



Endless ways to the future

WHITEPAPER

# A PATH FORWARD FOR THE RESOURCE- CONSTRAINED EDGE

## Part 2



A PATH FORWARD FOR THE RESOURCE-CONSTRAINED EDGE

# A Path Forward for the Resource-Constrained Edge

## Part 2

*PICMG's COM-HPC® specification delivers a scalable infrastructure upgrade for cloud data exchanges where high performance and robust networking are a must.*

*Featuring higher-bandwidth interfaces across the board, a broad power envelope, and multi-architecture support, the open standard is designed to satisfy the requirements of next-generation IoT systems. Specifically, COM-HPC® enables the creation of advanced computing platforms that can reduce latency, minimize expensive data transfers over the network, and add unprecedented intelligence across the edge-fog-cloud continuum.*

*In Part 1, we reviewed the technical merits of COM-HPC® as a next-generation edge compute and networking platform and introduced module solutions based on the standard that demonstrate its capabilities in embedded environments. In part two, we look deeper at the technology in robotics, medical imaging, and edge video surveillance deployments as well as three simple steps for designing and implementing custom-off-the-shelf COM-HPC® solutions.*

The demand for high-performance local data processing and networking capabilities is nearly ubiquitous across edge environments. However, it's even more pronounced in applications where IoT edge analytics and vision-based AI have taken hold, such as medical imaging, autonomous industrial robots, and video surveillance.

While the applications mentioned above serve different markets, they all share the common technical requirements of being able to support heterogeneous workloads, the need for excellent performance per watt (PPW), and the ability to reliably transmit data using high-bandwidth wired or wireless connectivity media.

As addressed in Part 1, the COM-HPC® standard was developed to meet requirements like this that straddle the line between embedded and data center technology. Let's dive deeper into how the COM-HPC® solutions introduced there – **SECO's LAGOON and CARINA COM-HPC® Client size A modules** – enable these use cases.



## A PATH FORWARD FOR THE RESOURCE-CONSTRAINED EDGE

### A dynamic controller for autonomous robots

Even today's smart factories are relying less on human workers and stationary automation systems and more on autonomous mobile robots (AMRs) that independently navigate their surroundings and perform complex manufacturing tasks safely.

This dictates that **AMRs run a sophisticated blend of route mapping, obstacle detection and avoidance, image classification, and other learning algorithms locally alongside the deterministic actuation and control functions traditionally found in robotics systems.** To manage cost, power consumption, and complexity, these designs are trending towards workload consolidation, which leverages powerful multicore embedded processors and virtualization technology to run both sets of workloads on the same control hardware.

**SECO CARINA COM-HPC® module is tailor made for these design requirements.** 3D and imaging cameras used by AMRs for perception can be integrated seamlessly using its backward-compatible USB4 interface, while lidars or radars connect over two onboard UARTs. Captured video and images can take one of multiple user-defined paths through an image processing pipeline:

- 12-bit HEVC, 10-bit AV1, or other codecs built into the 11th gen processors that permit low-bandwidth 4K/8K video streaming;
- Up to 96 Intel® Iris Xe graphics execution units mentioned previously;
- The PCIe Gen 4.0 x4 link to an external GPU resource.

This multimedia processing leaves plenty of headroom for system management, control, and other tasks on COM-HPC® CARINA's four CPUs. Out of the box, general-purpose workloads can be administered by compatible industrial-grade operating systems like long-term support versions of Windows 10 IoT Enterprise and Linux. With hardware virtualization enabled, real-time functions can be managed separately by RTOSs like Wind River VxWorks 7.0 or Linux PREEMPT\_RT, which SECO engineers can help implement.



**Figure 1.** SECO's CARINA line of COM-HPC® Client Size A modules are based on 11<sup>th</sup> generation Intel® Core™ and Celeron® processors (formerly Tiger Lake UP3) with two-to-four cores.



## A PATH FORWARD FOR THE RESOURCE-CONSTRAINED EDGE

### Integrated medicine for mobile point of care

**Healthcare is another industry that's increasingly untethered.** For example, there's a growing need for portable, AI-enabled imaging equipment that improves bedside diagnosis in hospitals and other medical facilities. But with better compute density and PPW from platforms like COM-HPC®, it's now possible to extend those abilities deeper into the field.

