

# Carnival Corporation & plc Continues Modernizing Shipboard Connectivity Services

**NodeWeaver's edge operating platform is the foundation for consolidating network services and delivering higher density compute and network performance in a HA cluster built on Supermicro platforms utilizing 4th Gen Intel® Xeon® Scalable Processors, enabling Carnival Corporation to deliver agile and performant connectivity services across its entire fleet.**



The amount of data produced, processed, and consumed at locations that make up the edge – remote offices, points of presence, cellular base stations, content delivery network (CDN) nodes, and even ships – is growing rapidly. So is the edge compute infrastructure market as companies in a wide range of industries are exploring how to process and analyze this data for actionable insights. Industry analyst firm IDC is tracking the growth of the industry and predicts the edge compute investments will reach \$232 billion in 2024, reaching nearly \$350 billion by 2027<sup>1</sup>.



Edge computing requires a new deployment model. As technology advances, edge servers are becoming increasingly powerful and are performing complex tasks such as network functions virtualization (NFV) and AI and machine learning algorithms directly on-site. The increased number and complexity of compute-centric services require deployment, operating, and management capabilities that have traditionally only been found in hyperscale cloud and core datacenter environments.



In addition, many distributed edge locations are filled with fixed-function appliances that need to be consolidated to make room for new servers to support new edge services. Remote locations also have a lack of management capabilities or staffing with proper expertise.



One company that saw an opportunity in deploying advanced edge compute nodes is Carnival Corporation & plc, the world's largest cruise company. The company manages a global fleet of 90-plus cruise ships, focusing on delivering unforgettable happiness to millions of guests by providing extraordinary cruise vacations. With a vision for innovation and operational excellence, Carnival Corporation sought to optimize its onboard edge infrastructure to deliver enhanced compute and network security for cruise operations, networking and entertainment services for guests and crew. This infrastructure was subject to severely constrained space, limited cooling and power, as well as support expertise available for compute and network infrastructure onboard.

Data networks are a critical part of a cruise ship's infrastructure, delivering internet access services via satellite for all guests and crew, intraship communications, IP television services for guests, and crew communications. Shipboard applications needing to access the network are also growing including point of sale, scheduling, and souvenir photographers among others.

Carnival Corporation worked with NodeWeaver, an Intel® Network Builders Gold Tier ecosystem member, to build an edge/ship compute platform based on private cloud servers that provide virtualized networking services across its entire fleet. NodeWeaver has optimized its software to get maximum performance from Intel® architecture processors – running the entire software stack on a single powerful core. This small footprint results in more available cores per server allowing Carnival Corporation to provision more services with fewer servers, establishing high availability and redundancies, and reducing power and space and thermal requirements dramatically.

### NodeWeaver Provides Edge Cloud Infrastructure

Businesses across nearly every vertical industry are exploring ways to leverage actionable insights that come from processing and analyzing data that is generated outside of traditional datacenters. Deploying, managing, and operating compute infrastructure at the network edge (thousands of small, geographically separate, and diverse environments) to support these types of advanced workloads, presents many challenges which are very different from hyperscale or core datacenter infrastructure (very small number of large, traditional datacenter environments). NodeWeaver solves these challenges and minimizes the total lifecycle cost of deploying, managing, and operating edge compute by addressing the main drivers of cost and complexity.

NodeWeaver is a software-defined operating platform that simplifies the deployment, management, and orchestration of edge cloud infrastructure and applications. The software installs on bare metal servers powered by a wide range of Intel architecture processors. With NodeWeaver, enterprises can deliver an edge-native experience with highly resilient, agile and scalable compute clusters capable of running multiple virtual machines and container-based workloads, reliably and cost-effectively.

