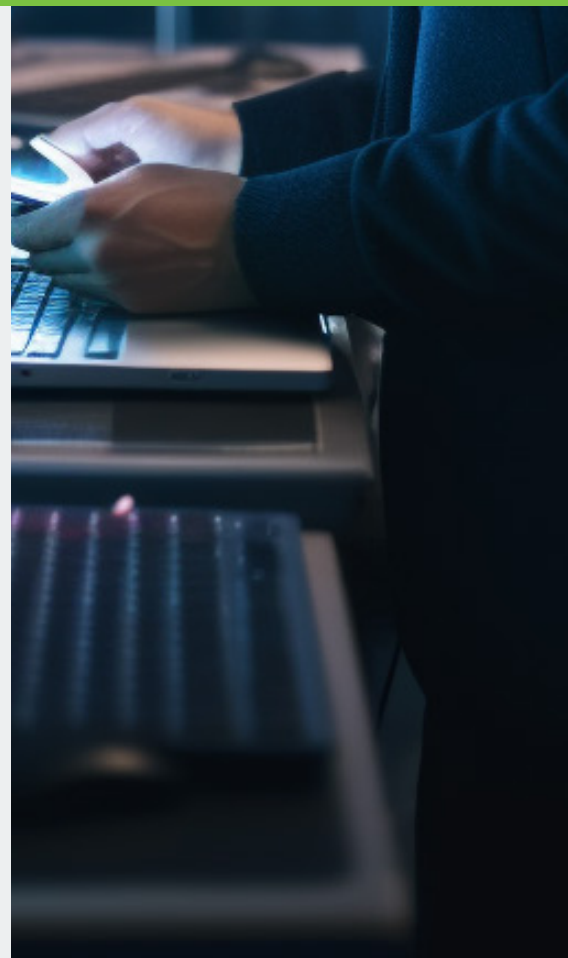**HyperBlox** | **napa:tech;**
SMARTNIC+IPU SOLUTIONS

EDGE SENSOR FUSION OPTIMIZATION

Optimizing the performance and capacity of compute infrastructure for mobile edge sensor fusion applications is a strategic initiative utilizing HyperBlox software on HPE servers configured with Napatech SmartNICs.

ABOUT
HYPERBLOX

The global shift towards AI/AGI-enabled autonomous systems interconnected via wireless networks for mobility, such as autonomous vehicles, drones, autonomous factories, Augmented Reality (AR), Virtual Reality (VR), and Edge AI, necessitates a robust computing platform. HyperBlox addresses this demand as an end-to-end solution, facilitating the development, deployment, and interconnection of AI-enabled sensor-fused applications at scale and cost-effectively.

HyperBlox offers a low-code/no-code platform that integrates facilities for creating and deploying AI-enabled edge applications. These applications are seamlessly connected over wireless networks, utilizing private 5G, 4G, or Wi-Fi for converged connectivity solutions.

The low-code/no-code nature of the HyperBlox platform adopts a code-once-and-deploy-many approach. This methodology allows applications to be developed once and deployed across multi-cloud environments (e.g., AWS, GCP, Exoscale, or bare metal), accommodating x86-64 or ARM64-based systems.

Effective video and AR/VR data stream handling for data fusion necessitates processing substantial data volumes over wireless networks. To meet this demand, HyperBlox has strategically partnered with Napatech to offload and accelerate the compute-intensive User Plane Function (UPF). This collaboration liberates server CPU resources, enabling optimal application and service utilization.

This solution brief articulates the technical and business-level advantages of the comprehensive end-to-end system solution provided by HyperBlox.

ABOUT **NAPATECH**

Napatech's SmartNIC solution for UPF offload strategically addresses the essential business objective of minimizing the cost-per-device or cost-per-user for 5G packet core deployments. This innovative solution encompasses an integrated hardware/software framework, delivering unparalleled UPF performance. The fully offloaded UPF fast path, seamlessly incorporated within the Link-Inline™ software stack, operates on the NT200 PCIe SmartNIC, boasting a remarkable total bandwidth capacity of 200Gbps.

