



# Lockheed Martin CDL Systems

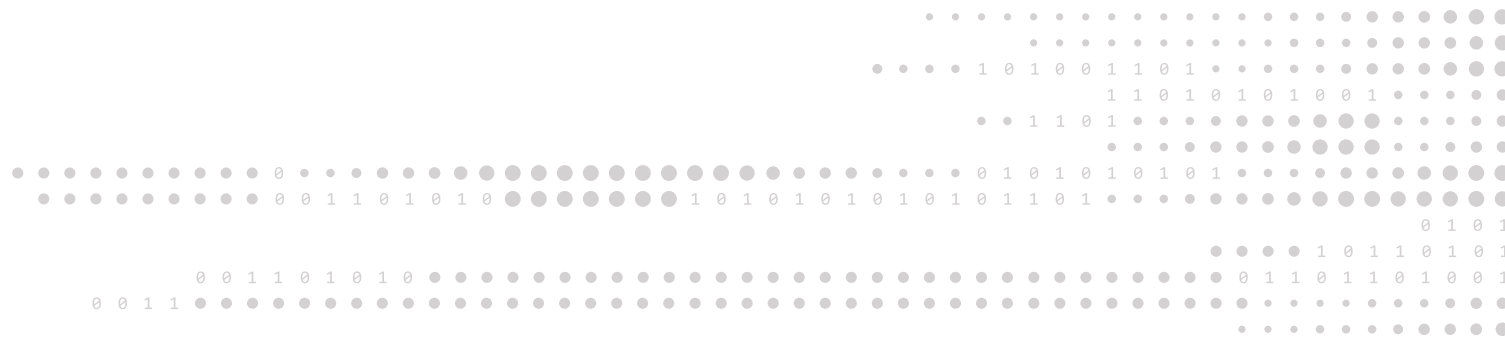
SOFTWARE SOLUTIONS FOR  
UNMANNED VEHICLE SYSTEMS





# Software Solutions

FOR UNMANNED VEHICLE SYSTEMS





Insurance Corp

No Parking





# Who We Are.

Lockheed Martin CDL Systems specializes in the development, deployment, sales and application of unmanned systems for high-end commercial, civil and military applications. Our primary focus is developing software that helps our customers become highly effective using unmanned vehicles and the data they gather. Once a small technology start-up, we are a 40-employee workforce in Calgary, Alberta, Canada.

We leverage international standards and design our software to run on easy-to-find hardware. This provides our customers low lifecycle costs and long-term options for growth, sustainment and flexibility. Our software has been integrated with, and used to control, over 40 unmanned vehicle systems including propeller-driven aircraft, helicopters, jets, airships, convertible aircraft, rigid hull and inflatable boats, large-scale ground robots, quad-copters and solar wings. Our customer set is equally diverse including the U.S. Department of Defense, Canadian Forces, UK Ministry of Defense and commercial service operators. Our combined flight hours exceed 1.5 million.

With an emphasis on low cost, interoperability, automation and low-dependency architecture we support emerging technologies, safety and a growing dependency for actionable intelligence. We look forward to working with you in developing an unmanned future.

# 25 Years of Success



First release of VCS for UTCS to control Barracuda USV

**1993**

**1994**

VCS for UTCS flies Vindicator UAV



VCS for UTCS operates multiple vehicles (USV and UAV)

