White Paper

Intel® Network Builders
Wide-Area Networking

# Dynamic Private Data Networking Without Pre-configured Tunnels

**Graphiant gives businesses cost-effective private networking among constantly changing sets of resources, by providing an alternative to relying on networks they don't control. The solution stack is delivered as a service, with optimizations for Intel architecture that accelerate packet processing and traffic handling.**


Today's business innovation is powered by data coursing through transient, shifting connections among myriad sources and services. Ephemeral networks are defined in software, cloud instances are spun up and shut down on demand and agility has become a fundamental measure of both business and technology success. The static network topologies that have served the industry in the past increasingly represent a liability, as maintenance and configuration requirements weigh against the need for dynamic responsiveness.

For decades, multi-protocol label switching (MPLS) has enabled class-of-service for real-time and other prioritized traffic, with tunneling to protect data in transit. It has provided scalability, performance and efficiency in enterprise networks and made superior user experiences possible amid dramatic expansions in data volume, variety and velocity. On the other hand, MPLS is costly to operate and maintain with today's complex networking requirements. It was also developed to aid the transition of enterprises from a hub-and-spoke data-networking topology to the any-to-any topology required by unified communication and other enterprise applications. Today's businesses operate in a more decentralized fashion than in years past, with a significant role played by interconnected cloud providers and edge computing services.

Software-defined wide-area networking (SD-WAN) provides cost and scalability advantages over MPLS networks, increasing last-mile flexibility and aggregating commodity bandwidth at branch locations. It was built with cloud connectivity specifically in mind and has made high-bandwidth, latency services such as streaming video communications viable for businesses at scale. Still, SD-WAN is defined with pre-built bespoke networks in mind, whereas today's topologies are defined by unpredictability and continual change, with processing displaced from the data center core to the distributed network edge.

The Graphiant architecture enables enterprises to connect to a shifting landscape of clouds, partners, customer sites and IoT devices with the agility to deliver competitive advantage. With data moving away from centralized silos as endpoints generate and consume it at the edge, Graphiant helps mitigate the complexity of disparate networking technologies and large sets of difficult-to-manage tunnels. Businesses benefit with shortened lead times to deliver new services and fewer resources occupied with daily moves, adds and changes to support shifting needs.

## Graphiant optimized edge and stateless core

For any-to-any connectivity with the agility to harness constant change, the Graphiant solution is provided as a cloud-delivered service. It is built explicitly to provide high-performance private connectivity, without requiring advance configuration of tunnels or other static routes, as illustrated in Figure 1. The Graphiant network solution stack consists of three primary components:

- **Graphiant Stateless Core** is a Graphiant-built network that operates from points of presence (PoPs) geographically distributed across carrier-neutral facilities, with private connectivity established between them. The Stateless Core carries traffic among the PoPs and connects to internet and cloud services and applications, including those provided by Graphiant and others.
- **Graphiant Edge** is the hardware or software entity that provides connectivity from enterprise and third-party resources to the Stateless Core. The Graphiant Edge represents the boundary between the LAN and WAN, and as such it provides functionality associated with routers, firewalls, SD-WAN and secure access service edge (SASE) appliances, consumer premises equipment (CPE), etc.
- **Graphiant Gateway** provides interconnection with cloud, IaaS, SaaS and other services on the internet. External provider networks are attached to multi-tenant gateway nodes in PoPs. Edge-to-core and core-to-core traffic is accelerated by the optimized Graphiant data plane and control plane architectures, and the gateways attach to external domains that run industry-standard protocols for integration.

The entirety of this Graphiant solution stack is built without using any specialized hardware. It relies solely on commercial off-the-shelf (COTS), general-purpose servers based on Intel architecture, sharing resources with other enterprise solutions and benefiting from the Intel platform roadmap and the broader Intel ecosystem.

## Private data networking based on metadata label switching

The Graphiant solution addresses control-plane inefficiencies that have persisted because of prevailing approaches to setting up private networks, based on point-to-point tunnels. Key concerns with this approach include the operational overhead of maintaining static configurations, as well as the systems overhead of continually processing routing tables and tunnel state. Graphiant routes traffic using dynamically applied metadata labels to replace static tunnel configurations, as illustrated in Figure 2.

