MoSMB-S3 Server

Technical White Paper

11 November 2025

Market Need and Problem Context

Enterprises are increasingly shifting from traditional storage systems to scalable object storage for cost efficiency, durability, and operational simplicity. However, many mission-critical applications, users, and workflows still depend on file access semantics. This creates a fundamental compatibility gap: object storage does not natively support file-interfaces, hierarchical namespaces, or file-level locking semantics.

MoSMB-S3 Server addresses this gap by providing native Server Message Block (SMB) file access to S3-compatible object storage, enabling seamless application continuity while taking advantage of object storage economics.

Product Overview

MoSMB-S3 Server is a high-performance SMB protocol server that translates SMB file operations into S3 object operations. It preserves expected SMB behavior—file sharing, locking, leasing, directory listing, and permissions—while ensuring data persistence and scalability through object storage.

Key Capabilities:

- **File Semantics & Compatibility:** MoSMB-S3 Server preserves POSIX-like file semantics, ensuring that legacy applications expecting file-based access can utilize object storage with no/minimal code changes. It supports clients on major operating systems—Windows, macOS, and Linux—allowing users to manage S3 buckets with familiar tools like Explorer and Finder.
- **Enterprise-Grade Security:** Data access to S3 storage is performed over HTTPS, ensuring secure transport. Communication between the SMB client and the MoSMB server is protected using signing and encryption to ensure confidentiality and integrity. Integration with Active Directory and Kerberos provides strong, centrally managed authentication for enterprise environments.
- **High Performance & Scalability:** The server leverages features such as asynchronous I/O and local data caching to minimize latency and maximize throughput, with support for SMB Multichannel, SMB Direct, active-active scale-out clustering to handle growing workloads and demanding applications.
- **Cost-Effective Storage Integration:** By combining POSIX semantics and heterogeneous backend support, MoSMB enables unified SMB exports across multiple storage types, reducing operational costs and simplifying management.

New Features:

- **File Pinning:** Frequently accessed files can be pinned to the server cache for rapid retrieval.

- **Partial File Reads:** Partial file read optimizations reduce latency when accessing large files. Even if the file is not yet cached, applications can open it immediately without experiencing initial access delays.
- **Clustered High Availability:** Support for clustered servers with shared cache for scalability and uptime.
- **Bucket Notification:** Integration with S3 bucket change notifications ensures local file listings are always up to date for consistent access.
- **Storage Tiering:** Users can view and selectively retrieve objects from archive tiers like AWS Glacier directly through the SMB interface.
- **Configurable Performance Controls:** Supports adjustable bandwidth throttling and customizable worker thread counts for the upload engine to balance performance, resource usage, and network load.
- **Heterogeneous storage shares:** Allows S3-based shares to coexist with traditional shares in the same configuration. Each share can be configured independently, enabling mixed storage tiers within a single server.

Core Architecture

MoSMB-S3 Server operates as a cluster of SMB protocol servers backed by a shared distributed cache layer and an object storage backend.

Key Mappings:

- **Bucket-to-Share Mapping:** Each S3 bucket is exported as an SMB share, supporting extended file paths and preloading metadata for immediate visibility.
- **File/Object Mapping:** Direct mapping and local caching ensure efficient file access and reduced transfer times. Asynchronous transfers boost workflow throughput.

SMB Client Layer:

SMB clients (Windows, macOS, Linux SMB clients, or applications) access storage through familiar SMB shares. Authentication, permissions, and file system semantics behave consistently with enterprise expectations.

MoSMB Protocol Engine:

- Handles SMB negotiation, sessions, and permissions.
- Translates file-level operations into corresponding S3 object operations.
- Manages leases and locks to maintain consistency.

Shared Distributed Cache Layer:

A shared distributed file store maintains metadata, file existence information. This ensures consistent behavior across all cluster nodes.

Object Storage Backend:

All persistent file data is stored in the S3-compatible object storage system. MoSMB writes and retrieves object data using optimized S3 operations, including multipart upload/download for large files.

Deployment Models

Standalone (Single Node) Deployment:

Suitable for edge and compact environments.

