LMI TECHNOLOGIES

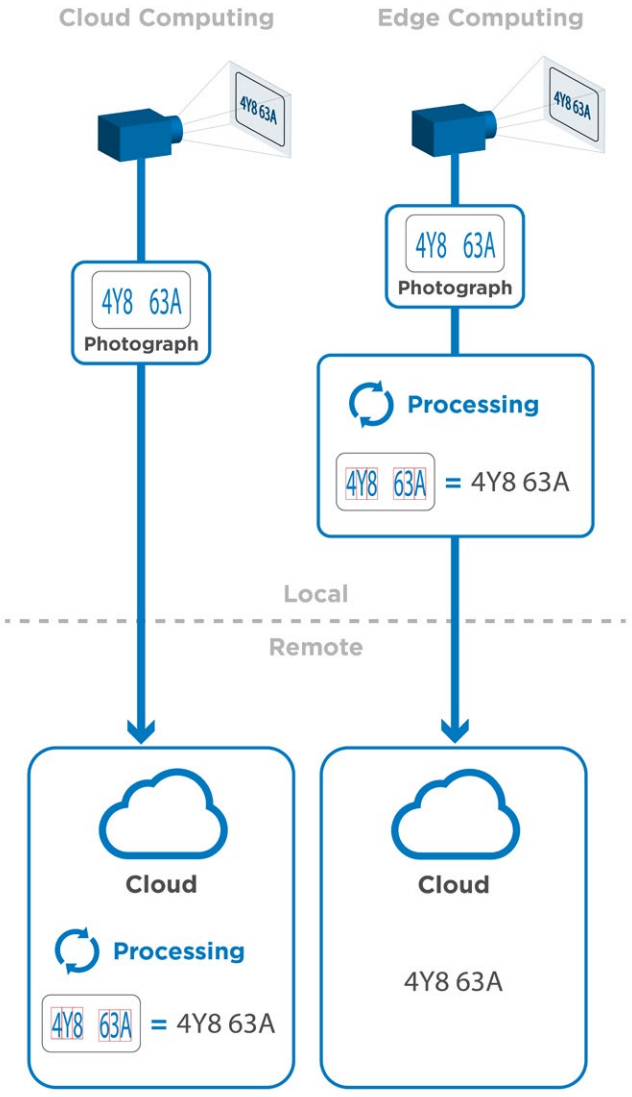
TRENDS IN 3D INSPECTION:

Edge Computing, Acceleration, and 3D Smart Sensors for IIoT

UNLOCKING THE "EDGE COMPUTING" PARADIGM

Industrial Internet-of-Things (IIoT) devices typically function as simple gateways for sensing and relaying data, relying on cloud connectivity to perform their heavy lifting and number-crunching. Machine vision sensors in today's factory produce massive amounts of data, continuously and at high speed.

What is the solution for handling these massive amounts of data? Edge computing is an emerging paradigm that uses local computing to enable data reduction schemes at the source, and as a result accelerate data processing and inline inspection rates.



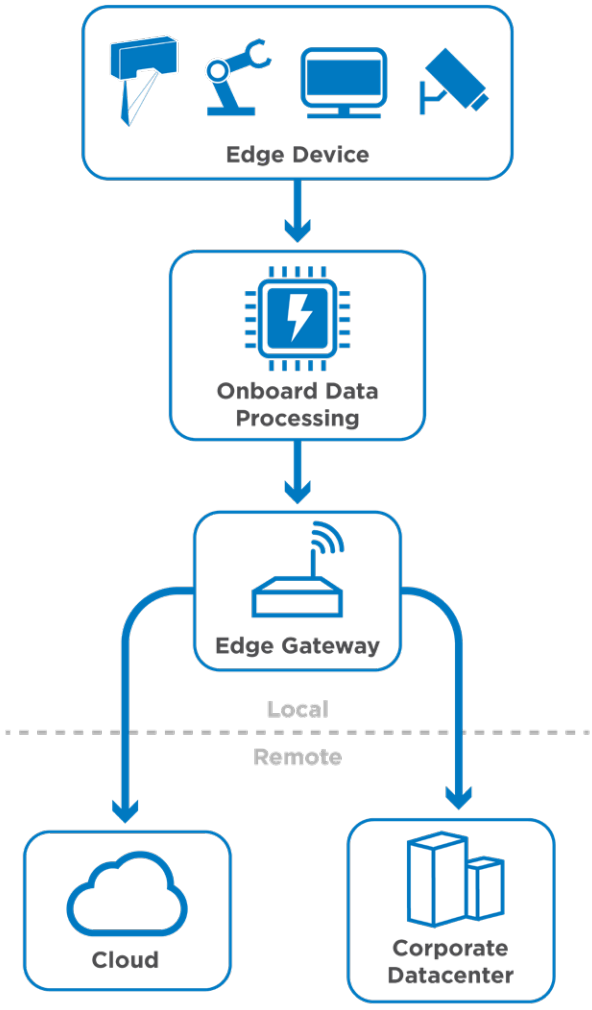
THE PUSH FOR ACCELERATED DATA PROCESSING (AT THE EDGE)

