

# Delivering game-changing, actionable intelligence with AI-driven computer vision

Data-driven organizations across all industries are unlocking actionable intelligence from real-time video data coupled with other edge sensor data (audio, biometric, etc.), artificial intelligence (AI), and high-performance edge computing. Adding stored historical data enables a powerful method of using deep learning techniques on videos and digital images known as computer vision, and it's not only transforming organizations, but more importantly, it's transforming how they build or deliver a product or service.

According to IDC, forward-looking organizations that maximize their data to generate insights are two times more profitable and see eight times more growth than their peers.<sup>1</sup> Computer vision capabilities are fast becoming a significant contributor to that end. In fact, analysts at Omdia expect the global computer vision software market to reach \$33.5 billion by 2025 (growing at 42.1 percent year over year).<sup>2</sup> Connecting computer vision to the edge allows for a direct impact on what customers do to drive revenue in their organizations. Whether it's gaining a greater knowledge of customer behavior within a retail space, predicting failures in oil and gas pipelines, controlling autonomous vehicles in a smart city, or managing traveler flow in an airport, both private and public organizations of all sizes are capitalizing on the petabytes of audiovisual data being captured on a daily basis.

Implementing computer vision systems can present some unique challenges. Not only does it require orchestration of large quantities of different types of sensors with powerful edge compute, low-latency networking, and multi-cloud ecosystems, but it also requires the right analytics engines, automation capabilities, security standards, and data management workflows needed to generate insights from unstructured data. Additionally, organizations can inadvertently create isolated silos of data by purchasing point solutions for specific use cases. Bringing together the right combination of technologies and workflows requires an enterprise-integrated approach.

## DELL TECHNOLOGIES COMPUTER VISION SOLUTIONS

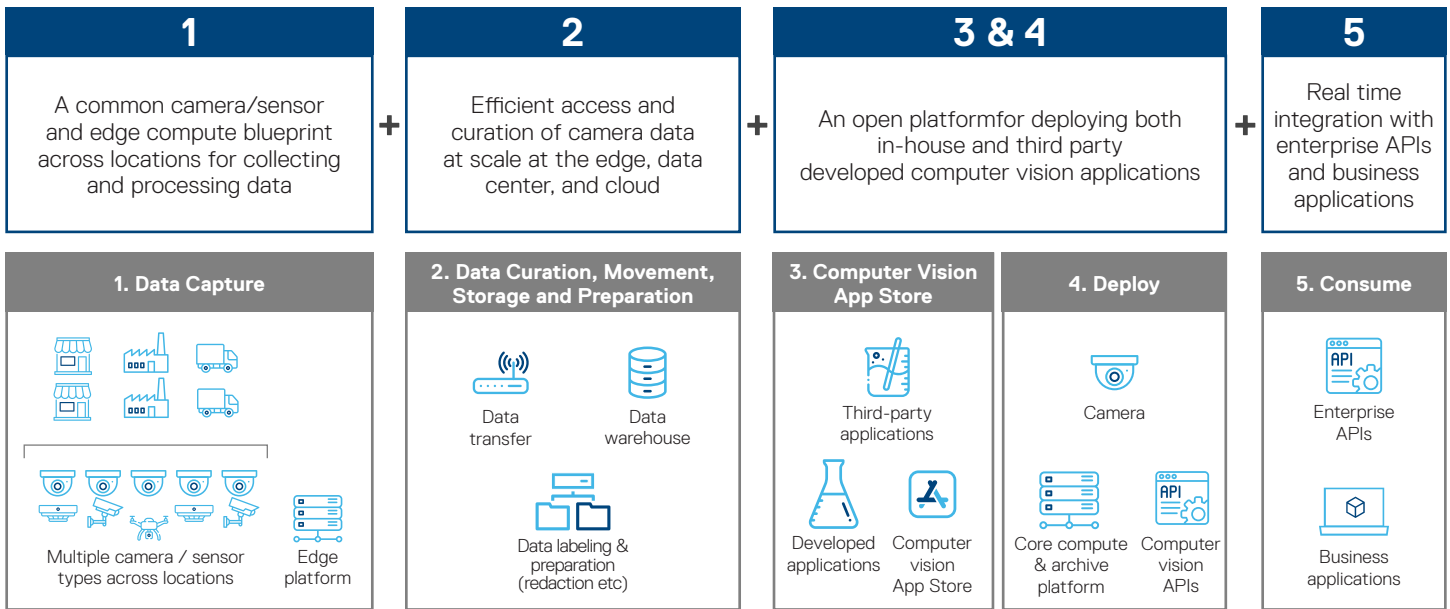
Dell Technologies addresses your unique requirements by providing a comprehensive workflow strategy that brings together a full range of scalable computer vision components from edge to core to cloud. Every part of the ecosystem is represented by our infrastructure, services, and industry-leading partner solutions as a fully tested and validated solution. Working with your organization, our team of global data management and infrastructure experts can help ensure that your computer vision approach is tailored to your specific business use case by defining the most optimal workloads and workflows designed to drive profitable outcomes while decreasing time to value.