**1996**

**1998**

VCS for Shadow flies Shadow UAV



VCS for Shadow deployed in theatre

**2002**

**2004**

VCS-4586 (STANAG 4586) flies Grasshopper UAV



VCS for Hunter flies Hunter UAV

**2005**

VCS for UTCS (Using STANAG 4586) deployed

**2006**

**2007**

VCS-4586 flies Gray Eagle UAV



VCS for UTCS operates 16 USV's in SWARMEX demo

**2010**



**2011**

VCS-4586 in Manned Unmanned System Integration Capability demo

**2012**

**LOCKHEED MARTIN**  
Acquires CDL Systems

**2013**

mGCS flies Maveric UAV



**2016**

VCS for Shadow achieves 1,000,000 flight hours



**2018**

VCSi flies Indago™ UAV

# What We Do.

## VEHICLE CONTROL STATION

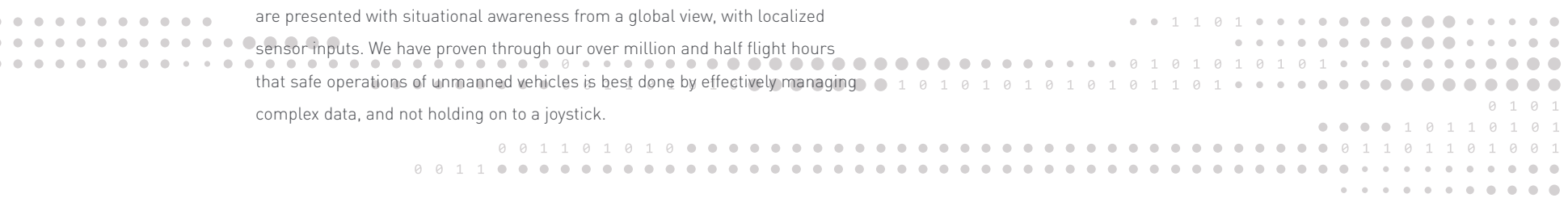
For over 25 years, Lockheed Martin CDL Systems has been at the forefront of unmanned vehicle command and control technology. Going back to 1992, we introduced two innovations to the industry – the Fly-by-Mouse interface, and an open communication language. Both of these innovations remain true today and a part of our control station paradigm.

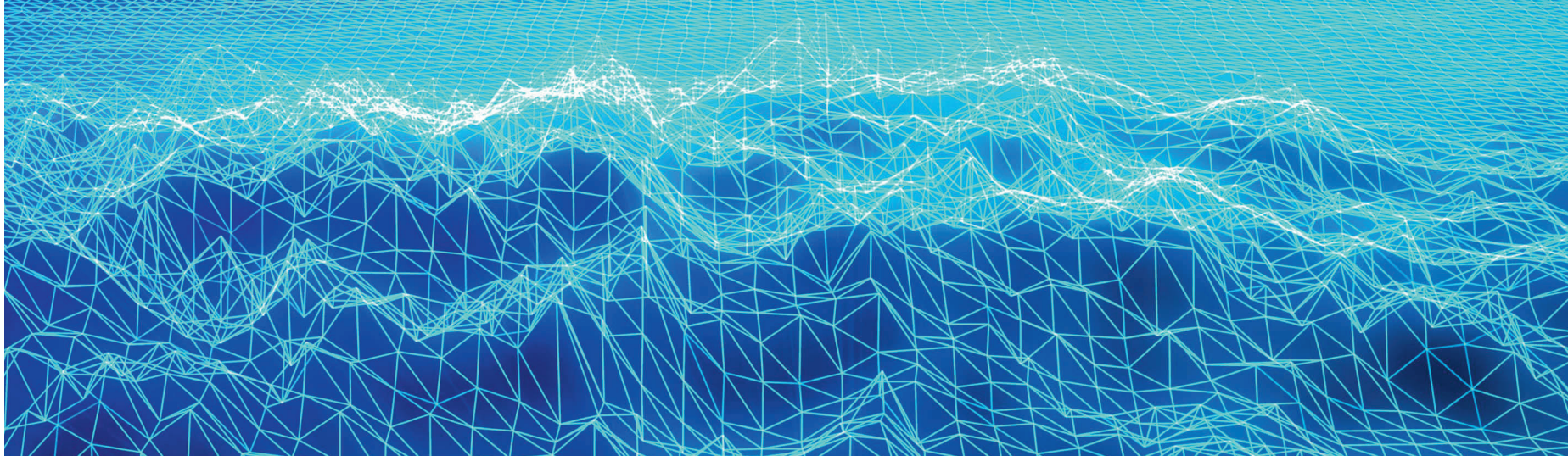
Released for the first time in 2018, the VCSi is our newest and evolving software solution for controlling unmanned systems in multiple domains – from the air to the sea. While VCSi is optimized for use by operators in a seated configuration, using today's most modern and available computing hardware – the PC, it is not confined to that experience. VCSi is extensible from numerous screens down to a hand-held tablet, allowing for a form factor to match your operating environment. Our belief is not to pretend the operator is on-board the aircraft, but rather to treat the operator as an activity manager where they are presented with situational awareness from a global view, with localized sensor inputs. We have proven through our over million and half flight hours that safe operations of unmanned vehicles is best done by effectively managing complex data, and not holding on to a joystick.

