WHITE PAPER

Edge Computing
Convereged Edge Reference Architecture (CERA)

Versa Offers SD-WAN Converged Edge Solutions

Using Converged Edge Reference Architecture (CERA), Versa offers an SD-WAN solution that delivers more secure, segmented multi-tenant services for edge computing applications

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Introduction

Edge computing use cases, including artificial intelligence (AI), wireless, and cloud native services, have become more cost-effective to deploy as powerful universal customer premises equipment (uCPE) products facilitate advanced workload processing and services delivery. Virtualized infrastructure combined with cloud native services and edge intelligence layered onto the uCPE provide agile and innovative workload processing and services with reasonable deployment and operational costs.

Cloud native edge platforms based on Converged Edge Reference Architecture (CERA) offer a new value proposition to enterprise market segments such as smart cities, transportation, industrial, and media (see Figure 1) by enabling new video and analytics use cases and delivering improvements in key performance indicators (KPIs) such as reduced latency, backhaul savings, data privacy, and reliability.

CERA Developed for Edge Computing Innovation

With the development of multi-access edge computing (MEC) standards, edge computing has given communications service providers (CommSPs) and enterprises a network architecture that reduces backhaul network traffic and delivers low-latency cloud applications in a wide range of use cases (see Figure 1).

Edge computing has also opened the door to new edge-deployed workloads such as edge analytics, AI and inferencing, virtualized radio access networks (vRAN), virtualized evolved packet core (vEPC), more secure orchestration, and multi-platform connectivity with the same seamless scalability that has been prevalent in the cloud.

CERA supports development and innovation of platforms to deliver these workloads. CERA offers a compute, storage, and networking specification that unifies and converges internet of things (IoT) with 4G and 5G wireless infrastructure to simplify workload convergence at the edge while densifying wireless networks.

With the expected proliferation of edge nodes, one aspect of particular importance is connectivity management. As the number of connected branch offices and remote workers grows, network connectivity becomes more important to ensure workers have the tools to be productive. This requires delivering network performance, security, and uptime while minimizing the cost of maintaining the network. With these needs in mind, the Versa SD-WAN solution provides a highly scalable, automated, access-independent multi-tenant platform to serve the networking requirements of the next-generation MEC platform.

Industry Use Cases

CERA combines Intel architecture processors with a strong software foundation to advance next-generation edge computing solutions.