Today's factories need to generate and process data directly from the production floor to ensure quality, drive automation, and enable customization. As a result, manufacturers are embracing Industry 4.0 concepts of networked smart devices that communicate information to drive these automated processes, as well as reconfiguration, and just-in-time processes that produce high-quality product on demand. Smart sensors are an integral part of this factory ecosystem, where digitization and computing take place at "the edge."

Edge devices reduce data loads and report meaningful, high-level results that supply e-commerce systems with real-time information. This approach allows organizations to scale and distribute processes efficiently by leveraging advances in compute speed to reduce raw data closer to the source.

Accelerated edge computing is an effective solution in applications where:

1. **Rapid data sampling and low-latency** are critical (such as high-speed, closed-loop inline inspection of manufactured parts).
2. **Large amounts of data or significant bandwidth constraints** (causing bottlenecks) make it inefficient or impossible to send all data to a central location, at all times.
3. The engineer needs to **secure and protect vulnerable data** against cyber threats in factories connected to the Internet.



Edge computing is a distributed, open IT architecture that features decentralized processing power, enabling mobile computing and Internet of Things (IoT) technologies. In edge computing, the device processes data itself, or by local computer or server, rather than being transmitted to a data center.

— Hewlett-Packard Enterprise

HOW THE INDUSTRY IS ACHIEVING HIGHER SPEEDS

How is edge computing being achieved today, and what approach is the industry taking to address this need? The answer is clear. Chip manufacturers have already moved into the era of "acceleration," and they recognize the solution requires a hybrid of three technologies:

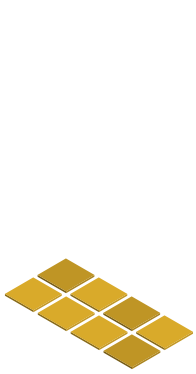
- FPGA (pixel-based processing)
- GPU (array processing)
- CPU (general purpose logic processing)

THE KEY INGREDIENT: GPU POWER

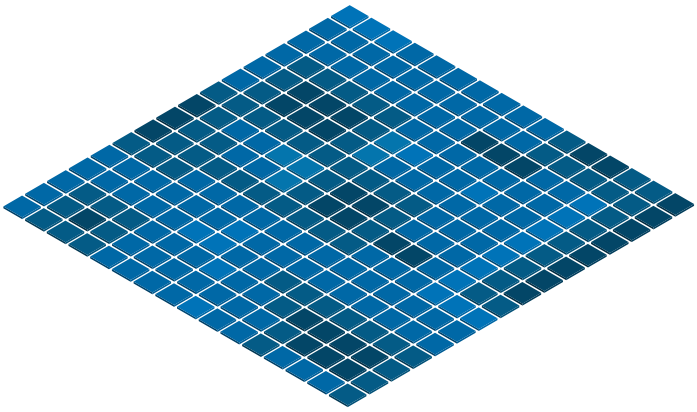
Factories typically use 2D machine vision designed around FPGAs (built into an industrial camera) to deliver raw image data to local PCs for quality control inspection. Smart 2D cameras use a CPU and FPGA to process raw data within the device for simple inspection tasks. As the camera resolution increases from VGA to 10-25Mp, the cycle time dramatically slows down and another level of acceleration is required. That's where the GPU comes in.

