Seamless VMware Workload Migration to Microsoft Azure Using Zerto: A Hypervisor-Based Replication Approach

Venkata Raman Immidisetti

Sr. Systems Engineer, Raleigh, North Carolina
vimmidisetti@gmail.com

Abstract

The adoption of hybrid cloud architectures is strategic for enterprises integrating on-premises VMware environments with Microsoft Azure for enhanced scalability, flexibility, and disaster recovery (DR). Organizations face challenges migrating workloads to different Azure regions due to conflicts between Azure Site Recovery (ASR) and Azure Migrate, which use agent-based replication. These conflicts cause operational inefficiencies, replication failures, and data inconsistencies, complicating cloud migration efforts. This study investigates Zerto as an efficient alternative for workload migration and disaster recovery in hybrid cloud environments. Unlike agent-based tools, Zerto's hypervisor-based replication eliminates the need for multiple agents, ensuring a seamless migration process. Through block-level replication, journal-based recovery, and consistency grouping, Zerto enables near-zero Recovery Point Objectives (RPOs) and minimal Recovery Time Objectives (RTOs), ensuring high data integrity and reduced downtime. The paper presents a methodology for migrating VMware workloads to Azure using Zerto, including pre-migration assessment, deployment of replication components, data synchronization, failover, and post-migration validation. A case study highlights Zerto's efficacy over agent-based solutions, demonstrating its ability to reduce complexity, mitigate migration risks, and enhance performance. By leveraging Zerto's unified disaster recovery and migration capabilities, enterprises can achieve seamless cloud transitions while maintaining business continuity, operational efficiency, and cost-effectiveness

Keywords: Azure Migrate, Azure Site Recovery (ASR), Disaster Recovery as a Service (DRaaS), Hybrid cloud, Migration tools, Zerto, Cloud migration, Agent conflicts, Minimal downtime and On-premises to cloud migration.

I. INTRODUCTION

The hybrid cloud model has emerged as a fundamental architectural approach for contemporary enterprises, offering the capability to integrate on-premises infrastructure with public cloud platforms, such as Microsoft Azure. This model provides scalability, flexibility, and enhanced disaster recovery capabilities, rendering it an advantageous choice for organizations seeking to optimize their IT strategies. However, one of the most significant challenges in hybrid cloud adoption is the migration of production workloads from on-premises VMware environments to Azure, particularly when organizations require a solution that supports both disaster recovery and workload migration.

Azure Site Recovery (ASR) is widely adopted as a disaster recovery (DRaaS) solution, enabling the continuous replication of VMware workloads to Azure to ensure business continuity in the event of infrastructure failure. However, when the same workloads need to be migrated to a different Azure region,

conflicts can arise between the ASR and Azure Migrate because both solutions rely on agent-based replication mechanisms. These conflicts can introduce operational inefficiencies, replication failures, performance degradation, and potential data inconsistencies, ultimately increasing migration complexity. The simultaneous deployment of ASR and Azure Migrate may lead to resource contention, in which both agents compete for system resources, resulting in latency issues and potential data loss. This problem is particularly challenging for organizations seeking to migrate workloads between Azure regions while maintaining the existing DRaaS setup.

To address these challenges, this study proposes Zerto as an efficient and unified alternative for workload migration in hybrid cloud environments. Unlike traditional agent-based tools, Zerto's hypervisor-based replication platform eliminates the need for multiple agents, thereby ensuring a seamless and conflict-free migration process. Its block-level replication technology and consistency grouping mechanisms enable minimal downtime, high data integrity, and simple operation. Zerto's agentless architecture makes it particularly advantageous for organizations seeking to migrate VMware workloads to Azure without interfering with the existing ASR configurations.

This paper presents a detailed case study demonstrating the application of Zerto for migrating VMware workloads across Azure regions while preserving disaster recovery configurations. These findings highlight the advantages of Zerto over traditional agent-based replication methods, including reduced complexity, lower risk of data inconsistencies, and enhanced migration performance. By leveraging Zerto's unified disaster recovery and migration platform, organizations can achieve seamless hybrid cloud transitions while maintaining business continuity and operational efficiency.

