FUJITSU

White Paper
Combining FUJITSU Storage ETERNUS CS800 M1 and Veeam Backup & Replication to Realize Optimal Backups of Virtual Environments

ETERNUS CS800 M1, which is a deduplication appliance, and Veeam Backup & Replication, which is used around the world as backup software for virtual environments, is an optimum combination for reducing backup cost.

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Preface

As businesses must cope with fast-paced changes and higher speed requirements, they are turning to digitalization and require flexible and agile IT infrastructures. Because of this, virtual infrastructures are becoming standard.

Furthermore, as the scale and value of IT infrastructures and their data continue to increase, ensuring their availability and protection is an important requirement for businesses. However, circumstances may prevent businesses from devoting sufficient funds and resources to adequately satisfy these requirements. Therefore, solutions that are more efficient than ever are required for IT infrastructures. The combination of the FUJITSU Storage ETERNUS CS800 M1 deduplication appliance and Veeam Backup & Replication provides optimal availability and data protection for IT infrastructures and data.

The FUJITSU Storage ETERNUS CS800 M1 deduplication appliance is a dedicated backup storage that offers excellent data deduplication and compression performance, which reduces the required disk capacity for backups of ever-increasing amounts of business data by 90% or more for a highly efficient storage.

Veeam Backup & Replication was developed with the aim of protecting the data of virtual infrastructures to ensure simple data protection operation and availability of IT infrastructure without the need for agents.

This document explains the benefits of combining the FUJITSU Storage ETERNUS CS800 M1 with Veeam Backup & Replication using backup examples of virtual environments.

The product lineup and product information stated in this document are current as of November 2021.

■Target Audience
  This document targets the following audience:
    - Those who want to reduce the cost of storage used for business
    - Those who want to create full backups without changing the virtual environment
    - Those who want to restore virtual environments quickly to resume business in the event of an emergency
    - Those considering the adoption of Veeam Backup & Replication

■Applicable Series
  This document covers the following series:
    - FUJITSU Storage ETERNUS CS800 M1 deduplication appliance

■Naming Conventions
  The following abbreviations are used in this document.
    - ETERNUS CS800 M1 for the FUJITSU Storage ETERNUS CS800 M1 deduplication appliance
    - VDMS for Veeam Data Mover Service

1. ETERNUS CS800 M1

1.1. ETERNUS CS800 M1 Overview
The ETERNUS CS800 M1 is a deduplication appliance that implements the deduplication/compression function for efficient backups at low cost.

ETERNUS CS800 M1 lineup
The ETERNUS CS800 M1 is available in three models that differ in capacity scalability: the ENTRY model, the SCALE model, and the ENTERPRISE model.
The ENTRY model supports a capacity of 11 TB (2U) to 23 TB (2U) and the SCALE model 11 TB (2U) to 315 TB (10U) to satisfy the customers' system environment requirements.
The ENTERPRISE model is scalable from 51 TB (4U) to 1,020 TB (22U).   The ENTERPRISE X model is scalable from 204 TB (6U) to 2,040 TB (18U) for EMEIA only.

In addition to the VDMS installed directly on CS800 M1 (SCALE and ENTERPRISE models), there is a Hardware dedicated for VEEAM parallel streaming feature, therefore the Ultra configuration for the ENTERPRISE model for EMEIA is offered, which has more RAM and multi-Core CPU. It has a separate order code, but is fully compatible with all extensions and for components CS8000 M1 ENTERPRISE model.

Figure 1-1 ETERNUS CS800 M1 Lineup

Deduplication/compression
The deduplication/compression function of the ETERNUS CS800 M1 compares the variable length block units of newly written data with the data already on the disks and compresses and stores only the unique new data, thereby reducing the amount of stored data by 90% or more.[1]

Easy installation/operation
With its management GUI and integrated wizards, the ETERNUS CS800 M1 can be set up simply by following instructions.
Furthermore, it supports various Windows and Linux OSs and leading backup software, allowing backups in various environments.
Because of its support for Ethernet connectivity, the ETERNUS CS800 M1 is easy to install.

[1]: A reduction rate that can be achieved when a full backup is created weekly and incremental backups are created daily for typical business data.

Disaster recovery

Since data duplication is possible between ETERNUS CS800 M1 systems at different locations, the ETERNUS CS800 M1 lends itself to the construction of a disaster recovery system. Because differential block data is only transferred to a shared folder right after deduplication/compression, inexpensive low-bandwidth WANs can be used. The ETERNUS CS800 M1 supports a 1-to-1 (unidirectional/bidirectional) replication, simultaneous replication to two different locations, and integrated backup of multiple systems to remote locations. Furthermore, data is transferred through secure encrypted communication using the 256-bit AES method.[*2]
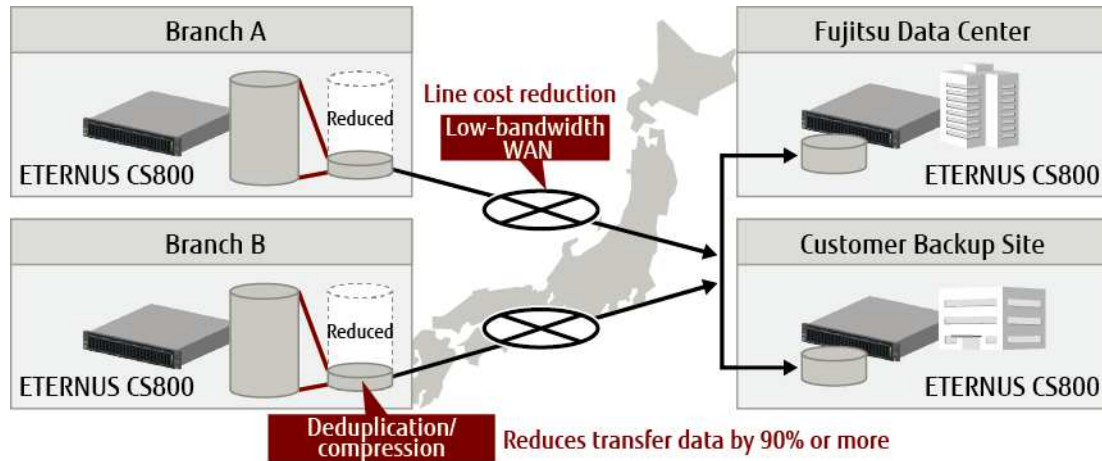
Figure 1-3 ETERNUS CS800 M1 Disaster Recovery

High-speed data transfer

High-speed data communication is realized with 10-gigabit and 25-gigabit[*3] Ethernet. Furthermore, the ETERNUS CS800 M1 supports jumbo frames, which are a larger size than the standard frame size[*4] to allow more data to be transferred at one time.

VDMS support (for Veeam Backup & Replication)

The ETERNUS CS800 M1 supports VDMS, which is linked with Veeam Backup & Replication, to replicate and migrate data efficiently via Veeam communication.[*5]

Support of VDMS by the ETERNUS CS800 M1 simplifies deployment of the ETERNUS CS800 M1 in VMware vSphere and Microsoft Hyper-V virtual environments, and allows space efficient data storage with quick, easy backup and restoration operations (such as incremental file only transfers).

Refer to Section 2.5 for details about the VDMS provided Veeam communication.

Figure 1-4 VDMS Support of ETERNUS CS800 M1

*2: Acronym for Advanced Encryption Standard, a standard encryption method adopted by the National Institute of Standards and Technology (NIST) in the U.S. and recommended by the Japanese government. 256-bit AES encryption is most robust type of AES encryption.
*3: 25-gigabit is supported by the SCALE model and ENTERPRISE model of the ETERNUS CS800 M1.
*4: Data division unit for transferring data over Ethernet. The maximum standard transfer unit is about 1,500 bytes.
*5: Supported by the SCALE model and ENTERPRISE model of the ETERNUS CS800 M1. Required the VEEAM license option.

Linking with various backup software
The ETERNUS CS800 M1 has the ability to link with various data protection software in addition to Veeam products.
For details, refer to the documentations for the ETERNUS CS800 M1.

2. Veeam Backup & Replication

2.1. Veeam Product Lineup

The main product lineup of Veeam is shown below. Veeam Backup & Replication is the flagship product of Veeam Software corporation.

