# Ransomware Defense with StorageGRID

Protecting your S3 objects

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## Abstract

Ransomware attacks are on the rise. This document provides some recommendations on how to protect your object data on StorageGRID.

TABLE OF CONTENTS

## Introduction

Ransomware today is an ever-present danger in the data center. Ransomware is designed to encrypt data and make it unusable by the users and applications that rely on it. Protection starts with the usual defenses of hardened networking and solid user security practices, and we need to follow through with data access security practices.

## StorageGRID Best Practices

For StorageGRID, security best practices include using HTTPS with signed certificates for both management and object access. Create dedicated user accounts for applications and individuals, and do not use the tenant root accounts for application access or user data access. In other words, follow the least privilege principle. Use security groups with defined Identity and Access Management (IAM) policies to govern user rights, and access accounts specific to the applications and users. With these measures in place, you still must ensure that your data is protected. In the case of Simple Storage Service (S3), when objects are modified to encrypt them, it is accomplished by an overwrite of the original object.

## Methods of defense

The primary ransomware protection mechanism in the S3 API is to implement object lock. Not all applications are compatible with object lock, so there are two other options to protect your objects that are described in this report: replication to another bucket with versioning enabled and versioning with IAM policies.

## Object Lock

Object lock provides a WORM model to prevent objects from being deleted or overwritten. StorageGRID's implementation of object lock is Cohasset assessed to help meet regulatory requirements, supporting legal hold, compliance mode, and governance mode for object retention, and default bucket retention policies. You must enable object lock as part of the bucket creation and enable versioning. A specific version of an object is locked, and if no version ID is defined, the retention is placed on the current version of the object. If the current version has the retention configured and an attempt is made to delete, modify, or overwrite the object, a new version is created with either a delete marker, or the new revision of the object as the current version, and the locked version is retained as a non-current version. For applications that are not yet compatible, you might still be able to make use of object lock and a default retention configuration placed on the bucket. After the configuration is defined, this applies an object retention to each new object put into the bucket. This works as long as the application is configured to not delete or overwrite the objects before the retention time has passed.

Here are a few examples using the object lock API:

Object lock legal hold is a simple on/off status applied to an object.

```
aws s3api put-object-legal-hold --bucket mybucket --key myfile.txt --legal-hold Status=ON --
endpoint-url https://s3.company.com
```

Setting the legal hold status does not return any value if successful, so it can be verified with a GET operation.

```
aws s3api get-object-legal-hold --bucket mybucket --key myfile.txt --endpoint-url
https://s3.company.com
{
    "LegalHold": {
        "Status": "ON"
    }
}
```

To turn legal hold off, apply the OFF status.

```
aws s3api put-object-legal-hold --bucket mybucket --key myfile.txt --legal-hold Status=OFF --
endpoint-url https://s3.company.com
aws s3api get-object-legal-hold --bucket mybucket --key myfile.txt --endpoint-url
https://s3.company.com
{
    "LegalHold": {
        "Status": "OFF"
    }
}
```

Setting the object retention is done with a retain until timestamp.

```
aws s3api put-object-retention --bucket mybucket --key myfile.txt --retention
'{"Mode":"COMPLIANCE", "RetainUntilDate": "2022-06-10T16:00:00"}'  --endpoint-url
https://s3.company.com
```

Again, there is no returned value on success, so you can verify the retention status similarly with a get call.

```
aws s3api get-object-retention --bucket mybucket --key myfile.txt  --endpoint-url
https://s3.company.com

{

    "Retention": {

        "Mode": "COMPLIANCE",

        "RetainUntilDate": "2022-06-10T16:00:00+00:00"

    }
```

Putting a default retention on an object lock enabled bucket uses a retention period in days and years.

```
aws s3api put-object-lock-configuration --bucket mybucket --object-lock-configuration '{
"ObjectLockEnabled": "Enabled", "Rule": { "DefaultRetention": { "Mode": "COMPLIANCE", "Days":
1 }}}' --endpoint-url https://s3.company.com
```

