



# Software-Defined Edge

## Orchestrating connectivity and workloads across enterprise and telecommunications

The software-defined edge is a distributed digital infrastructure for connecting, securing, and running workloads across dispersed locations, close to endpoints that produce or consume data. The edge looks different across use cases, from offices and work-from-anywhere locations to cell sites, retail stores, factory floors, medical centers, wind turbines, or a vehicle on the move. VMware by Broadcom's portfolio of software-defined edge solutions addresses business needs across enterprises and communications service providers (CSPs).

### The need for the software-defined edge

Gartner<sup>1</sup> estimates that by 2025, more than half of enterprise-managed data will be created and processed outside the data center or cloud—in other words, at the edge. As the edge grows rapidly, enterprises and CSPs are encountering both opportunities and obstacles:

- Organizations want to use AI and ML to make better data-driven decisions and create new services that delight customers and provide opportunities for new revenue. Solutions such as real-time AI analysis and decision-making, automation, and extended reality require more advanced intelligence and resources at the edge. These workloads cannot afford the cost and latency burden of being routed through a data center or to a cloud. They need fast local connectivity and immense processing power for real-time results.
- Enterprises are contending with edge sprawl, seeking more efficient ways to manage hundreds and thousands of operational technology (OT) devices and software instances. They want to take advantage of edge technology, not spend time managing it.
- Edge locations are often defined and constrained by OT hardware. Decoupling hardware from software will provide opportunities for scale, flexibility, agility, programmability, and cost savings.
- CSPs are looking for new revenue opportunities as they develop edge services for enterprise customers. To deliver more value, CSPs have begun

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<sup>1</sup> Gartner, Hyperscalers Stretching to the Digital Edge, 24 July 2023

disaggregating and modernizing their radio access network (RAN) infrastructure—the edge sites of their networks. The next step is to extend the programmable telco network to their customers’ edge locations.

## Layers of the software-defined edge

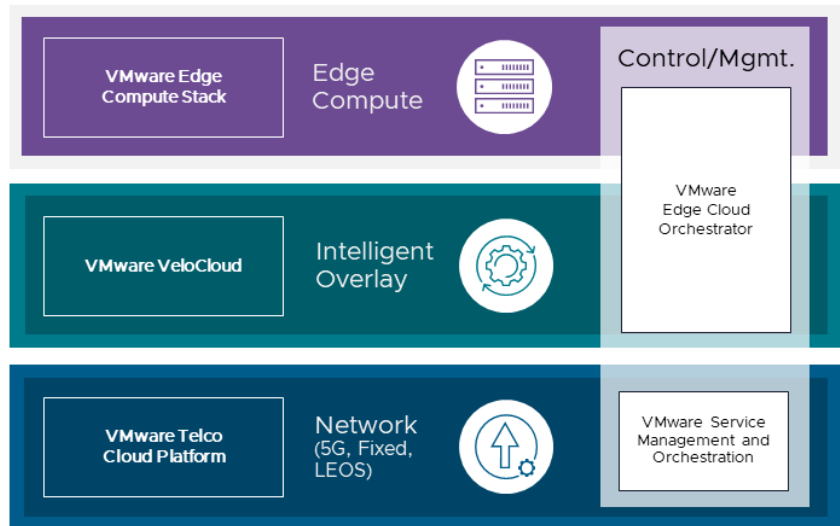


Figure 1: Three layers of the software-defined edge

The software-defined edge is the intersection of workloads, an intelligent overlay, and a network.

- **Edge workloads**—both hardware and software — that enterprises use to accomplish business goals at edge locations
- An **intelligent and programmable overlay** that extends across the edge, clouds, IaaS, and SaaS
- A **network**—fixed wireless, fiber, broadband, satellite, and more—delivered by CSPs to connect the layers

## Intelligent connectivity across the layers

For optimal performance, edge workloads need to be recognized and prioritized across different network types. This is where the SD-WAN layer, the intelligent overlay, comes into play. SD-WAN identifies 4,000+ applications to identify and prioritize IT and OT workloads. The intelligent overlay can aggregate multiple network sources, detect network conditions, and choose the best path to maximize bandwidth and reduce factors such as latency and jitter. This ensures business-critical applications have access to the best available network resources before sending application traffic to the CSP network.