The UPF offload solution from Napatech empowers HyperBlox to support a significantly higher number of users or devices per server compared to pure software solutions or alternative offload offerings. This increased efficiency minimizes the overall cost-per- user while simultaneously enhancing energy efficiency.

Leveraging a single NT200 SmartNIC to sustain 100Gbps of full duplex traffic, the Napatech UPF offload solution demonstrates impressive capabilities, processing 140 million concurrent flows. With stateful

operation, the flow learning rate surpasses 1.5 million flows per second, achieving a commendable total throughput of 85 million packets per second.

Notably, Napatech's UPF offload solution aligns seamlessly with the industry-standard DPDK RTE_-FLOWS API for flow configuration. This compatibility ensures that 5G packet core software vendors, including HyperBlox, can readily harness the performance advantages of the Napatech solution without necessitating a rewrite of their software to accommodate a proprietary API. Further enhancing flexibility, Kubernetes support enables the deployment of the solution within a cloud-native environment, utilizing a standard orchestration platform.
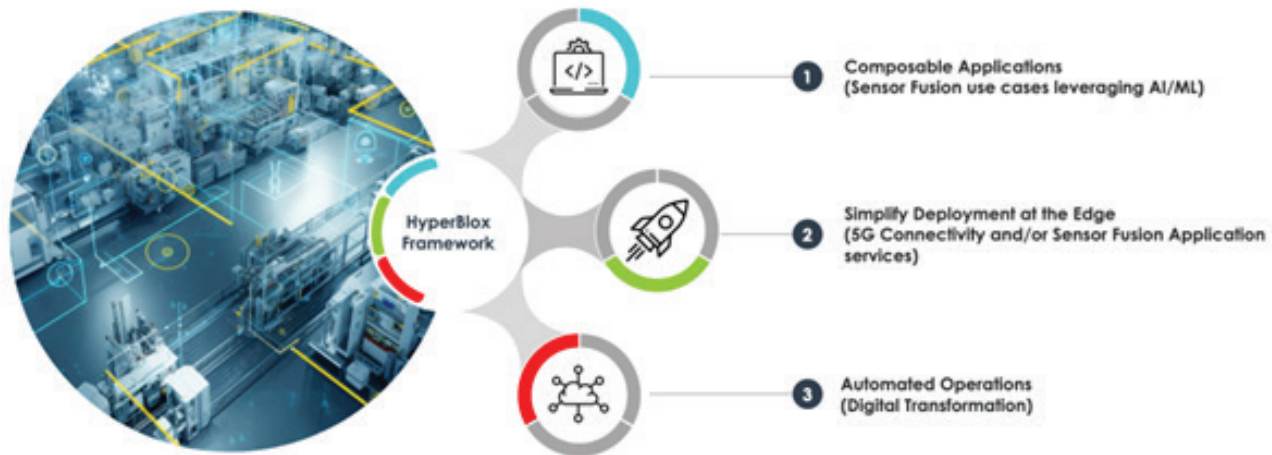
From a hardware standpoint, the NT200 SmartNIC is a full-height, half-length PCIe Gen3 card, available in both active and passive (NEBS) cooling variants, featuring standard QSFP28 network ports. The SmartNIC seamlessly integrates into industry-standard servers, as an alternative to standard or "foundational" NICs lacking offload features.
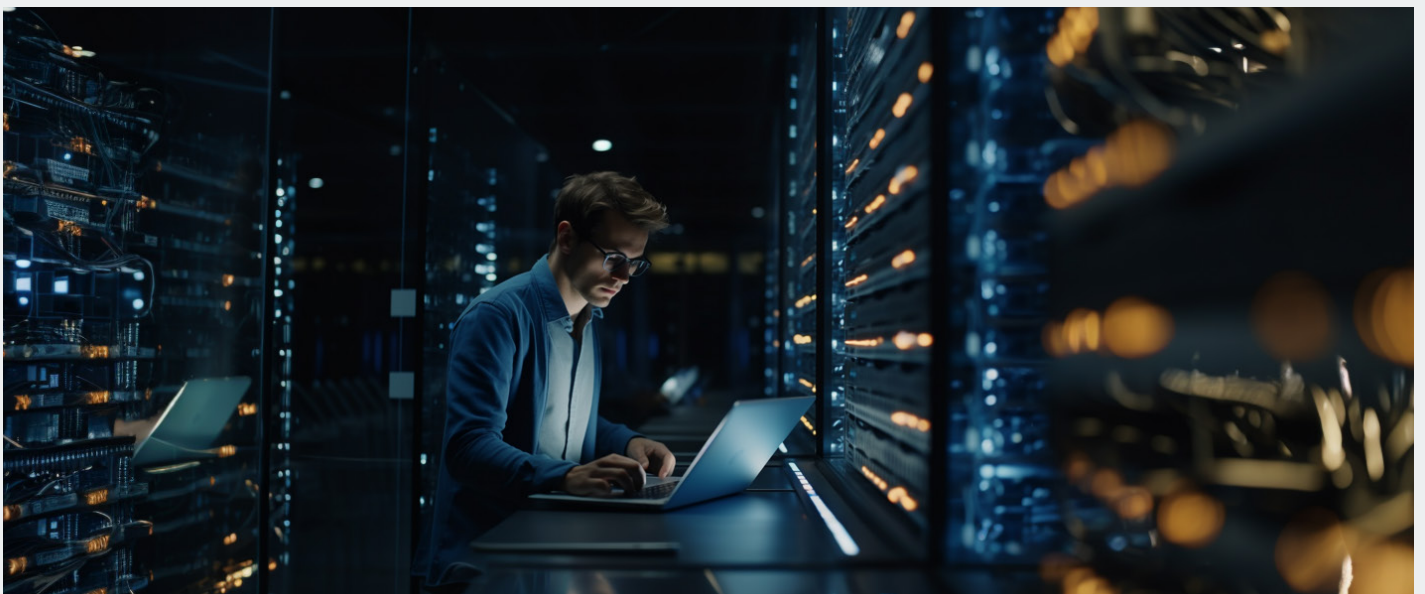
HyperBlox **VISION**

