Video Analytics for Industrial Applications

With the widespread availability of high-resolution cameras, coupled with powerful image recognition technology, video analytics is rapidly gaining traction in manufacturing quality use cases. Video analytics is a category of software applications designed to analyze a video stream and draw new actionable insights beneficial to the ongoing operations. They provide a mechanism to automate the identification of people and objects, and a means to trigger a response when things are amiss.

These capabilities make video analytics ideally suited for industrial use cases that include:

- Verification of part transportation and placement
- Quality assurance, parts and final assembly
- Process improvement and proactive plant maintenance

Collectively these use cases are sometimes called visual inspection. These visual inspection solutions are deployed outside the IT domain in factory floors and manufacturing facilities. Lynx refers to this as the Mission Critical Edge (MCE), which is the blending of traditional embedded functionality including real-time, security and safety with the attributes of IT DevOps such as ongoing delivery of high quality software updates.

Visual inspection deployed at the MCE turns out to be a much more effective solution than the non-AI options such as a human staring at parts coming out of an assembly line or batch sampling on a frequent basis. These methods are not only ineffective in catching defective parts but are also unable to provide enough data to the production planners to understand the source of the quality issues.

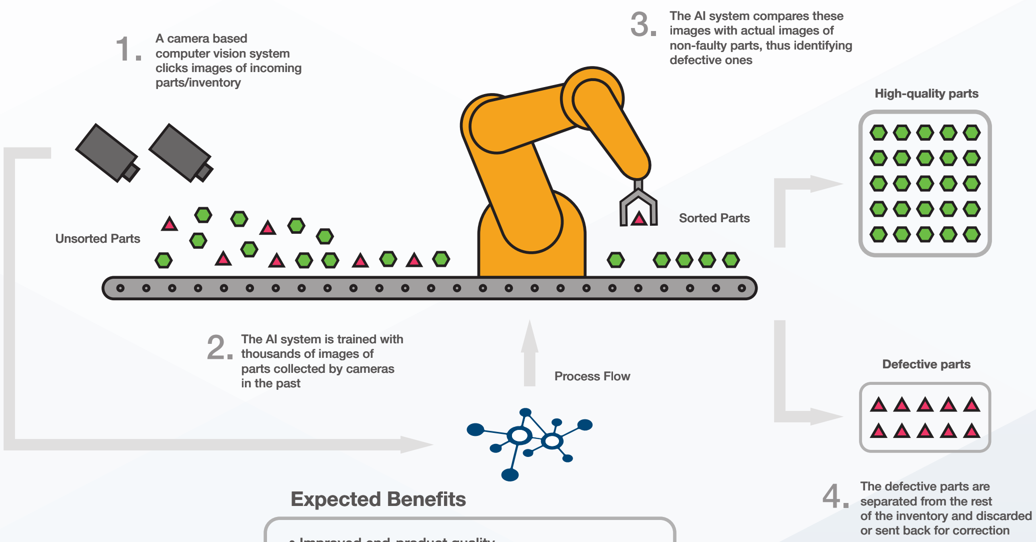
Challenges

Typical industrial video analytics solutions need to handle four key challenges:

- Handling large quantities of data in the form of streamed video or still photographs. This gives them the basis to be able to distinguish a good component from a bad one, and one part type from another.
- Integrating multiple, disparate applications from different vendors potentially running on different operating systems. Example applications include Artificial Intelligence/Machine Learning (AI/ML) classification, camera applications, picture extraction, production line input and feedback, IoT gateway control and OPC-UA clients.
- Supporting of multiple network interconnections with dedicated switches and cabling.
- Ability to evolve data models through ongoing tuning and updates to the deployed system.

Once these challenges are solved, the video analytics system generates new insights and data that can not only prevent defective parts from going out, but also allow the plant operator to get to the root cause of the defects occurring in the first place.