II. KEY FEATURES AND COMPONENTS OF ZERTO

Zerto's architecture comprises two primary components that integrate seamlessly into virtualized environments, ensuring efficient replication and disaster recovery.

A Zerto Virtual Manager is embedded within virtualization management consoles (e.g., VMware vCenter), providing centralized oversight of the replication process. It functions as the orchestration hub, manages replication, tracks workloads, and ensures data consistency across virtual machines (VMs).

The VRA is a lightweight software module that is automatically deployed on each host within a virtualized infrastructure. Rather than installing agents on individual VMs, the VRA operates at the hypervisor level, continuously replicating write operations from protected VMs, and transmitting them over WAN connections to a disaster recovery site. This hypervisor-based approach enhances the efficiency and reliability, mitigating the latency and performance bottlenecks associated with storage-based replication methods.

In contrast to snapshot-based replication solutions, which may introduce performance degradation, Zerto's continuous replication model has a minimal impact on application performance. Furthermore, it is storage-agnostic, enabling organizations to replicate workloads across different storage platforms while fully utilizing virtualization features, such as high availability, clustering, and workload mobility.

A salient feature of Zerto's disaster recovery and migration framework is its journal-based recovery system that retains replicated data changes for up to 30 days. This feature enhances the granularity in recovery operations by automatically creating checkpoints every few seconds, allowing organizations to restore data at precise moments.

This capability significantly reduces data loss, as it enables organizations to revert workloads to their most recent state or a specific pre-failure point, such as prior to a ransomware attack or a data corruption event. The checkpoint-based approach ensures that files, entire VMs, applications, or even full data center environments can be efficiently restored with minimal downtime.

Replication at an appropriate level within a virtualized environment is crucial for maintaining data consistency and ensuring effective disaster recovery. Zerto's hypervisor-based replication technology ensures consistent replication of the entire VM environment, including all associated metadata, facilitating rapid and complete recovery in the case of failure or migration requirements. Enterprise applications frequently comprise multiple interconnected components such as web servers, application servers, and databases, each associated with its respective virtual disk. Conventionally, administrators consolidate all the application disks into a single logical unit to facilitate replication. However, this approach lacks granularity, necessitating replication of the entire unit, including superfluous components, resulting in inefficient storage utilization and increased replication overhead.

In contrast to the traditional storage-based replication methods, Zerto's hypervisor-based approach is hardware-agnostic, rendering it compatible with heterogeneous storage environments. This flexibility enables organizations to replicate data between diverse storage technologies, including Storage Area Networks (SANs) and Network-Attached Storage (NAS). Furthermore, Zerto supports multiple virtual disk formats, such as Raw Device Mapping (RDM) and the VMware File System (VMFS), ensuring broad applicability across various IT infrastructures.

Two critical performance metrics in disaster recovery and workload migration are the Recovery Point Objective (RPO) and Recovery Time Objective (RTO).

The Recovery Point Objective (RPO) quantifies the amount of data at risk of loss between replication intervals, and defines the maximum acceptable timeframe for data recovery. The (Recovery Time Objective) specifies the duration required to fully restore services after a data-loss incident, ensuring a return to normal operations as expeditiously as possible.

Zerto's hypervisor-based replication technology delivers near-zero RPOs (measured in seconds) and RTOs (measured in minutes), providing high availability, minimal downtime, and enhanced disaster resilience. This capability ensures that organizations can achieve seamless workload migration without disrupting production environments or compromising data integrity.

III. MIGRATION PHASES

The migration of VMware workloads to Azure using Zerto encompasses six primary phases: pre-migration assessment, deployment of zero-components, replication setup, data synchronization, failure and cutover, and post-migration validation.

1) Pre-Migration Assessment & Planning

Before initiating migration, organizations must assess their existing VMware environment and define a structured migration strategy.