As with most of these operations, no response is returned on success so, we can perform a GET for the configuration to verify.

```
aws s3api get-object-lock-configuration --bucket mybucket --endpoint-url
https://s3.company.com
{
    "ObjectLockConfiguration": {
        "ObjectLockEnabled": "Enabled",
        "Rule": {
            "DefaultRetention": {
                "Mode": "COMPLIANCE",
                "Days": 1
            }
        }
    }
}
```

Next, you can put an object in the bucket with the retention configuration applied.

```
aws s3 cp myfile.txt s3://mybucket --endpoint-url https://s3.company.com
```

The PUT operation does return a response.

```
upload: ./myfile.txt to s3://mybucket/myfile.txt
```

On the retention object, the retention duration set on the bucket in the preceding example is converted to a retention timestamp on the object.

```
aws s3api get-object-retention --bucket mybucket --key myfile.txt --endpoint-url
https://s3.company.com
{
    "Retention": {
        "Mode": "COMPLIANCE",
        "RetainUntilDate": "2022-03-02T15:22:47.202000+00:00"
    }
}
```

## Replication to a Bucket with Versioning

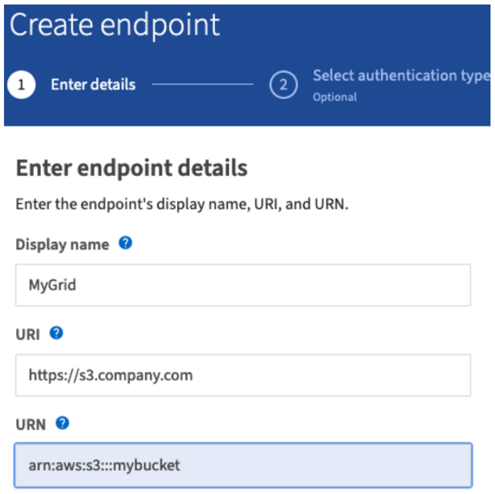
Not all applications and workloads are going to be compatible with object lock. Another option is to replicate the objects to a secondary bucket either in the same grid (preferably a different tenant with restricted access), or any other S3 endpoint with the StorageGRID platform service, CloudMirror.

StorageGRID CloudMirror is a component of StorageGRID that can be configured to replicate the objects of a bucket to a defined destination as they are ingested into the source bucket. CloudMirror does not replicate deletes. Because CloudMirror is an integrated component of StorageGRID, it cannot be turned off or manipulated by an S3 API-based attack. You can configure the replicated bucket with versioning or object lock enabled. When object lock is enabled, you must configure the default retention duration long enough to enable you to catch and recover from an attack. Because object lock relies on versioning, in both scenarios you need some automated cleanup of the replicated bucket's old versions that are safe to discard. For this, you can use the StorageGRID ILM policy engine. Create rules to manage the object placement based on non-current time for several days – enough time to have identified and recovered from an attack. If implementing object lock, the rule's duration must exceed that of the default retention period.

One downside to this approach is that it consumes more storage by having a complete second copy of the bucket, plus multiple versions of the objects retained for some time. Additionally, the objects that were intentionally deleted from the primary bucket must be manually removed from the replicated bucket. There are other replication options outside of the product, such as NetApp CloudSync, that can replicate deletes for a similar solution. Another downside for the secondary bucket being versioning enabled and not object lock enabled is that a  number of privileged accounts will exist that might be used to cause damage on the secondary location. The advantage is that it should be a unique account to that endpoint or tenant bucket and any compromise likely does not include access to accounts on the primary location or vice-versa.

After the source and destination buckets are created and the destination is either configured with object lock or versioning, you can configure and enable CloudMirror replication, as follows:

1. To configure CloudMirror, create a platform services endpoint for the S3 destination.


Create endpoint

1 Enter details — 2 Select authentication type Optional

**Enter endpoint details**

Enter the endpoint's display name, URI, and URN.