Computer vision-based quality in action



Expected Benefits

- Improved end-product quality
- Reduced cost and increased accuracy of inspection
- Reduced cost of quality assurance (less final control)

Delivering on the promise of data

While some companies may have the luxury of a greenfield environment, the vast majority of companies are faced with delivering this functionality by upgrading equipment that is already deployed. Discussions with companies up and down the value chain associated with delivering connected, secure industrial solutions has led Lynx to view the following as the “best practice” path:

- The majority of existing deployments have a controller connected to an industrial PC-type compute node. The initial step is to make these systems managed. This means that it is possible to monitor, deploy security patches and update applications.
- Establish a cloud presence. Systems should be able to securely deploy at least one workload to the system, such as a machine learning inference engine. Then manage those workloads from the cloud.
- Run applications from multiple tenants on an Edge compute node, saving power, cost and footprint of electronics. While consolidation is an advantage, the real benefit comes from the ability to leverage video analytics applications that need to procure data from the OT applications, such as a PLC or an industrial camera application, running on the same platform. But for this to be realized, the plant manager needs to be confident that a tenant’s applications are only able to access the data that they have been granted access to.
- Enable all of the tenants and their different apps to deliver new capabilities that can execute locally, while maintaining isolation between the different workloads and the existing data permissions.

Lynx’s approach

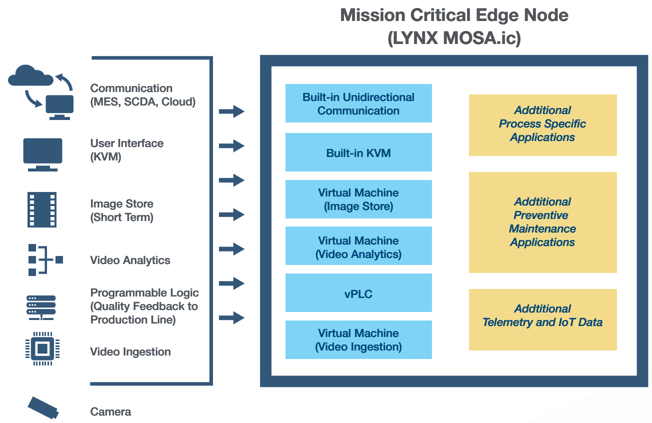
For decades, customer have built solutions on LYNX MOSA.ic that run for 10+ years with very high MTBF (mean time between failure). However, most of these solutions were very largely static with functionality minimized in favor of availability and reliability. However, modern solutions that leverage modern AI and container frameworks, in addition to running controllers, have to be designed to be both flexible and highly available. In order to build these solutions that remain viable in deployed settings for very long periods, the solutions need to

- Combine the benefits of cloud infrastructure with the efficiencies of local processing. Cloud infrastructure brings scaling and upgrade benefits. Local processing brings latency, performance, and operational efficiencies.
- Deliver provable isolation between the production line (OT), the plant data center (IT), and the cloud.
- Shift as much functionality to software from today’s diverse, expensive (in terms of cost, real estate and power) combination of hardware.

The following chart outlines how the shift to a software-centric solution enables a richer set of system functionality to be delivered over time.

The left side shows all the building blocks needed to build a video analytics solution:

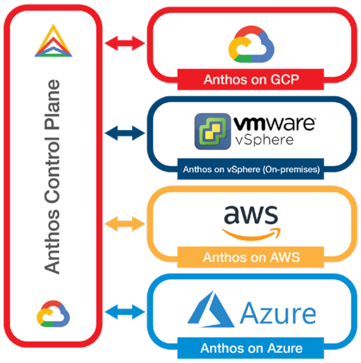
1. Industrial Camera with adequate lighting
2. Video ingestion applications
3. Supervisory control for feedback
4. Video analytics application
5. Image database to store the images
6. IT network access for the video analytics application
7. OT network access for the camera and the supervisory control



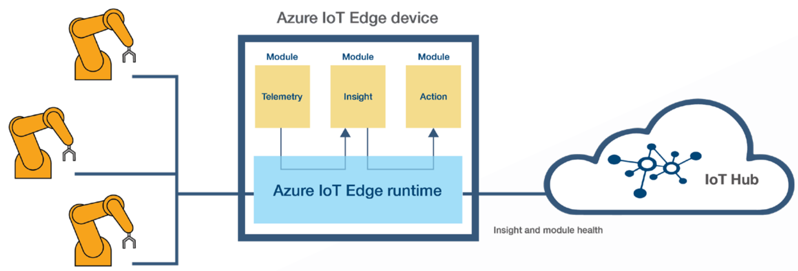
Without LYNX MOSA.ic, a typical implementation would require a separate hardware system for each of these functions. This makes the system complex, difficult to implement and expensive to maintain. With LYNX MOSA.ic, most or all of these applications can be deployed on a single managed hardware system. This enables fast deployment, easy data transfer and seamless management.