Both SECO [CARINA](#) and [LAGOON](#) COM-HPC® modules accept an 8VDC to 20VDC input power supply, meaning they could be powered by a car battery when attached to an inverter. While most of us don't need the equivalent of an edge server in our daily commute, **first responders would make quick use of the intelligence COM-HPC® can provide while administering treatment at remote points of care.**

In equipment like portable ultrasounds, high-bandwidth COM-HPC® interfaces usher high-speed data exchanges between analog front ends and the host processor, which performs signal conditioning, filtering, and analysis. Native support on the COM-HPC® CARINA and LAGOON platforms for up to four independent displays over HDMI 2.0b, DisplayPort 1.4a, and embedded DisplayPort 1.4b or MIPI DSI channels allows processor outputs to be reflected on 4K/8K UHD displays in emergency vehicles, helping improve awareness, decision making, and overall care when it matters most.

Another interesting possibility in mobile healthcare applications is **the availability of wireless connectivity on CARINA COM-HPC® modules.** Bluetooth, in particular, offers an effective means of point-to-point and point-to-multipoint data sharing between electronic systems at the medical edge to gain instant insight into complex conditions. There's also the opportunity to use plug-in cellular modules that extend the edge of healthcare IoT even further.

### An AI on video surveillance

Where resource and cost savings are concerned, the **video surveillance market** probably stands to gain more than any other in the shift to edge computing. Recent research estimates there were 770 million operational CCTV cameras worldwide in 2019, and almost all of them were processing data somewhere other than locally. If there was one bill for streaming all that video over networks, it would bankrupt a small country.

The [LAGOON](#) COM-HPC® modules family presents a local alternative. With support for two, four-lane MIPI CSI-2 interfaces and a scalable number of CPU cores and graphics execution units across the portfolio, it can be used in edge or fog UHD multimedia processing servers to analyze multiple video streams simultaneously. Because the analysis happens so close to the video or image capture, data would only have to be transmitted across a network when points of interest are identified.



## A PATH FORWARD FOR THE RESOURCE-CONSTRAINED EDGE



**Figure 2.** SECO LAGOON COM-HPC® Client size A modules are a scalable portfolio of 11<sup>th</sup> generation Intel® Xeon®, Core™ vPRO, and Celeron® devices with two-to-eight CPU cores

Identifying those points of interest is aided by Intel® DL Boost, which makes use of the efficient numeric format bfloat16 and cache-saving Intel® Vector Neural Network Instructions (Intel® VNNI) to optimize AI workload execution. Object detection, recognition, and image classification algorithms can run on COM-HPC® LAGOON hardware to help flag snippets or create new value-added services.

The only question is, «Where do those sophisticated algorithms come from?»

SECO Mind exists to answer that kind of question. A division of SECO, it offers market – and technology – specific services like custom AI model training and algorithm optimization for embedded hardware targets. They also oversee the **SECO CLEA platform, an integrated AI, IoT, and data orchestration solution** that streamlines the management and deployment of those algorithms onto platforms like LAGOON-based image processing servers.

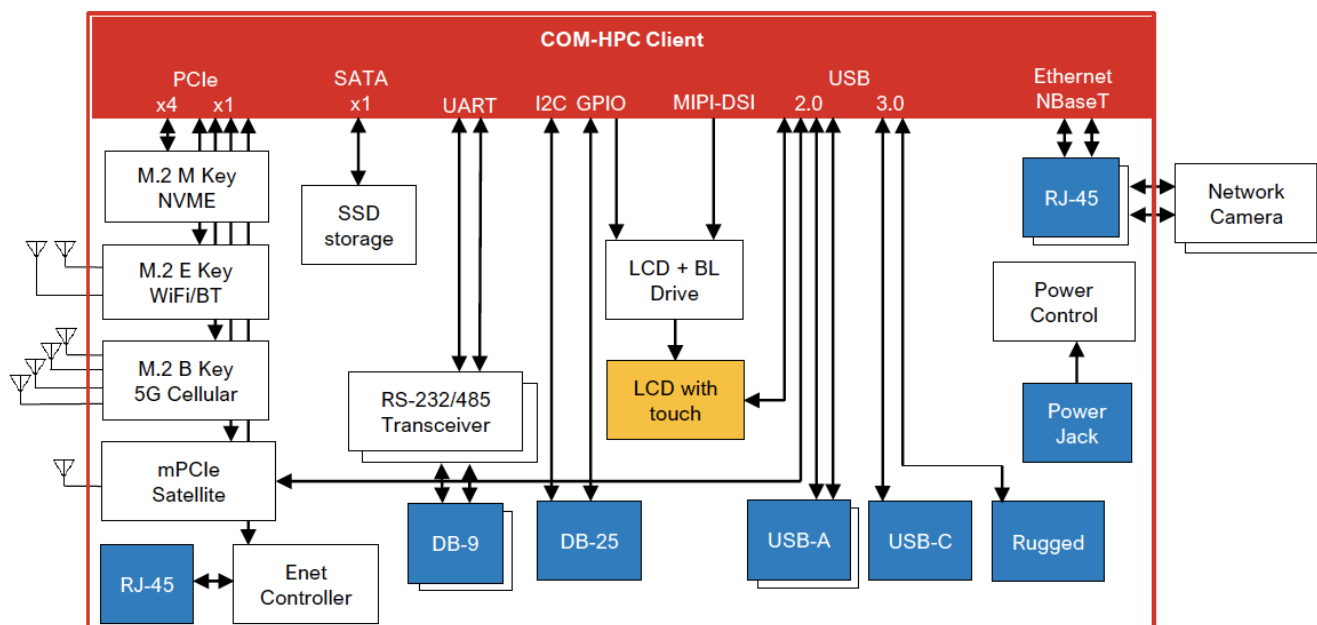
Together, SECO, CLEA, and COM-HPC® Clients can chart a clear path into next-generation video surveillance. Still, one of the most important facts about the technology isn't about tomorrow, it's about today: the COM-HPC® LAGOON's high-speed, standards-based PCIe, Ethernet, USB, and other I/O means it can be dropped into existing deployments without having to redesign entire video surveillance architectures.

