

# Technical White Paper

## Fujitsu Storage ETERNUS SF

Flexible Data Management for ETERNUS DX Business-centric Storage.



Content	
Flexible Data Management for Business-centric Storage	3
ETERNUS SF Product Features at a Glance	8
ETERNUS SF Operations	9
Configuration Management	10
Correlation Management	11
Fault Management	12
Performance Management	13
Optimization Management	14
Automated Quality of Service	20
Reporting	22
NAS Management	23
AdvancedCopy	24
AdvancedCopy Function Scenarios	28
Appendix	30
Operational Functions Overview	30
Related documents	30

# Preface

---

## Today's challenges

The ongoing and rapid growth of data volumes demands answers. To minimize the costs and complexity of IT operations, many IT managers try to consolidate their storage systems. But by doing this, the volume of data stored per system literally explodes. Managing the amounts of data while maintaining sufficient performance is challenging and increases storage administration workloads. Soaring costs, resulting from the growing complexity of operations and management of storage infrastructures, can only be prevented with a very flexible and business-centric storage management tool that delivers efficient support for all important operational tasks while supporting business processes in an optimal way.

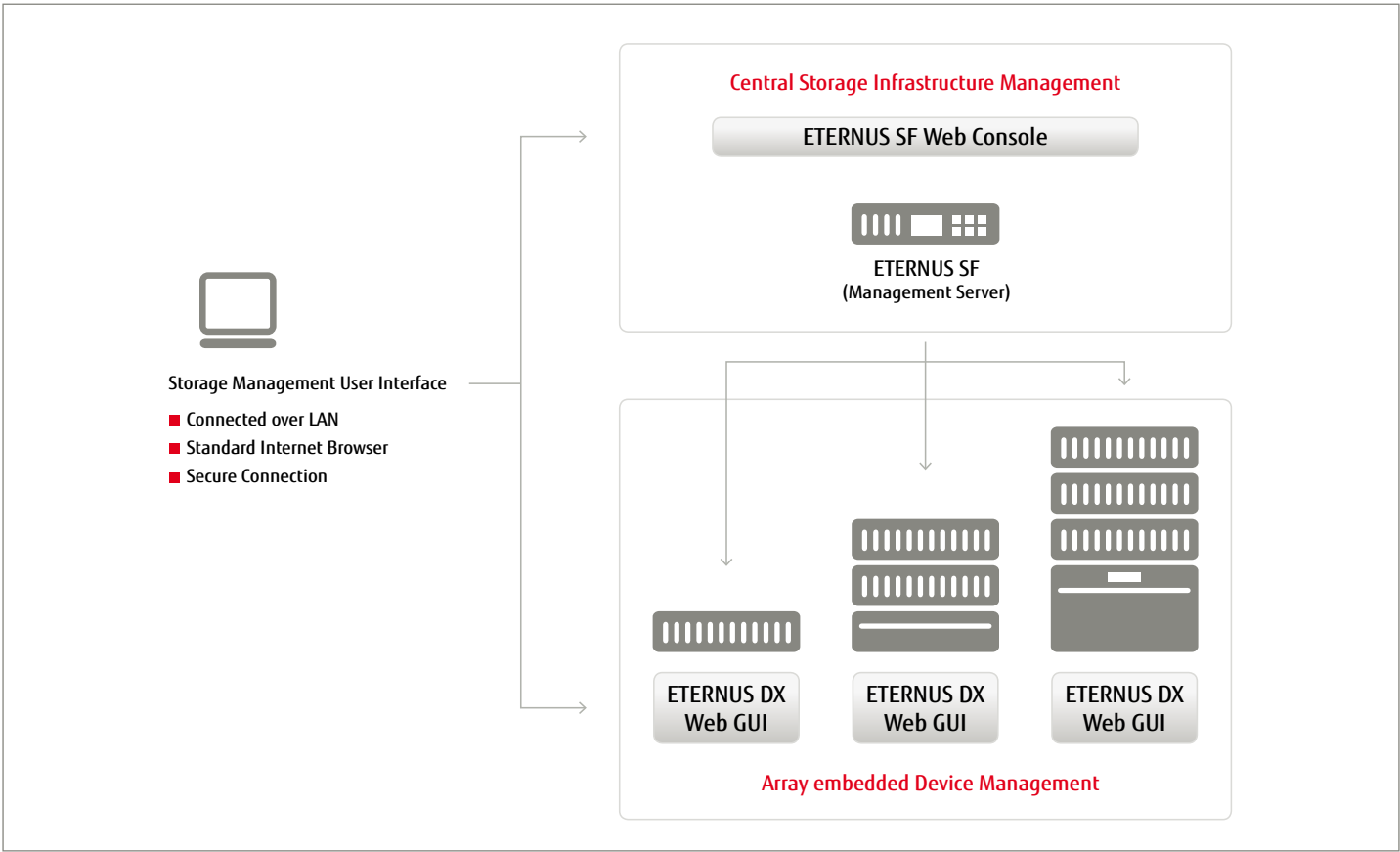
IT managers must constantly find ways to deliver the best storage service levels to meet today's challenges, for example:

- More data per storage system and consolidated big data containers
- Server virtualization with heavy impact of storage
- Different applications with different requirements on storage performance
- Cloud-like infrastructures
- High speed and no interruption for reliable Business Continuity Management
- Disaster resilience, high efficient backup and disaster recovery methods with support for always on IT infrastructures
- Continuous automated balancing and provisioning of storage resources with regards to business priorities.