Key Considerations:

- Azure Infrastructure Readiness:
- Ensure an Azure subscription is available.
- Define the Azure Virtual Network (VNet) and Subnets for VM placement.

- Plan for Azure ExpressRoute or VPN Gateway for hybrid connectivity.
- Identify VMs for migration and their dependencies.
- Evaluate storage, networking, and performance requirements.
- Check compatibility of VM configurations with Azure VM sizes.
- Map VMware compute, memory, and storage requirements to Azure VM types.
- Estimate Azure storage and bandwidth costs using Azure Pricing Calculator.

2) Deployment of Zerto Components

To enable migration, the following Zerto components must be deployed in both the VMware source environment and the Azure destination.

- Install Zerto Virtual Manager (ZVM) on VMware
- ZVM is deployed on a Windows VM within vCenter to manage replication and orchestration.
- Ensure proper connectivity to VMware ESXi hosts and vCenter Server.
- Deploy Zerto Cloud Appliance (ZCA) in Azure
- ZCA is a preconfigured virtual machine in Azure responsible for receiving replicated data.
- It is deployed from the Azure Marketplace and requires a managed disk for replicating journal storage.
- Establish Network Connectivity
- Configure Azure Virtual Network (VNet) peering or VPN/ExpressRoute to connect Azure and VMware.
- Ensure firewall rules allow communication between ZCA and ZVM.

3) Configuring Replication and Protection

Once zero-to components are deployed, the next step is to set up replication for VMware VMs.

- Create a Virtual Protection Group (VPG)
- VPGs are logical groups of VMs that need to be migrated together.
- Define consistency groups for applications with interdependencies.
- Configure Replication Settings
- Choose target Azure region, VM sizes, and storage accounts.
- Define network mapping for VM failover into Azure.
- Set up journaling and retention policies for point-in-time recovery.
- Start Initial Data Synchronization
- Zerto performs an initial full replication of VMware VMs to Azure.

After the initial sync, continuous replication keeps data updated.

4) Failover and Cutover to Azure

Once the replication is fully synchronized, a controlled failover process is executed to migrate the workloads.

- Perform Test Failover (Dry Run)
- Execute a test failover in Azure to validate performance, networking, and dependencies.
- Ensure application consistency by testing workloads before production cutover.

- Final Failover & Cutover
- Select the latest recovery point for migration.
- Power off source VMs in VMware to avoid data inconsistency.
- Trigger failover in Zerto to boot VMs in Azure.
- Update DNS records and reconfigure networking as needed.

3.5 Post-Migration Validation & Optimization

- After the cutoff, the final step involves verifying the migrated workloads and optimizing performance.
- Verify Application Functionality
- Test all applications, databases, and services to ensure operational integrity.
- Validate network connectivity and firewall rules.
- Monitor Performance & Cost
- Use Azure Monitor and Log Analytics to track VM performance.
- Optimize Azure VM sizes and disk configurations to control costs.
- Decommission VMware Resources (Optional)

Once workloads are stable in Azure, decommissioning on-premises VMs to free up resources.