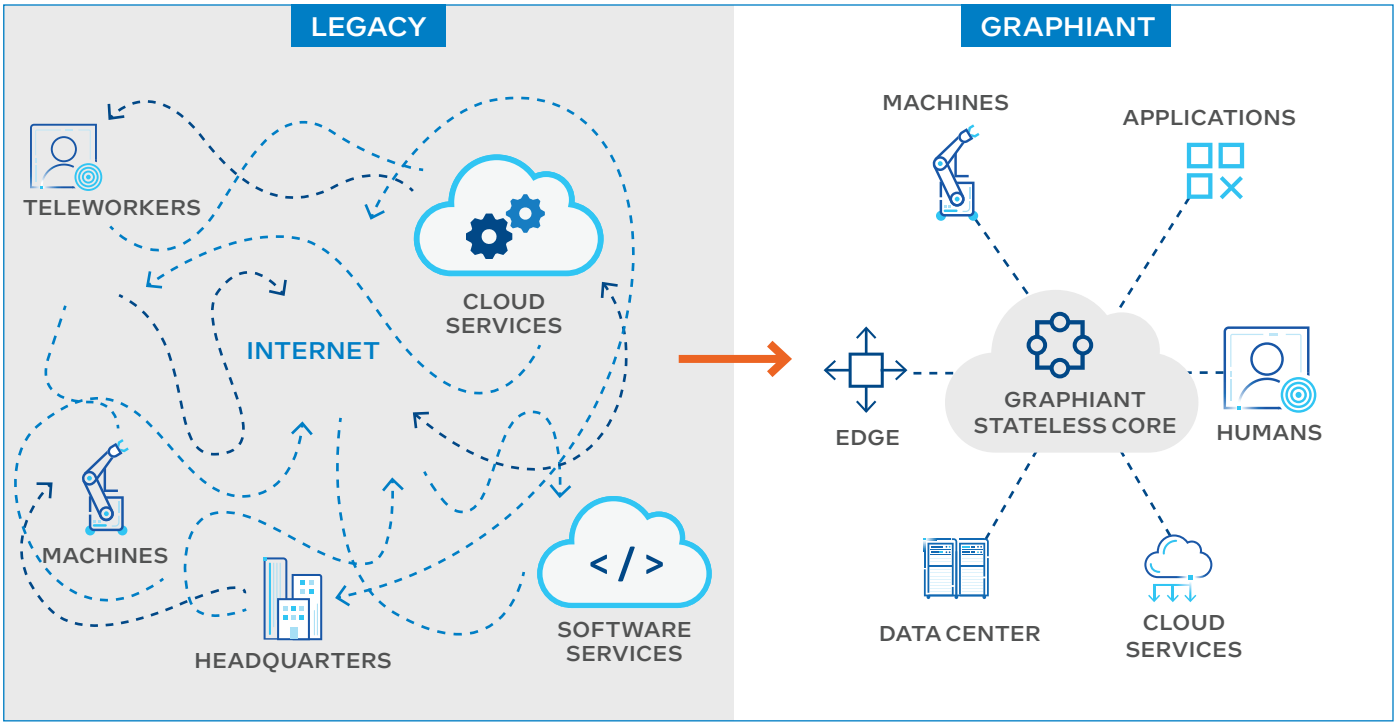


**Figure 1.** From tangled static tunnels to the Graphiant Stateless Core.

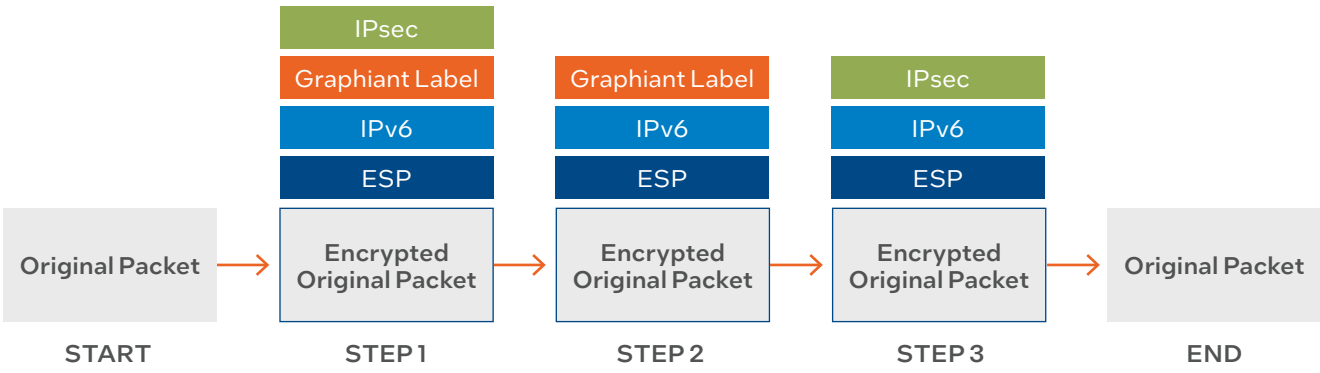


**Figure 2.** Metadata encapsulation on the Graphiant data plane.

Traffic traverses the pathway shown here without multiple decrypt-encrypt operations in transit, accelerating throughput. The workflow for packet forwarding in the Graphiant solution includes the following steps, as represented in the figure:

- **Step 1:** The packet is encrypted using Encapsulating Security Payload (ESP) and encapsulated in IPv6 before having a Graphiant metadata label applied. The source edge uses IPsec to access the Graphiant Stateless Core.
- **Step 2:** At the point of ingress to the Graphiant Stateless Core, the metadata label is used to direct the packet through to the correct egress core node, as shown in Figure 3, after which the label is removed.
- **Step 3:** The destination edge accesses the Graphiant Stateless Core using IPsec and de-encapsulates the original packet from its IPv6 wrapper, then decrypts it before passing it to the local LAN.

The architectural simplicity of this approach streamlines deployment and maintenance while reducing networking systems overhead. Graphiant's inherent flexibility makes fast-changing business-to-business connectivity viable at any scale, with private networking anywhere on demand.

## Intel Solution Building Blocks

Graphiant services are built on Intel architecture and are the product of an ongoing co-engineering relationship between the two companies. Looking forward, this collaboration is poised to deliver continuing value over future generations of technology development.

### Intel Smart Edge for Builders

To help foster an edge ecosystem where applications, services and network functions can be on-boarded and managed with agility across any network, Intel Smart Edge for Builders provides a foundation for edge solutions, as illustrated in Figure 4. It is an edge-native distributed computing platform that enables deployment and management of container-based workloads with cloud-like ease, resiliency and security at the edge. Smart Edge runs demanding workloads like AI, media and software-defined networking functions, powered by pre-validated blueprints and solutions provided by Intel and a robust partner ecosystem.

Built on a microservices-based architecture — with optional support and turnkey capabilities — Smart Edge removes edge-networking barriers for application developers, infrastructure builders and end users at the network and enterprise edge.