The intelligent overlay can program the CSP network to reserve application network requirements such as high bandwidth and low latency. Programmability allows the software-defined edge to provide enterprise-grade

performance, security, visibility, and control of the WAN for users and devices accessing applications over both the public Internet and private networks.

CSPs provide the networks that make edge connectivity possible. Many enterprises already work with a CSP to provide the physical links to their distributed edge locations. By adding new compute and orchestration tools to these links, CSPs can create a comprehensive SDE offering to deliver even more advanced digital capabilities wherever customers need them.

To secure edge workloads and protect users and infrastructure from threats, SD-WAN integrates with security service edge (SSE) services to form secure access service edge (SASE). When SASE and SD-WAN are both part of the intelligent overlay that knows the state of a workload, dynamic policies can optimize and orchestrate security services more efficiently. Businesses can reduce cost and complexity with unified SASE so their users, devices, and workloads have fast, reliable, secure connectivity with visibility, control, and compliance—anytime, anywhere.

Software-defined technology has become an integral part of networking for both CSPs and enterprises. The shift of SD-WAN to the edge allows enterprises to virtualize their underlying networks, eliminating concerns about the complexity of different network types like broadband, satellite, fixed wireless, or 5G. Instead, they can focus on the intelligent overlay that prioritizes and programs applications over these networks.

### Three essential characteristics of the software-defined edge

Many edge locations have pain points—such as limited compute or network, multiple sites, limited IT staff availability—that make it difficult to use traditional IT methods for compute and connectivity. The software-defined edge addresses these with three characteristics:

- **Right-sized infrastructure** “shrinks the stack” into a ruggedized unit that can fit in small spaces and use any available network. In data centers, virtualization scales to accommodate hundreds or thousands of diverse workloads on shared infrastructure. But edge workloads are highly specialized and constrained by hardware. While they can be virtualized, the scale is around a 6:1 ratio rather than 100,000:1 because tailored solutions take precedence over scale. Right-sized edge infrastructure balances flexibility and resource constraints to meet the specialized demands of edge workloads while reducing cost and administrative complexity.
- **Zero-touch orchestration** with pull-based updates lets enterprises easily scale management across hundreds, thousands, even millions of devices. Traditional IT administration is push-based: IT sends updates to devices on IT’s schedule. Pull-based updates are driven by a demand-centric model of edge workloads that essentially administer themselves and seek out updates, policy, and resources when they are needed, at the correct time. For example, a workload that runs a manufacturing robot may only have a small window

each day where it can be updated without disrupting operations. With zero-touch orchestration, edge devices and systems can be remotely deployed, configured, and managed automatically, reducing the need for on-site personnel, and minimizing the risk, time, and cost of manual interventions.

- **Network programmability** ensures the network is aware of edge workload needs and is enabled to optimize for or provision the right blend of resources when needed. A programmable network paired with an intelligent overlay can anticipate the unique requirements of edge compute workloads and dynamically program the network for availability and optimal performance. With real-time data and analytics, enterprises can proactively identify changes in workload demand, traffic patterns, and potential congestion points, enabling them to make informed, automated adjustments. This creates a responsive and agile network ecosystem that not only meets but anticipates the requirements of edge workloads, delivering reliability, low latency, and connectivity, even in unpredictable conditions.

