A5G Networks maximizes the performance and capacity of mobile edge network infrastructure via Advantech edge servers configured with Napatech SmartNICs.

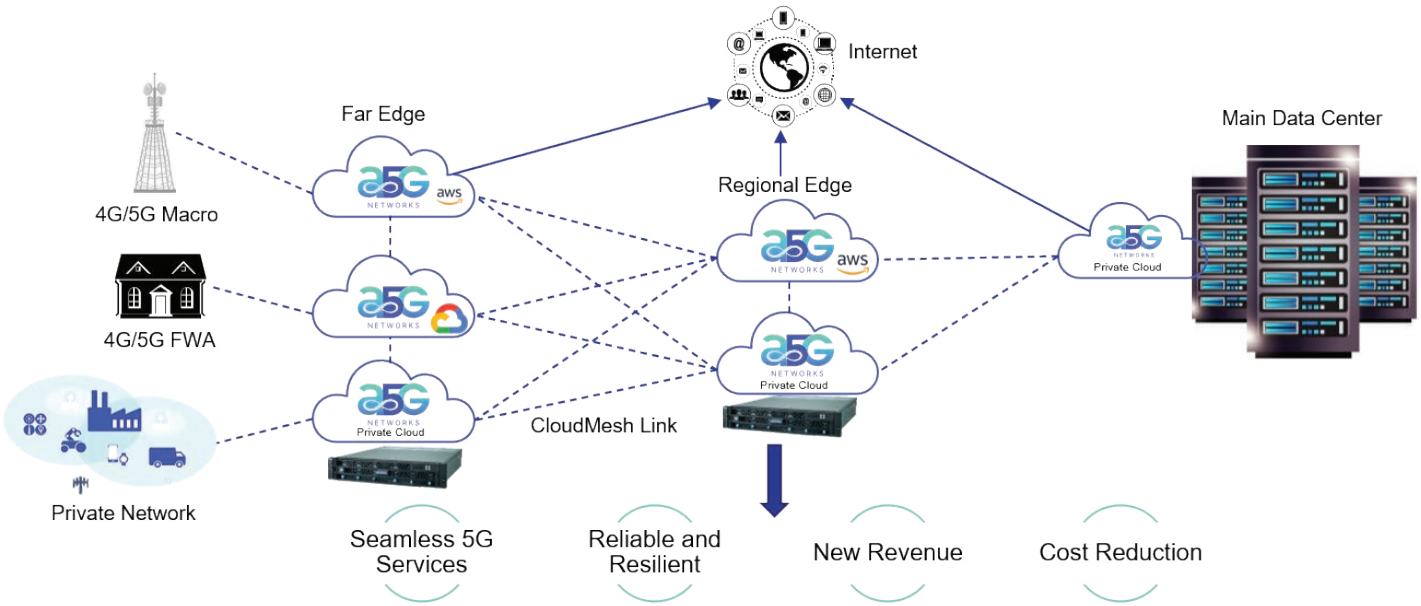
Enterprises and Communications Service Providers (CSPs) are ramping up the deployment of private networks that leverage edge computing for applications like industrial automation, connected vehicles, smart retail and healthcare. In order for these networks to be commercially viable across as wide a range of use cases as possible, it's important for them to be cost-effective in terms of maximizing the number of subscribers or IoT devices that can be supported in a small-footprint server.

A5G Networks, a provider of autonomous mobile core software for 4G and 5G networks, has maximized the cost-performance of their mobile edge infrastructure by deploying their autonomous and converged mobile core (ANoNCore) software on small-footprint SKY 8000 telco servers from **Advantech** that are optimized for network edge deployments. These servers are configured with Smart Network Interface Cards (SmartNICs) from **Napatech** that offload and accelerate the compute-intensive User Plane Function (UPF), freeing up the server's CPU for running applications and services.

This solution brief outlines the technical and business-level benefits of this end-to-end system solution.

Enabling distributed, autonomous private networks for 5G and beyond

The vision of A5G Networks is to enable and catalyze the upcoming transition to a distributed and autonomous mobile network of networks for 4G, 5G and beyond. Its unique IP helps realize significant savings in capital and operating expenditures, reduces energy requirements, improves the quality of user experience and accelerates the adoption of new business models.