LYNX MOSA.ic, is a software framework for building and integrating virtually air-gapped security and safety-critical systems using independent application modules. The key capabilities of this offering are:

- Isolated applications: It enables fully featured operating systems (e.g. Windows, Linux), real-time operating systems and bare-metal code to be combined and deployed on consolidated hardware platforms in a way that delivers provable (and immutable) isolation of applications from each other. Effectively this isolates operational technologies (OT) from information technology (IT) networks on the plant floor.
- Granular allocation of compute and memory resources to each workload: The direct assignment of NICs, USB and serial ports enables a complex deployment to be accomplished using a single box. Network connections can be virtualized and secured.
- Deterministic real-time behavior: The Lynx solution guarantees that very aggressive response times can be met, irrespective of what workloads are running on the system.

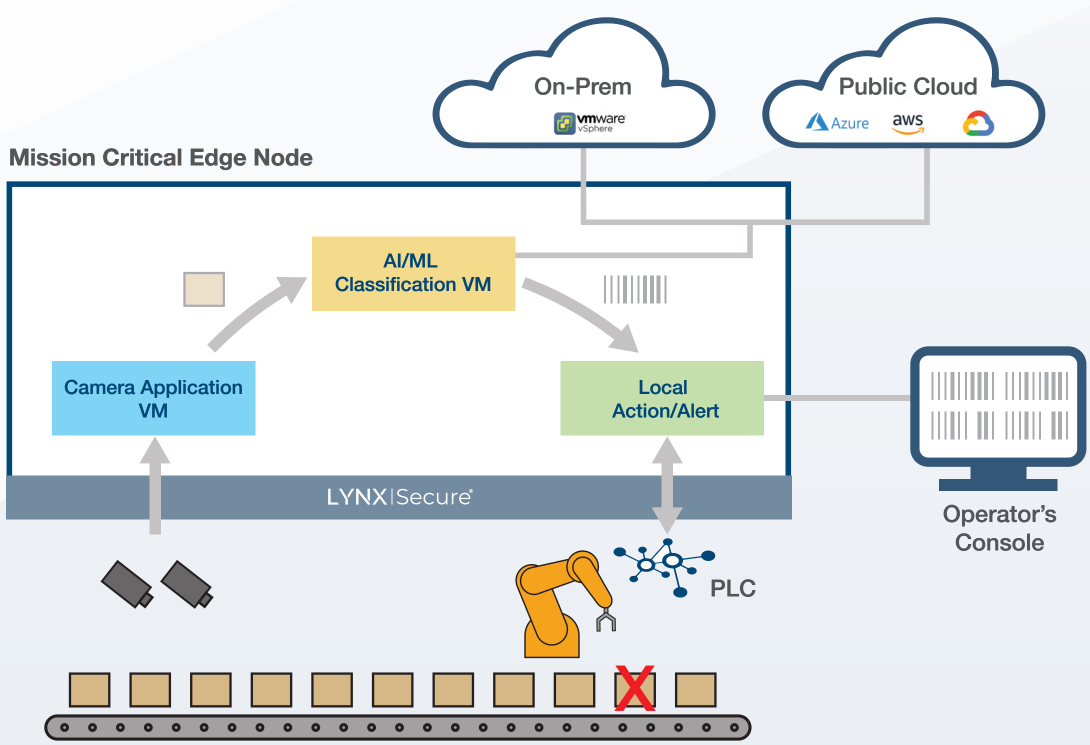


Model 1: Multi-cloud model



Model 2: Cloud extended to IoT

LYNX MOSA.ic is able to provide this level of workload isolation at the HW level since it is constructed using LynxSecure, a separation kernel hypervisor as the foundation. It ensures that the MCE node configuration is tamper-proof and suitable for a harsh production environment, and provides for pervasive security (including data encryption, tamper proof software, and network isolation).