## Components of the VMware software-defined edge

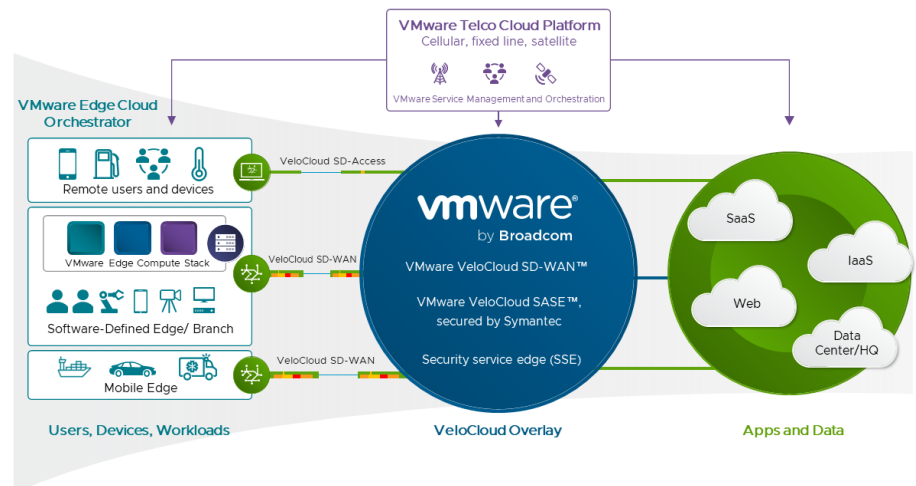


Figure 2: Comprehensive solution for edge deployments across enterprises and CSPs

The software-defined edge is a comprehensive portfolio of solutions that work together to provide value and business-led solutions across enterprises and telecommunications networks.

### VMware Edge Compute Stack

VMware Edge Compute Stack is an edge-optimized runtime and orchestration platform for frictionless management of edge apps and infrastructure across many sites with limited resources. For organizations that want to build, run, manage, connect, and protect applications across many edge sites with limited compute, network, and IT resources, VMware Edge Compute Stack expertly runs operational workloads, including real-time applications, and its simplified operations reduce complexity and cost.

VMware Edge Compute Stack consists of an edge-optimized management and runtime. Both are tailored to the challenges faced in running and managing workloads at edge sites.

Edge-optimized management is provided by **VMware Edge Cloud Orchestrator**. It features a pull-based architecture which works best with many edge sites with varying levels of connectivity (similar to how a smartphone updates itself). Integrated telemetry in VMware Edge Cloud Orchestrator provides visibility into applications and traffic at the edge.

Edge-optimized runtime uses proven VMware technology to run both virtualized and container applications. It is optimized to fit OT workloads on smaller and diverse hardware common at edge sites. It operates at low latency to run demanding real-time workloads like robotics and computer vision, repeatedly and safely.

### VeloCloud solutions for the intelligent overlay

**VMware VeloCloud SD-WAN** is an intelligent overlay network layer that offers enterprise-grade performance, security, visibility, and control of the WAN for users accessing applications over both the public Internet and private networks.

Today's branch and edge users are consuming more WAN bandwidth as they collaborate online, consume SaaS and cloud services, access large rich-media files, and use other bandwidth-intensive applications. WAN infrastructure needs to be fast, reliable, and secure. However, most branch and edge WAN traffic is carried over slow and expensive leased lines or cheaper, faster, but unpredictable, consumer-grade Internet connections. This results in a poor user experience accessing applications hosted in the cloud or data centers.

VeloCloud solutions solve these problems by providing intelligent services (intelligent overlay) running on top of any circuit (underlay), including private line, cable, DSL, 4G-LTE, 5G, fixed wireless, or satellite.

VeloCloud SD-WAN uses **Dynamic Multipath Optimization™** (DMPO) and deep application recognition to improve delivery reliability. It automatically bundles all available uplinks and load-balances traffic, identifying and steering the most critical business applications over the best performing links. At the same time, it provides sub-second failover, automatically fixing underlying circuit issues such as packet drops, jitter, and delay.

The intelligent overlay hides the complexity of the underlay from enterprises, providing resiliency, connectivity, and security over whichever underlay or combination of underlays best serves the business. It can program the underlay to understand the application running on it and obtain the appropriate level of connectivity based on business policy and security needs. This allows enterprises to assign priority to critical services across a distributed network, and allows CSPs to monetize new, differentiated services.

**VMware VeloCloud SD-Access** provides enterprise IT with an easy and secure remote access solution for remote workers and IoT devices anywhere that optimizes connections for speed and reliability—bridging the needs of IT and

OT. Based on the principles of zero trust, it offers a simple, secure, and cloud-managed remote access service to securely connect remote users, endpoints and devices from anywhere to applications and critical resources that are located at the edge and in the cloud.