As unmanned systems embark on missions measured in months, humans become supervisory participants in the activity, which involves focusing on objectives, threats, alerts and data. It is the data generated by unmanned systems which is of the utmost importance.

## ACTIONABLE INTELLIGENCE

Most unmanned systems capture data. However, large volumes of data are a problem in their own right. What users want is actionable intelligence – data condensed and presented to the decision maker which can immediately answer questions, solve problems, and spur action. Gathering data is useful, but the immediacy of decision-making transforms the value of an unmanned system. CDL Systems is leading efforts to extract actionable intelligence from UAS data by investing in advanced technology. Technologies such as Structure from Motion, Simultaneous Localization and Mapping (SLAM), Monocular Visual Odometry, Point Cloud Generation, Orthomosaicking, Machine Learning and Photogrammetry are all becoming a part of our offerings. We are merging those technologies into new product offerings that empower users. Paired with other Lockheed Martin partners, we are able to truly transform the intelligence generating capability of unmanned systems.





## Real-time Structure From Motion

The ability to generate 3D point clouds and 3D imagery in real-time as a vehicle flies.

## GPS Denied Operation

Using imagery to track the real-time position of an aircraft from passive imagery and not from satellite based triangulation.

## Site Mapping

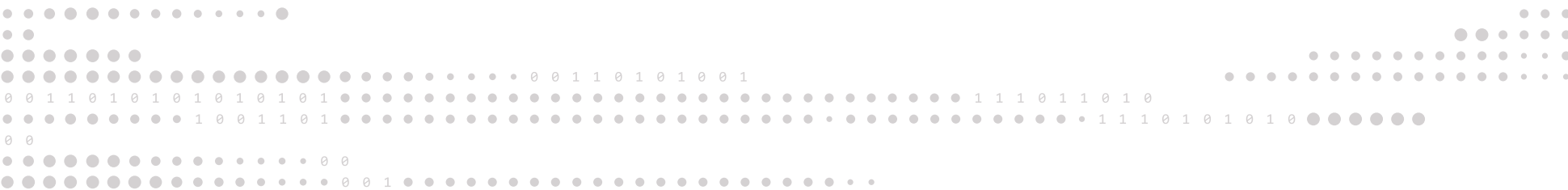
The ability to compare architectural drawings to actual 3D imagery to gather progress updates.

## Tactical Surveying

The ability to produce wide area maps of tactical situations or installations.

## Earth Moving

The ability to generate immediate and up to date 3D renderings of terrain through mining or earth moving activities.









# Portfolio

We have worked alongside a diverse group of international clients on an array of unmanned vehicles and simulation platforms.

Advanced Subsonics Grasshopper  
AeroVironment Raven B  
Airbus Defence Do-DT 25/35/45/55  
ATK Outrider  
Aurora Flight Sciences Centaur  
Aurora Flight Sciences Excalibur  
Aurora Flight Sciences GoldenEye 80  
Aurora Flight Sciences Lightning Strike  
BAE Systems (ACR) Silverfox  
BAE Systems Kingfisher  
Boeing (Insitu) ScanEagle  
Boeing A160 Hummingbird  
Bosh Swiper  
CAE STRIVE  
CAE UAV Simulator  
E.M.I.T. Sparrow  
GA-ASI Gray Eagle (U.S. Army MQ-1C)  
General Dynamics Canada FORESIGHT  
Lockheed Martin Condor

Lockheed Martin Desert Hawk  
Lockheed Martin Fury  
Lockheed Martin Indago  
Lockheed Martin Prepar3d  
Lockheed Martin Vector Hawk  
MBDA Fire Shadow  
MetaVR VRSG  
Northrop Grumman Hunter B (U.S. Army MQ-5B)  
QinetiQ Target Systems Barracuda  
QinetiQ Target Systems Hammerhead  
QinetiQ Target Systems Humpback  
QinetiQ Target Systems Mosquito  
QinetiQ Target Systems Vindicator  
Simlat STS-Pro  
Textron Aerosonde  
Textron Nightwarden  
Textron Shadow 200 (U.S. Army RQ-7B)  
Textron Shadow 400

We have gained recognition for our strong understanding of ground control software unmanned vehicle systems, experience in on-site integration and testing, and our personalized and long-term customer relationships. Our dedicated team of highly skilled engineers brings a wealth of expertise and innovation to the products and services we provide.