### Intel and Supermicro Provide Hardware and Technology for High Performance

Because the NodeWeaver platform is highly optimized for Intel architecture, it efficiently uses fewer process cycles on CPU cores. The software also supports advanced features for deployments that need ultimate performance improving the compute density of the limited edge resource available on ships. The platform utilizes the following Intel capabilities for high-end applications:

**Intel® Xeon® Scalable processors:** The edge network servers for the solution are based on Intel Xeon Scalable processors. These processors are the foundation for powerful servers that deliver compute agility, scalability, and workload density. These CPUs benefit from decades of innovation for the most in-demand workload requirements and are part of a complete set of edge technology from Intel. Intel Xeon Scalable processors feature a balanced architecture that supports AI with built-in acceleration, high throughput packet processing,

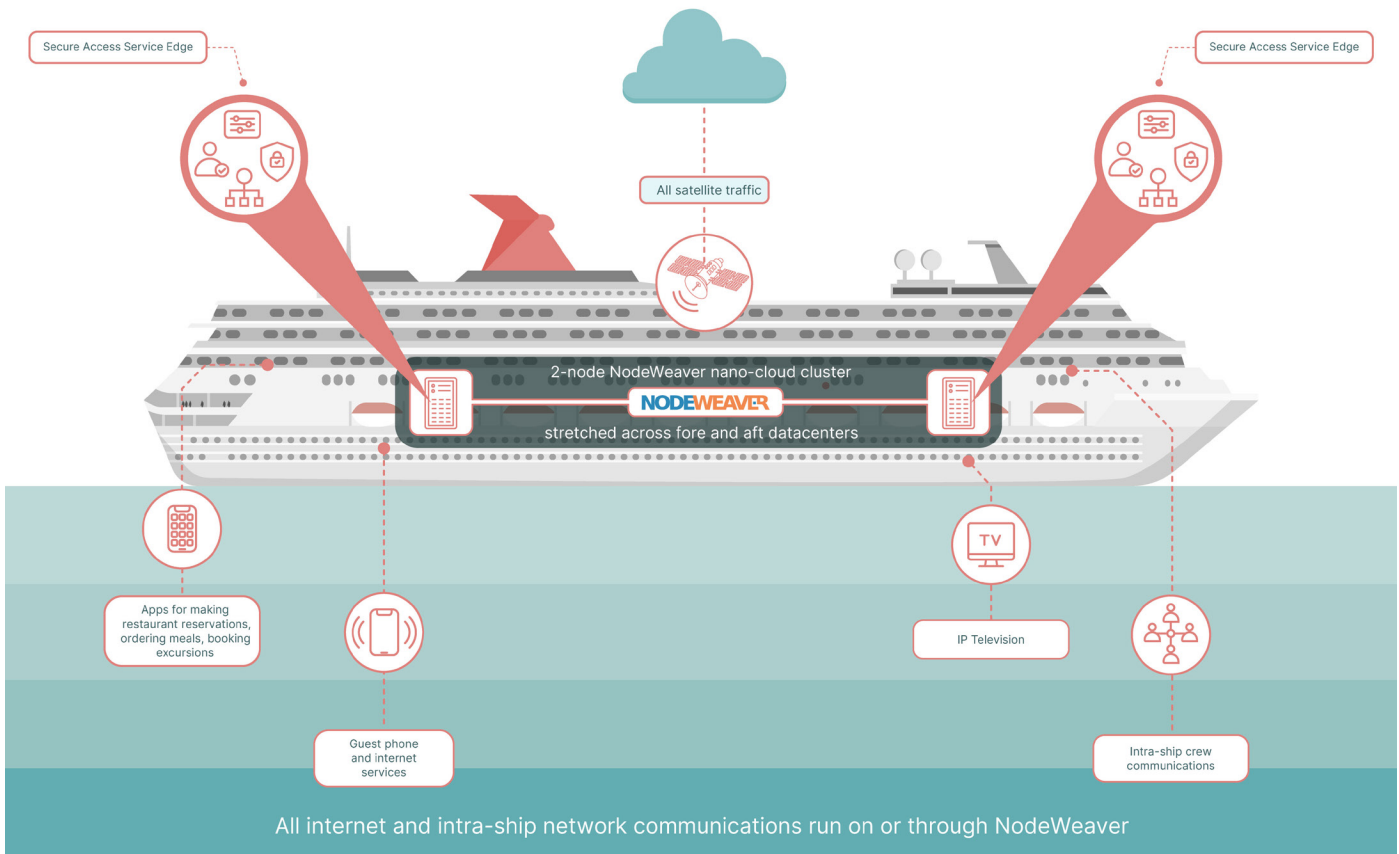


Figure 1. How a NodeWeaver implementation can enable digital and communications services on a cruise ship.

and hardware-based security features. Other features for modern edge compute network workloads target low latency, high throughput, deterministic performance, and higher performance per watt.