Display name: MyGrid

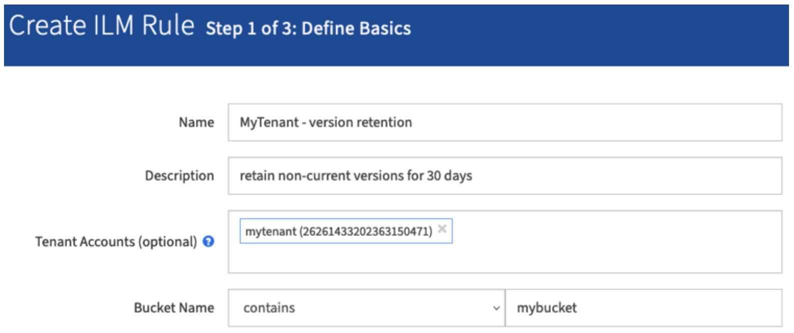
URI: https://s3.company.com

URN: arn:aws:s3:::mybucket

2. On the source bucket, configure replication to use the endpoint configured.

```
<ReplicationConfiguration>
    <Role></Role>
    <Rule>
        <Status>Enabled</Status>
        <Prefix></Prefix>
        <Destination>
            <Bucket>arn:aws:s3:::mybucket</Bucket>
            <StorageClass>STANDARD</StorageClass>
        </Destination>
    </Rule>
</ReplicationConfiguration>
```

3. Create ILM rules to manage the storage placement and version storage duration management. In this example, the non-current versions of the objects to store are configured.

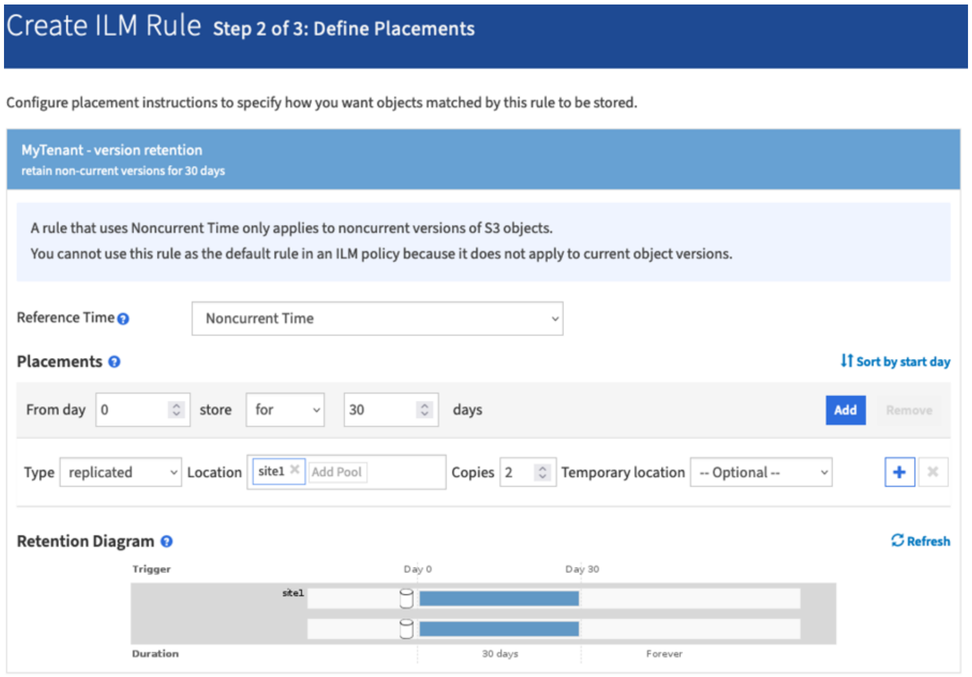

Create ILM Rule Step 1 of 3: Define Basics

Name: MyTenant - version retention

Description: retain non-current versions for 30 days

Tenant Accounts (optional): mytenant (26261433202363150471)

Bucket Name: contains mybucket


Create ILM Rule Step 2 of 3: Define Placements

Configure placement instructions to specify how you want objects matched by this rule to be stored.

MyTenant - version retention
retain non-current versions for 30 days

A rule that uses Noncurrent Time only applies to noncurrent versions of S3 objects.
You cannot use this rule as the default rule in an ILM policy because it does not apply to current object versions.