A5G Networks enables the deployment of enterprise private networks, connected car networks and distributed public mobile networks, while playing a pivotal role in a range of smart city projects.

The A5G Networks ANoNCore software uses a fully cloud-native, microservices-based architecture that scales elastically across hybrid and multi-cloud deployments.

ANoNCore is a 3GPP R16-compliant 4G, 5G converged core. Scaling vertically and horizontally, it can run on multiple processor architectures. The ANoNCore UPF, accelerated by Napatech's SmartNIC in this integrated solution, is truly distributed and elastically scalable to meet the growing demand of user plane traffic and processing. It can work with a wide variety of NIC cards, from non-DP-DK-compatible traditional NICs to performance-centric DPDK-compatible SmartNICs like those from Napatech. The ANoNCore UPF

can provide high throughput by adding cores and high capacity NICs, catering to many different use cases including Enhanced Mobile broadband (eMBB), Ultra-Reliable Low-Latency Communications (uRLLC), and Massive Machine-Type Communications (mMTC), while providing all the required optimizations.

In a multi-slice environment, the ANoNCore UPF software delivers the intelligence required to selectively offload the traffic for a particular slice to provide the best end-user experience.

Edge infrastructure is very different from traditional IT infrastructure. To meet the unique requirements of edge use cases, it's important that the ANoNCore software be deployed on servers that are optimized in terms of form-factor, energy consumption, environmental tolerance and performance. The Advantech SKY series servers represent an ideal solution.

Advantech telco servers optimized for edge applications

The Advantech SKY 8000 Series is a range of carrier-grade servers optimized for network edge applications. They balance best-in-class processing power with maximum I/O and offload density in a short depth chassis. SKY 8000 servers have been designed to meet high availability for business-critical use cases. They are based on Intel Xeon Scalable processors, which not only upgrade the total core counts per each consumed power watt, but also provide a high performance and highly reliable platform for network edge, virtualization applications, telecom and 5G private mobile network infrastructure.

SKY-8232D Dual socket edge server
based on 3rd Gen Intel Xeon processor

In compute-intensive cloud or edge computing use cases, it's essential to increase network performance and agility while ensuring faster provisioning of applications and resources. By pairing with multiple NICs or accelerator cards (e.g. a Napatech SmartNIC), the dual-socket SKY-8232D offers a stable carrier-grade service of network and computing acceleration. Powered by third-generation Intel Xeon Scalable processors and with a highly flexible PCI-Express (PCIe) and I/O expansion capability, the SKY-8232D can be applied in enterprise private network infrastructure, science calculation and specific mission-critical application applications.

The SKY 8000 servers from Advantech are also designed to accommodate a wider range of temperature, dust and humidity in order to support applications running in harsh environmental conditions. Redundant and field-replaceable power supply units (PSUs), fan modules and management firmware minimize costly downtime, service interruptions and onsite interventions. The SKY 8000 range is designed for NEBS Level 3 carrier grade environments and locations where limited rack space is available.

Within the 5G packet core that represents a major element of the A5G Networks ANoNCore software, the highest compute workload is the UPF, which performs critical functions associated with connecting user and device traffic from the Radio Access Network (RAN) to the Data Network (DN). The UPF implements packet inspection, packet routing, packet forwarding and Quality of Service (QoS) handling. These are all functions that are not well-suited to general-purpose server CPUs like the Intel Xeon Scalable processors, which are designed for running applications and services.

