetation.
Differential Advantage	• CONNEX Wireless HD link brings the next level full 1080P 60fps wireless video transmission with zero latency. • Regarded as the industry standard in the broadcast and cinematography markets; Used in remote surgery where zero latency is an imperative. • It's 5GHz radio, 2x5 MIMO and automatic channel selection ensures resilient connectivity, free from interference, specifically from UAV controls and 2.4GHz links. • Multicast feature supports four screens simultaneously, each receiving perfect HD images; Simply Plug-and-Fly. • Encrypted and secured.

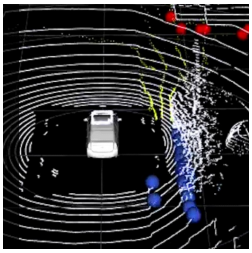
Section VIII: Autonomy & Integration; Deep Learning

AutonomouStuff (Central, IL) www.autonomoustuff.com

Contact Robert Hambrick, CEO, 314-270-2123

Products/ Services

- World leader in supplying specialized product solutions and services related to autonomous driving, robotics, terrain mapping, collision avoidance, object tracking, intersection safety and a variety of industrial applications.



Portfolio of products include: Platform, LiDAR, Radar, GPS/IMU, Computing and Knowledge-based Services.

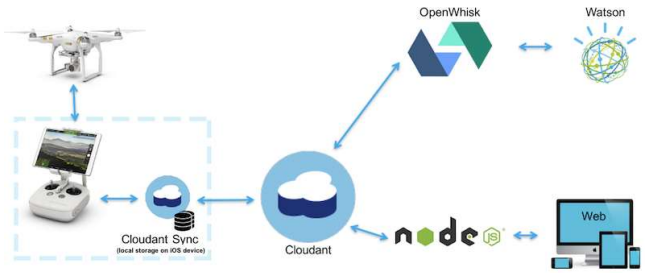
- Polysync (Portland, Oregon) www.polysync.io/
  - Like Android or iOS for Autonomy, enables developers to build, test and deploy automated vehicle applications quickly
- YellowScan Mapper (France) www.yellowscan.fr
  - Lightweight and fully integrated LiDAR system. It is composed of a multi-echo laser scanner, an attitude and heading reference system (AHRS), a GNSS receiver, an on-board computer, and a battery for 2-hours of operation.

XPONENTIAL Announcement

1. Showcased the company's Automated Research Development Platform and a variety of sensors, promoting, "we've got sensors, we've got a research vehicle, a vapor drone, a real-time stencil, ***and Polysync middleware!"***
2. YellowScan had their Mapper attached to a Vapor drone and Polysync was running demos.

Differential Advantage

- AutonomouStuff offers customizable Automated Research Development Platform. A by-wire vehicle, perception kit, middleware. and software applications come together to revolutionize the future of transportation.
- Polysync is a platform for building Level 4/5 automated vehicle architectures. It sits between the OS and the application software, providing a range of tools to enable: Distributed computing, High bandwidth/high compute, Networks, Sensor fusion, Functional safety and cybersecurity, and Software modularity
- YellowScan Mapper – The first turn-key LiDAR system giving you access to highly accurate 3D images from any drone.
  - **Weighs only 2.2kg (battery included) YellowScan is the lightest standalone surveying solution.**



IBM Watson (Armonk, NY) www.ibm.com/cloud-computing/bluemix/watson/

Contact Gavin Arthurs, Systems Solution Architect for IBM

Products/Services

- IBM Watson is a question answering technology platform that uses natural language processing and machine learning to reveal insights from large amounts of unstructured data, which represents 80 percent of all data today, including news articles, research reports, social media posts, and enterprise system data. IBM Watson can answer your customers' most pressing questions, quickly extract key information from all documents and reveal insights, patterns and relationships across data.
- **IBM Bluemix Platform with OpenWhisk** as a Service (PaaS) is an open standard, cloud *platform* for building, running, and managing apps and service.