### COM-HPC®: off the shelf and into the field

With a COM-HPC® processor module selected, all that's left is to design the application-specific carrier board that makes compute and other boards resources available to the rest of the system. Carrier board design involves PCB layout of radios and connectors (including the two COM-HPC® connectors), accounting for any thermal management constraints, and, of course, compensating for signal integrity issues (**Figure 3**).



## A PATH FORWARD FOR THE RESOURCE-CONSTRAINED EDGE



**Figure 3.** The design of a COM-HPC® carrier board is complex, as I/O and connector placement, thermal management, and signal integrity issues must be addressed. (Source: SECO)

To assist COM-HPC® users in this process, **PICMG recently published version 2 of its COM-HPC® Carrier Board Design Guide** that provides supplementary technical reference material to the main specification. In it, there is a detailed discussion of backplane signaling that runs from the plug-in compute module to the carrier board, which includes a series of diagrams that illustrate how designers should serialize and deserialize high-throughput Ethernet interfaces on either side of the COM-HPC® connector.

Users should be forewarned that designing a carrier is not a trivial pursuit. Especially with high-speed 10, 25, 40, and 100 Gbps Ethernet KR interfaces and 16 or 32 GTps PCI Express links that are highly susceptible to electromagnetic interference (EMI), the electrical and circuit board architectures of a COM-HPC® carrier are complex enough that they represent significant design risk.

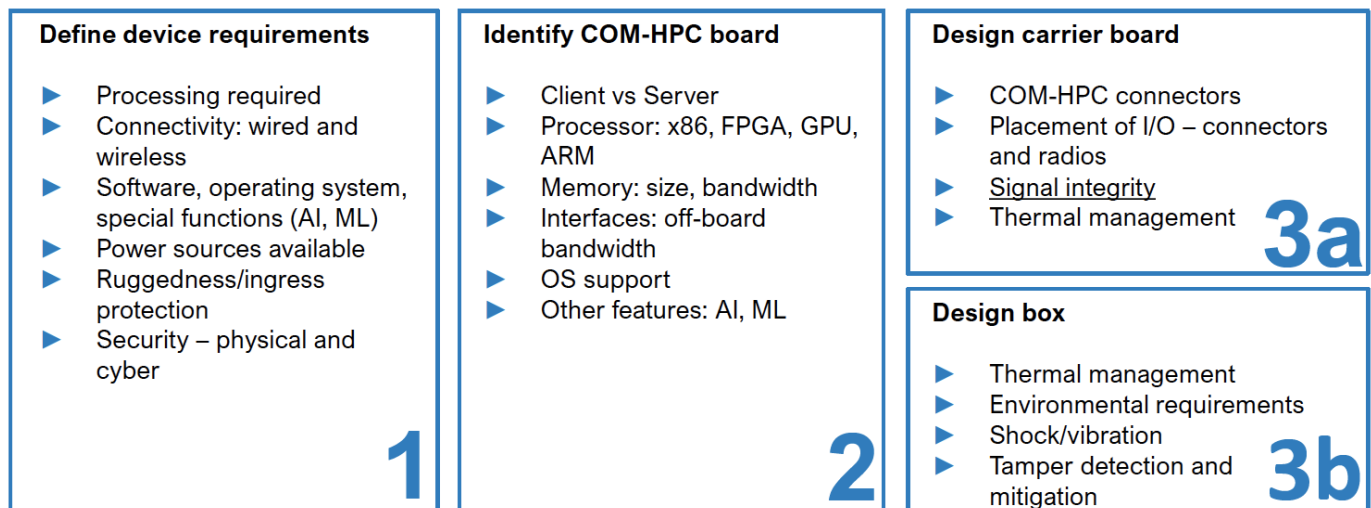
This risk could reveal itself immediately in added cost or design cycles that result in missed time to market goals. Or it could lead to interoperability issues down the road that make it impossible to capitalize on the biggest benefit of a COMs: the ability to swap out the processor module later to add performance.