The systems that Carnival Corporation builds and deploys using the Intel architecture offer ubiquitous availability and coherent architecture. These features allow agile development and consistent life cycle management.

### Flexibility of Platform Choice

Supermicro has the most extensive industry-leading server edge portfolio in the industry, featuring support for the latest Intel® processors including 5th Gen Intel® Xeon® Scalable processors. With such an extensive portfolio, it was possible for a Carnival Corporation to select the optimal platforms to meet their specific performance and deployment requirements of compute, storage and networking. Learn more about Supermicro edge portfolio from this link: <https://www.supermicro.com/en/solutions/iot-edge>

AI at the edge is a key use case that partners and customers are delivering with the combination of NodeWeaver and Intel® Distribution of OpenVINO™ toolkit – in particular, by applying computer vision and deep learning to live video streams to make decisions in near-real time.

Due to the amount of data generated by video cameras, it is not feasible to transmit that data to the cloud for analysis, so the inferencing must be done locally on edge compute infrastructure. Intel OpenVINO toolkit is an open-source software toolkit for optimizing and deploying AI inference. The toolkit streamlines AI development and integration of deep learning in domains like computer vision, large language models, and generative AI. It provides the ability to convert models trained using popular frameworks like TensorFlow\* and PyTorch\* and easily move AI workloads across CPU, GPU, and NPU to optimize models for efficient deployment.

**OneAPI:** oneAPI provides a full suite of libraries that can significantly improve the runtime on all common machine learning (ML) and deep learning (DL) frameworks when using the latest generation Intel Xeon Scalable processors along with GPUs and other accelerators. By improving runtimes for the entire pipeline, oneAPI delivers a much faster time-to-result that reduces the overall footprint and ultimately power consumption of AI workloads. These improvements are important in edge networks because they can result in orders of magnitude of savings considering the frequency of running these different tasks.

**Intel® QuickAssist Technology:** Intel QuickAssist Technology (Intel® QAT) provides hardware acceleration to assist with performance demands of applications such as IPsec or TLS networking. Intel QAT provides a vital accelerator of the cryptography needed for edge computing applications. The technology also provides compression/decompression for storage, cloud, enterprise, database, or machine learning, while reducing storage footprint and reserving processor cycles for application and control. Intel QAT complements the cryptography acceleration available through instruction sets

and extensions including Intel® Advanced Encryption Standard Instructions (AES-NI) and Intel® Advanced Vector Extensions (Intel® AVX).

**Intel® Intelligent Storage Acceleration Library (Intel® ISA-L):** Edge computing needs advanced storage features to manage the massive amount of data being generated from many different sources. Intel ISA-L provides tools to minimize disk space use and maximize storage throughput, security, and resilience. The library has optimized functions for RAID, erasure code, cyclic redundancy check (CRC) functions, cryptographic hash, encryption, and compression. The combination of the Intel Xeon processor family and Intel ISA-L can provide edge applications with the tools to process data securely and quickly and even reduce storage space requirements.

Supermicro has the most extensive edge portfolio in the industry, featuring Intel® processors including 5th Gen Intel® Xeon® Scalable Processors.<sup>2</sup>

### Carnival Corporation Revolutionizes Maritime Operations with VNF Solution powered by NodeWeaver

Some ships in the Carnival Corporation fleet can accommodate up to 6,000 guests and crew – all of whom are dependent on network services. To serve these users, a ship's network was typically built using standalone, single-function appliances. Some of the challenges of this architecture include:

**Data Center Space Constraints:** Carnival Corporation's ships were originally designed with data centers that fit in a limited space. But as the number of applications and amount of data generated onboard has grown, space, power and cooling are increasingly at a premium.

**Limited Flexibility:** The existing fixed-function appliance-based solution made it difficult to adapt to evolving business needs and seamlessly integrate new services. Adopting virtualized networking appliances running on NodeWeaver gives Carnival Corporation enhanced flexibility to quickly add or change services in their network stack.