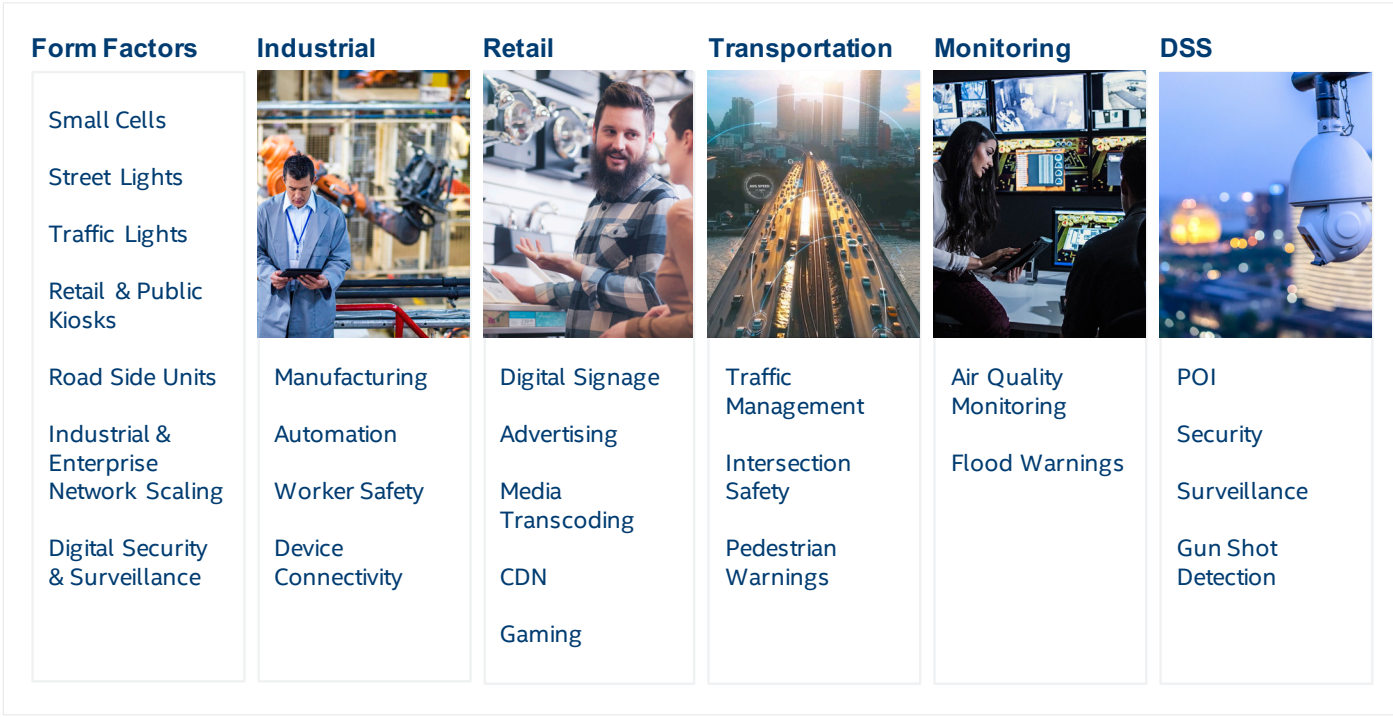

Figure 1. Example of top use cases for CERA-based platforms

Versa, an Intel® Network Builders ecosystem partner, has developed a software defined wide area network (SD-WAN) designed to run on CERA-based servers.

Introducing the Versa SD-WAN Solution

Enterprises around the world have moved to a "cloud-first" approach by embracing multiple public cloud and software as a service (SaaS) services. In this multi-cloud world, the network must transition from a site-to-site context to a client-to-cloud context with the goal of delivering the best application user quality of experience (QoE). This shift has compelled many enterprises to re-architect their wide area network and security architecture.

Versa, a Gartner WAN Edge leading visionary, enables this transition with its innovative SD-Branch solution that combines routing, networking, SD-WAN, and security features in a unified solution that simplifies and automates branch network operations and WAN edge services while helping secure the distributed enterprise. The main elements of the Versa SD-WAN product include the following:

- **Versa FlexVNF** is intelligent multiservice and multi-tenant edge software that delivers scalable, segmented, programmable, and automated SD-Infrastructure (SD-Routing, SD-WAN, SD-Security and SD-Branch) at the branch.
- **Versa Director** offers centralized control and management for both connectivity and services.
- **Versa SD-WAN Controller** is the network-wide controller with data security features that manage the distributed control plane across the SD-WAN fabric.
- **Versa Analytics** provides holistic big-data driven visibility, base lining, correlation, and predictive analysis for network, application usage, and security events.

Versa Networks enables organizations to simplify their WAN and branch office networks by consolidating networking, SD-WAN, and security features into a single software platform, instead of deploying siloed hardware or virtual appliances from multiple vendors. Key differentiated features and functionality of the Versa solution, as cited by customers, partners, and analysts, include the following:

Integrated Security Features: Versa's solution enables enterprises to deploy a more secure SD-WAN fabric for their branch/multi-cloud networks, with deep contextual visibility, enabling better WAN costs management.

Multi-Cloud Extensibility: Versa enables multi-cloud topologies with cloud-to-cloud interoperability for workload migration, additional security, management, analytics, and monitoring.

SaaS Acceleration: Versa employs end-user QoE computations that determine how a specific app is performing, effectively utilizing SaaS application monitoring, to deliver deterministic and adaptive traffic conditioning optimized for each application.

Versa SD-WAN provides an elastic, application-aware, access-agnostic networking solution with integrated security features. Versa SD-WAN integrates with the CERA-based platform to create multiple virtual private networks for helping secure the communication of each and every VNF hosted on a CERA-based platform.

Versa CERA-based Solution

Versa SD-WAN can be deployed on universal customer premises equipment (uCPE) white box servers. These offer the compute and storage functions with networking functionality limited to wireline and potentially Wi-Fi. Running Versa SD-Branch on a CERA-based platform offers several differentiating attributes, including the following:

1. **Control Plane and Data Plane Segmentation:** CERA can host a number of VNFs, each VNF having a management/control aspect as many solutions will be managed centrally. For example, the virtual evolved packet core (EPC) might have MME/AMF as well as OSS/BSS in a central location owned by a CommSP. Additionally, the data that flows through the vEPC is destined for some application in an external data center or cloud. Versa SD-WAN segmentation creates multiple overlay tunnels to keep such traffic separate while helping protect the network.
2. **Multi-tenancy:** When used in a CommSP network, there may be several VNFs on the CERA-based platform, which are owned by different organizations or different groups within the same organization. In either case, Versa separates traffic with different policies for networking and security. The Versa SD-WAN groups a set of applications into a single tenant and separates it from other groups of applications belonging to other organizations or business units. For example, imagine processing a security camera feed segmented from corporate traffic over 5G. This enables an extra layer of protection by keeping IoT traffic separate from corporate applications.
3. **Automation:** Every time a new application is instantiated, Versa creates a new tenant and/or updates a destination branch and/or updates policies. Versa Director provides APIs to programmatically perform these tasks without manual intervention.
4. **Security Function:** Versa SD-WAN with integrated security features provides a full suite of defense-in-depth capabilities, including NGFW, URM, SWG, URL filtering, and NG-IPS (NSS Labs recommended).

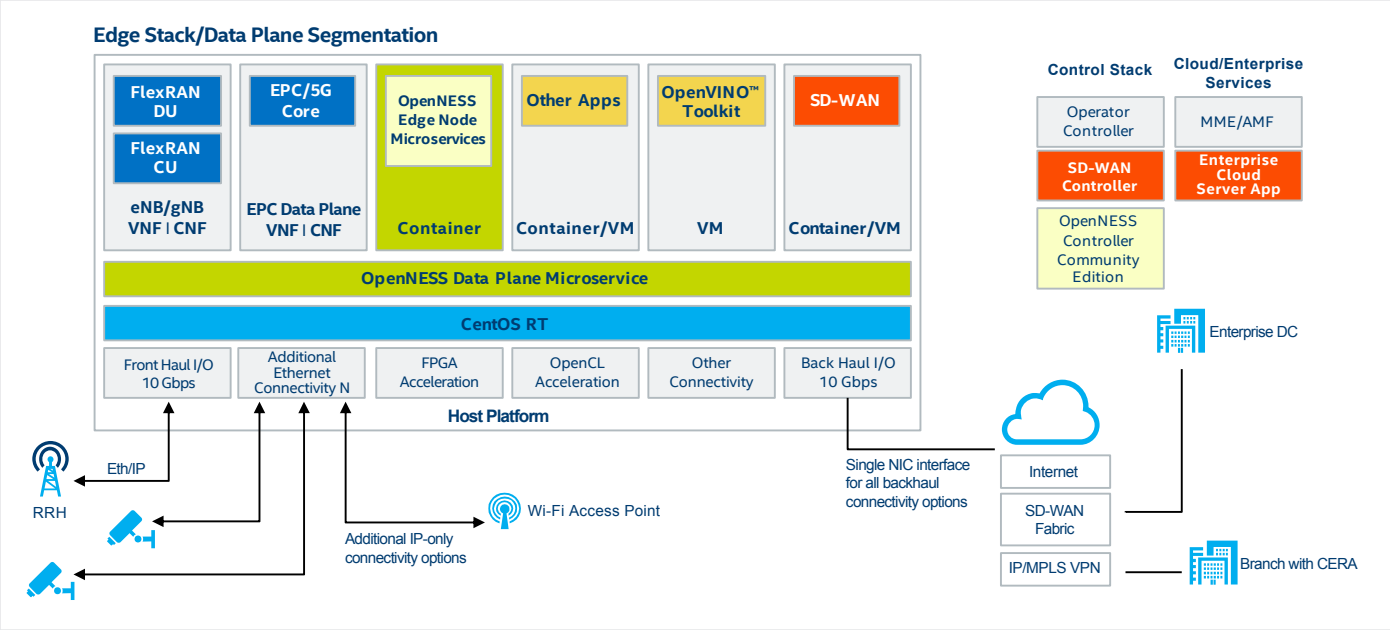

Figure 2. CERA 5G reference solution architecture

CERA 5G Reference Solution

Figure 2 presents the architecture of CERA's 5G reference solution. The architecture comprises the following:

- 5G access network and core network (AN and CN) components (including FlexRAN L1, third-party L2, and L3 or FlexCore) that deliver a 3GPP-compliant solution that services remote radio heads (RRHs) at the front haul and delivers an SGi interface connectivity onto the platform.
- Open Network Edge Services Software (OpenNESS), an open source initiative from Intel that directs traffic to edge services co-located on CERA-based platforms and manages the lifecycle of these services.
- OpenVINO™ toolkit framework and sample applications that represent edge services for inferencing.
- Versa FlexVNF SD-WAN to provide more secure IPsec-enabled backhaul functionality.