	Veeam Availability Platform
Application	Veeam Backup & Replication (VBR)
	Veeam Agent
	Veeam Backup for Microsoft Office 365
	Veeam Backup for Nutanix AHV
	Veeam Backup for AWS
	Veeam Backup for Microsoft Azure
	Veeam Backup for Google Cloud Platform
	Veeam KASTEN
Tools	Veeam ONE
	Veeam Disaster Recovery Orchestrator
	Veeam Management Pack for Microsoft System Center
Application + Tools	Veeam Availability Suite (VAS)
	Veeam Backup Essentials

Figure 2-1 Veeam Product Lineup

2.2. Features of Veeam Backup & Replication

Veeam Backup & Replication is a data protection software and availability solution. Designed primarily for VMware vSphere and Microsoft Hyper-V[6] virtual environments, it integrates virtual machine backups and replications in a single solution and offers a large array of optional features that support leading applications.
The primary features of Veeam are as follows.

● Agentless backup
To perform backups using VMware VADP (which is a virtual infrastructure snapshot) or VSS of Windows Server, an agent may be required for the target virtual machine, but it is unnecessary for Veeam Backup & Replication.
Agents are available for physical environments such as Windows Server and Linux and can also be used for non-virtual infrastructures.

● Advanced replication
Virtual machines can be replicated either directly or from a backup, and reliable business continuity is ensured with the failover/failback functions.
In addition, a restore is possible from the replication destination virtual machines.

● High affinity with storage
Backups can be made in coordination with the snapshot function of the storage. Furthermore, coordination with deduplication storage is possible.

● Application-aware backups
Online backups while maintaining application data consistency is possible and an item-level restore can also be realized.

● Secondary backups to tape or object storage
Secondary backups to tape or object storage is possible. This is effective for long-term storage and as a malware countermeasure.

*6: Virtual environments supported by Fujitsu.

2.3. Configuration of Veeam Backup & Replication

Veeam Backup & Replication uses VMware and Hyper-V virtual machines as the backup source.
As a backup destination, in addition to the backup repository as the primary destination, off-site external storages and DR sites that store replication data can be used as secondary destinations.
For physical environments, agents for Windows OS and Linux OS are also provided. These agents work together with Veeam Backup & Replication.
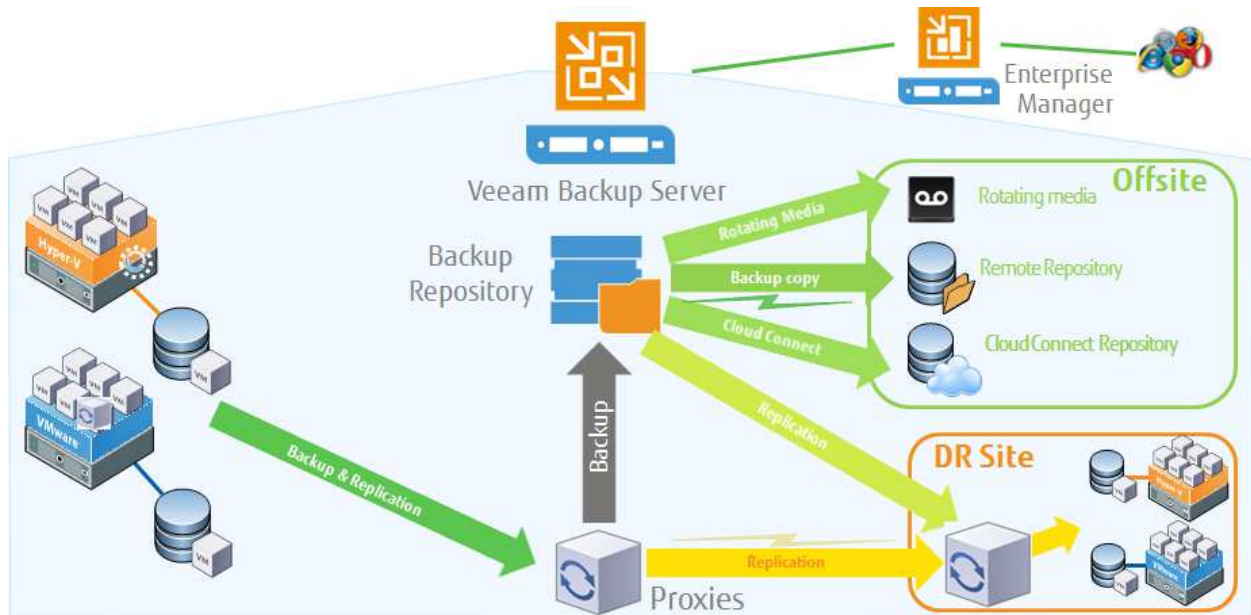

Figure 2-2 Veeam Backup & Replication Configuration

2.4. Basic Components of Veeam Backup & Replication

Veeam Backup & Replication consists of the following three components.
The copy source will hereafter be referred to as "source" and the copy destination as "target".

- **Veeam backup server (single unit)**
  This component, which includes a built-in SQL database for storing the configuration data, manages the various jobs and components. The backup server itself does not have a user interface and operates using the Veeam Backup & Replication console, which is a separate component.
- **Backup proxy (multiple units can be configured)**
  This component is responsible for data transfers during a virtual machine backup and restore. It receives data from the source during a backup and sends it to the backup repository.
- **Backup repository (multiple units can be configured)**
  This component is responsible for storing data received via the backup proxy. During a backup, it receives data from the backup proxy and sends it to the target.
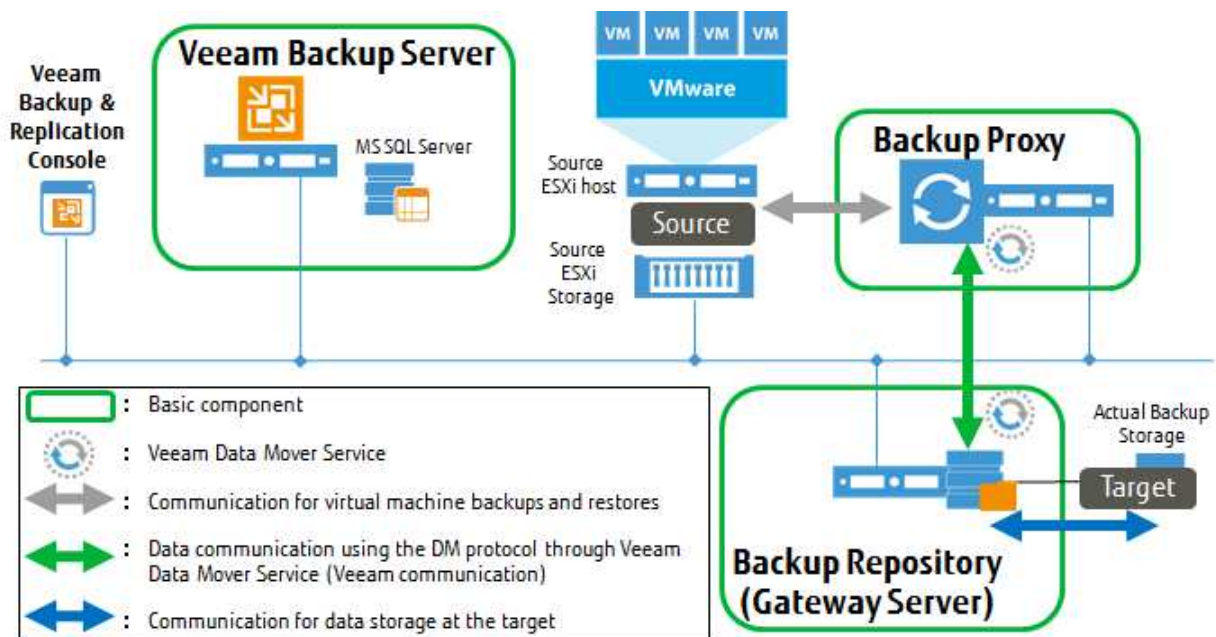
Figure 2-3 Basic Components of Veeam Backup & Replication

