

TECHNICAL WHITE PAPER: June 2024



VMware Cloud Foundation Edge Design Considerations

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Executive Summary

In the context of edge computing, this technical whitepaper explores the innovative role of VMware Cloud Foundation (VCF)[™]. By leveraging VMware Cloud Foundation, a full stack private cloud platform, enterprises can efficiently deploy and manage edge infrastructure by integrating edge environments with their core data centers. VMware Cloud Foundation's capabilities enable easier deployment, resiliency, better security, more scalability, and seamless connectivity with current infrastructure and edge environments. In order to drive innovation and generate value in today's digital ecosystem, the whitepaper demonstrates how VMware Cloud Foundation helps enterprises to unlock new use cases and applications at the edge through various design options.

Use Cases

In order to enable businesses to provide edge infrastructure everywhere, new edge compute, network technologies, and architectures will be required as business applications and workloads develop and spread beyond data centers and the cloud to the sites where data is produced and consumed. For customers looking to deploy edge solutions for use cases within retail, banking, energy, healthcare and utilities, VMware Cloud Foundation is a scalable solution that enables the ability to support secure, edge solutions using the full stack or required elements of VMware Cloud Foundation.

Overview of VMware Cloud Foundation

VMware Cloud Foundation is a comprehensive private cloud platform that uses a cloud operating model for building and managing cloud infrastructure on-premise, at the edge or as a managed service across supported cloud endpoints. VMware Cloud Foundation delivers a full stack, private cloud solution with a consistent infrastructure layer using best of breed compute, storage, networking and cloud management products fully integrated with automated deployment and lifecycle management. By providing comprehensive tools for centralized administration and automation as well as available cyber security protection, VMware Cloud Foundation is ideal for organizations with complex private cloud deployments that further extend to Edge.

VMware Cloud Foundation Edge is a powerful feature that extends its cloud operating capabilities across geographically dispersed sites. This enables unified management and control of Edge or Remote Office/Branch Office (ROBO) locations from a central data center. VCF Edge eliminates the need for dedicated administrators at remote sites by centralizing operations such as provisioning, life cycle management, and cluster management from SDDC Manager. This streamlines operations and delivers a consistent, cloud-like experience across the entire infrastructure.

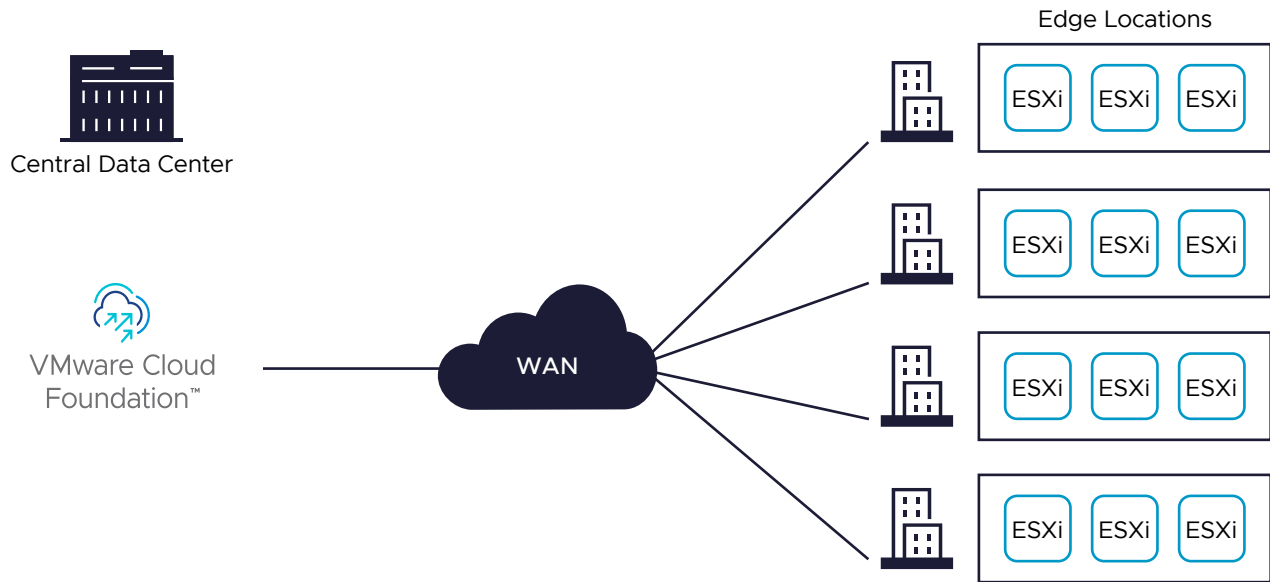


Figure 1: VMware Cloud Foundation at Datacenter and Edge

Edge Design options with VMware Cloud Foundation

VMware Cloud Foundation Edge extends the centralized management capabilities of the platform to geographically dispersed edge locations. This section dives into different design options for deploying VMware Cloud Foundation Edge, catering to various needs and complexities.