**Deployment Complexity:** In some cruise ships, manual deployment processes were time-consuming, complex, and had to be taken care of when the ship was in port. These posed challenges for deploying and managing network infrastructure across the maritime fleet.

### Carnival Corporation Deploys NodeWeaver Solution

To comprehensively address these challenges, Carnival Corporation partnered with NodeWeaver to deploy a VNF-based solution tailored specifically to its shipboard operations. The solution encompassed:

- **VNF Deployment:** NodeWeaver employed its edge operating platform supporting the VNF technology needed to virtualize essential network functions such as routing, firewall, identity management, and load balancing, eliminating the need for dedicated hardware appliances and optimizing space utilization onboard.
- **SDN:** SDN principles were leveraged to centralize network management, automate provisioning, and streamline

operations, enhancing flexibility and efficiency.

- **Cloud-Native Architecture:** By embracing cloud-native architecture, the NodeWeaver solution provided greater scalability, resilience, and simplified deployment across the entire fleet.
- **Orchestration and Zero Touch Deployment:** Orchestration tools and zero-touch deployment mechanisms were integrated to automate the deployment and configuration processes, reducing complexity and time required for implementing the solution fleet-wide.

Some of the benefits achieved by this new architecture include:

**Space/Power/Cooling Reduction:** In some cruise ships, virtualization of network functions replaced between six and eight standalone appliances in each shipboard data center with a single 1U-high Intel Xeon processor-based server. This change resulted in a significant reduction in onboard hardware, increasing compute density, along with reducing the amount of power and cooling required and freeing up space for valuable new applications and other essential operations.

**Enhanced Flexibility:** The adoption of SDN and cloud-native architecture provides Carnival Corporation with increased flexibility, enabling rapid deployment and modification of network services to meet evolving business demands.

**Simplified Deployment:** Orchestration and zero-touch deployment capabilities streamlined the deployment process, reducing complexity and time required for implementing the solution fleet-wide, thereby enhancing operational efficiency.

**Cost Savings:** Reduced operational costs associated with server consolidation, maintenance, and deployment complexity, driving overall equipment and operational cost efficiencies.

**Improved Agility:** Enhanced flexibility and automation enable Carnival Corporation to respond swiftly to market demands and deploy new services seamlessly across its maritime fleet.

**Streamlined Operations:** Orchestration and automation minimized manual intervention, streamlining operations and freeing up resources for other strategic initiatives.

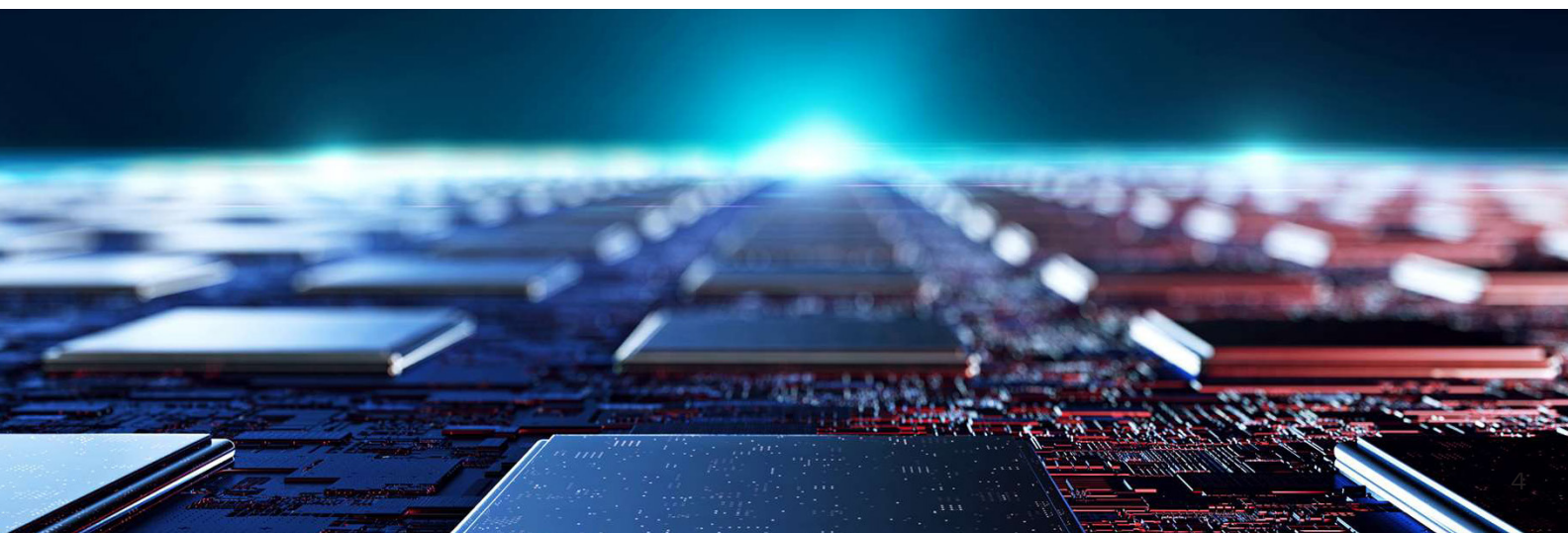
**Competitive Edge:** By embracing innovative networking and server technologies and deployment methodologies, Carnival Corporation fortifies its competitive position in the maritime industry through efficiency and performance advancements.