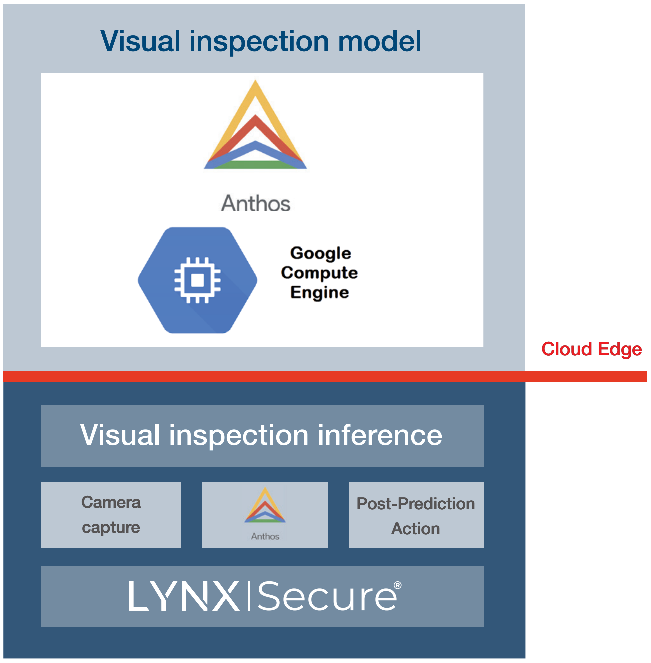


Hybrid requirements

The video analytics solutions at the mission critical edge are required to be hybrid in nature. On one hand, the systems need to be locally managed, handling both OT and IT networks, and on the other hand, they have to enable cloud workloads including management of those workloads via cloud portal. The process-specific components – camera, supervisory control, OT network – are typically managed locally. In addition, the management of the system that sets the security and access policies, deploys updates and upgrades is set locally.

The inference model is created using the data captured from the factory floor benefits from the cloud scale and the acceleration of AI analysis through the use of the cloud. Once the inference model is created in the cloud, however, it needs to be run locally on the edge device. The creation and deployment of the model to edge devices has to be automated such that the model is being constantly updated and refined.

LYNX MOSA.ic allows the line operator to maintain control of their infrastructure, while cloud services with the capability to virtually airgap the cloud workloads from the OT network and workloads are deployed.



Cloud Models

When implementing cloud connected. MCE solutions, Lynx sees two different approaches being proposed by the Tier 1 Cloud Infrastructure companies. The first approach is to enable multi-cloud environments using technology (e.g. Anthos, an implementation of Kubernetes on Google Cloud) that is supported across a diverse set of Cloud offerings as well as the edge. The second approach is the extension of the cloud to the edge with a tight, well defined communication strategy between the software pieces that operate at both ends of that connection.

Edge Deployment with Lynx

LYNX MOSA.ic can be used with either of these models, but this document focuses on the approach to enabling multi-cloud solutions, given the strong desire for many customers to avoid supplier lock-in. Lynx has proven its solution with Google's Visual Inspection Service. The model is built on Google Cloud Anthos (bare-metal) servers and is run on the Edge node. The edge node can be deployed onto any production line and can now have a combination of local services and cloud services. In this case, the camera capture and post prediction actions are local services whereas the Google Anthos running the visual inspection inference model is locally hosted but managed by the cloud.

The visual Inspection use case is just an example of a container-enabled use case deployed at the OT edge. With LYNX MOSA.ic, any modularized services spanning data analytics, security, and communication applications can now be deployed at the OT edge.

Summary

LYNX MOSA.ic provides a unique capability to deploy hybrid video analytics solution at the edge. Current solutions are either stand-alone or are managed completely from the cloud. There is a need for a hybrid solution that combines cloud-hosted services for video analytics with local administrative ownership and local process elements such as a camera and a supervisory controller. LYNX MOSA.ic, with its ability to provide virtually air-gapped applications, gives plant managers confidence to allow the landing of the cloud services within a carefully carved partition on their OT hardware platforms. In turn, plant managers can now deploy video analytics quickly and cost-effectively towards their desired business outcomes such as quality assurance, parts monitoring and process improvement.

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