# Standardization & Quality

Throughout our history, CDL has always been committed to ongoing advocacy, quality control, continuous improvement, and international standardization. All of these are blended together to create a company committed to the growth of our industry, the success of our customers, and the long term safe integration of unmanned systems into society. CDL Systems has participated in the following initiatives.

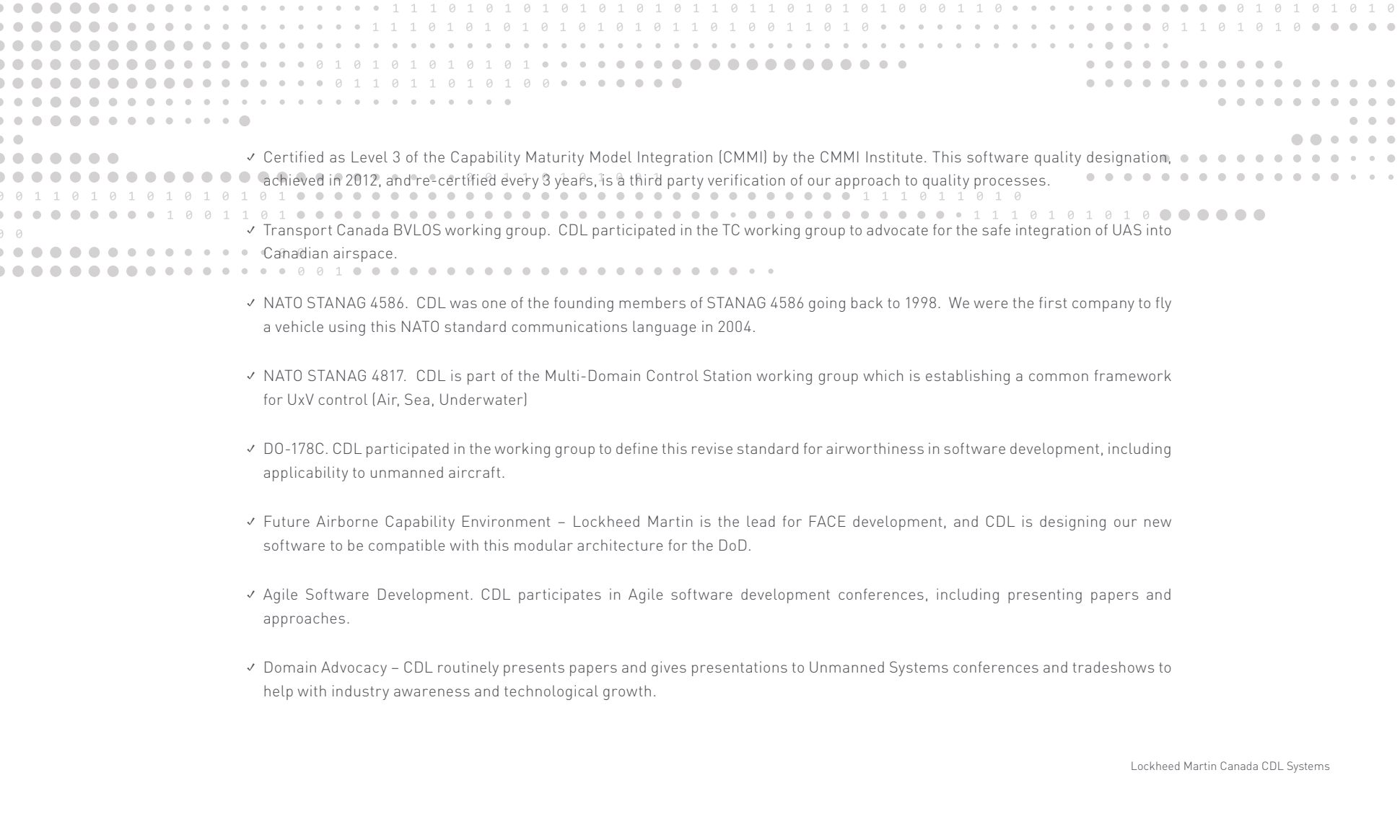
“Typical Agile implementations are bare-bones and result in a lot of rework caused by poorly defined requirements, minimal planning, no design and narrowly focused testing. LM-CDL has refined its Agile implementation by adopting numerous additional engineering and project management practices from CMMI and elsewhere to create a well-defined and robust life cycle for creating software.