Versa's CERA-based solution has adopted CERA's data plane segmentation implementation, which is a key architecture tenet underpinning the architecture. With this data plane, all 4G, 5G, wireless LAN and wired LAN data traffic is decapsulated on the edge node. For 4G/5G, the SGi interface presents itself on the edge.

In an enterprise or CommSP WAN environment, it is expected that the CERA-based platform is replicated across hundreds or even thousands of branch office sites. The SD-WAN software and other applications hosted on the CERA-based platform are also deployed at similar scale.

Each of these applications can be centrally managed by the application service provider (ASP) and are controlled and managed by OSS/BSS, NMS, orchestrators, and others that are deployed in an enterprise data center or public cloud. For example, the 4G/5G network deployed would need to communicate with MME/AMF in the operator mobile core network for authentication and billing purposes. The OSS/BSS in the operator core is used for configuration management and monitoring purposes. This control and management traffic traverses the network as data traffic over the WAN interface. The Versa SD-WAN software can protect this critical infrastructure by segmenting it from other traffic received from the rest of the users.

In addition to centrally hosted applications, the CERA-based server might host enterprise applications that need communication between the enterprise's branch servers or data center. There is a need for privacy and security between the different application data flows. Versa leverages its multi-tenancy capability to segment, monitor, and manage the segmented network.

Segmentation, Multi-tenancy, and Privacy

To support multi-tenancy, the Versa Director management portal supports role-based access control to separate the administration of individual tenants, in this case applications. This multi-tenancy translates into a separate configuration that is downloaded to the SD-WAN FlexVNF. The FlexVNF creates separate private encrypted tunnels for each tenant.

On the edge node, Versa FlexVNF has sole ownership of the WAN interface and is direct-connected via SR-IOV to this port. This implies all WAN traffic, ingress and egress, flows through FlexVNF. In SD-WAN parlance, the CERA-based platform is characterized as an SD-WAN branch node.

Downstream traffic that is ultimately destined for the user is managed and directed via the data plane module on the CERA-based platform, which is based on Open vSwitch (OVS) and Data Plane Development Kit (DPDK). Whether the traffic is from the vEPC and destined for the cloud, or whether the traffic is locally intercepted by MEC applications that then in turn require connectivity to the cloud, in either case OVS-DPDK is configured to direct traffic to FlexVNF, which in turn applies SD-WAN logic to the traffic flows.

The entirety of the above architecture is hosted on a single server powered by an Intel® Xeon® D processor.

The second and equally important integration point worth highlighting is the control stack. While the edge stack is predominantly concerned with the management of per node traffic flows, the control stack works with nodes across the network to coordinate these traffic flows. The control plane oversees:

- 4G/5G control plane placement, for example, MME on edge vs. in central office/data center
- Location of specific VNF management functions; on edge or in central office/data center
- OpenNESS service management

Both OpenNESS and SD-WAN controllers handle a myriad of management tasks within their zone of responsibility. The former is predominantly responsible for MEC application management. The latter is concerned with the security and management of an SD-WAN branch node and the WAN connection. Figure 3 shows the specific and non-overlapping roles of the controller and OpenNESS.