Looking ahead, Carnival Corporation remains committed to leveraging emerging technologies and best practices to further enhance its operational capabilities and maintain its leadership in the global cruise industry. Continued investment in automation, optimization, and innovation will drive sustained growth and success in an evolving industry landscape.

“We are continuously seeking innovative solutions to enhance our operational efficiency and maintain our competitive edge, and our partnership with NodeWeaver and Intel gives us tremendous flexibility and reliability in delivering network services at sea,” said Ying-Yuang (Y.Y.) Chen, Associate Vice President, Network, Connectivity Solutions and Operations at Carnival Corporation. “The implementation of the solution running on NodeWeaver’s edge operating platform represents a significant step in our journey toward digital transformation. By leveraging cutting-edge technology and best practices, we have not only overcome longstanding challenges related to onboard back-office space constraints, power consumption, and deployment complexity, but have also positioned ourselves for future capabilities and growth in an ever-evolving market. This initiative underscores our commitment to ensuring each of our world-class cruise lines has the tools and technologies it needs to own its space in the vacation market by delivering extraordinary experiences tailored to its guests.”

“At NodeWeaver we are proud to have partnered with Carnival Corporation in its pursuit of excellence and innovation within the cruise industry. Our platform’s capabilities have empowered Carnival Corporation to transform its onboard networking infrastructure, achieving benefits in terms of cost savings, flexibility, and operational efficiency. This collaboration exemplifies our commitment to delivering solutions that drive tangible value for our customers,” said Carlo Daffara, CEO of NodeWeaver Corporation.

“When it comes to edge compute in remote locations, Carnival Corporation pushes the limits with edge servers in the middle of the ocean,” said Bob Ghaffari, Vice President Network Edge Group, General Manager Enterprise and Cloud Network Division at Intel. “The highly efficient NodeWeaver software provides an immediate benefit helping Carnival Corporation to reduce server footprint, power and data center heat, while Intel’s architectural coherency and consistency over many generations of CPUs provides a compute foundation that will deliver for decades to come.”



## Conclusion

Edge computing solves big problems for enterprises that are seeking to deliver services from remote locations or get insights from data created in these locations. NodeWeaver helps companies to build out the network infrastructure needed to efficiently deliver these services using Intel architecture processors.

Through the strategic adoption of VNF solutions, coupled with orchestration and zero-touch deployment capabilities, Carnival Corporation successfully addressed key challenges while unlocking new opportunities for efficiency, flexibility, and competitiveness. This case study underscores the transformative potential of innovative networking technologies and deployment methodologies in revolutionizing maritime operations.

## Learn More

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[Intel Xeon Scalable processors](#)

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[oneAPI](#)

[Intel Intelligent Storage Library](#)



<sup>1</sup><https://www.idc.com/getdoc.jsp?containerId=prUS51960324>

<sup>2</sup><https://www.supermicro.com/en/solutions/iot-edge>

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