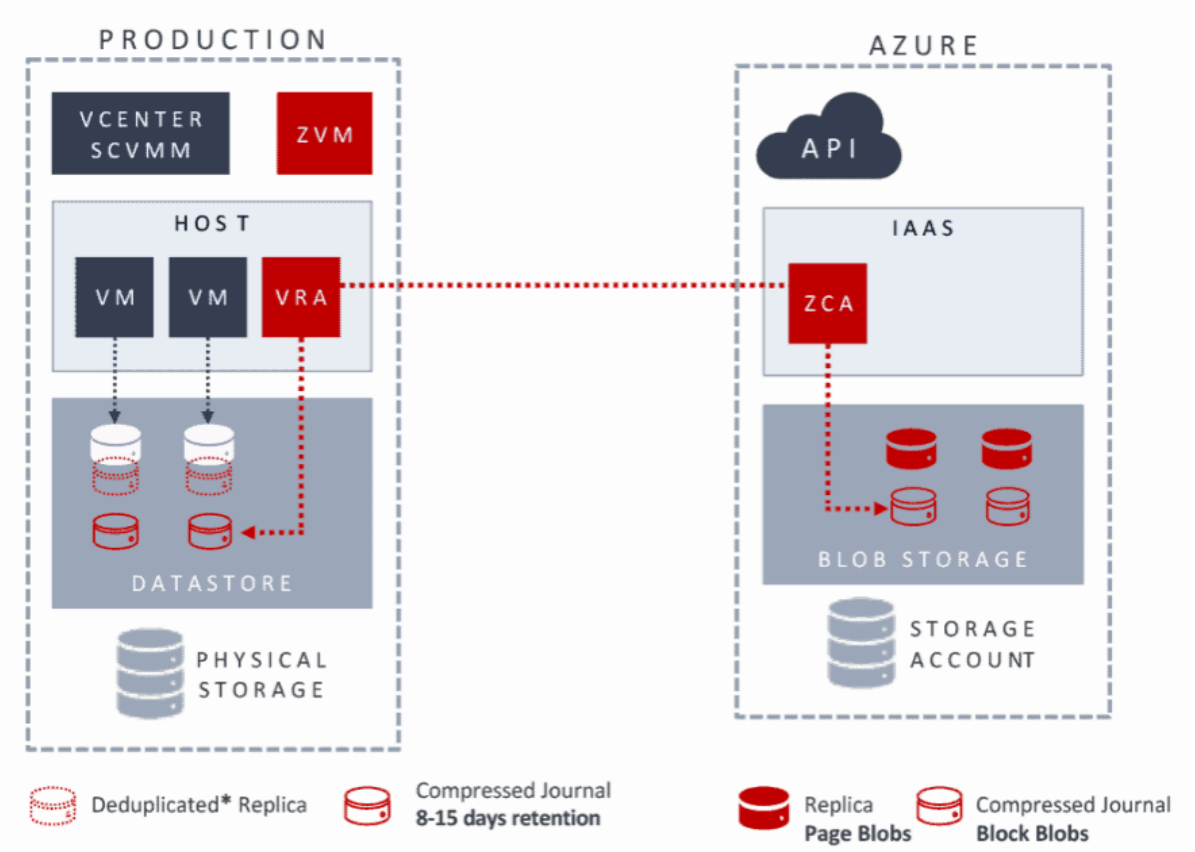

Figure1: Migrating workloads from VMware On-premises to Azure

IV. CONCLUSION

The migration of on-premises VMware workloads to Microsoft Azure constitutes a critical component of hybrid cloud adoption. However, it presents various technical and operational challenges. This study examined Zerto's hypervisor-based replication solution as a robust alternative to agent-based migration

tools, particularly in scenarios in which organizations need to migrate workloads from on-premises to Azure regions while maintaining disaster recovery configurations. Zerto's architecture eliminates agent conflicts, enhances data consistency, and ensures seamless workload transitions by leveraging continuous replication, journal-based recovery, and storageagnostic integrations. Compared to ASR and Azure Migrate, Zerto provides superior RPO and RTO performance, ensuring minimal downtime and improved application availability. The study delineated a structured migration strategy encompassing pre-migration assessment, deployment of Zerto components, replication setup, and failover execution, demonstrating its efficacy in real-world migration scenarios. The findings of this study indicate that Zerto significantly simplifies the VMware-to-Azure migration process, reduces operational complexity, improves resilience, and optimizes cloud migration workflows. As organizations continue to adopt hybrid and multi-cloud strategies, future research should explore further automation of Zerto's migration workflows, AI-driven replication optimization, and cross-cloud interoperability. By leveraging hypervisor-based replication, enterprises can accelerate digital transformation, while maintaining business continuity, security, and cost efficiency in evolving cloud landscapes.

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