At HyperBlox, our vision is to expedite the impending convergence of physical and virtual domains by seamlessly integrating sensor fusion and AI/AGI technologies, while preserving autonomy through wireless connectivity

HyperBlox Framework

1 Composable Applications
(Sensor Fusion use cases leveraging AI/ML)

2 Simplify Deployment at the Edge
(5G Connectivity and/or Sensor Fusion Application services)

3 Automated Operations
(Digital Transformation)
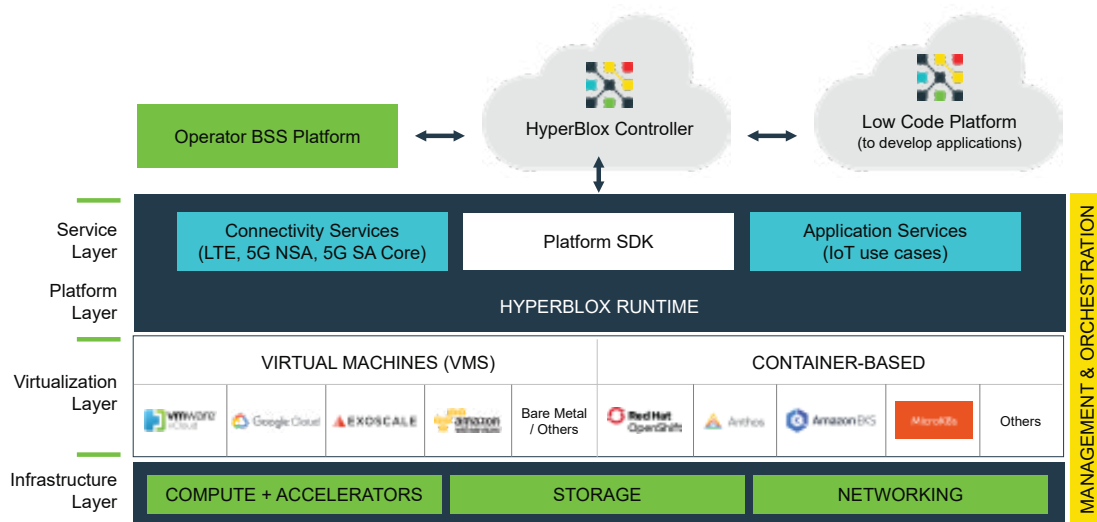
HyperBlox IP

Its exclusive intellectual property enables

Substantial savings in both capital and operating expenditures through the implementation of AI-driven automation for system management.