2.5. Veeam Data Mover Service and Veeam Communication

The Veeam Data Mover Service is a service that communicates between the backup proxy and the backup repository. Veeam communication uses Veeam's proprietary DM protocol, which is used by the Veeam Data Mover Service. Veeam communication provides efficient data replication and transfers.
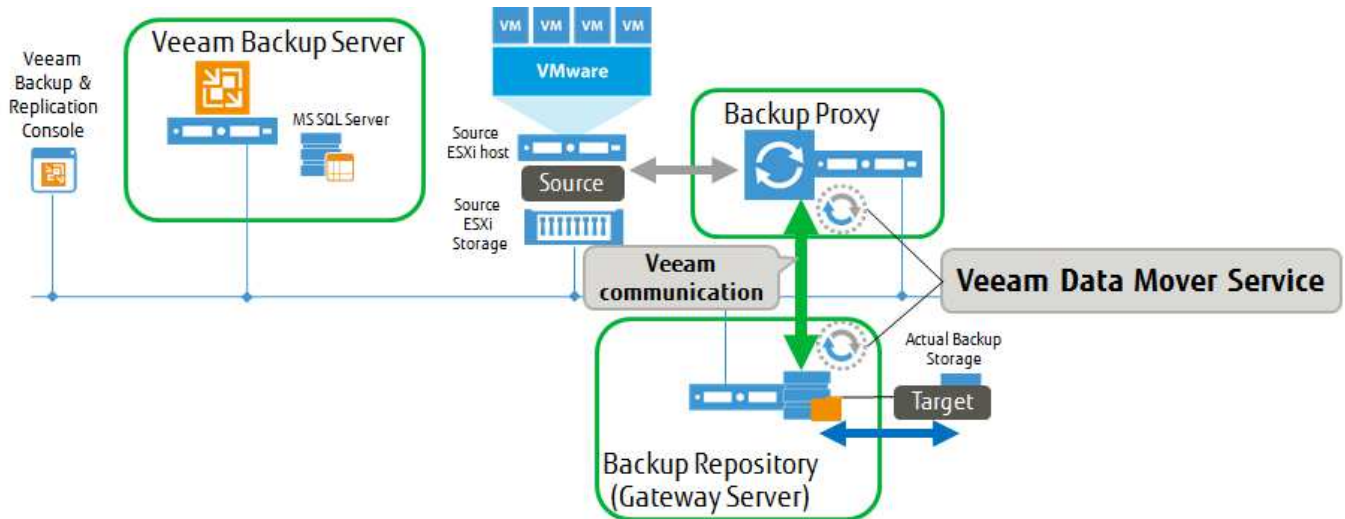Deduplication/compression and encryption can be used via Veeam communication.

Figure 2-4 Veeam Data Mover Service and Veeam Communication

2.6. Deployment of Veeam Backup & Replication Components

Veeam Backup & Replication is installed as an all-in-one solution during the initial installation in which all the components are installed in the same host. Installation of software and drivers in the hypervisor is not required.
Depending on the configuration, it may be necessary to build a separate MS SQL server, or add more backup proxies or backup repositories, but even if additional components are deployed, Veeam's license remains unchanged. Veeam Backup & Replication components can be deployed in physical or virtual Windows Servers to satisfy sizing and driver requirements.
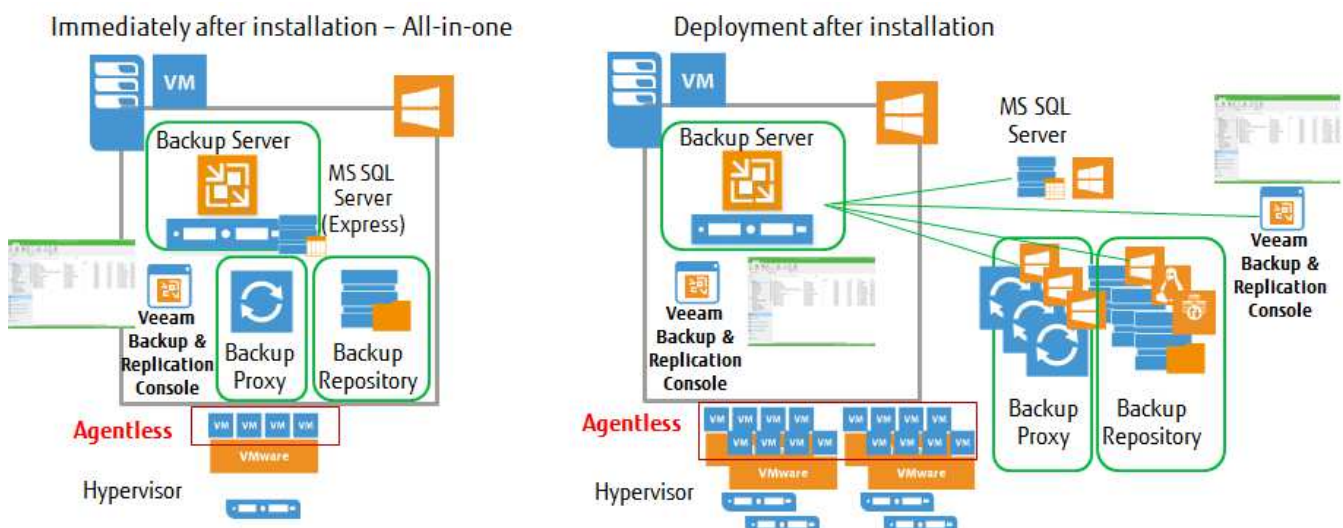

Figure 2-5 Deployment of Veeam Backup & Replication Components

2.7. Veeam Backup & Replication Editions and Licensing Structure

Veeam Backup & Replication has four editions available: Community, Standard, Enterprise, and Enterprise Plus.
Except for Community, which is a limited free edition (up to 10VMs supported), purchase of a license is required to use each edition.

The following are the main types of licenses and can be selected according to the customer's requirements.
There is no limit to the size of data to be protected with these licenses. Therefore, Veeam Backup & Replication can be used without worrying about increased data.

- **Perpetual License**
  Permanent licensing per-CPU (socket). A license is required for each CPU (socket) in the servers where the hypervisors (VMware vSphere, ESXi, Microsoft Hyper-V, etc.) are running. This license allows the use of the product for its entire lifetime.
  This license is suitable for relatively small-scale systems that are used in an internal environment and are not planned for future expansion or reduction.
  Some products and functions cannot be used with this license.

- **Instance License**
  Subscription licensing per-instance. This license is required for virtual machine protection, cloud protection, and physical server/workstation protection, as well as using specific Veeam products.
  The subscription license must be updated to continue using the product because it only allows the use of the product for a specified term.
  This license is suitable for corporate systems that are also using cloud environments and for systems that are planned for future expansion or reduction.

✔ Feature included   — Feature not included

No.	Feature/Edition	Community	Standard	Enterprise	Enterprise Plus
1	Backup and replication (Basic backup and replication)	✔	✔	✔	✔
2	File-level recovery (File/folder level recovery)	✔	✔	✔	✔
3	Deduplication storage linkage	—	—	✔	✔
4	Storage linkage (Backup from storage snapshots)	—	—	—	✔
5	Application linkage (Application-level verification and restore)	—	—	✔	✔
License	License	None (Up to 10VMs)	Perpetual License or Instance License		

Figure 2-6 Veeam Backup & Replication Editions and Licensing Structure

For more details, refer to the Veeam website.

3. Configurations with Storage Products and Veeam Backup & Replication

This section describes a configuration with a basic NAS and Veeam Backup & Replication and a configuration with the ETERNUS CS800 M1 and Veeam Backup & Replication. The ETERNUS CS800 M1 with VDMS is required the VEEAM license option.

3.1. Configuration with Basic NAS and Veeam Backup & Replication

If, for example, NAS is used as the target, Veeam communication is used between the backup proxy and backup repository, and CIFS is used between the backup repository and the target.
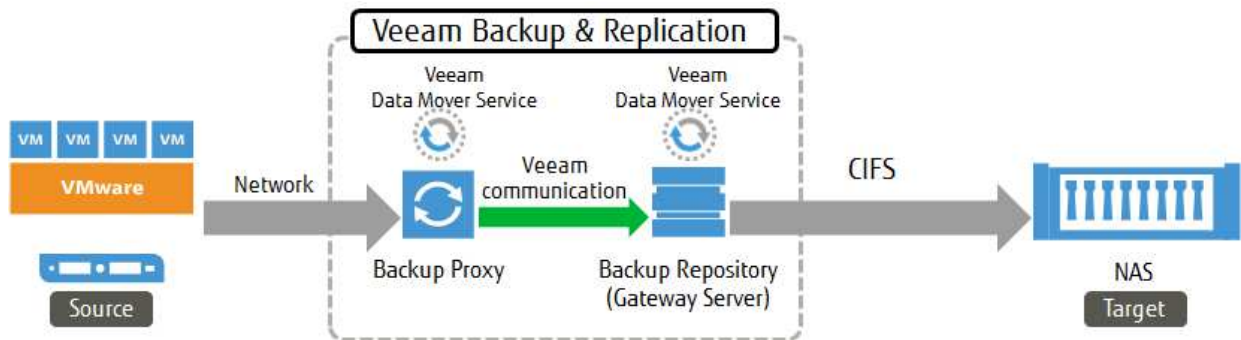

Figure 3-1 Veeam Backup & Replication and General NAS Configuration

3.2. Configuration with ETERNUS CS800 M1 and Veeam Backup & Replication

If the ETERNUS CS800 M1 is used, the VDMS that acts as the backup repository allows direct communication between the backup proxy and the target via Veeam communication. Because CIFS is not required, the amount of transferred data can be reduced.