XPONENTIAL Announcement

1. Gavin Arthurs, Systems Solution Architect for IBM, demonstrated the IBM Watson IoT platform. This presentation will demonstrate capabilities of IBM's IoT platform by using a connected UAV to produce operational data collected, analyzed, and visualized in the cloud.
2. Prior to the event, IBM hosted a webinar, Drones Take-off with IBM Bluemix OpenWhisk, on April 26, 2016 that examine the steps for integrating a DJI Phantom drone into IBM Bluemix through an application paired with a smartphone or tablet, complete with offline data persistence *(preventing data loss in the event network outage)*, data replication to the IBM Cloud, reactive/event driven processing leveraging OpenWhisk, and cognitive image tagging and facial recognition using both IBM Watson and Alchemy services.

Differential Advantage

- Unlimited knowledge from the Cloud vs. on-board machine learning
- IBM Bluemix PaaS API's enable developers to tap into the power of IBM's Watson APIs to build cognitive apps or machine learning.
- This opens the doors to a host of Watson tools that can be used to analyze images from drones and brings the power of cognitive computing to your apps. From analyzing images and video to gaining insights from text, discover how language, vision, speech and data APIs from Watson Developer Cloud can help you solve complex problems.
- Need to train Visual Recognition on specific or custom content? Easily train a new classifier by sending examples and voila! Custom image recognition!

NVIDIA (Santa Clara, CA) www.nvidia.com

VISUAL, DEEP LEARNING COMPUTING

Contact **NVIDIA Partner Network (NPN); and Jetson TX1**

Products/Services NVIDIA has pioneered visual computing—the art and science of computer graphics—for more than 20 years. The company offers specialized platforms for the gaming, professional visualization, data center and autonomous markets. Over the last three years, VMI has witnessed NVIDIA's growth and impact on autonomous vehicle – ground, surface, underwater and air. Their general-purpose graphics processor unit (GPGPU), gives developers access to tremendous parallel performance and power efficiency.

- NVIDIA Jetson TX1, a Tegra X1 module and development kit, brings supercomputing power to an embedded platform, driving breakthrough advances in deep learning, artificial intelligence, autonomous machines, robotics, and more.

THE LATEST TECHNOLOGY

- The Jetson SDK supports the latest drivers, libraries, and APIs.
- cuDNN is a CUDA-accelerated library for deep learning. It's compatible with many industry-standard deep learning frameworks for both training and inference, including Caffe, Theano, and Torch.
- VisionWorks™ is a CUDA-accelerated library and framework for computer vision. It is an implementation of the OpenVX 1.0.1 specification with additional NVIDIA extensions.
- Jetson TX1 supports the latest graphics drivers and APIs, including OpenGL 4.5, OpenGL ES 3.1, and Vulkan.

XPONENTIAL Announcement

1. Announced prior to the show: "Look, Ma, No Hands!" 3 Unmanned Systems Companies to Watch at Xponential 2016.

Differential Advantage

- NVIDIA is refreshing its Jetson platform with the new Jetson TX1 which leverages the more powerful Tegra X1 SoC and its full ARMv8 AArch64 CPU + Maxwell GPU capabilities. NVIDIA claims **that Jetson TX1 should offer 2-3 times the performance of Tegra K1, particularly where the GPU is involved.**
- The TX1 iteration of Jetson enables NVIDIA to better serves the COTS market while also continuing to serve the Tegra developer kit market.

About VMI – Seeing What's Next, Being What's Next™

Founded in 1992, in Phoenix, Arizona, Vanguard Marketing International's longstanding mission is, "to be widely recognized for clear, cutting edge thinking and delivery of actionable results that make a difference for our clients." VMI's methodologies and expertise gives us the ability to analyze markets and design processes that produce disruptive, innovative, low-risk strategies, and action plans. Our goal is to help you see what's next so that you may be what's next! VMI works on an ongoing basis with its clients to ensure that they address changing market needs, capitalize on important industry trends, and maintain brands, which clearly differentiate their company and innovations throughout the investment community and prospective markets.

As a follow-up, we encourage you to check out Vanguard Marketing's website for its Best of the Best at CES (2012 – 2016) selections and published white papers on topics related to *innovation* and VMI's core competencies:

http://www.e-vmi.com
http://www.e-vmi.com/html/papers.html

For more information or to contribute to this or other white papers, please call 480-488-5707