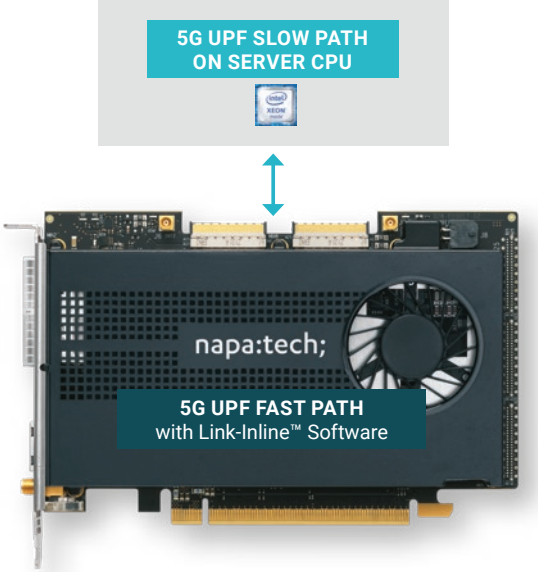
In order to maximize the performance of the UPF and the overall cost-performance of their packet core, A5G Networks leverages the UPF offload solution from Napatech that comprises a high-performance SmartNIC together with an optimized software stack.

Napatech's SmartNIC solution delivers industry-leading UPF performance in an industry-standard environment

Napatech addresses the business imperative of minimizing the cost-per-device or cost-per-user for 5G packet core deployments by providing an integrated hardware/software solution that delivers industry-leading UPF performance. This solution comprises a fully-offloaded UPF fast path implemented within the Link-Inline™ software stack, running on the NT200 and NT400 PCI-Express (PCIe) SmartNICs.

Napatech's UPF offload solution enables A5G Networks to support significantly more users or devices per server than with either a pure software solution or competing offload solutions, while at the same minimizing the overall cost per user and improving energy efficiency.

Using a single NT200 or NT400 SmartNIC to sustain 2x100G of full duplex traffic, the Napatech UPF Offload software processes up to 185 million concurrent flows, with a flow learning rate greater than 3 million flows per second, achieving a total throughput of up to 297 million packets per second (stateless operation) and ensuring full wire speed operation for typical packet sizes.

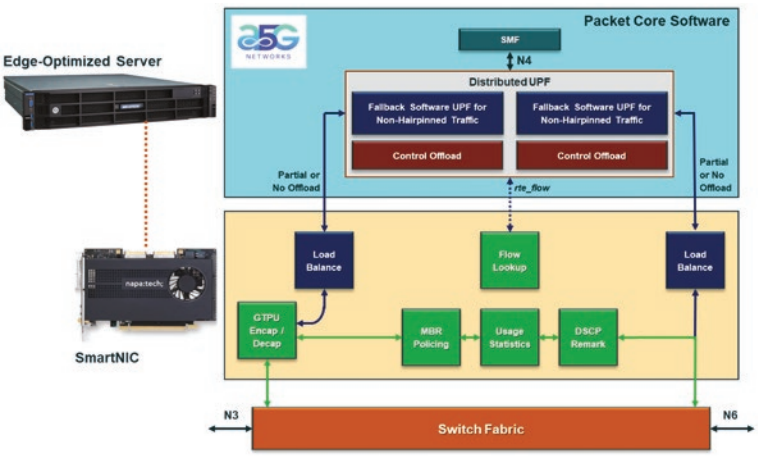


Napatech's UPF offload solution is fully compatible with the industry-standard DPDK RTE_FLOWS API for flow configuration. This ensures that 5G packet core software vendors like A5G Networks can readily leverage the performance benefits of the Napatech solution without having to rewrite their software to use a proprietary API. Kubernetes support enables the solution to be deployed within a cloud-native environment using a standard orchestration platform.

From a hardware perspective, the NT200 SmartNIC is a full-height, half-length PCIe Gen3 card with standard QSFP28 network ports, while the NT400 is a full-height, half-length PCIe Gen4 card with standard QSFP56 ports. These SmartNICs fit into industry-standard servers like the Advantech SKY-8232D as an alternative to standard or "foundational" NICs that provide no offload features.

End-to-end packet core solution maximizes system performance while minimizing server CPU utilization

The combined packet core solution from A5G Networks, Advantech and Napatech implements the UPF data path as a port-to-port "hair-pinned" architecture, which ensures that following initial setup all flows are processed on the SmartNIC with no need for traffic to flow to and from the server CPU. This maximizes the overall performance of the system while minimizing the utilization of the server CPU, freeing up its resources for running control plane functions as well as edge applications and services.