2 Node with External Storage (Minimum)	3 Node vSAN Cluster (Minimum)	Consolidated Architecture (4 minimum)
<ul style="list-style-type: none"> • SDDC Manager required at central site • External NFS or FC storage required (no vSAN) • NSX required • Max host in a cluster – 16 • Up to 8 Workload Domain (If using NSX) • Up to 24 Workload Domain (If using VLAN backed network) • Central LCM with SDDC Manager • 100ms latency with 10 Mbps bandwidth needed 	<ul style="list-style-type: none"> • SDDC Manager required at central site • Max host in a cluster – 16 • vSAN required • Up to 8 Workload Domain (If using NSX) • Up to 24 Workload Domain (If using VLAN backed network) • Central LCM with SDDC Manager • NSX required • 100ms latency with 10 Mbps bandwidth needed 	<ul style="list-style-type: none"> • SDDC Manager required at remote site • vSAN required • NSX required • Max host in a cluster – 64 • Each site is a VMware Cloud Foundation instance • No central site

Table 1: Edge Design options with VMware Cloud Foundation (As of today with 5.1.1)

Design Scenario 1:

Customer has a Central Data Center and few Edge sites. Customer wants to manage and life cycle both central data center and edge sites from a central location with SDDC Manager.

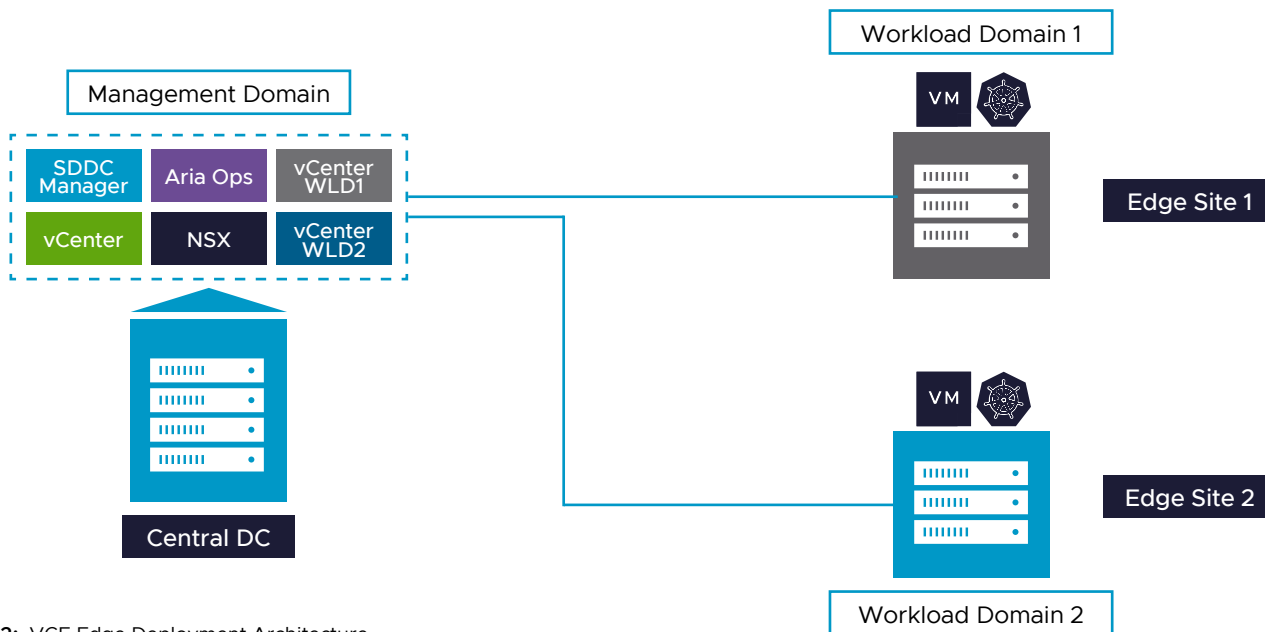


Figure 2: VCF Edge Deployment Architecture

In this above scenario, a customer will deploy a VMware Cloud Foundation instance in central data center and depending on the requirement, customer can deploy a dedicated workload domain for each edge site with few hosts.

In the above design we have:

1. One central data center, consisting of 1 Management Workload Domain with 4 hosts.
2. Two edge sites, each site deployed as a workload domain with three hosts each.
3. VMware Cloud Foundation SDDC Manager is used to deploy a remote Edge Workload Domain.
4. Edge Workload Domain management components such as vCenter and NSX-T Manager is hosted in Management Workload Domain which is hosted at Central Data Center.
5. VMware Cloud Foundation operations like lifecycle management, adding cluster, and removing cluster is managed centrally from Central Data Center.

Note: When designing edge with VMware Cloud Foundation, please refer to Table 1 for the design characteristics and supported configuration for your specific design.

Design Scenario 2:

Data Center to Edge - Extending your overlay network to the Edge.