## KEY BENEFITS AND VALUE

- 1
**Curated partner ecosystem:**  
 Dell Technologies works with key partners to bring together otherwise fragmented components into a consolidated, streamlined computer vision solution to lower investment risk.
  
- 2
**Comprehensive, lab-validation test approach:**  
 To help deliver a solution that works for your organization from day one, Dell Technologies aligns validation standards with our partners to test hardware and software in extreme, real-world scenarios.
  
- 3
**Scalable and proven solutions:**  
 Our approach decreases time to value by bringing together the right hardware and software from edge to core to cloud needed to precisely suit your particular use case and can scale from point solutions to enterprise environments.
  
- 4
**Dedicated global subject matter experts:**  
 Maximize the value of your investment by relying on our global network of subject matter experts for guidance with infrastructure and data management, including video workloads, workflows, and data governance.

# AN INTEGRATED APPROACH TO COMPUTER VISION DATA MANAGEMENT

Modern computer vision solutions require video platforms that can aggregate inputs at scale.



## Introducing computer vision into your safety and security strategy

Computer vision fits within the broader framework of an organization’s overall safety and security ecosystem. In mapping out your computer vision approach, it’s helpful to define the process of how individual components within your safety and security ecosystem work together to deliver the desired insights. An optimized computer vision workflow incorporates the following steps:

**1. Data capture:** The data capture layer is the first edge aggregation point for all sensor data. The edge platform within this layer is responsible for collecting, formatting and storing the huge amounts of data arriving from the cameras and IoT sensors. A certain degree of deduplication can be performed at this layer depending on requirements and architectural design. Digital video data and IoT sensor data arrive in a wide array of formats, types, and structures. For instance, there is a significant difference in the data being received from a vibration meter to that being received from a CCTV camera; however the centralized systems expect the pertinent data to arrive in a predefined and usable format ready for analysis. This manipulation and consolidation of data happens at the edge within the edge platform.

**2. Data curation, movement, storage and preparation:** Transferring data generated at the edge to the necessary development environments is accomplished with intelligent networking and security operations and a centralized data warehouse for secure, scalable access and curation of camera data at the edge, data center, and cloud. Generating labeled data sets and conducting the necessary preprocessing of the data