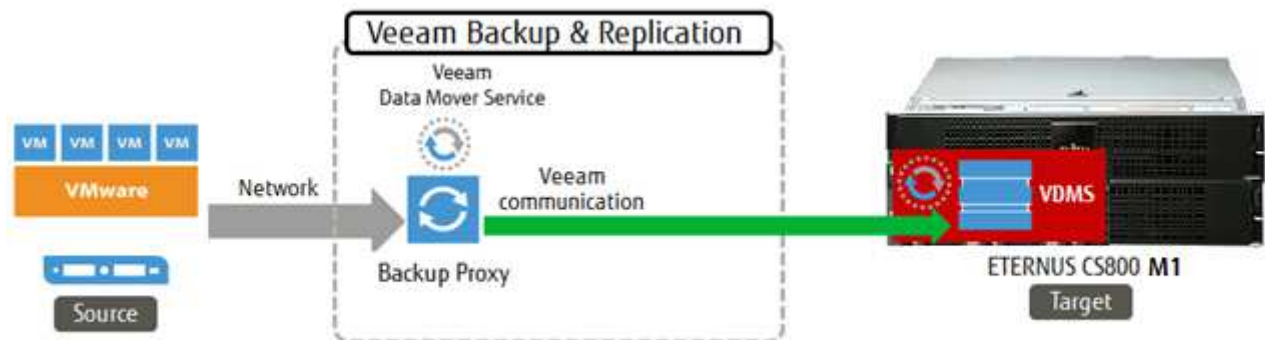**Figure 3-2 ETERNUS CS800 M1 and Veeam Backup & Replication Configuration**

The ETERNUS CS800 M1 provides enhanced network efficiency due to its built-in VDMS in comparison to other deduplication appliances that instead require a Gateway Server.

4. Using Deduplication/Compression
This section explains the deduplication/compression performed by the ETERNUS CS800 M1 and Veeam Backup & Replication.

Deduplication/compression performed by the ETERNUS CS800 M1 is highly effective in reducing the amount of stored data.
Deduplication/compression performed by Veeam Backup & Replication reduces the network load between the backup proxy and the backup repository on a per-backup-job basis. Veeam Backup & Replication can perform deduplication and compression in the backup proxy and perform a decompression in the backup repository.
The most effective deduplication/compression combination is described below.

4.1. ETERNUS CS800 M1 Deduplication/Compression

Because the ETERNUS CS800 M1 performs a deduplication/compression on a per-data-store basis, a high reduction rate of stored data can be expected.
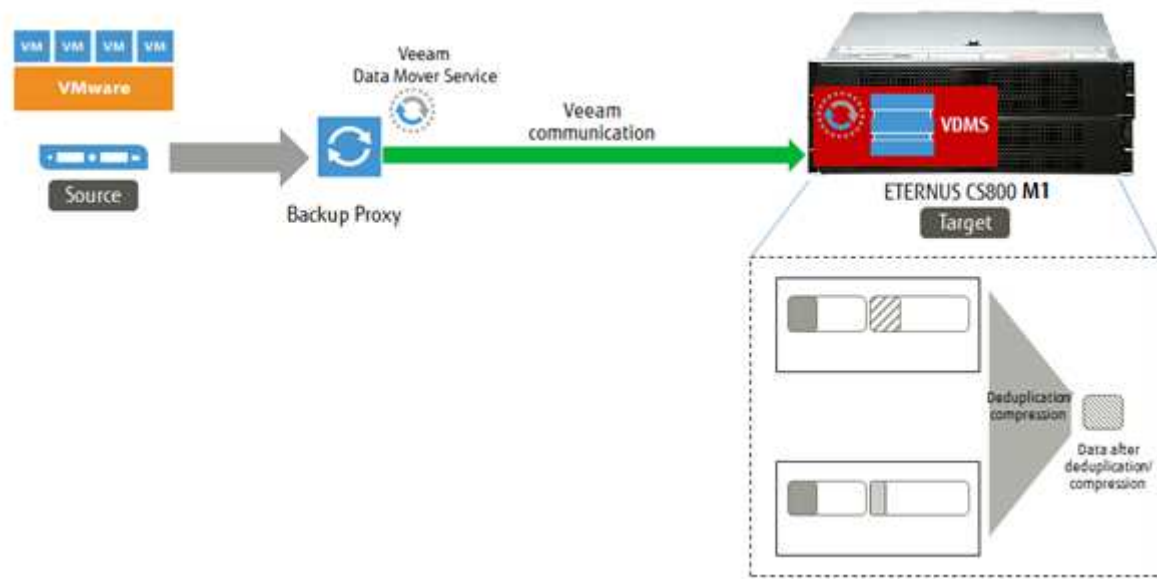

Figure 4-1 Effectiveness of Deduplication/Compression by ETERNUS CS800 M1

4.2. Deduplication in the Backup Proxy using Veeam Backup & Replication
For deduplication in the backup proxy using Veeam Backup & Replication, only differential blocks that do not exist in the previous backup are transferred over the network for each backup job.
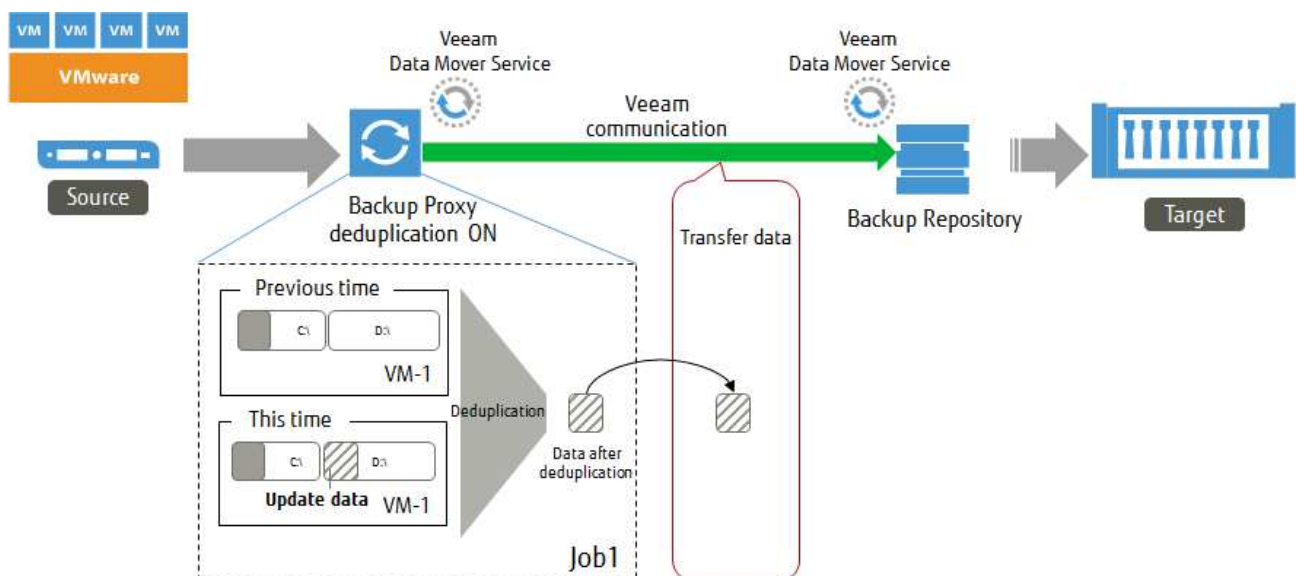

Figure 4-2 Effectiveness of Deduplication in the Backup Proxy

4.3. Compression in the Backup Proxy using Veeam Backup & Replication

Performing compression in the Backup Proxy using Veeam Backup & Replication can be set in stages to allow proper adjustment of the balance between the used storage and the load on the backup proxy, which may affect the performance. Setting a high compression rate increases the load on the backup proxy. To reduce the load, set a lower compression rate.