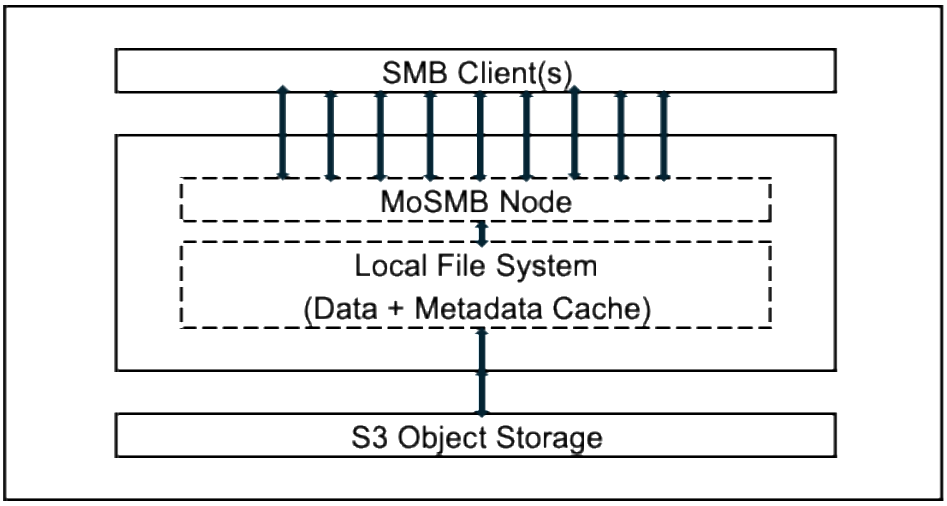

Diagram 1:Standalone Deployment Model

Multi-Node Cluster:

Recommended for production environments requiring high availability and scalability.

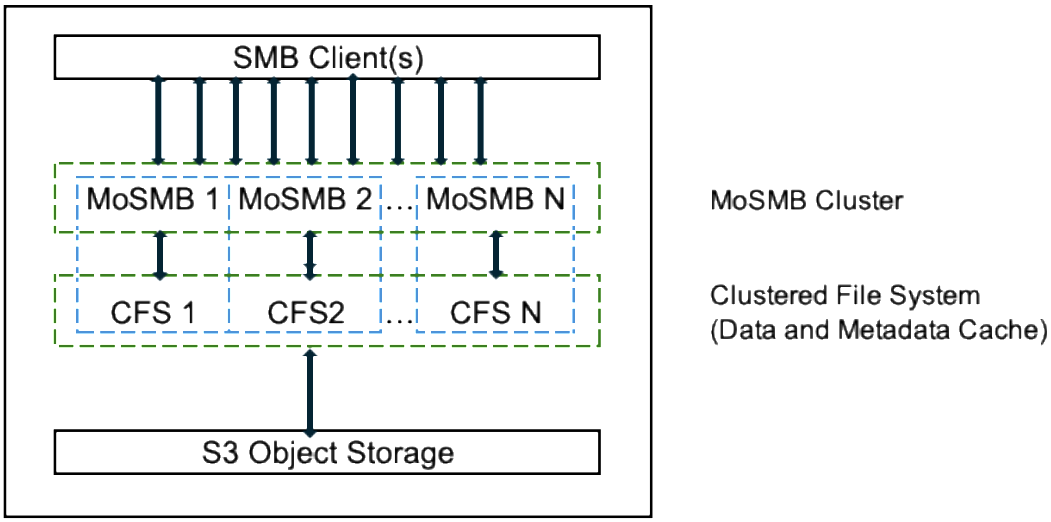

Diagram 2: MoSMB-S3 Clustered Deployment Model

High Availability and Failover

MoSMB-S3 Server supports both standalone and clustered high availability configurations. In clustered deployments, multiple MoSMB nodes run concurrently, sharing access to a distributed cache and the object storage backend.

Standalone High Availability:

In a single-node setup, MoSMB stores operation state in the shared distributed cache layer. If the node goes offline unexpectedly, pending tasks and in-progress transfers are recorded. When the node returns, it resumes tasks from the point of interruption.

Multi-Node Failover:

If a node in a cluster becomes unavailable, other active nodes detect stalled tasks via the shared cache. After a short delay, another active node claims and resumes these operations, ensuring uninterrupted client access.

Multiple Node Failure Recovery:

If several nodes become unavailable simultaneously, remaining nodes recover task queues in a deterministic order. The shared cache acts as the authoritative source of truth.

Caching and Data Flow Behavior

MoSMB-S3 Server uses a caching strategy to improve performance and minimize object store interactions.

Local Cache:

MoSMB node maintains local cache for frequently accessed file content, reducing read latency.

Distributed Cache:

The shared distributed cache layer stores metadata, directory structure, and operation state to ensure consistent multi-node behavior.

Cache Initialization:

At startup, MoSMB scans object storage and creates lightweight placeholder files for existing objects. Only one node performs this initialization in a cluster.

Business Value Summary

MoSMB-S3 Server enables seamless data modernization:

- **Lower TCO:** Object storage delivers cost-effective scaling vs. NAS/SAN.
- **Simplified Infrastructure:** Eliminates costly data migrations, appliances, and dual-tier deployments.
- **Continuity:** No disruption to user workflows, scripts, or organizational processes.
- **Scalability:** Distributed caching and clustering support growing workloads enterprise-wide.
- **Hybrid Flexibility:** Deployable on-premises, in private cloud, or hybrid environments.

Conclusion

MoSMB-S3 Server by Ryussi Technologies delivers interoperability between file-centric workflows and cloud-scale object storage. Its advanced feature set, security, and performance pave the way for robust hybrid cloud adoption, ensuring enterprises retain the agility and continuity needed in mission-critical data operations.