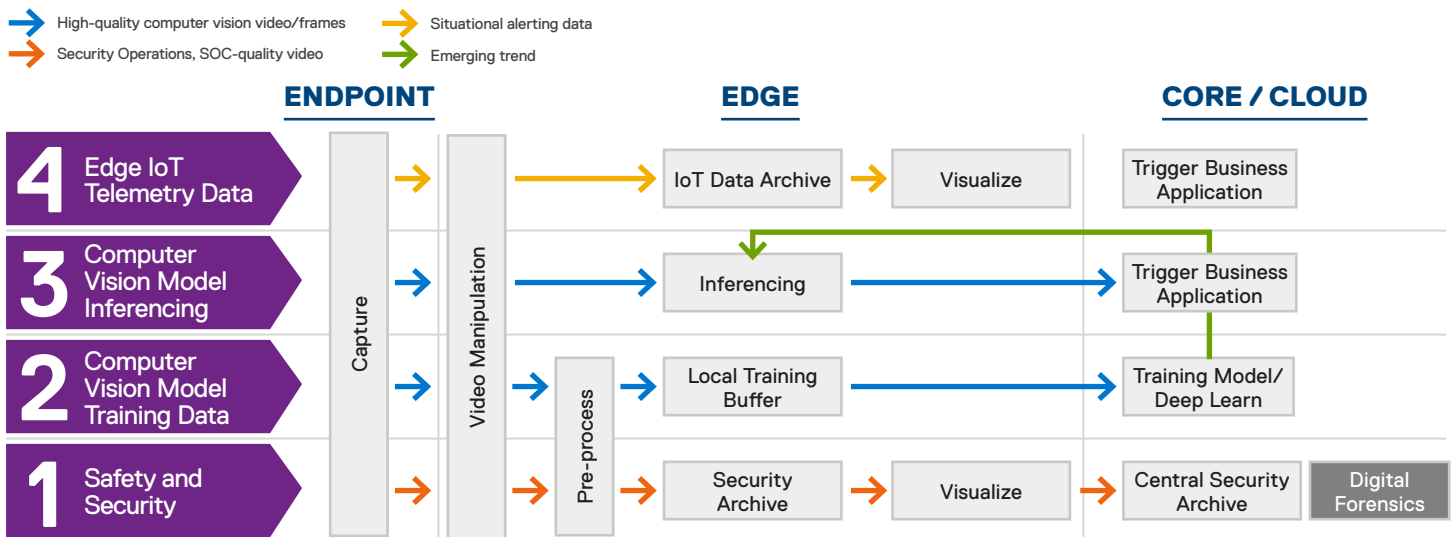
such as face redaction are the next critical stages in the process to help train machine learning models. Historical data can be used as a training archive to develop increasingly accurate models for more effective insights. As training of AI and machine learning is a compute-heavy exercise, many hold off to run these models until the organization is closed for the day and much of the real-time data processing associated with their computer vision systems are dormant.

**3. Computer Vision App Store:** Training in-house computer vision models and/or integrating with third party computer vision applications require an open platform to help with integration and eliminating analytical errors introduced when siloed copies of data are out of sync. An open platform also enables a uniform set of governance, provenance, and security processes to be applied to ensure consistent quality checking of data. Likewise, the use of industry-standard APIs means that organizations can develop their own bespoke applications more easily, which can then be layered on top of the system.

**4. Deploy:** Computer vision models should be deployed to run with low latency at the edge, relying on edge compute appliances in a scalable architecture.

**5. Consume:** Real-time integration with enterprise APIs and business applications generate insights in real-time to help you deliver the desired operational efficiencies and timely business insights. Continuous computer vision data streams from different sources can track and respond to inputs as a closed loop system—providing the information necessary for the evaluation, improvement, and preparation for additional use cases. For example, transit authorities can start with surveillance data and add pedestrian traffic to a popular intersection for additional insights and potential actions.

**Figure 1:** An example of a computer vision workflow where data capture, curation, movement, pre-processing, security archiving, data training and inferencing provide real-time situational awareness and insights at the edge.



### GAINING THE EDGE

Data's center of gravity is shifting to the edge. Gartner predicts that by 2025, 75 percent of enterprise data will be processed at the edge, compared to only 10 percent today.<sup>3</sup> The need to process compute-intensive workloads at the source quickly is amplified when outcomes are near real-time, as is the case for government agencies needing real-time monitoring at public events, or for organizations in agriculture, construction, or mining who require immediate response to system failures in the field.