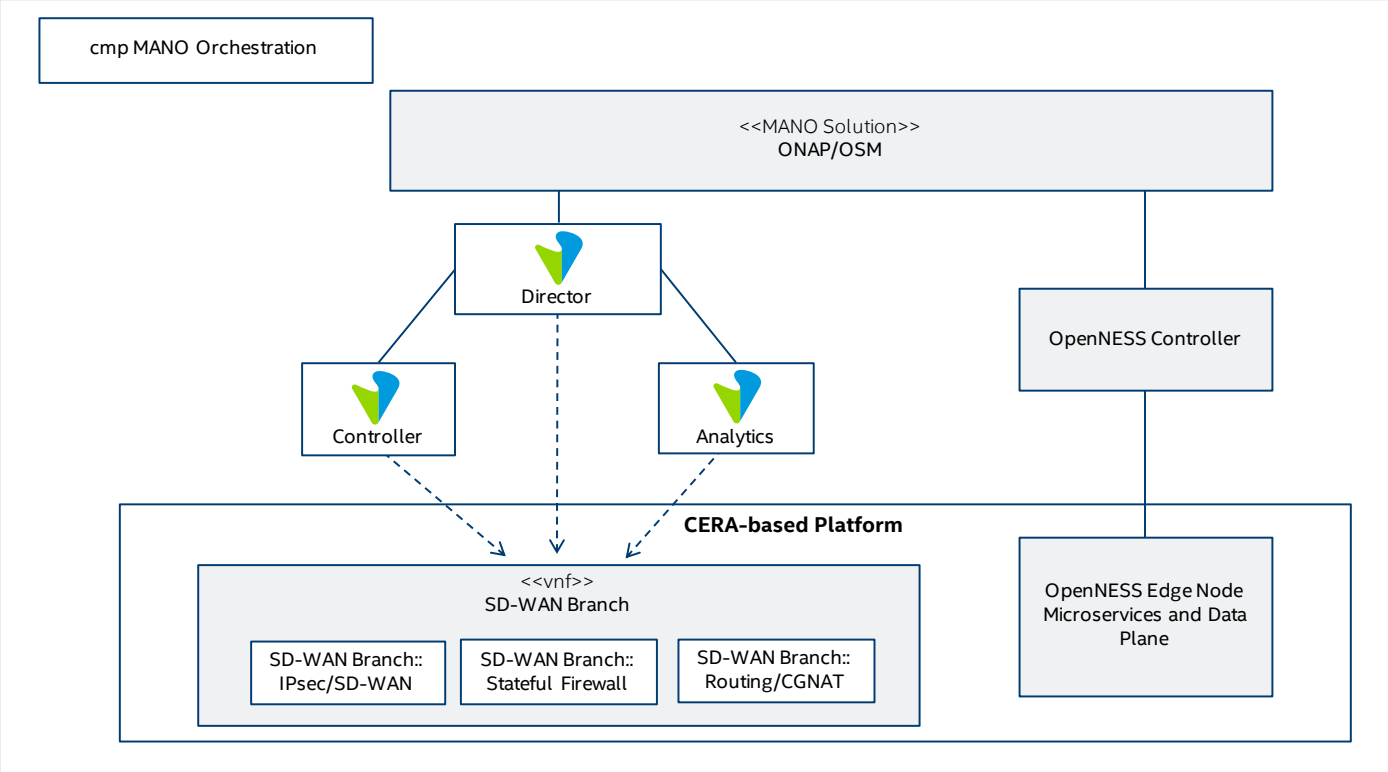

Figure 3. CERA-based SD-WAN control architecture.

One of the key requirements for enterprise MEC platforms is the ability to deploy and update new applications dynamically. A MEC application can be deployed on-demand based on the triggers received from other MEC applications or external events (for example, a security alert can trigger an image processing application to be deployed on-premises) or can be deployed as part of normal change process.

In either case, whenever a new application is deployed, appropriate virtual private networks are required in order to connect the platform to their management network and/or other MEC nodes/servers.

Versa SD-WAN provides automated networking architecture. The Versa SD-WAN solution provides API-based access that can be integrated with north-bound orchestrators. Being multi-tenanted, multiple north-bound orchestrators (each owned by individual applications) are instantiated to control the segment of the network the applications operate on.

The north-bound APIs provide functionality to onboard new sites, create segments, configure policies, and monitor the network. In a similar vein, CERA's OpenNESS Controller presents a north-bound interface. This interface offers services to lifecycle manage services, create and incarnate traffic policies, and manage the network interfaces on an edge node. Coordination between these two north-bound interfaces is thus required. Each controller is a peer to each other. Hence, a MANO layer can facilitate the coordination of action between these controller as presented in Figure 3.

Conclusion

The edge network is evolving to support converged applications ranging from SD-WAN to IoT to 4G/5G base stations. CERA was designed to offer the performance and functionality to deliver these next-generation services. By embracing CERA, Versa has developed an SD-WAN solution that utilizes the advanced features of CERA-based platforms to support multi-tenant SD-WANs that have the deployment and management features for mass deployment by CommSPs.

Learn More

Intel® Network Builders Edge Ecosystem: https://networkbuilders.intel.com/network-technologies/networkedgeecosystem

Versa Networks SD-WAN: https://www.versa-networks.com

ACRONYMS

AI	Artificial intelligence
AMF	Access management function
CERA	Converged Edge Reference Architecture
CommSPs	Communications service providers
DPDK	Data Plane Development Kit
EPC	Extended Packet Core
FPGA	Field programmable gate array
IPsec	Internet protocol security
KPI	Key performance indicators
MEC	Multi-access edge computing
MME	Mobility management entity
NMS	Network management system
OpenNESS	Open Network Edge Services Software
OSS/BSS	Operations support systems/business support systems
OVS	Open vSwitch
RAN	Radio access network
SD-WAN	Software defined wide area network
uCPE	Universal customer premises equipment
VNF	Virtual network function

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