Decreased energy requirements by enabling the utilization of more energy-efficient systems such as ARM64, with an added capability for automatic utilization of hardware accelerators when applicable.

Enhanced user experience quality through a reduction in cognitive workload.

Acceleration of the adoption of innovative business models, achieved by employing a low-code engine for the seamless development and deployment of new applications.

Operator BSS Platform

HyperBlox Controller

Low Code Platform
(to develop applications)

Service Layer	Connectivity Services (LTE, 5G NSA, 5G SA Core)	Platform SDK	Application Services (IoT use cases)	MANAGEMENT & ORCHESTRATION
Platform Layer	HYPERBLOX RUNTIME			
Virtualization Layer	VIRTUAL MACHINES (VMS)		CONTAINER-BASED	
	vmware vCloud · Google Cloud · EXOSCALE · amazon · Bare Metal / Others		Red Hat OpenShift · Anthos · Amazon EKS · MicroK8s · Others	
Infrastructure Layer	COMPUTE + ACCELERATORS	STORAGE	NETWORKING	

HyperBlox
Connectivity Suite

The Hyperblox Connectivity Suite (5G/4G/Wifi) empowers the deployment of enterprise private networks, connected car networks, and distributed public mobile networks, playing a pivotal role in various smart city projects.

Leveraging a fully cloud-native, nano services-driven architecture, the Hyperblox Connectivity Suite demonstrates remarkable scalability in hybrid and multi-cloud environments. This suite serves as a 3GPP R16/17/18-compliant converged core for 4G/5G/-Wi-Fi, proficient in both vertical and horizontal scaling.

Designed for versatility, the Hyperblox Connectivity Suite operates on x86-64 platforms for centralized workloads and ARM64 processors for power-sensitive edge workloads.

The Hyperblox Connectivity Suite UPF, enhanced by Napatech's SmartNIC-based UPF offload solution, meets the escalating demand for high-bandwidth user plane traffic and processing. This results in superior overall performance and capacity, coupled with lower hardware costs, a reduced hardware footprint,

and decreased power consumption compared to purely software-based UPF implementations. This is particularly advantageous for use cases like Enhanced Mobile Broadband (eMBB), Ultra-Reliable Low-Latency Communications (uRLLC), and Massive Machine-Type Communications (mMTC) with a significant number of IP flows or packets per flow.

Tailored to meet the distinct requirements of edge use cases, the Hyperblox Connectivity Suite is optimized for form factor, energy consumption, environmental tolerance, and performance. Deployment options span from low-end servers, including Intel Next Unit of Computing (NUC) and Intel Celeron-based low-power systems, to high-end systems such as ARM64-based Ampere systems, AMD x86-64 Ryzen-based systems, or Intel x86-64 Xeon-based systems.
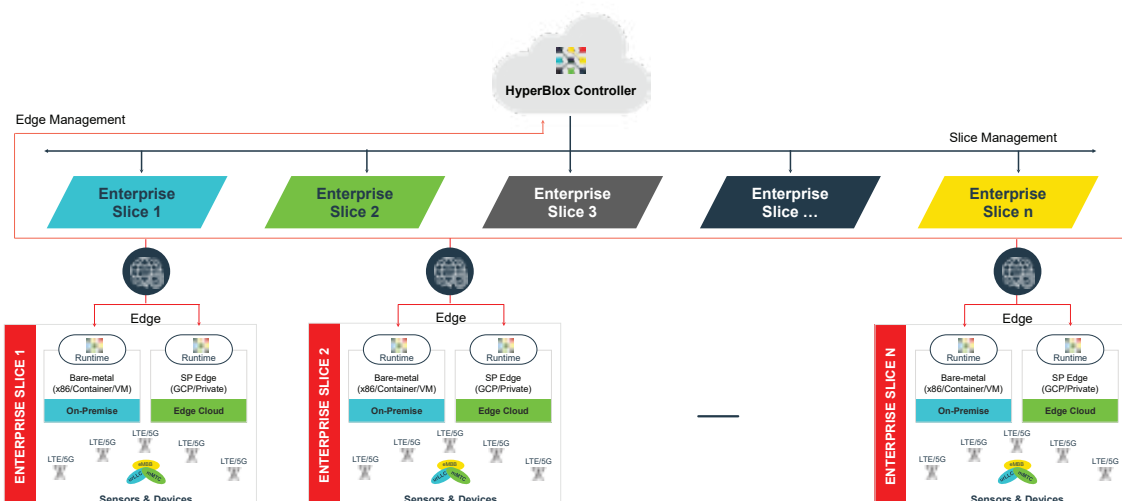
HyperBlox – Napatech
PARTNERSHIP