Computer vision applications requiring powerful edge computing with streamlined workflows are becoming more critical with the adoption of sophisticated, higher resolution cameras, new types of imaging sensors, and larger quantities of data. Organizations that take advantage and implement technologies and system workflows where much of the data processing (including inferencing) occurs at the edge (Figure 1), will realize tangible business and operational benefits, including decreased downtime, tighter security, and faster decision making.

### Optimized computer vision workflows executed at the edge deliver these operational and business benefits:

- Greater value:** Remotely analyzing data sets onsite to foresee critical events helps to avoid unplanned downtime.
- Improved safety and security:** Sensing, thinking, and acting on data automates safety systems and reduces human error.
- Reduced costs:** Industrial edge equipment used to monitor the health of assets detects problems in real-time.
- Tighter security:** Processing data locally prevents it from having to travel across external networks where it's most vulnerable.
- Faster decisions:** AI-driven platforms that analyze massive data volumes accelerate innovation.

### Moving forward with simplified, integrated solutions

Deploying a computer vision solution can be a challenge even for the most data-forward organizations. Dell Technologies has taken the necessary steps to simplify, consolidate, and streamline your organizational deployment process with solutions that combine validated workloads for video analytics, safety and security, converged and hyperconverged infrastructure (CI/HCI), and partner-supplied appliances in a scalable architecture.

With Dell Technologies computer vision solutions, your organization can ingest video streams at the edge and pre-process these streams before moving the pertinent video data to an on-/off-premises central archive where computer vision models can be developed and trained for additional uses cases. This agile edge-to-core computer vision platform and framework allow cognitive insights to be generated at close proximity to the data sources while preserving the ability to search these insights across the continuum. Dell Technologies ensures that the organization can easily connect to its video data sets and enable data management in place by multiple systems and analytics. This allows the use of purpose-built appliances to process large data sets without having to consume unnecessary bandwidth associated with its transmission.

Our expansive range of essential IT offerings includes client devices and peripherals, servers, storage, software-defined open networking, and industry tools for video management, virtualization, and analytics.

### OUR ROBUST PARTNER ECOSYSTEM

Dell Technologies teams with best-of-breed technology partners, including ISVs, system integrators, and cloud providers, to streamline deployment and improve overall IT performance. Our extensive ecosystem of partners also helps deliver the tailored approach needed to address your business objectives from simple workflows to advanced organization-wide automation—turning passive video into scalable, intelligent video analytics systems.



# AN INTEGRATED, VALIDATED AND SECURE PORTFOLIO

A full range of safety and security components for your computer vision solution from edge to core to cloud

<b>VMS MANAGEMENT</b>	Virtualization	Orchestration	Automation	Dashboard	Diagnostics	Analytics
<b>SOFTWARE DEFINED OPEN NETWORKING</b>	PowerSwitch N and S series	SD-WAN powered by VMware		Virtual Edge Platform (VEP)		
<b>HCI/CI INFRASTRUCTURE SOLUTIONS</b>	Converged Consolidated Compute	vmware	Hyper-Converged Pre-Built   Software-Defined Storage		vmware	
<b>STORAGE INFRASTRUCTURE</b>	Structured PowerStore PowerVault	Unstructured ECS PowerScale Isilon	Dell EMC Cloud Storage Services Multi-Cloud Connect		vmware	
<b>SAFETY &amp; SECURITY EDGE APPLIANCES</b>	Bare Metal	Virtualized		vmware		
<b>VIDEO ANALYTICS APPLIANCES</b>	Dell EMC PowerEdge XR2 / C4140 / R740					Video Accelerator / Deep Learning / AI Cards
<b>CLIENTS/MONITORS</b>	Workstations	Laptops		Monitors		

## A PROVEN GO-TO-MARKET SOLUTION

Dell Technologies provides a custom-designed solution, based on hyperconverged and storage platforms, purpose-built for video safety and security use cases with access to the required system building blocks from distributed locations to a centralized location (on-premises and cloud). Combined with our ecosystem of SI/SO partners, we help you deploy, manage, and scale your solution as you grow—all without needing additional IT expertise.