To offset these risks and maximize the inherent time and cost advantages of an off-the-shelf processor module, many customers partner with a COM-HPC® expert on their carrier board design. **As a member of PICMG's COM-HPC® subcommittee, SECO has an intimate knowledge of the specification that lends itself to the design and manufacture of robust, highly interoperable, cost- and performance-optimized solutions.**

## A PATH FORWARD FOR THE RESOURCE-CONSTRAINED EDGE

It also doesn't hurt that they are lead partners for Intel® silicon, including 11th Gen Intel® Core™ and Celeron® (formerly Tiger Lake-UP3) processors as well as the recently released 12th Gen Intel® Core™ (formerly Alder Lake - P series) processors.

On a technical level, SECO engineers use techniques like signal and power integrity verification, EMC debug, and cutting-edge simulation tools to implement their knowledge in reliable, long-lasting COM-HPC® solutions. These activities have become so precise that SECO now offers a predictable, three-phase device implementation process to ensure customers stay on target with their design and product delivery timelines (Figure 4).



**Figure 4.** SECO has developed a three-phase COM-HPC® device implementation process that ensures customers on track for their product design, fabrication, and delivery targets. (Source: SECO)

## The new IoT Edge: the market is open

Today's economies are built on data, with data marketplaces of all types. Some are open, others are closed. Some are secret, others are shared. Whatever they are, the market is open, and we need to analyze data as quickly and efficiently as possible.

As such, we must start thinking about edge computing the same way we think about the infrastructure that supports industries like agriculture or transportation. These require continued investment in utilities, roads, and so on, and as the demands on that infrastructure change, so does the investment to keep it up to date.





## A PATH FORWARD FOR THE RESOURCE-CONSTRAINED EDGE

Since our demand for data hasn't slowed since the Internet was made public, we can make some confident guesses about what will be required of our data infrastructure in the future. And we can use those predictions to inform electronic design decisions of today.

Here are two:

1. The data economy will need increasingly powerful edge computing platforms to keep valuable data flowing into the markets it serves;
2. The infrastructure will be so massive that rip-and-replace upgrades won't just be impossible, but entirely cost-prohibitive; it must evolve incrementally with demand.

Those predictions seem would suggest the need for an architecture like COM-HPC®.

For more SECO COM-HPC® solutions, visit <https://edge.seco.com/usa/products/modules/com-hpc/>.





## A PATH FORWARD FOR THE RESOURCE-CONSTRAINED EDGE

### About SECO

SECO (IOT.MI) develops and manufactures cutting-edge technological solutions, from miniaturized computers to fully customized integrated systems combining hardware and software. SECO also offers [CLEA](#), a proprietary end-to-end IoT-AI analytics software suite, made available on a SaaS basis, that allows clients to gather insightful data from their on-field devices in real time. SECO employs almost 800 people worldwide and operates through 5 production plants, 9 R&D hubs and sales offices in 9 countries. SECO serves more than 300 blue-chip customers which are leaders in their respective fields, including Medical, Industrial Automation, Aerospace & Defense, Fitness, Vending and many other sectors. SECO R&D capabilities are further enhanced by long-lasting strategic partnerships with tech giants and collaborations with universities, research centers, and innovative start-ups. Corporate social responsibility is part of the strategy of SECO, that undertakes several actions to reduce its environmental footprint and increase its impact on its people and local communities.

**For further information:**

[info.us@seco.com](mailto:info.us@seco.com)