In dedicated GPU-accelerated hardware devices, such as the NVIDIA Jetson TX2, the decision logic part of the workload runs on an ARM CPU—which is optimized for multi-threaded performance—while the compute-intensive portion of the application runs on hundreds of GPU cores in parallel. This combination is the new paradigm of performance at "the edge," driven by high-performance multi-core technologies.

With these three technologies (FPGA, multi-core CPU, and now massive GPU cores) the resolution and speed of machine vision systems can meet demanding factory cycle times. This additional processing capability is available to drive advances in machine vision including a move from traditional 2D vision to smart 3D vision that adds the critical dimension of measuring shape to quality control.



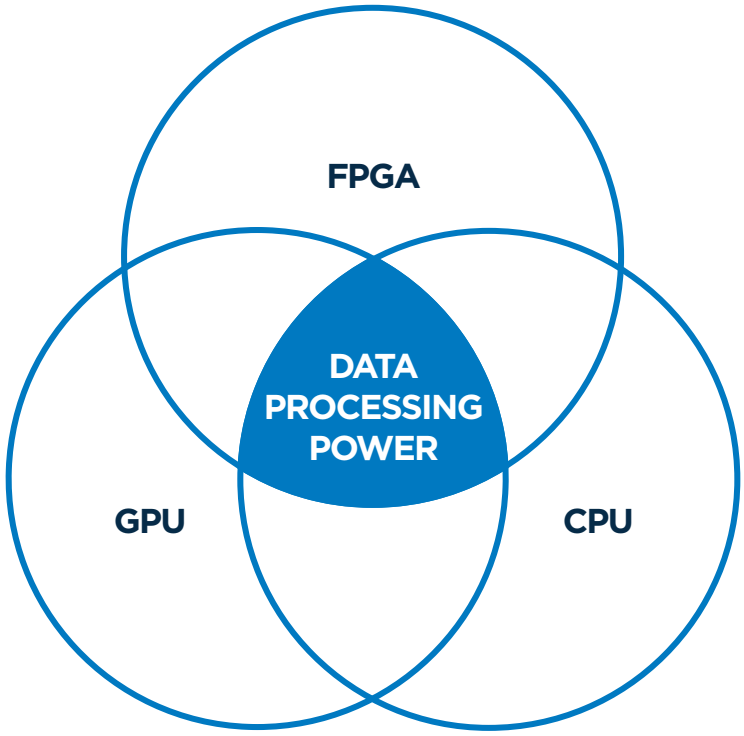
CPU
8 cores



GPU
256 cores

3D SMART SENSORS: THE SECRET TO ACCELERATION AT "THE EDGE"

3D smart sensors have all three of the necessary technologies required for effective acceleration, including embedded FPGA and CPU power onboard the sensor itself, and the ability to be paired with a dedicated sensor accelerator (that has GPU + CPU processing power) to add even further compute performance.



The result?

Massive compute power at "the edge" (i.e., where the source of data is processed to produce pass/fail results). Acceleration allows engineers to digest, process, analyze, and take action on massive amounts of manufacturing data in smaller, more manageable packets.