Reference Time: Noncurrent Time

Placements

From day 0 store for 30 days

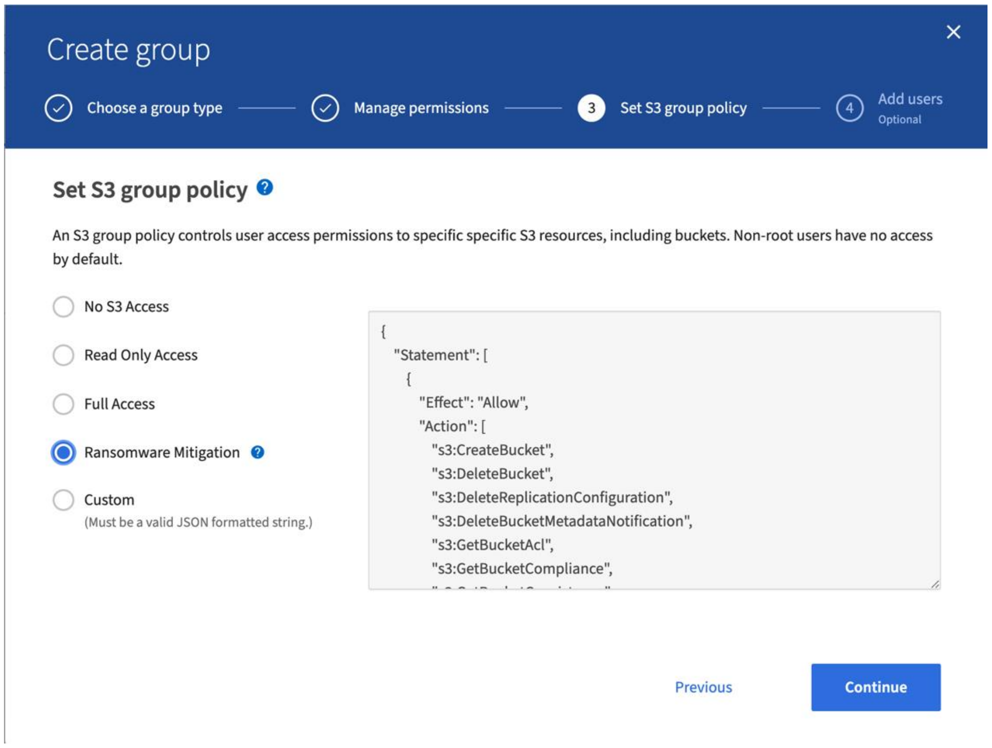
Type: replicated Location: site1 Copies: 2 Temporary location: -- Optional --

There are two copies in site 1 for 30 days. You also configure the rules for the current version of the objects based on using ingest time as reference time in the ILM rule to match the source bucket storage duration. The storage placement for the object versions can be erasure coded or replicated.

## Versioning with a Protective IAM Policy

A method to protect your data without using object lock or replication is to enable versioning on the bucket and implement IAM policies on the user security groups to limit users' ability to manage versions of the objects. In the event of an attack, new bad versions of the data are created as the current version, and the most recent non-current version is the safe clean data. The accounts compromised to gain access to the data do not have access to delete or otherwise alter the non-current version protecting it for later restore operations. Just like the previous scenario, ILM rules manage the retention of the noncurrent versions with a duration of your choice. The downside is that there is still the possibility of privileged accounts existing for a bad actor attack, but all application service accounts and users must be configured with a more restrictive access. The restrictive group policy must explicitly allow each action you want the users or application to be capable of and explicitly deny any actions that you do not want them to be capable of. NetApp does not recommend using a wildcard allow because a new action might be introduced in the future, and you will want to control whether it is allowed or denied. For this solution, the deny list must include DeleteObjectVersion, PutBucketPolicy, DeleteBucketPolicy, PutLifecycleConfiguration, and PutBucketVersioning to protect the versioning configuration of the bucket and object versions from user or programmatic changes.

In StorageGRID 11.7 a new S3 group policy option "Ransomware Mitigation" has been introduced to make implementing this solution easier. When creating a user group in the tenant, after selecting the group permissions, you can see this new optional policy.



Set S3 group policy

An S3 group policy controls user access permissions to specific specific S3 resources, including buckets. Non-root users have no access by default.