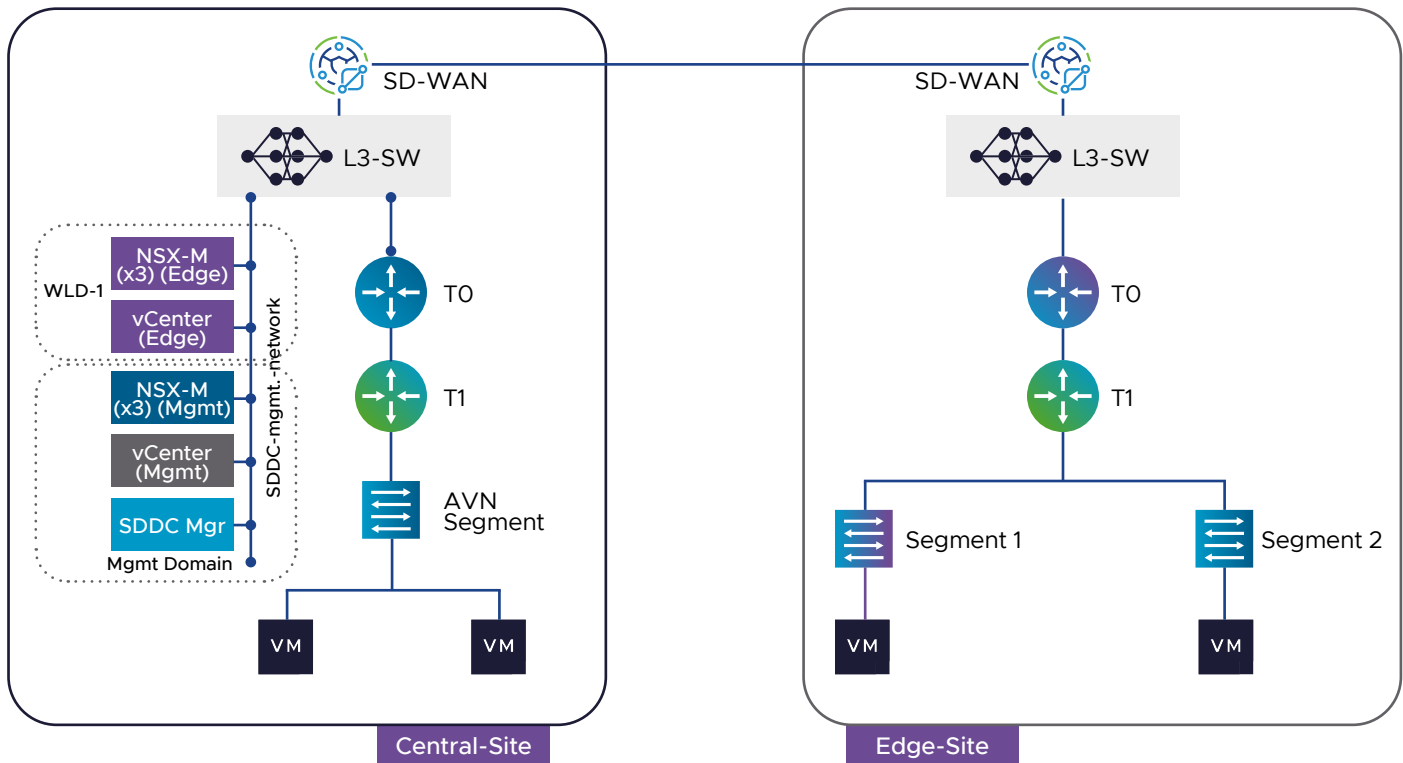


Figure 3: Data Center to Edge with NSX Overlay

In this design:

6. VMware Cloud Foundation is deployed at Central Site with a Management Domain
7. SDDC Manager is used to deploy the Workload Domain with NSX Edge at the Edge.
8. NSX is used to segregate the network segments for both Central Site and Edge site.
9. NSX is used to extend the overlay network from Central Data Center to Edge.
10. All management components such as SDDC Manager, vCenter, NSX Manager and Aria components are hosted in the Central Data Center.

Design Scenario 3:

Mix Near Edge and Far Edge deployments.

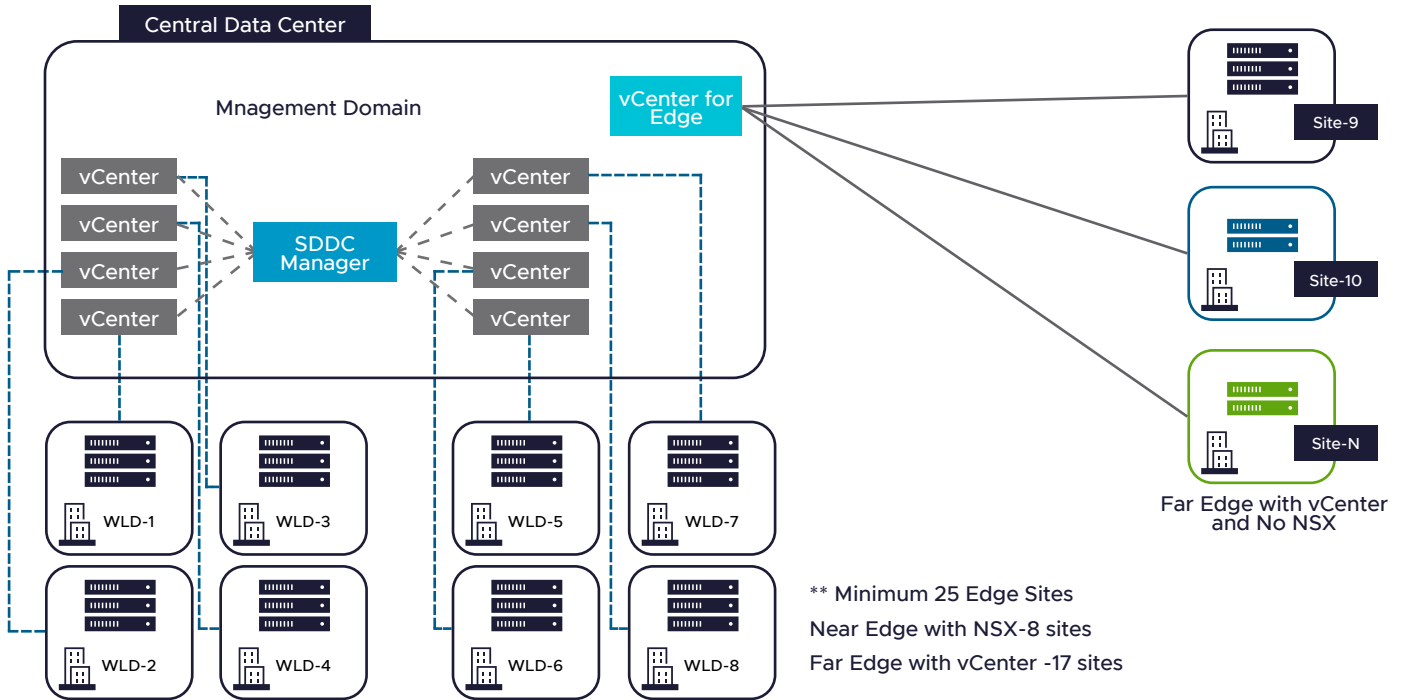


Figure 4: Mix Near Edge and Far Edge Deployments

In this design:

1. Customer has a Central Data Center where they have deployed a private cloud along with a few near Edge with SDDC Manager and NSX.
2. Customer also deployed a few VMware Cloud Foundation Edge with a dedicated vCenter for Edge sites without SDDC Manager and NSX.
3. Customer wants to manage and life cycle Central Data Center and near Edge with SDDC Manager and separately manage and life cycle all the far Edge sites with vCenter.

Design Scenario 4:

Unified Monitoring for Private Cloud and Isolated Edge Deployment

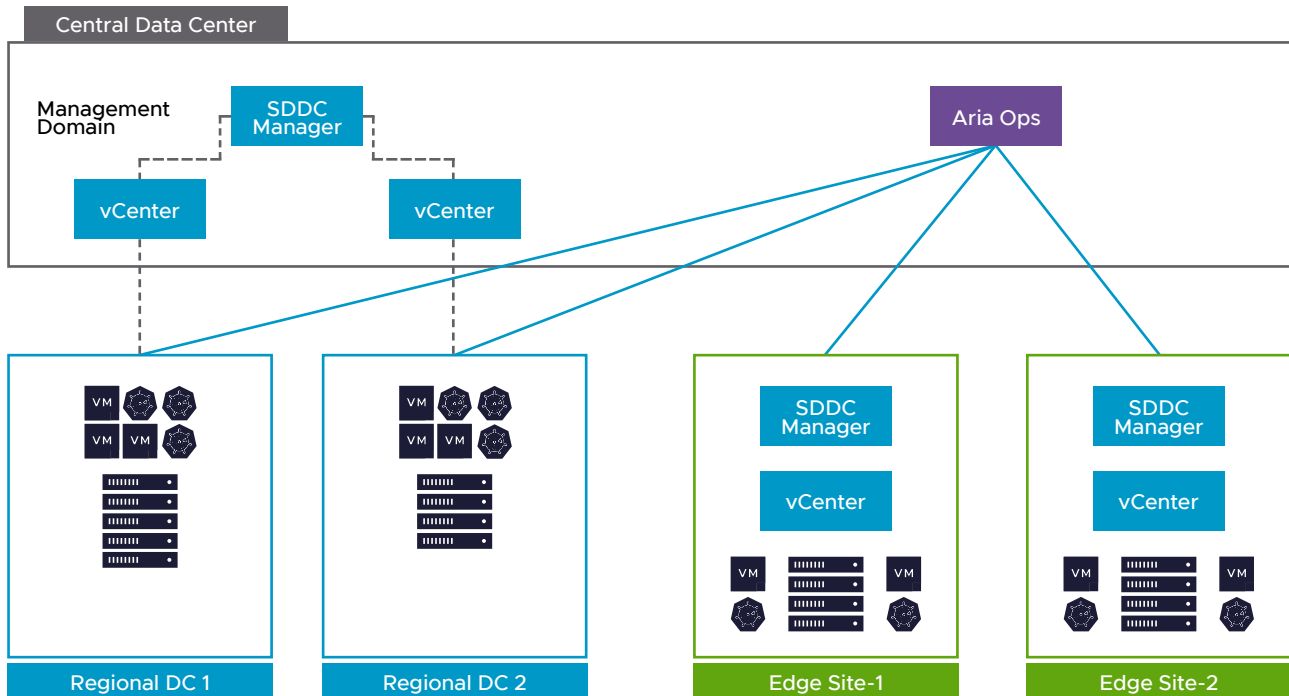


Figure 5: Unified Monitoring for Private Cloud and Isolated Edge

In this design:

1. Customer has a central data center with a VMware Cloud Foundation instance for their private cloud.
2. Customer also has a few small regional data centers managed by SDDC Manager.
3. Customer also has few Fat edge locations with isolated and dedicated VMware Cloud Foundation instance. Each site is independently managed by the respective SDDC Manager. The life cycle management of every site is under the purview of each SDDC manager.
4. The Central Data Center hosts Aria Operation, which is responsible for overseeing the daily operations of the Edge locations, Regional Data Center, and Central Data Center.

Design Scenario 5:

Multiple Data Centers managed by SDDC Manager and Edge sites managed by vCenter. Unified Monitoring both Data Centers and Edge with Aria Operations.