Our solutions bring together:

- Real-time edge compute and analytics:** Our Dell Technologies family of compute platforms from gateways to high-performing servers helps capture, analyze, and gain insights from cameras and other sensing devices for real-time data analytics and machine learning at the edge to the data center to the cloud.
- The software-defined data center:** With Dell Technologies next-generation storage and data protection solutions, you can manage both current data and future workloads with efficiency, security, and scalability. Our Dell EMC VxRail HCI combines servers, storage, networking, and virtualization into one cloud-ready solution to achieve true application deployment flexibility.
- Data integration across a multi-cloud environment:** As you expand your safety and security capabilities using multiple cloud-native workloads, Dell Technologies Cloud combines VxRail and VMware Cloud Foundation (VCF) into one pre-engineered ready-to-run platform to eliminate silos of operation with service management, governance, security, automation, and orchestration tools. For cloud-based storage, we take a multi-cloud approach via Dell Technologies Cloud service providers that leverage VCF.

This capability enables customers to easily extend their storage from edge to core to cloud.

- Secure, resilient IT:** Dell Technologies helps our customers to mitigate cybersecurity risks through our open network community. Our industry-leading hardware and partner offerings help address network complexities in an end-to-end safety and security deployment. Software-defined open networking solutions such as Dell EMC PowerSwitch and SD-WAN powered by VMware help optimize your computer vision solution based on an open architecture with fast and secure access to the needed computer vision applications across the safety and security ecosystem.

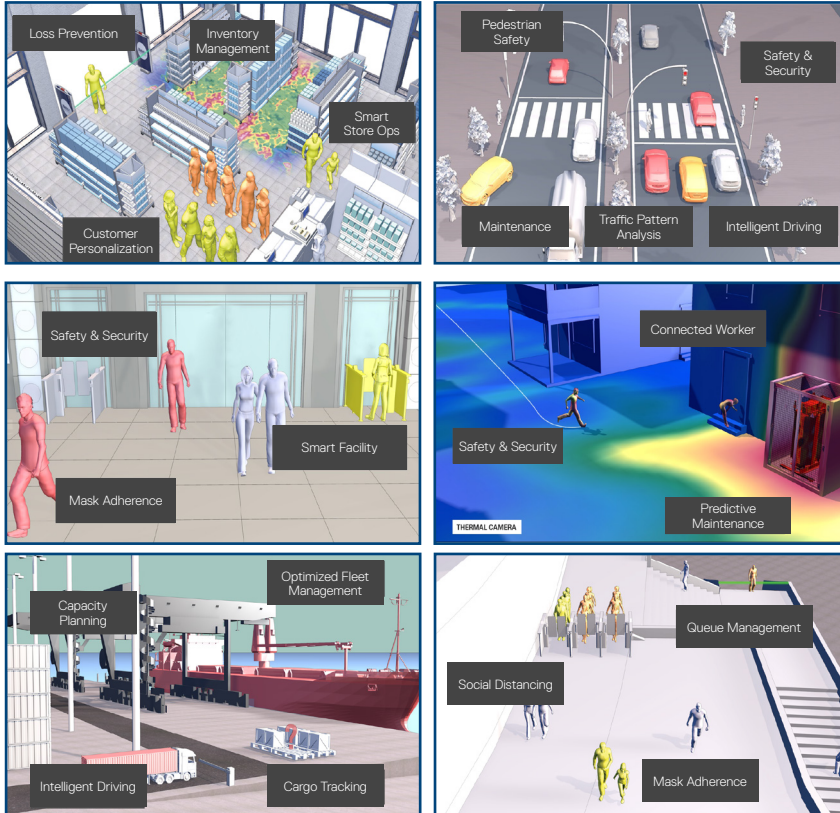
## ACCESS TO ADVANCED SAFETY AND SECURITY VALIDATION LABS

At the heart of the Dell Technologies computer vision offerings is our global validation and testing labs, where reference architectures and design guides are built, implemented, and calibrated to design concepts, all in a scalable and controlled loading environment.