- No S3 Access
- Read Only Access
- Full Access
- [✓ Ransomware Mitigation]
- Custom (Must be a valid JSON formatted string.)

```
{
  "Statement": [
    {
      "Effect": "Allow",
      "Action": [
        "s3:CreateBucket",
        "s3:DeleteBucket",
        "s3:DeleteReplicationConfiguration",
        "s3:DeleteBucketMetadataNotification",
        "s3:GetBucketAcl",
        "s3:GetBucketCompliance",
```

The following is the content of the group policy that includes most of the available operations explicitly allowed and the minimum required denied.

```
{
   "Statement": [
      {
         "Effect": "Allow",
         "Action": [
            "s3:CreateBucket",
            "s3:DeleteBucket",
            "s3:DeleteReplicationConfiguration",

"s3:DeleteBucketMetadataNotification",
            "s3:GetBucketAcl",
            "s3:GetBucketCompliance",
            "s3:GetBucketConsistency",
            "s3:GetBucketLastAccessTime",
            "s3:GetBucketLocation",
            "s3:GetBucketNotification",

"s3:GetBucketObjectLockConfiguration",
            "s3:GetBucketPolicy",
            "s3:GetBucketMetadataNotification",
            "s3:GetReplicationConfiguration",
            "s3:GetBucketCORS",
            "s3:GetBucketVersioning",
            "s3:GetBucketTagging",
            "s3:GetEncryptionConfiguration",
            "s3:GetLifecycleConfiguration",
            "s3:ListBucket",
            "s3:ListBucketVersions",
            "s3:ListAllMyBuckets",
            "s3:ListBucketMultipartUploads",
            "s3:PutBucketConsistency",
            "s3:PutBucketLastAccessTime",
            "s3:PutBucketNotification",

"s3:PutBucketObjectLockConfiguration",
            "s3:PutReplicationConfiguration",
            "s3:PutBucketCORS",
            "s3:PutBucketMetadataNotification",
            "s3:PutBucketTagging",
            "s3:PutEncryptionConfiguration",
            "s3:AbortMultipartUpload",
            "s3:DeleteObject",
            "s3:DeleteObjectTagging",
            "s3:DeleteObjectVersionTagging",
            "s3:GetObject",
            "s3:GetObjectAcl",
            "s3:GetObjectLegalHold",
            "s3:GetObjectRetention",
            "s3:GetObjectTagging",
            "s3:GetObjectVersion",
            "s3:GetObjectVersionAcl",
            "s3:GetObjectVersionTagging",
            "s3:ListMultipartUploadParts",
                "s3:PutObject",
                "s3:PutObjectAcl",
                "s3:PutObjectLegalHold",
                "s3:PutObjectRetention",
                "s3:PutObjectTagging",
                "s3:PutObjectVersionTagging",
                "s3:RestoreObject",
                "s3:ValidateObject",
                "s3:PutBucketCompliance",
                "s3:PutObjectVersionAcl"
            ],
            "Resource": "arn:aws:s3:::*"
        },
        {
            "Effect": "Deny",
            "Action": [
                "s3:DeleteObjectVersion",
                "s3:DeleteBucketPolicy",
                "s3:PutBucketPolicy",
                "s3:PutLifecycleConfiguration",
                "s3:PutBucketVersioning"
            ],
            "Resource": "arn:aws:s3:::*"
        }
    ]
}
```

## Conclusion

Ransomware is one of today’s largest security threats. The NetApp StorageGRID team is working with our customers to keep ahead of these threats. With the use of object lock and versioning, you can protect against unwanted alterations and recover from malicious attacks. Data security is a multi-layer venture, with your object storage being just one part in your data center.

## Version history

| Version | Date | Document version history |
|---|---|---|
| Version 1.0 | April 2022 | Initial release. |
| Version 2.0 | December 2023 | Fix images, update for 11.7 group policy option. |

Refer to the Interoperability Matrix Tool (IMT) on the NetApp Support site to validate that the exact product and feature versions described in this document are supported for your specific environment. The NetApp IMT defines the product components and versions that can be used to construct configurations that are supported by NetApp. Specific results depend on each customer's installation in accordance with published specifications.

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