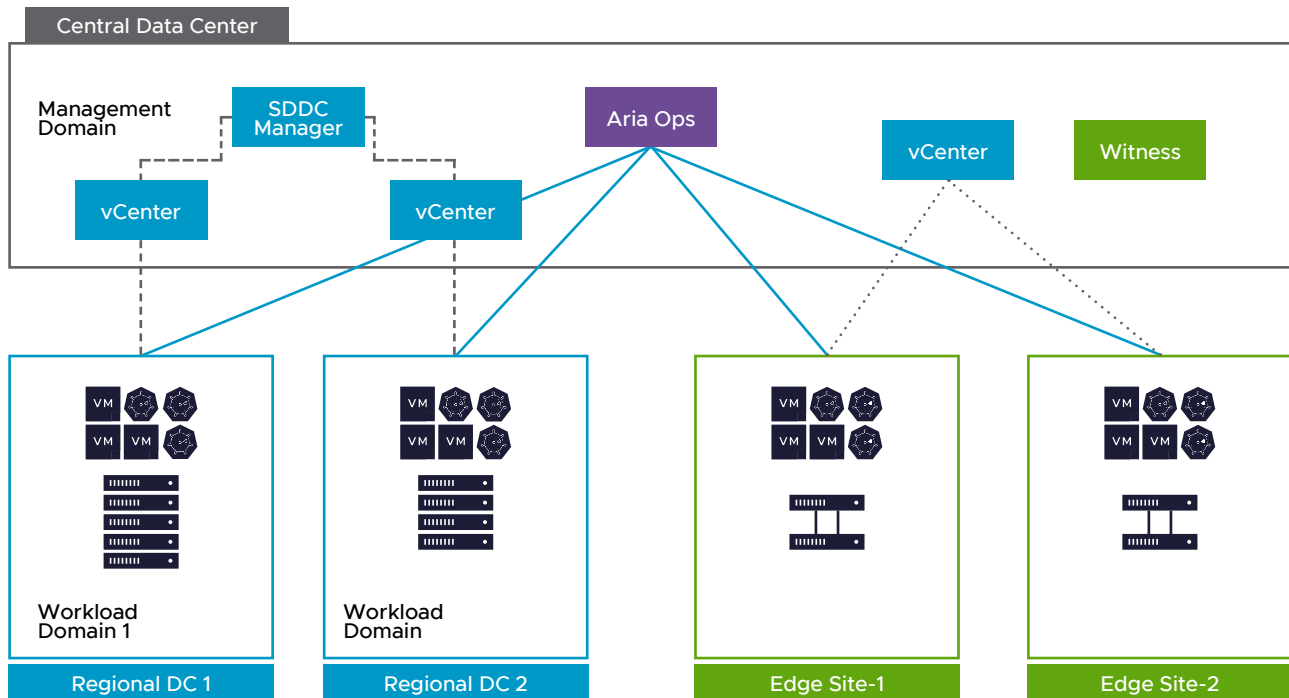


Figure 6: Multiple Data Centers and Edge with Aria Operations

In this design:

1. Aria Operations oversees daily operations for multiple data centers and all the edge sites.
2. Each data center has its own SDDC Manager. SDDC Manager manages the life cycle for all the data centers.
3. All the edge sites use dedicated vCenter and Witness hosts. Dedicated vCenter manages the life cycle of all the edge sites.
4. Aria Operations, hosted at the Central Data Center, monitors and manages operations across all sites, ensuring smooth functioning.

Design Scenario 6:

Mixed Data Center and Edge Deployments

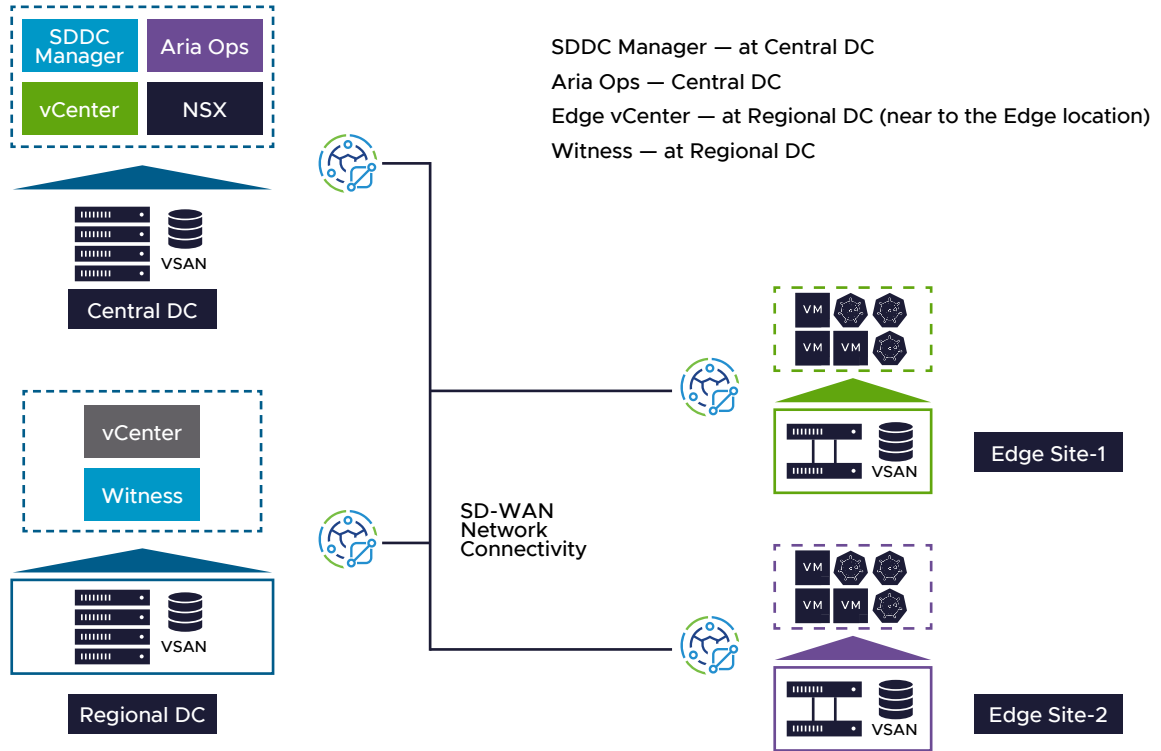


Figure 7: Mixed Data Center and Edge Deployments

In this above scenario:

1. You have one Central Data Center with VMware Cloud Foundation, where SDDC Manager and Aria Operation is hosted. Aria Operation centrally manages all the health monitoring and statistics for Central Data Center, Regional Data Center and all the Edge sites.
2. You have another Regional Data Center dedicated for all the near Edge sites. Here you have a dedicated vCenter and Witness appliance, which manages your Edge sites.
3. All the sites are connected over WAN.