Compressing the transfer data in the backup proxy reduces the amount of data being transferred during Veeam communication. This is especially effective in reducing the network load when multiple backups are performed using multiple backup proxies.
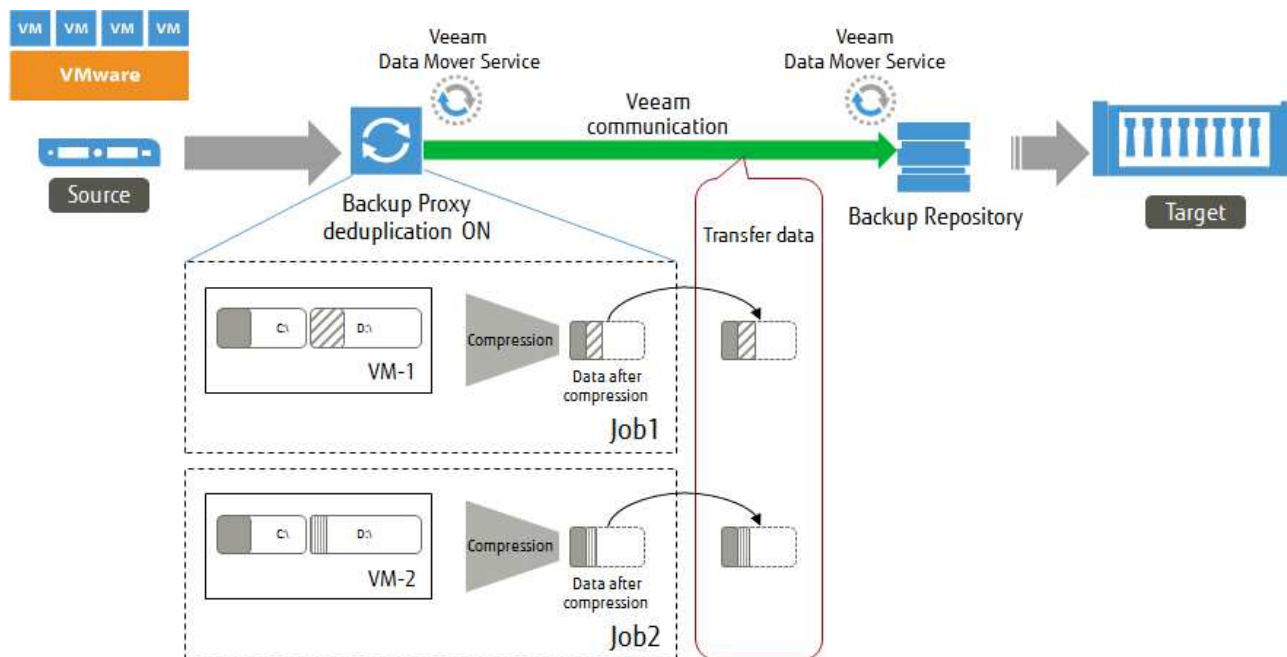

Figure 4-3 Effectiveness of Compression in the Backup Proxy

4.4. Recommended Combination of Deduplication/Compression

The recommended combination of deduplication/compression reduces the network load by performing compression in the backup proxy using Veeam Backup & Replication. After the ETERNUS CS800 M1 performs a decompression, the amount of stored data is reduced using the deduplication/compression function unique to the ETERNUS CS800 M1.
By combining the compression of Veeam Backup & Replication with the deduplication/compression of ETERNUS CS800 M1, the transfer capacity is increased and the storage capacity effectively reduced. In addition, the backup performance is improved and the network load is reduced.
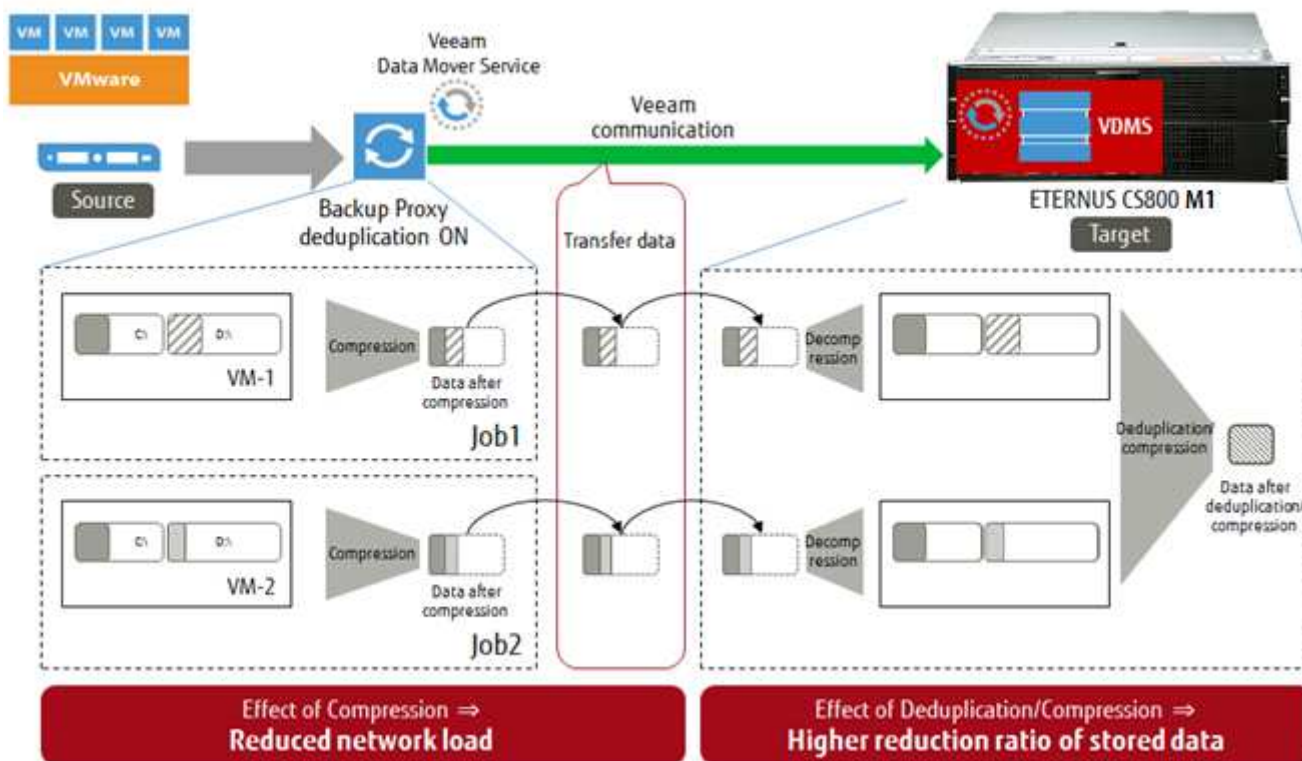

Figure 4-4 Recommended Combination of Deduplication/Compression

The reason for performing decompression within the ETERNUS CS800 M1 is that the deduplication rate is likely to decrease with the compressed data left as is.
Even if the data is the almost the same before the compression, they are entirely different when compressed. If the target is a deduplication appliance such as an ETERNUS CS800 M1, decompression is performed for more efficient data storage.
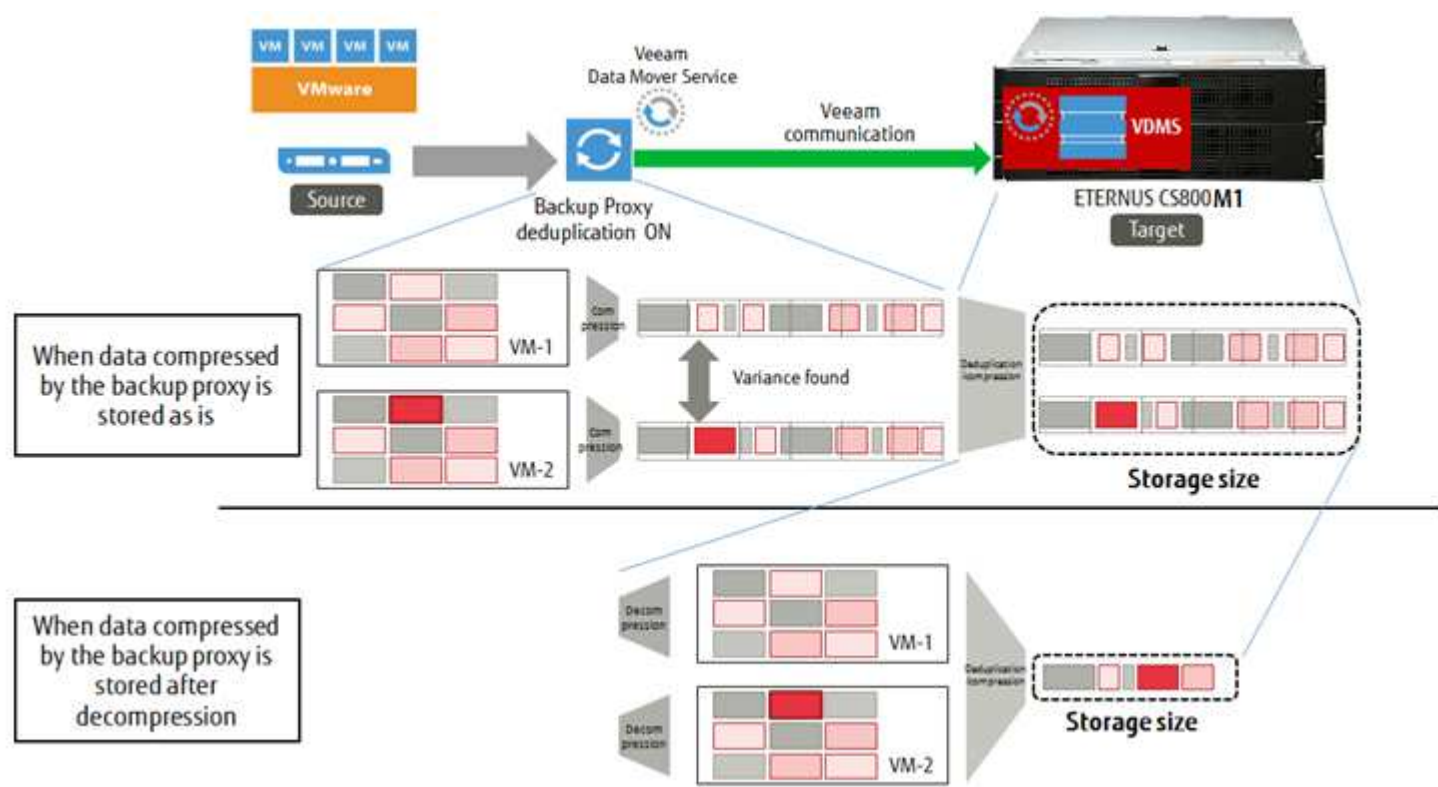