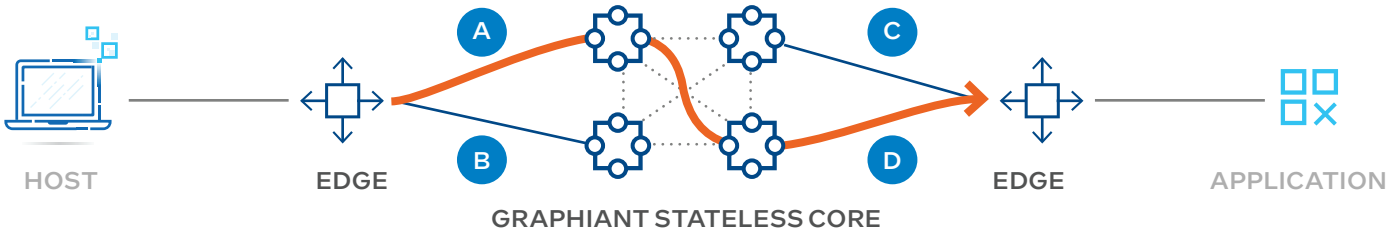


**Figure 3.** Label-switching encrypted packets in the Graphiant Stateless Core using Graphiant labels.

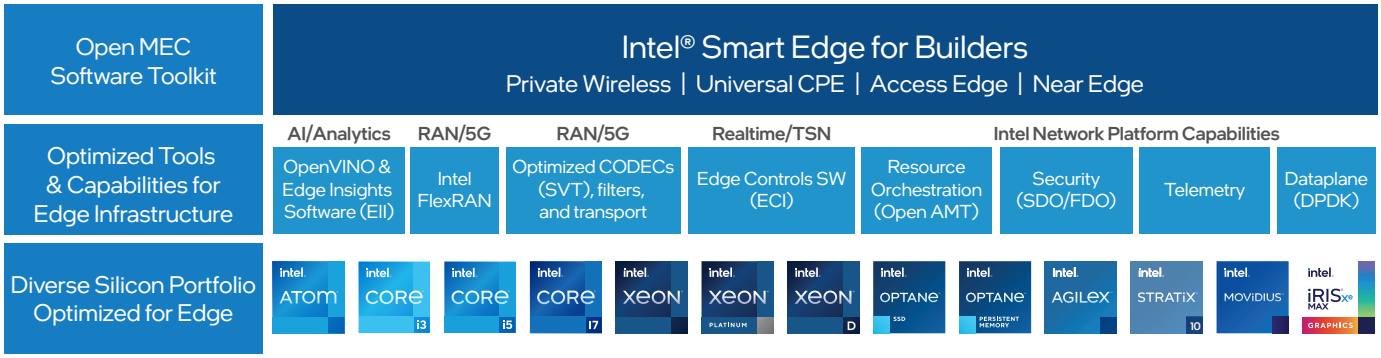


**Figure 4.** Intel Multi-Edge Computing (MEC) technologies: Intel Smart Edge for Builders.

Intel Smart Edge for Builders provides experience kits for specific edge use cases like private wireless, SASE and telco edge networks. Each kit includes hardware specifications, the Intel Smart Edge Kubernetes engine and reference software for ready-to-build solutions. This factor helps the Graphiant solution enable the emerging network paradigm where functionality is generated at the edge, rather than being delivered from a centralized point. Graphiant allows edge services to be delivered with predictable behavior and quality, end to end.

### Intel Xeon® Scalable Processors

Graphiant's solution is optimized for Intel Xeon Scalable processors, taking advantage of the high core counts and per-core performance of premium SKUs. This server platform is available in SKUs that are optimized for cloud, enterprise, network and IoT workloads, providing a holistic, integrated environment that can be tailored to specific needs, with a range of core counts, frequencies, feature sets and power levels. The balanced, scalable processor architecture is augmented by a growing array of built-in acceleration technologies that help provide cost-effective performance.

To accelerate packet forwarding on Intel Xeon Scalable processors, Graphiant utilizes open source vector packet processing (VPP) software. The Graphiant solution uses IPsec from edge to edge, with encryption handled at the edge. VPP provides very fast encrypted packet forwarding, taking advantage of the data plane development kit (DPDK) to bypass the kernel and handle packet processing in user space. That offload dramatically reduces overhead and makes it possible to accelerate throughput by an order of magnitude or more. Intel QuickAssist Technology (Intel QAT) accelerates data encryption and decryption at the Graphiant Edge, further increasing the rate of packet movement through the environment.

Intel Ethernet network adapters deliver efficient, workload-optimized performance for Graphiant topologies at Ethernet speeds of up to 100 Gbps, with intelligent offload technologies built into the controllers and advanced packet-handling optimizations for high-bandwidth workloads. The Graphiant solution utilizes the Intel Ethernet programmable packet pipeline to increase throughput, lower latency and reduce host CPU overhead.

## Conclusion – Private Networking for the Cloud Age

The Graphiant Stateless Core provides a private network that eliminates the need to build tunnels between edge points. The architecture simplifies IT network operations by eliminating constant tunnel management and configuration, freeing those resources for more value-added work. Traffic never needs to be decrypted within the Graphiant Stateless Core, reducing the threat surface and helping to preserve data sovereignty, privacy and compliance. Provided as a service, the Graphiant solution enables fast time to market for introducing new services and applications, with a simplified means of cloud connectivity. With Graphiant's MPLS-class QoS and end-to-end SLAs, enterprises have a path to performance, availability and scalability that is more cost-effective and sustainable than what came before.

## More Information

Graphiant: https://graphiant.com/

Intel® Xeon® Scalable processors: https://www.intel.com/xeon/scalable

Intel Smart Edge for Builders: https://www.intel.com/content/www/us/en/edge-computing/smart-edge.html