Logical Architecture – Deploy as Workload Domain

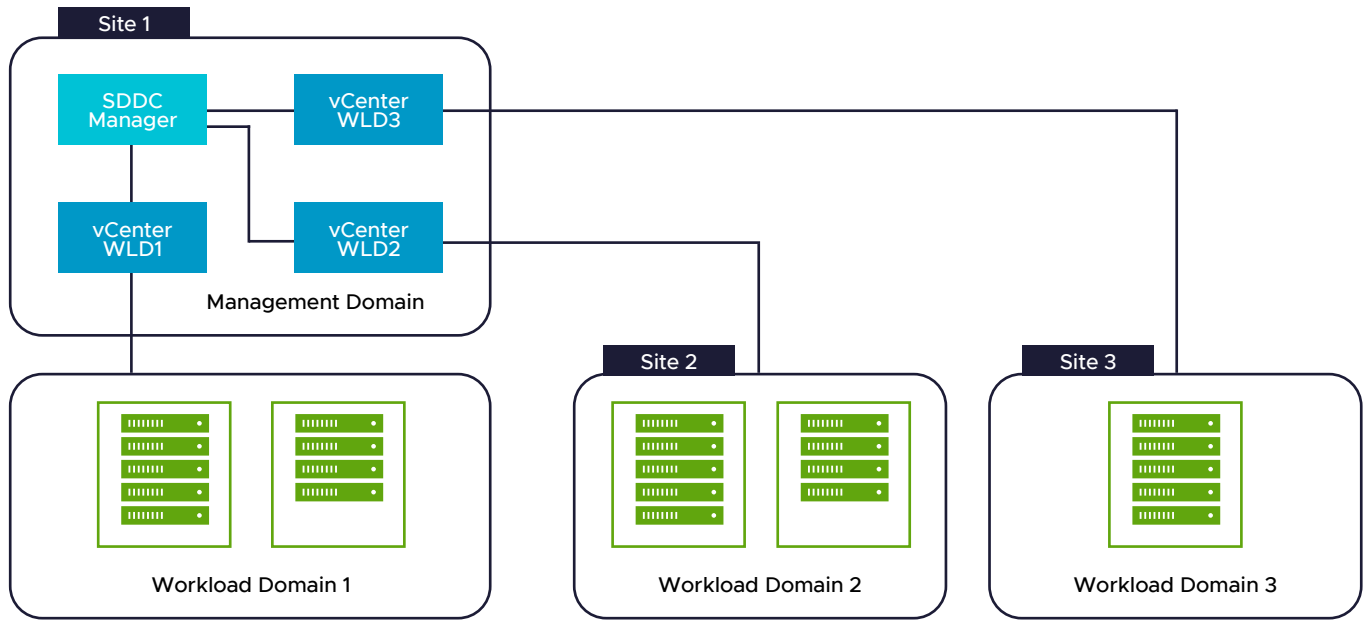


Figure 8: Deploy as Workload Domain

In this approach, VMware Cloud Foundation is deployed with multiple workload domains and each workload domain is dedicated to each edge site. This approach is suitable for expanding the capabilities of an existing VCF deployment by adding additional resources or enabling specific use cases without the need for separate management.