Their Agile implementation is supported with the use of tools to keep project data readily accessible and processes light-weight. The result is an excellent balance of the best features of Agile and disciplined engineering and project management practices.”

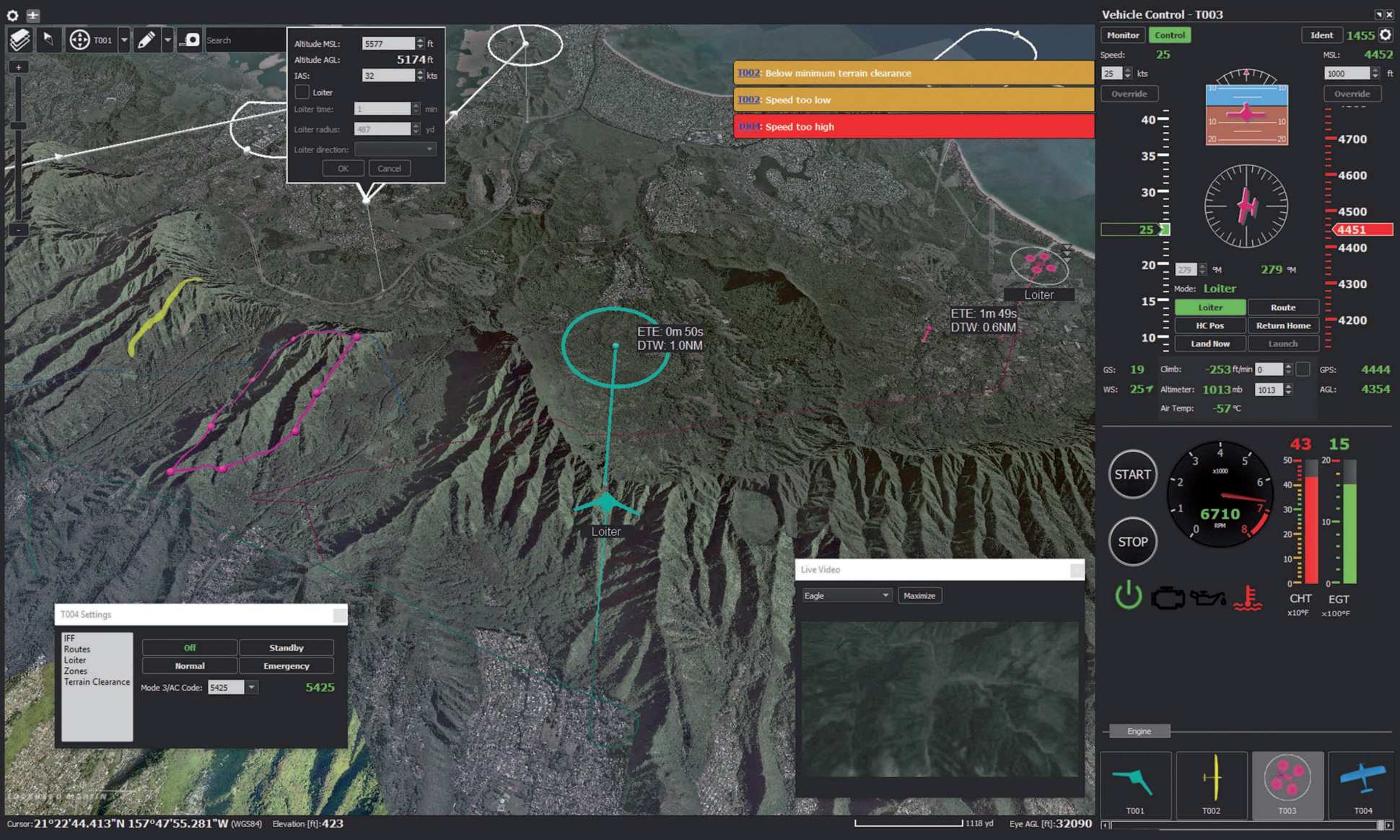
**Neil Potter**

CMMI Lead Appraiser and Agile consultant

The Process Group

- 
- ✓ Certified as Level 3 of the Capability Maturity Model Integration (CMMI) by the CMMI Institute. This software quality designation, achieved in 2012, and re-certified every 3 years, is a third party verification of our approach to quality processes.
  - ✓ Transport Canada BVLOS working group. CDL participated in the TC working group to advocate for the safe integration of UAS into Canadian airspace.
  - ✓ NATO STANAG 4586. CDL was one of the founding members of STANAG 4586 going back to 1998. We were the first company to fly a vehicle using this NATO standard communications language in 2004.
  - ✓ NATO STANAG 4817. CDL is part of the Multi-Domain Control Station working group which is establishing a common framework for UxV control (Air, Sea, Underwater)
  - ✓ DO-178C. CDL participated in the working group to define this revise standard for airworthiness in software development, including applicability to unmanned aircraft.
  - ✓ Future Airborne Capability Environment – Lockheed Martin is the lead for FACE development, and CDL is designing our new software to be compatible with this modular architecture for the DoD.
  - ✓ Agile Software Development. CDL participates in Agile software development conferences, including presenting papers and approaches.
  - ✓ Domain Advocacy – CDL routinely presents papers and gives presentations to Unmanned Systems conferences and tradeshows to help with industry awareness and technological growth.