Compelling business benefits for enterprises and CSPs

As a critical 5G packet core element between the RAN and Data Network the UPF is responsible for processing the massive amount of data traffic originating from various applications. The UPF represents a significant compute workload performing packet detection, enforcement of QoS policies and application of forwarding rules, in order to meet real-time packet processing requirements for latency-sensitive applications. Therefore, it is essential for packet core vendors to deploy solutions that enable enterprises and CSPs to address these challenges while optimizing CAPEX and OPEX.

Within the integrated solution comprising A5G Networks' cloud native UPF and Napatech's SmartNIC offload traffic flows are offloaded to the SmartNIC for faster processing, providing a better Quality of Experience (QoE) to end users. Regular traffic requiring best-effort QoS may continue to be processed in software.

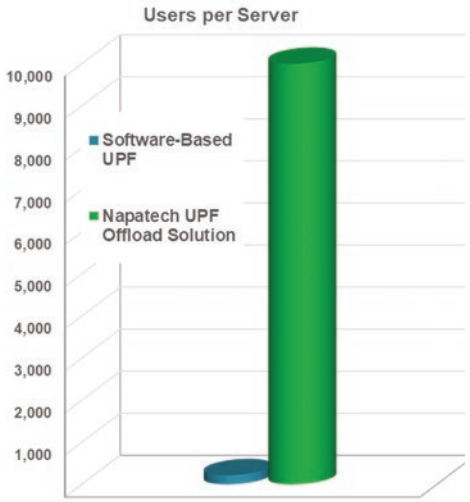
In the solution that leverages Advantech's edge-optimized server platform together with Napatech's SmartNIC-based UPF offload solution, A5G Networks was able to significantly improve the number of devices or subscribers that its ANoNCore software can support on a single server. This makes it commercially viable for enterprises and CSPs to deploy the A5G software in edge locations that are constrained by footprint, cost, environmental factors and power consumption.

To quantify these business benefits, A5G Networks and Napatech analyzed a representative use case for a private network edge deployment, comprising:

- 5,000 users;
- 20 Mbps average bandwidth per user;
- 10 flows per user;
- 256 Byte average packet size.

Using the Napatech NT200-based UPF offload solution running on the Advantech SKY-8232D server, A5G Networks was able to support **46 times as many users** than with a pure software-based UPF (5,000 users per server vs. 109).

For the edge data center, this translated into a **54% reduction in CAPEX** and a **65% reduction in OPEX**, over a five-year period.



Summary

As enterprises and CSPs scale up the deployment private networks leveraging edge computing, it's not commercially viable to rely on standard IT infrastructure to host the required networking workloads.

By leveraging Napatech's SmartNIC-based UPF offload solution running on an edge-optimized server platform from Advantech, A5G Networks has maximized the cost-performance of their edge infrastructure and delivered a highly-efficient mobile core for applications like industrial automation, connected vehicles, smart retail and healthcare.

A5G Networks Inc. is a leader and innovator in autonomous mobile core network software. A5G Networks is pioneering secure and scalable 4G, 5G and Wi-Fi packet core software to enable distributed network of networks. A5G Networks autonomous mobile core enables cost effective deployment across hybrid and multi-cloud. It can be used for IoT, private Networks, smart Cities, connected car networks and CSP networks to provide optimized service experience. The company is headquartered in Nashua, NH, USA with offices in Pune MH, India.

For more information, visit
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Advantech has the corporate vision to "Enable an Intelligent Planet". The company is a global leader in the fields of IoT intelligent systems and embedded platforms. To embrace the trends of IoT, big data, and artificial intelligence, Advantech promotes IoT hardware and software solutions with the industrial IoT platform - WISE-PaaS core to assist business partners and clients in connecting their industrial chains. Advantech is also working with business partners to co-create business ecosystems that accelerate the goal of industrial intelligence.

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Napatech is the leading supplier of programmable SmartNIC solutions used in telecom, cloud, enterprise, cybersecurity and financial applications worldwide. Through commercial-grade software suites integrated with robust, high-performance hardware, Napatech accelerates telecom, networking and security workloads to deliver best-in-class system-level performance while maximizing the availability of server compute resources for running applications and services.

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