Figure 4-5 Decompression

5. Backups with Veeam Backup & Replication

This section describes backups with Veeam Backup & Replication. Backup methods, created backup files, and backup jobs are also described here.

Veeam Backup & Replication provides three backup methods: active full backup, incremental backup, and synthetic full backup.
Active full backup creates a full backup file online by performing a full data backup from the backup proxy.
Incremental backup saves only the information of changed blocks. This method creates two different file types. The first is an incremental backup file that saves only the differences from the full backup file using the Changed Block Tracking (CBT) feature of the backup proxy and the other is a rollback file that saves data to roll back from the latest full backup file.
Synthetic full backup synthesizes a new full backup file using the existing full backup file and incremental backup files.
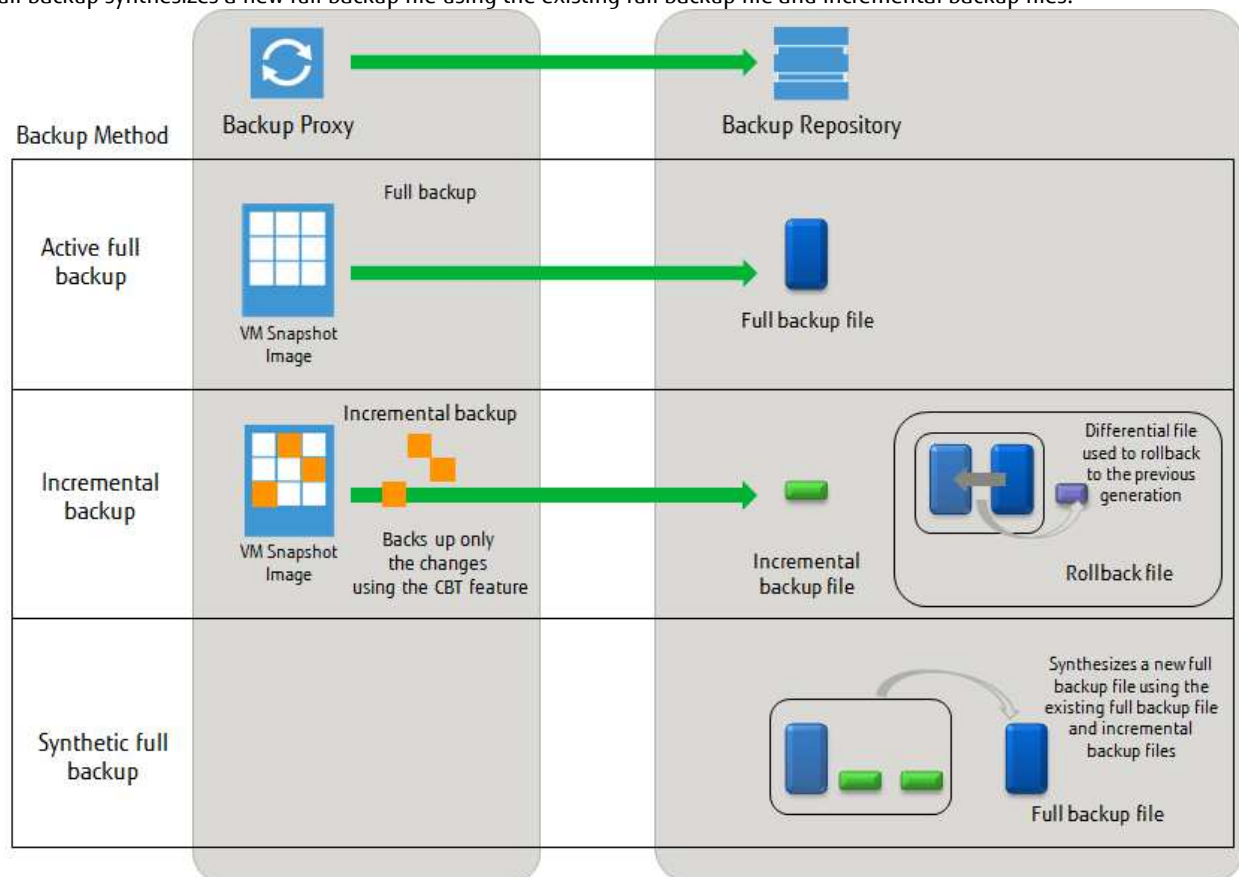

Figure 5-1 Backup Methods and Created Files

Veeam Backup & Replication uses three backup jobs: forward incremental, forever forward incremental, and reverse incremental. Each backup job is a combination of different backup methods to provide a unique backup.

The forward incremental backup job (hereinafter referred to as "forward incremental backup") consists of the active full backup method and the incremental backup method.
The forever forward incremental backup job (hereinafter referred to as "forever forward incremental backup") consists of the incremental backup method that creates incremental backup files and the synthetic full backup method.
The reverse incremental backup job (hereinafter referred to as "reverse incremental backup") consists of the incremental backup method that creates rollback files and the synthetic full backup method.

The sequence of backup data necessary for a data recovery (restore) is called a backup chain.

Table 5-1 below shows the backup jobs and backup method combinations of Veeam Backup & Replication. The mechanism and features of each backup method are described in the subsequent sections.

Backup Job	Backup Method Combination	Reference Destination
Forward incremental	Active full backup + incremental backup (creates a full backup file and incremental backup files)	5.1. Forward Incremental Backup
Forever forward incremental	Incremental backup + synthetic full backup (creates incremental backup files and a full backup file)	5.2. Forever Forward Incremental Backup
Reverse incremental	Incremental backup + synthetic full backup (creates rollback files and a full backup file)	5.3. Reverse Incremental Backup

Table 5-1 Backup Method Combinations and Reference Destinations

5.1. Forward Incremental Backup

Forward incremental backup performs an active full backup and incremental backups. The backup chain is switched to a new one when a full backup file is created.

Figure 5-2 shows an example of a forward incremental backup with 7 generations.

For the first backup chain (days 1 to 7), an active full backup on day 1 and an incremental backup on days 2 to 7 are performed and the created files are saved on the target (copy destination). For the second backup chain (days 8 to 14), a new active full backup is performed on day 8 and an incremental backup is performed on days 9 to 14.

For the third backup chain (days 15 to 21), a new active full backup is performed on day 15 and the files of the first backup chain are deleted. An incremental backup is then performed on days 16 to 21 and the cycle is repeated.