Logical Architecture – Deploy as separate edge clusters

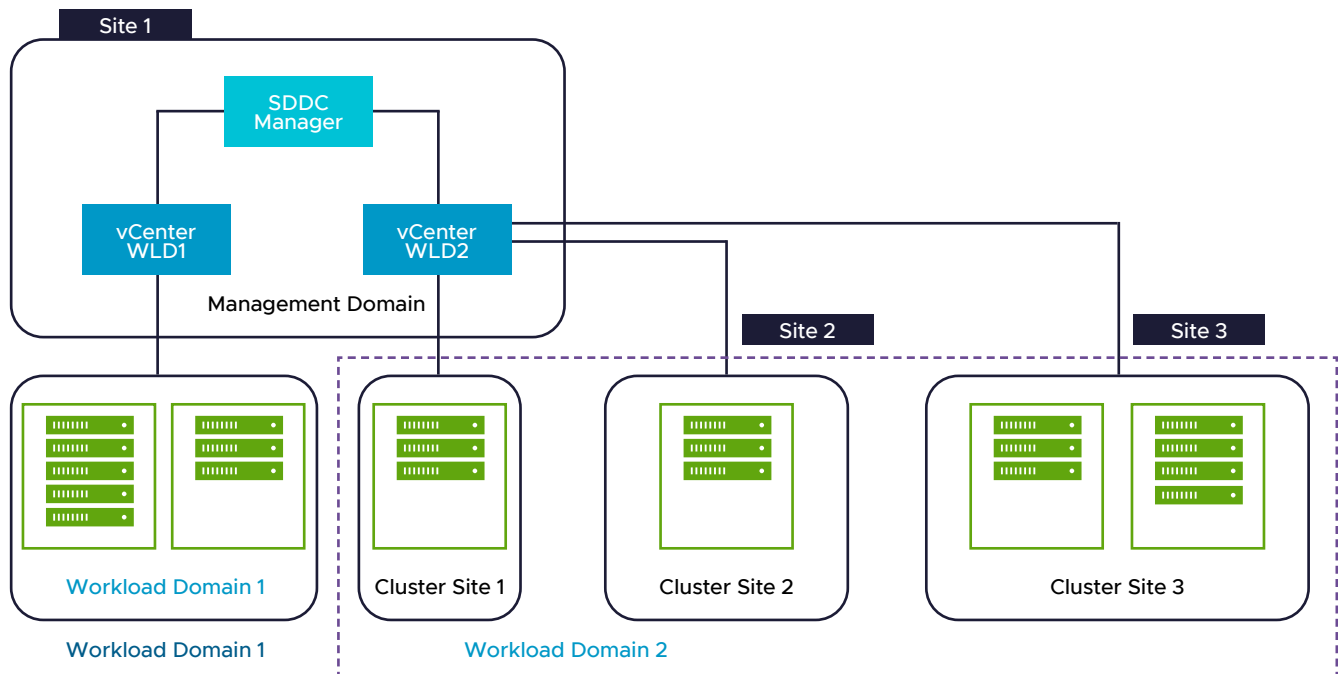


Figure 9: Deploy as separate edge clusters.

In this approach, VMware Cloud Foundation is deployed with a few workload domains. Each workload domain is then expanded to include smaller clusters located in different places, with each cluster dedicated to a specific edge site.

Prerequisites to deploy VMware Cloud Foundation Edge

- A reliable and stable WAN link with minimum 10Mbps bandwidth with less than 100ms of end-to-end latency*. (Note: It is recommended to have primary and secondary WAN links between the central site to VMware Cloud Foundation Edge site.)
- Edge site network should be reachable to VMware Cloud Foundation Management site to ensure connectivity of management components such as vCenter, SDDC Manager, NSX-T Manager etc.
- DNS and NTP Server is available locally or they are reachable to Edge site from Central site.

Other Edge Design options with VMware Cloud Foundation components

Customers can tailor their edge deployment to their unique needs by either deploying the VMware Cloud Foundation full stack or select components as required by the specific use case. Customers can construct an Edge architecture that best meets their operational requirements by using software components like vCenter and vSphere without SDDC Manager. By separating or opting to employ specific components customers can design a customized edge deployment that fits their unique requirements. At the same time VMware Cloud Foundation goes beyond simply managing multiple data centers and edge sites. It empowers you to effortlessly ingest your existing VMware environment into a newly deployed VMware Cloud Foundation Instance. By seamlessly integrating your existing VMware environment with VMware Cloud Foundation, you gain the power of unified management for a more efficient, centralized, and agile IT experience.



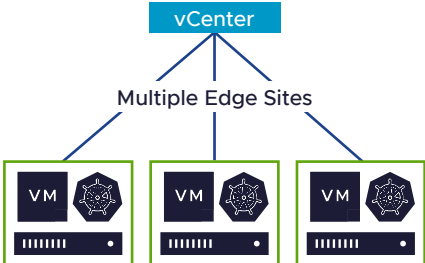
Standalone ESXi	vCenter + ESXi in each site	Centralized vCenter + ESXi with multiple sites
<ul style="list-style-type: none"> • Manage individually • No vCenter, NSX, vSAN and SDDC Manager required • Patch and Update – at site 	<ul style="list-style-type: none"> • Management through vCenter • No SDDC Manager and No NSX • Patch and Update through vCenter 	<ul style="list-style-type: none"> • Centrally Managed • Management through vCenter • No SDDC Manager and No NSX • Patch and Update through vCenter
Benefits	Benefits	Benefits
<ul style="list-style-type: none"> • Each site is independent • Bandwidth and latency may not be a constraint if it is running locally 	<ul style="list-style-type: none"> • Each site is independent • Bandwidth and latency may not be a constraint if it is running locally • Life Cycle Management through vCenter • Scale up to 2500 hosts per vCenter • Existing Environment into VCF possible 	<ul style="list-style-type: none"> • Sites are independent • Life Cycle Management through vCenter • Scale up to 2500 hosts per vCenter • Existing Environment into VCF possible
Drawbacks	Drawbacks	Drawbacks
<ul style="list-style-type: none"> • Management overhead • Single Point of Failure (SPOF) • Host LCM is local at site • Existing Environment into VCF may not be possible 	<ul style="list-style-type: none"> • Multiple vCenters • Management overhead 	<ul style="list-style-type: none"> • Bandwidth and latency may be an issue for LCM, if vCenter is remote
		