**VMware VeloCloud SASE™, secured by Symantec** is the single-vendor SASE solution that features best-in-class VMware VeloCloud SD-WAN and Security Service Edge (SSE) capabilities from Symantec. It enables users to access any application from any location in a secure, reliable, and efficient manner. VeloCloud SASE automatically connects VeloCloud SD-WAN and VeloCloud SD-Access users, devices and edge-native applications to Symantec security cloud enforcement on an optimal path. The solution performs deep packet inspection for threat and data protection, delivering a rich end user experience and reducing the operational burden for IT.

### VMware Telco Cloud Platform

Supporting the variety of use cases at the edge requires a highly performant and dynamic connectivity network so that edge locations can talk to each other and to clouds, data centers and networks. **VMware Telco Cloud Platform** is the programmable network foundation for CSPs. It can expose varying connectivity resources to edge locations via APIs to allow applications to program the right services with the right characteristics, at the right times.

With built-in telco-grade automation and assurance, Telco Cloud Platform brings unparalleled agility to CSPs' core networks. Telco Cloud Platform RAN extends those capabilities to the RAN, which opens previously siloed telco access networks to enable multi-vendor solutions. Modernized, software-defined infrastructure helps CSPs be more operationally agile, reduce OpEx across the core and the RAN, and expand their service portfolios for improved customer experiences.

CSPs are expanding and modernizing their offerings to include technologies such as fixed wireless access, to compete with new services and in new areas. Telco Cloud Platform allows CSPs to design more efficient wireless and 5G networks that help them develop innovative services and get to market faster. The cloud-native platform decouples containerized functions from the infrastructure so they can be deployed quickly, shared among services, updated easily, and managed independently. Orchestration and automation dynamically scale network functions to meet changes in demand.

For their enterprise customers looking to enable use cases at the edge, CSPs can use network slicing to partition, or slice, physical infrastructure to provide independent, isolated, and programmable virtual networks. This allows CSPs to address specific connectivity requirements for each customer's edge use case.

## Learn more

VMware Telco Cloud Platform,  
[telco.vmware.com](https://telco.vmware.com)

VMware VeloCloud solutions,  
[sase.vmware.com](https://sase.vmware.com)

VMware Edge Compute Stack,  
[www.vmware.com/products/edge-compute-stack.html](https://www.vmware.com/products/edge-compute-stack.html)

## Orchestration and management across the software-defined edge

**VMware Edge Cloud Orchestrator** is a unified management console for both VMware VeloCloud and VMware Edge Compute Stack. It helps enterprises plan, deploy, run, visualize, and manage edge infrastructure environments to eliminate silos and help streamline operational complexity for IT and OT teams from a single pane of glass. It allows business units within enterprises to adopt whatever OT technology they need to be successful, and lets IT orchestrate, secure, and network OT devices to benefit the entire business. VMware Edge Cloud Orchestrator helps both IT and OT teams reduce cost and complexity for their edge environments.

Edge solutions take advantage of the AIOps features of **VMware Edge Intelligence**, built in to VMware Edge Cloud Orchestrator and VeloCloud SD-WAN, to provide visibility and insight into users' application experience. With AI-based insights into an entire enterprise environment, companies can detect, isolate, and automatically remediate issues caused by wireless or wired LAN, SD-WAN, network services, security services, and applications with AI/ML—from the data center to a mobile device located anywhere. VMware Edge Intelligence also provides analytics and observability features to workloads and infrastructure managed by VMware Edge Compute Stack.

## Bringing leadership and expertise to the edge

VMware by Broadcom uniquely addresses all three layers of the software-defined edge with technology proven in the data center and telecom networks. VMware pioneered virtualization in data centers and is helping hundreds of CSPs modernize networks from the core to the RAN. VMware is a SASE and SD-WAN market share leader, and a six-time Gartner® Magic Quadrant™ Leader in SD-WAN. Our vision is to make the software-defined edge more sustainable, equitable, secure, and, most important, ubiquitously connected.