In some cases, the previous backup chain is required. For example, when restoring day 14 with the data of day 7, the full backup file of day 1 and the incremental backup files of days 2 to 7 are required.
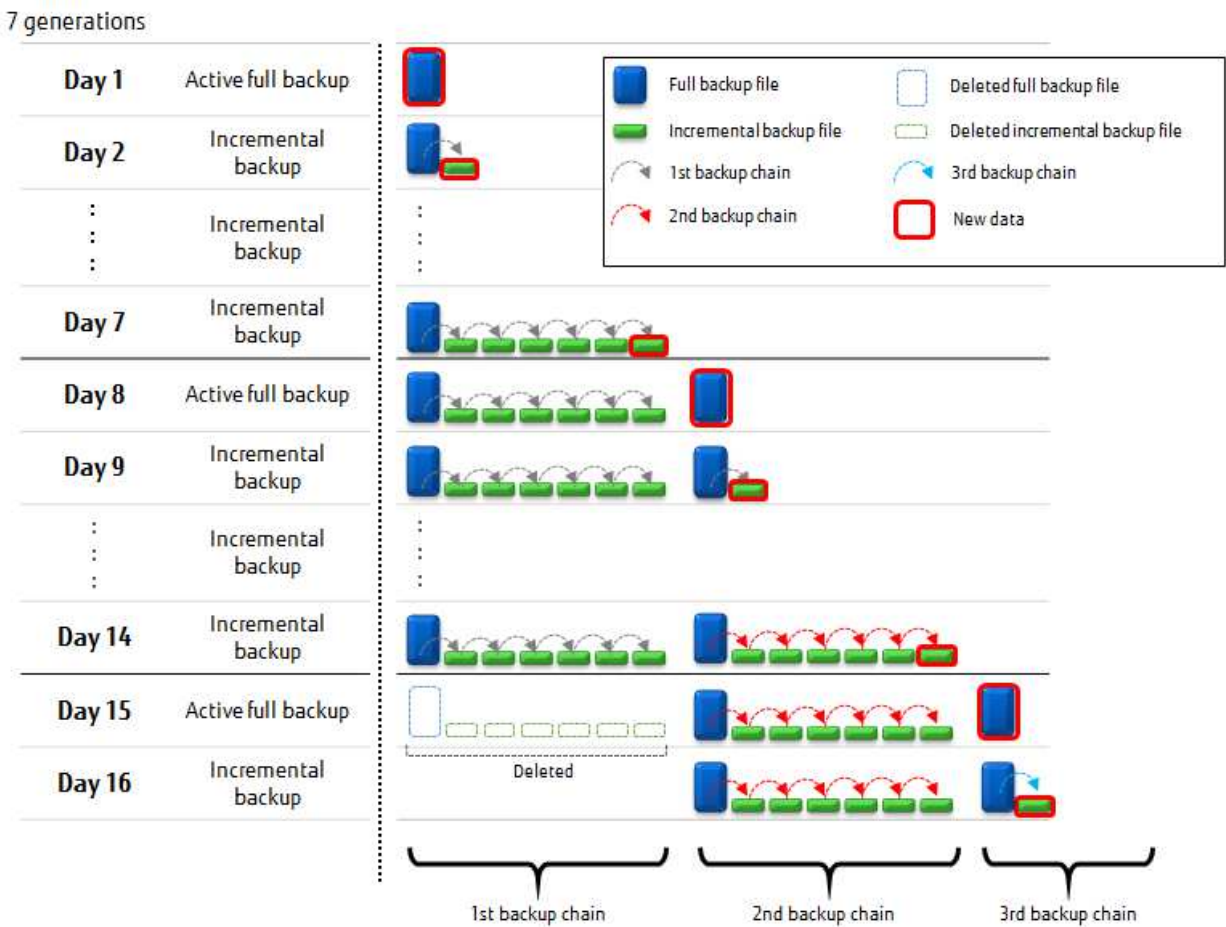

Figure 5-2 Forward Incremental Backup

5.2. Forever Forward Incremental Backup

Forever forward incremental backup reduces the total amount of backup data saved on the target. The full backup file of the oldest generation and the incremental backup files for "the number of generations - 1" are saved on the target.

Figure 5-3 shows an example of a forever forward incremental backup with 7 generations.
For days 1 to 7, the file created with active full backup on day 1 and the incremental backup files of days 2 to 7 are saved on the target.
On day 8, a new incremental backup file is created first, next synthetic full backup creates a full backup file for day 2 using the full backup file of day 1 and the incremental backup file of day 2, finally the full backup file of day 1 is then deleted.
From day 9 onward, the same transaction that occurred on day 8 is repeated. An incremental backup file is created, synthetic full backup creates a full backup file for the day prior to "the number of generations - 1" with the full backup file of the day prior to "the number of generations" and the increment backup file of the day prior to "the number of generations - 1", and then the backup file older than the number of generations day is deleted.

For forever forward incremental backups, the full backup file of the oldest generation and the incremental backup files for "the number of generations - 1" are saved. No new backup chain is created, but the generation is updated when a backup is created.
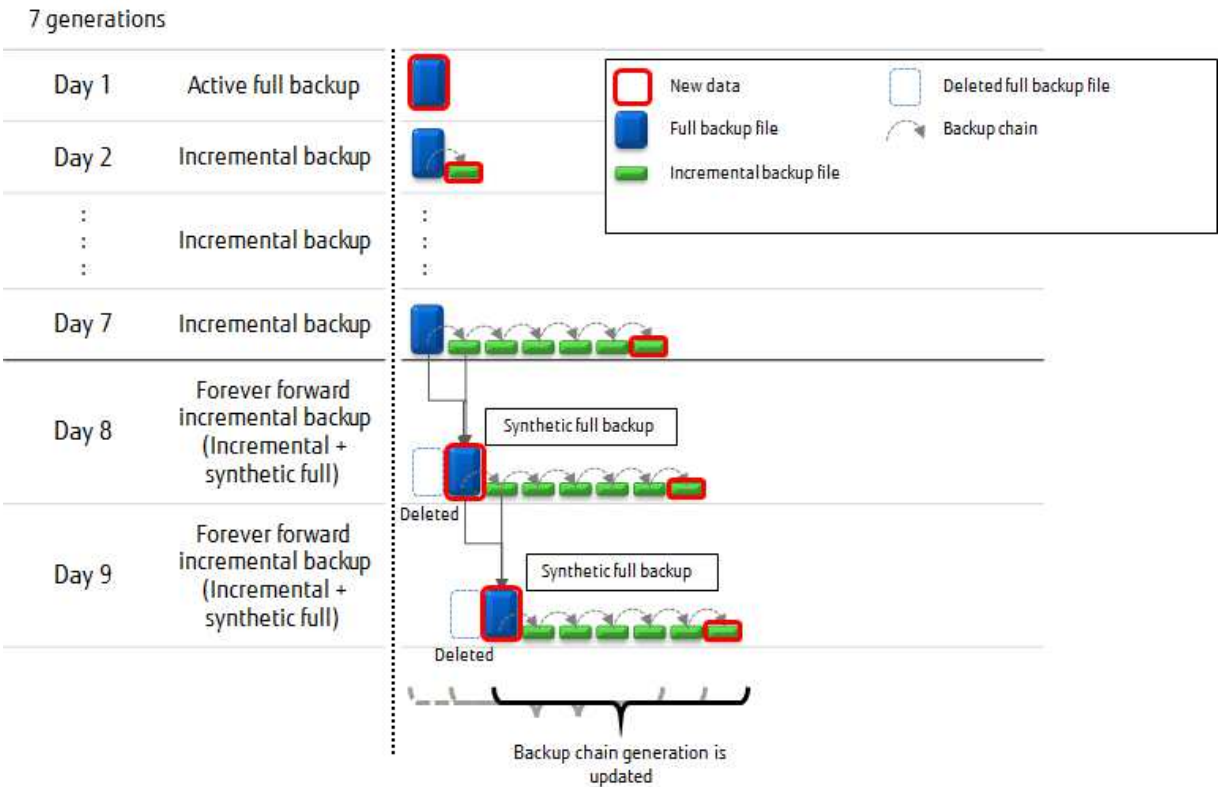

Figure 5-3 Forever Forward Incremental Backup

5.3. Reverse Incremental Backup

Reverse incremental backup, which is similar to forever forward incremental backup, reduces the total amount of backup data saved on the target. A full backup file of the latest generation is always saved to ensure recovery to a generation following the generation whose rollback file is corrupted or to the latest generation in the event that the rollback file is corrupted.
During reverse incremental backup, because synthetic full backup creates a full backup file of the latest generation and then saves the difference from the previous backup to a rollback file, the I/O load is higher and the backup time is longer than the other backup methods.

Figure 5-4 shows an example of a reverse incremental backup with 7 generations.
On day 1, active full backup creates a full backup file. On day 2, an incremental backup file (intermediate file) is created and then synthetic full backup creates a full backup file for day 2 using the created incremental backup file and the full backup file of day 1. Lastly, a rollback file that records the difference from day 1 is created and the intermediate incremental backup file is deleted.
Every time a backup is created up to day 7, synthetic full backup creates a full backup file of the latest day using the incremental backup file of the latest day and the full backup file of the previous day, and then creates a rollback file that records the difference between the previous day.
On day 8, synthetic full backup creates both a full backup file and a rollback file that records the difference between day 7, and then deletes the rollback file of day 1.
From day 9 onward, synthetic full backup creates a full backup file of the latest day and a rollback file of the previous day, and deletes the rollback file of the day prior to "the number of generations" in the same way as day 8.