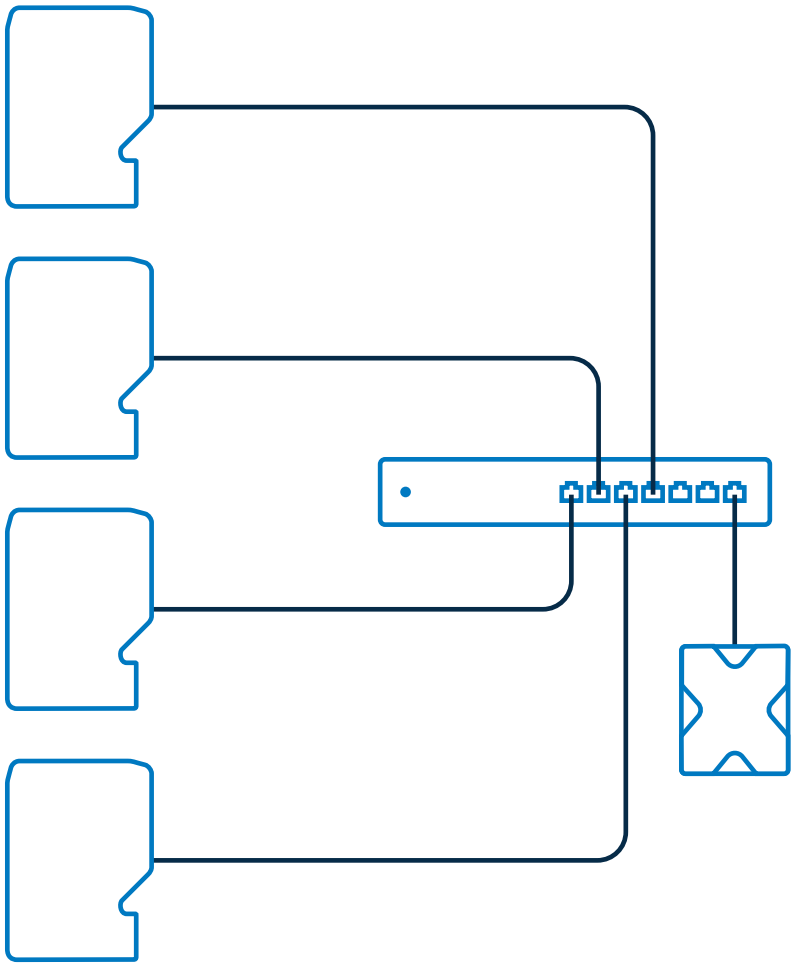
DNA OF AN ACCELERATED SMART SENSOR

DISTRIBUTED AND SCALABLE NETWORK ARCHITECTURE

Smart sensor networks are built on a distributed architecture that facilitates scalability by giving process engineers various strategies to develop solutions for each manufacturing cell. Applications are implemented by loading job files over the factory network. These job files configure measurements that run edge devices, which require minimum interaction with coordinating elements. As a result, accelerated data processing is achieved by preventing unnecessary or undesired uploads to servers in headquartered data centers.

ONBOARD DATA PROCESSING CAPABILITY

A smart sensor not only acquires data, but processes that data and communicates control decisions to factory equipment—directly from the edge, without having to send data back to a centralized location. As a result, the sensor is able to carry out computing and storage onboard so that select applications can be executed locally at very high speeds.

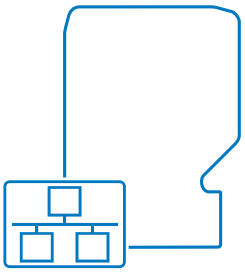


Edge devices act both independently and as part of a network.

ACCELERATE. OPTIMIZE. INSPECT.

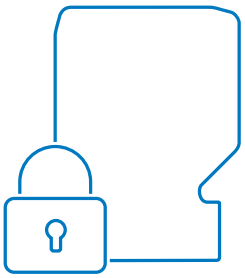
NETWORK-ENABLED

When 3D smart sensors digitize and measure a target object, smaller packets of high-level data are communicated to the factory, rather than transferring raw scan data continuously for processing elsewhere. This capability alleviates pressure on network bandwidth, minimizes latency, and accelerates inspection rates.



SECURE AND PRIVATE

In today's factory, proprietary information can easily be leaked through any connected device, platform, or even the network itself. As a result, manufacturers are becoming more and more concerned about the exposure risk to their proprietary data. In response, smart sensors support data security such as user profiles (e.g., technician vs. administrator), encrypted firmware and settings, and secure protocols to exchange data via cloud storage.



CONCLUSION

Edge computing through acceleration improves time-to-action and reduces latencies down to milliseconds while optimizing network bandwidth. In combination with factory systems and powered by accelerated smart sensor technology, edge systems have a profound impact on industrial system performance and ultimately increase quality, flexibility, and productivity for manufacturers.

It’s Better to Be Smart.

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