Validating computer vision solutions for hardware and software performance within the customer environment can be complex and time consuming. Dell Technologies Safety and Security Validation Labs are outfitted with leading technology from all major safety and security vendors, allowing the validation of best-of-breed computer vision applications with the entire Dell Technologies edge-to-core-to-cloud portfolio. These proven lab validations with key partners accompany extensive documentation to simplify deployment and reduce the risk of data loss for our customers. We test and deploy our computer vision solutions using the following steps: optimize,

# EXAMPLE INDUSTRY USE CASES FOR COMPUTER VISION

Generating insights across industries



## Computer vision use cases extend across industries, including:

- ♦ **HEALTHCARE:** Medical Device Management, Digital Pathology, Extended Patient Care
- ♦ **ENERGY:** Grid Modernization, Capacity Balancing, Vegetation Control, Maintenance
- ♦ **RETAIL:** Loss Prevention, Inventory Management, Smart Store Operations, Customer Personalization
- ♦ **MANUFACTURING:** Plant Visibility, Equipment Effectiveness, Quality Assurance, Predictive Maintenance, Connected Worker
- ♦ **TRANSPORTATION:** Capacity Balancing, Optimized Fleet Management, Cargo Tracking, Intelligent Driving
- ♦ **SMART CITIES:** Smart Buildings, Traffic Pattern Analysis, Environmental Quality & Management Campuses, Pedestrian Safety
- ♦ **EVENTS & ENTERTAINMENT:** Safety & Security, Queue Management, Smart Facility, Social Distancing, Mask Adherence

validate, enable, and implement. This four-step validation process also helps to increase system reliability thereby reducing overall support costs; gain a proven, repeatable architecture; obtain benchmarking results using a true production workload for mission-critical systems; test multiple ISV products simultaneously with our fault-tolerance and high-availability options; and validate virtual and non-virtual architectures.

## TRANSFORM YOUR ORGANIZATION WITH A PARTNER WHO SHARES YOUR VISION

At Dell Technologies, we are committed to providing you with a fully-integrated computer vision solution designed to help turn your data into information-driven decisions to deliver improved business insights.

Whether in healthcare or retail, transportation or the public sector, our computer vision solutions offer the scalability, efficiency, simplicity, and agility to fulfill your business needs while providing

real-time access to your data for analysis and deep learning.

Dell Technologies solutions portfolio and computer vision expertise help reduce the risk, cost, and complexity of implementation by leveraging a comprehensive solution to fit your specific industry requirements. In addition, our advisory, design, build, integration, and lab validation services help deliver the right edge-to-core-to-cloud computer vision system, helping to streamline deployment with orchestration and automation.

As the computer vision landscape evolves, we are committed to continued innovation, with significant investments allocated towards computer vision in R&D. This commitment extends to providing you with an open and scalable computer vision solution designed to deliver results from day one and as your business needs change—helping you to transform your organization with game-changing, actionable intelligence.



**Learn more**  
about our safety and security solutions



**Contact**  
one of our safety and security experts.



**Connect**  
with us.

1. IDC report: "The Data-Forward Enterprise: How to Maximize Data Leverage for Better Business Outcomes," May, 2020. DOC #US46264420. <http://bit.ly/39EIRFS>  
 2. Omdia, Market Report: Computer Vision Technologies and Markets, publicized 2Q20.  
 3. "What Edge Computing Means for Infrastructure and Operations Leaders," Gartner, 2018. [gtnr.it/322z9t2](http://gtnr.it/322z9t2)