The User Plane Function (UPF) serves as a critical component within the 5G packet core, positioned strategically between the Radio Access Network (RAN) and the Data Network. Tasked with processing extensive data traffic originating from diverse applications, the UPF shoulders a substantial computing workload. Its responsibilities encompass packet detection, enforcement of Quality of Service (QoS) policies, and application of forwarding rules to meet the real-time processing requirements of latency-sensitive applications. Packet core vendors must deploy solutions that empower enterprises and Communications Service Providers (CSPs) to effectively address these challenges while optimizing both Capital Expenditures (CAPEX) and Operational Expenditures (OPEX).

In the collaborative solution, integrating the cloud-native UPF from HyperBlox and Napatech's SmartNIC offload, traffic flows undergo efficient offloading to the SmartNIC for accelerated processing, thereby enhancing the Quality of Experience (QoE) for end users. Conventional traffic, requiring best-effort QoS, continues to be processed in software.

In the deployment scenario that harnesses HPE's edge-optimized server platform in conjunction with Napatech's SmartNIC-based UPF offload solution, the HyperBlox 5G Application Suite UPF achieved a substantial enhancement in its capacity to support devices or subscribers on a single server, compared to a purely software-based UPF implementation. This notable improvement in server capacity renders it commercially viable for enterprises and CSPs to deploy HyperBlox software in edge locations constrained by footprint, cost considerations, environmental factors, and power consumption.

BUSINESS **BENEFITS**

To quantify the business advantages inherent in the UPF offload solution, HyperBlox and Napatech conducted an analysis based on a representative use case for a network edge deployment.
This scenario involved:

10,000	**10 Mbps**	**10**	**1200 Byte**
users/sensors	average bandwidth per user	flows per user	average packet size

Leveraging the Napatech NT200-based UPF offload solution on an HPE 16-core server, HyperBlox demonstrated the capability to support 20 times the number of users compared to a purely software-based UPF (10,000 users per server vs. 500). Over a comprehensive five-year analysis period, this results in remarkable CAPEX savings of 94% and OPEX savings of 96%. A detailed analysis report is available upon request.

SUMMARY

In the realm of edge computing, the optimal benefits manifest when applied to compute- and data- intensive applications such as AI and video processing. The efficacy of edge computing for private networks hinges significantly on energy efficiency and the costs associated with both compute and network infrastructure. Utilizing standard IT infrastructure to host high-band-width networking workloads is not commercially viable, primarily due to the prohibitive power consumption, Capital Expenditures (CAPEX), and Operational Expenditures (OPEX) involved.

Through the strategic deployment of Napatech's SmartNIC-based UPF offload solution on an edge- optimized server platform from HPE, HyperBlox has achieved a pinnacle in cost performance for its edge infrastructure. This has resulted in the delivery of highly efficient connectivity tailored for autonomous vision and AI applications. These applications find relevance across diverse use cases, including agriculture, mining, transportation, industrial automation, connected vehicle infrastructure, smart retail, and healthcare.