Table 2

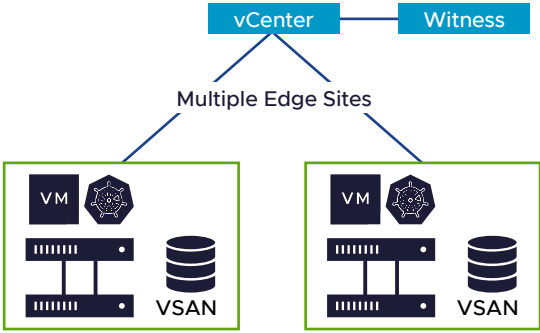
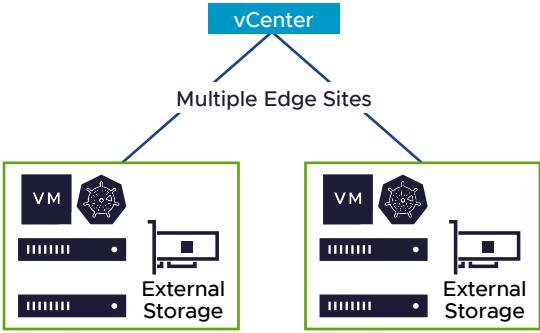
2 Node with vSAN	2 Node with External Storage
<ul style="list-style-type: none"> • No NSX and SDDC Manager required • vCenter located in a central Data Center • Patch and Update through vCenter • vCenter can be hosted in the same cluster 	<ul style="list-style-type: none"> • Central Management through vCenter • No SDDC Manager and No NSX • vCenter located in a central Data Center • Patch and Update through vCenter
Benefits	Benefits
<ul style="list-style-type: none"> • Central Management • High Availability • No External storage required • Life Cycle Management through vCenter • Scale up to 2500 hosts per vCenter 	<ul style="list-style-type: none"> • Central Management • High Availability • Life Cycle Management through vCenter • Scale up to 2500 hosts per vCenter • Existing environment into VCF possible
Drawbacks	Drawbacks
<ul style="list-style-type: none"> • vCenter Single point of failure if it is hosted in the same cluster • vSAN witness appliance required • More compute resources needed to host vSAN witness appliances depending on the number of sites • Bandwidth and latency challenge if witness is remote 	<ul style="list-style-type: none"> • External storage required • Bandwidth and latency challenge if external storage is shared between multiple sites
	

Table 3

Design Scenario 7:

With vSphere and vCenter: 2 Node vSAN cluster at the Edge.

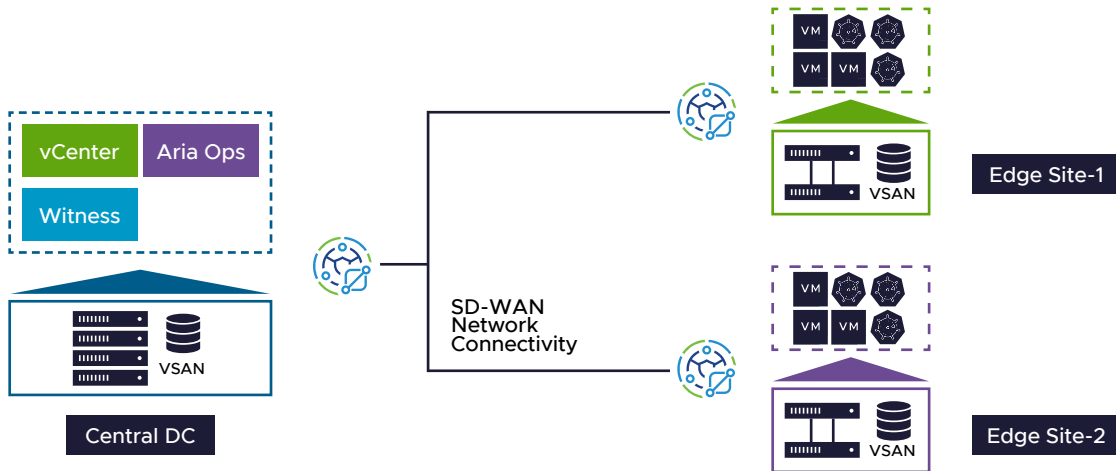


Figure 10: 2 node vSAN cluster with Witness

In this above scenario, customer will deploy a management cluster with vCenter at the central data center and depending on the edge site requirement, they can deploy multiple 2 node vSAN clusters at edge locations.

In the above design we have:

1. One central data center, where we have 1 Management vSAN cluster with 4 hosts.
2. vCenter, Aria Ops and Witness appliance is hosted in Management Cluster
3. Two edge sites with 2- node vSAN cluster. They are connected back-to-back with 10Gbe connection.
4. The central data center and edge sites are connected via SD-WAN L3 routed network.
5. Operations like, lifecycle management, adding cluster, and removing cluster is managed centrally through vCenter at Central Data Center.

Note: When designing edge solutions with VMware Cloud Foundation, please refer to Table 2 and Table 3 for the design characteristics and supported configuration for your specific design.

Integrate existing VMware Environment into VMware Cloud Foundation

Organizations frequently find themselves managing a combination of new and old infrastructure in today's dynamic IT ecosystem. Brownfield deployments—those that are currently in use—offer both possibilities and challenges. VMware Cloud Foundation provides a potent way to easily incorporate existing VMware environments to newly deployed VMware Cloud Foundation environments.

By doing this, you may take advantage of all of VMware Cloud Foundation advantages, such as:

- **Centralized management:** Gain a single pane of glass view and control over your entire virtualized environment, simplifying administration and resource provisioning.
- **Increased efficiency:** Optimize resource utilization by consolidating all your VMware environments and streamlining VM management.
- **Improved scalability:** Easily scale your infrastructure up or down based on changing business needs.

Note: For the supported design to integrate into existing environments, please refer to the design options mentioned in Table 2 and Table 3.

Conclusion

VMware Cloud Foundation (VCF) and its software components offer customers a range of design possibilities for tailoring their Edge deployment requirements. This flexibility proves advantageous for enterprises aiming to extend their private cloud strategy to remote office/branch office (ROBO) environments or the edge. Such businesses benefit from the ability to customize and manage their edge infrastructure to suit specific workload demands and scalability requirements, empowering them to plan and operate effectively in diverse operational environments.

Additional Resources

[VMware Cloud Foundation Product Page](#)

[VMware Cloud Foundation Remote Cluster Technical Documentation](#)