Altitude MSL: 5577 ft  
Altitude AGL: 5174 ft  
IAS: 32 kts  
 Loiter  
Loiter time: 1 min  
Loiter radius: 487 yd  
Loiter direction:   
OK Cancel

T002: Below minimum terrain clearance  
T002: Speed too low  
T004: Speed too high

### Vehicle Control - T003

Ident 1455  
MSL: 4452 ft  
Speed: 25 kts  
Override: 25 kts  
229 PM 279 PM  
Mode: Loiter  
Loiter Route  
HC Pos Return Home  
Land Now Launch  
GS: 19 Climb: -253 ft/min GPS: 4444  
WS: 257 Altimeter: 1013 mb 1013 AGL: 4354  
Air Temp: -57 °C

START STOP

6710 RPM

43 15

CHT x10°F EGT x100°F

### T004 Settings

IFF: Off Standby  
Routes: Normal Emergency  
Mode 3/AC Code: 5425 5425

### Live Video

Eagle Maximize

Engine

T001 T002 T003 T004



# VCSi

## Modular Unmanned Vehicle Control Software

VCSi is the next generation product in the VCS family. Built upon our extensive experience, VCSi brings modular and extensible control to your system. VCSi is made in Canada, commercially available, and ITAR free. Its modular architecture allows you to purchase only the components you need for your system. A developer-friendly API and plug-in architecture allows you to easily add or extend functionality for your unique needs. Leverage our wealth of experience and unman your future with VCSi.



### international

Made in Canada commercial software, not subject to U.S. ITAR export regulations. Supports translation to different languages, including non-latin scripts.



### intuitive

Fly-by-mouse interface simplifies complex actions.



### interoperable

Multiple disparate vehicles can be easily and effectively controlled from a single station.



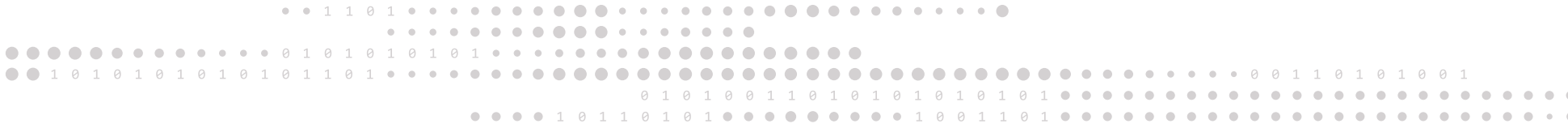
### interchangeable

Modular design allows you to purchase only the components necessary for your vehicle.