For reverse incremental backups, the full backup file of the latest generation and the backup files for "the number of generations - 1" are saved. No new backup chain is created, but the generation is updated when a backup is created.
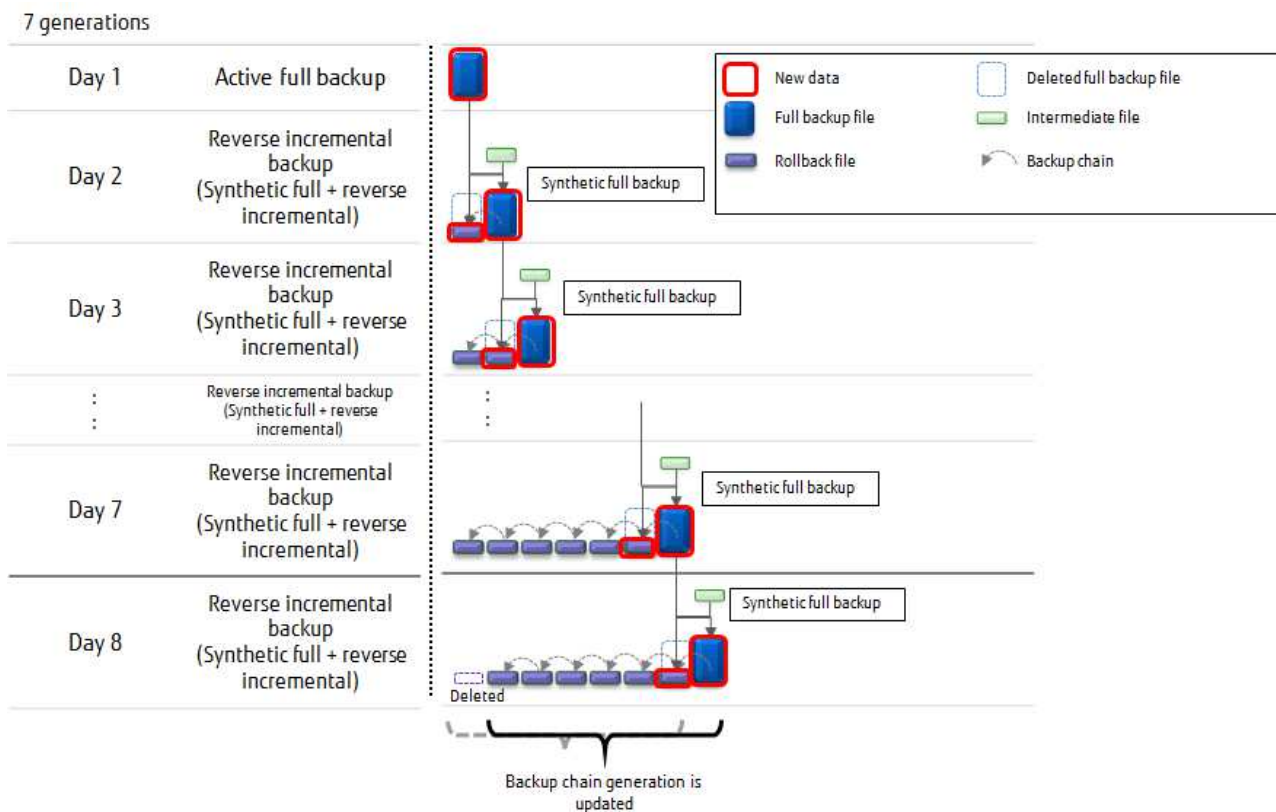

Figure 5-4 Reverse Incremental Backup

6. Instant VM Recovery

Various situations such as a storage destination corruption of the VM, file corruption, and a rollback from operation trouble must be resolved by performing a restore.
This section describes the restore of virtual machines using Instant VM Recovery, which is a feature of Veeam Backup & Replication.

Instant VM Recovery starts the VMs by referencing the backup files saved in the target without waiting for an actual restore. When the VM images are mounted as an NFS datastore by the restore target hypervisor, a backup file can be referenced. Since the vPower NFS Service of the backup server executes a series of actions, VMs can be started by performing simple operations from the Veeam Backup & Replication console ("1. Directly start VMs from backup files" in Figure 6-1).

The actual VM image is restored to the VM storage destination while the VM is online ("2. Online migration" in Figure 6-1). The update data of the VM generated during an online migration is recorded as a redo log and after the VM image is restored, the update data is reflected in the restore destination to update the VM.

Instant VM Recovery minimizes RTO in all types of virtual environments because the VM starts in just a few minutes regardless of the size of the backup file.
However, since I/Os occur over the network, operation of the VM is subject to the constraints of the I/O response. Therefore, Instant VM Recovery is not suitable for restoring VMs that use applications with high I/O load. Instant VM Recovery can be used for tasks with little impact on the I/O performance, simple verification of application operations, verification of disaster countermeasures, and virus quarantining.
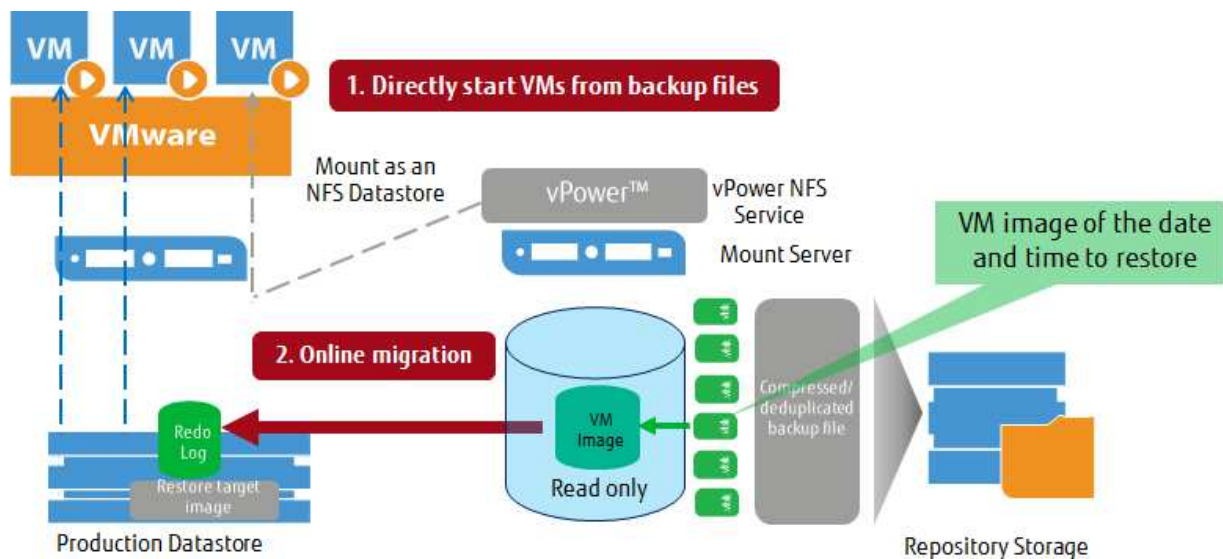The ETERNUS CS800 M1 supports Instant VM Recovery.

Figure 6-1 Instant VM Recovery

7. Conclusion

Combining the ETERNUS CS800 M1 and Veeam Backup & Replication to backup/restore virtual environments provides five major advantages.

1. Backups that do not require agents or clients
With this combination, agents and clients are not required to back up virtual machines and virtual environments.
By introducing the ETERNUS CS800 M1 and Veeam Backup & Replication, it is possible to create complete backups without modifying the virtual machines that are already in operation.

2. Instant recovery of virtual machines
Instant VM Recovery of Veeam Backup & Replication does not require preparation in advance and allows the backed up virtual machines to be ready for the startup process in only 1 minute and 40 seconds. For example, even in an emergency situation, such as when a virtual machine used in business is infected with a virus, timely response is possible using Instant VM Recovery.

3. Backup storage cost reduction
The deduplication and compression functions provided by the ETERNUS CS800 M1 and Veeam Backup & Replication greatly reduce the storage data size. This reduces the cost of storing backup data.

4. Gateway Servers are not required for the ETERNUS CS800 M1
The ETERNUS CS800 M1, which supports VDMS, is a deduplication appliance that does not require Gateway Servers.
However, other deduplication appliances require Gateway Servers to support VDMS.

5. Simple software licenses and options
Veeam Backup & Replication seamlessly integrates with the ETERNUS CS800 M1 to provide a variety of backup and restore functions that are easy to install and operate with the perpetual license or the instance license.

The ETERNUS CS800 M1 easily backs up and restores virtual environments by natively supporting Veeam Backup & Replication. A reduction in the data size using the deduplication/compression function maximizes limited storage capacities, which in turn reduces the costs associated with backup storage.

The ETERNUS CS800 M1 and Veeam Backup & Replication – a winning combination!