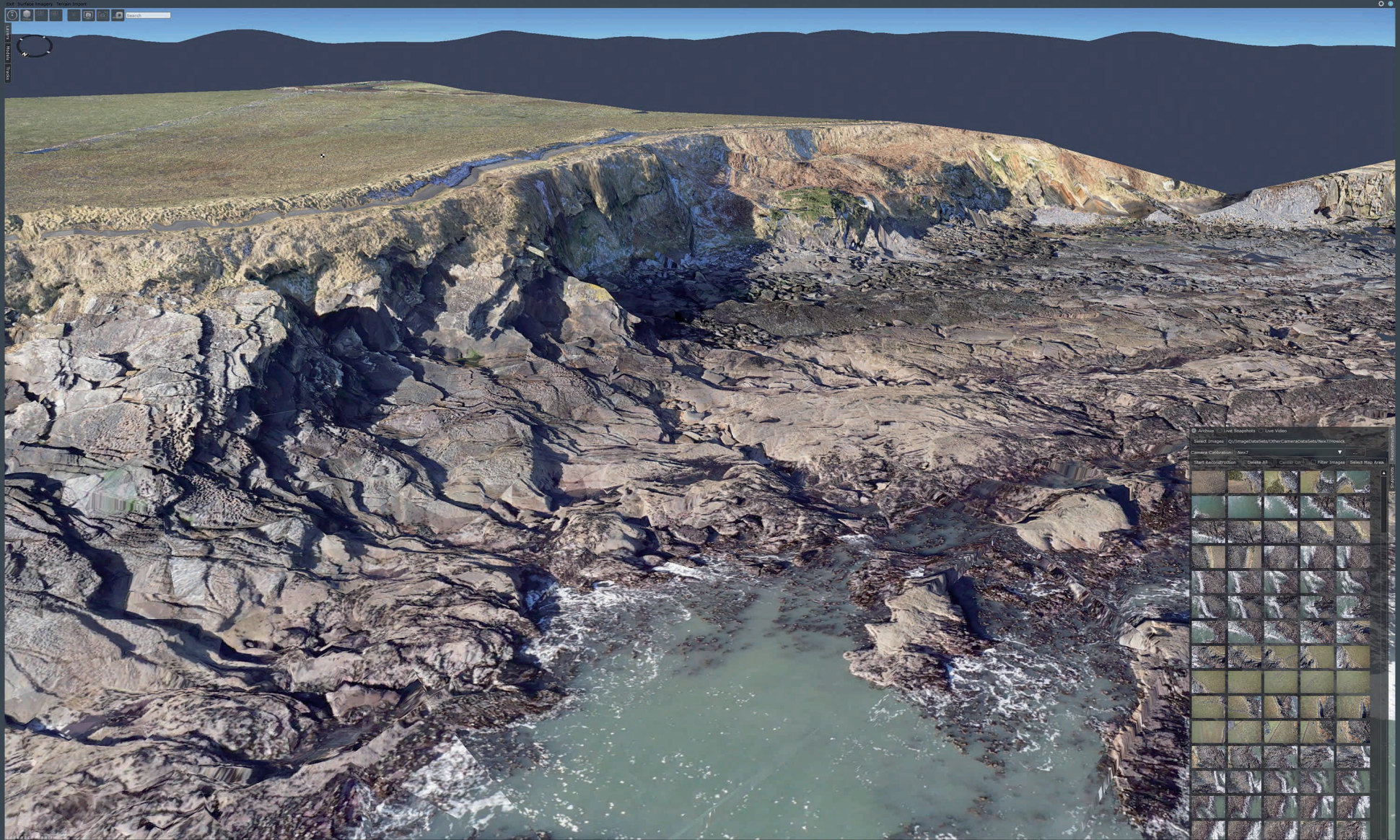


### indigenous

Robust plug-in architecture enables integration of local content and vehicle specific functions.







Assets 1000000000 1000000000

Select Images [Q:\img\0000000000\OtherCameraData\Set\New\1000000000](#)

Current Collection: New

Start Background [Delete All](#) [Cancel Grid](#) [Filter Images](#) [Select Map Area](#)



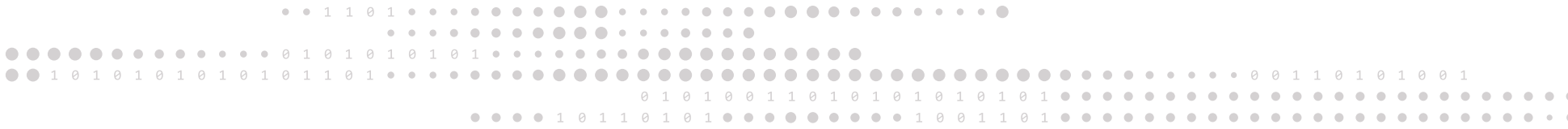

# Hydra Fusion Tools™

## Turn Big Data into Actionable Intelligence

Flying an unmanned aircraft system (UAS) is no longer a stand-alone activity. Operators are inundated with large quantities of disparate data – in the form of maps, images, video, and intelligence – that they must compare and interpret before taking action.

Hydra Fusion Tools™ is a real-time Geospatial Information System that is our answer to the challenges presented by Big Data. Hydra Fusion Tools simplifies information by fusing this data to create a 3D world presentation that gives immediate 'in context' information.

The stand-out feature of Hydra Fusion Tools is its ability to simultaneously localize and map (SLAM) incoming video or still image feeds from the aircraft while it flies. These images are incrementally matched up, stitched together, and geo-registered resulting in an immediate and immersive 3D reconstruction. Combined with 3D models of objects, Hydra Fusion Tools creates a rendering of any site – construction zone, industrial plant, mine, or farmer's field.





U.S. Army MQ-1C Gray Eagle

# VCS and the U.S. Army

## One System Ground Control Station

The US Army has been using VCS or VCS-4586 to operate their large UAS assets since the turn of the century. This includes both the One System Ground Control Station and the Universal Ground Control Station (its replacement.) This allows the U.S. Army interoperable control for the RQ-7B Shadow, MQ-5B Hunter, and MQ-1C Gray Eagle. Our software is installed in every US Army shelter to conduct intelligence, surveillance, reconnaissance, and other tactical UAS missions. To date, the U.S. Army and U.S. Marine Corps have accumulated over 1,500,000 operational flight hours using VCS in-theater. VCS helps the U.S. Army control their fleet of dissimilar UAV platforms from a common operator-interface.

CDL Systems has remained and will continue to be an active, contributing partner of the U.S. Army for decades to come. As the Army's needs have evolved, so has our software, with VCSi offering a modular, extensible and easy to integrate solution for today's complex operational theatres.

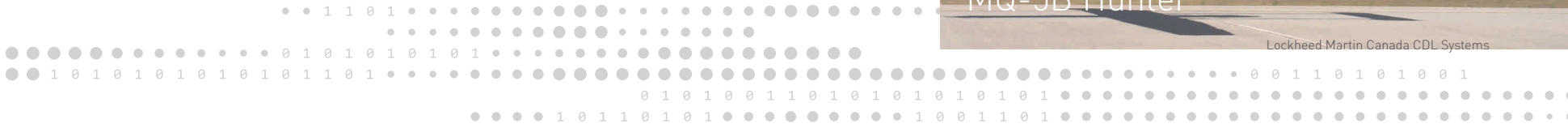


RQ-7B Shadow



MQ-5B Hunter

Lockheed Martin Canada CDL Systems







QinetiQ Target Systems

Lockheed Martin Canada CDL Systems

# Multi-Domain Control

Since 1996, CDL has been controlling multiple unmanned vehicles at the same time in different domains. The Universal Target Control Station (UTCS), developed with QinetiQ Target Systems is a ground control solution developed collaboratively which demonstrated simultaneous control of and aircraft and a boat at the same time by a single operator. Over the years, the UTCS has advanced to control up to a swarm of sixteen boats at once, or eight aircraft at one time. The UTCS is deployed in military target operations worldwide in Canada, Greece, Japan, Norway, Saudi Arabia, Singapore, Sweden, Germany, Korea and the United States. Multi-domain control is part of our DNA, and integral to our offerings.

Effective Multi-Domain control requires an understanding of each domain, a clear grasp of each vehicle's mission parameters, and generic interfaces (both human and machine) to effectively execute the task at hand. Vehicles in different domains have commonalities and differences which have to be effectively compartmentalized in ground control station design to create effective operators and reduce the complexity of these advanced systems.

CDL has not only designed multi-domain control stations, but we've also pushed for, and participated in, standardization within NATO for these applications. This includes both STANAG 4586 and STANAG 4817. With our breadth of understanding of each domain across millions of operational hours, and our commitment to commonality and standardization, we are an excellent partner for future Multi-Domain Control station developments.











# Lockheed Martin Family of Systems

As part of Lockheed Martin, CDL is the tie that binds between our small UAS family of systems. Our mGCS software is the common ground station between the Indago, Desert Hawk, Condor, and Vector Hawk. Each unique vehicle is designed for a unique application, but with a common architecture. All of these aircraft include a common autopilot, common components, common datalinks, common payloads and of course, a common mGCS ground control station. Having mGCS as the solution for common control allows for reduced training, shared development costs, and more robust software.



Lockheed Martin Canada CDL Systems

Lockheed Martin. Your Mission is Ours.™

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