# Flexible Data Management for Business-centric Storage

The comprehensive Flexible Data Management for ETERNUS DX storage systems is comprised of convenient, consistent and powerful tools with enterprise class functionalities. Innovative advanced functions increase the operational efficiency for implementation and control of different service levels. For initial settings, an integrated ETERNUS DX hardware storage management is provided within each individual ETERNUS DX storage system itself. The additional ETERNUS SF storage management software is used to support overall daily operations within the entire storage infrastructure.

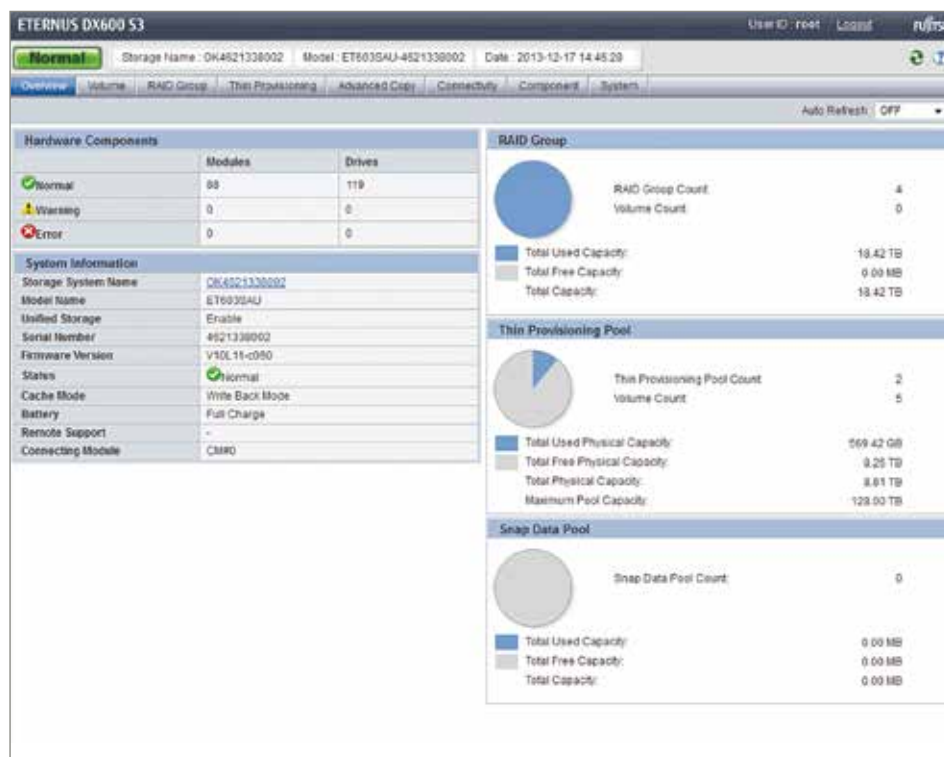
ETERNUS DX embedded management, together with ETERNUS SF, serve as the overarching basis for Fujitsu's highly efficient Flexible Data Management. The aligned unified integration of all commands and data repositories within the ETERNUS DX browser based graphical user interface (Web GUI) and the ETERNUS SF web console offers storage administrators the same usability for all operational workflows throughout the ETERNUS DX series, from entry-level systems up to the high-end models.



## ETERNUS DX Web GUI

The Web GUI improves the intuitive operability for initial settings. It is embedded into the operating system and provided by the controllers of the ETERNUS DX series hardware. The Web GUI can be accessed from a web browser by connecting the PC via LAN connection to the storage system. The overview screen appears immediately after logging into the Web GUI. The status of the disk storage system, the usage of RAID groups, Thin Provisioning Pools, and Snap Data Pools can be checked in this screen. Operation is easy – just choose the “operation object” and “what you want to do” from the server administrator’s view. Further extended operations for a specific individual ETERNUS DX system can be performed via separate tabs for:

- Overview of Configuration Settings
- Volume Management
- RAID Group Management
- Thin Provisioning Pool Management
- Advanced Copy Management
- Connectivity Management
- Component Management
- System Management



The main features of the Web GUI are as follows:

- Display of all relevant parameters, states and settings of the storage system
- Wizard supported initial settings provide instructions for the basic settings that are required to run the ETERNUS DX disk storage system – e.g. creation of RAID Groups, Volumes and Pools
- Failure display which also indicates fault implications on host ports, LUN groups, volumes, or RAID groups, showing the complete picture with regards to the total extent and aftermath of failures.
- Setup of role based user profiles, audit logging and alert routing e.g. call home

For special configurations and management tasks all ETERNUS DX storage systems are also accessible via a Command Line Interface (CLI). This enables quick preparation of customized setup and maintenance operations or individual scripts for execution of repetitive operations.

### ETERNUS SF Web Console

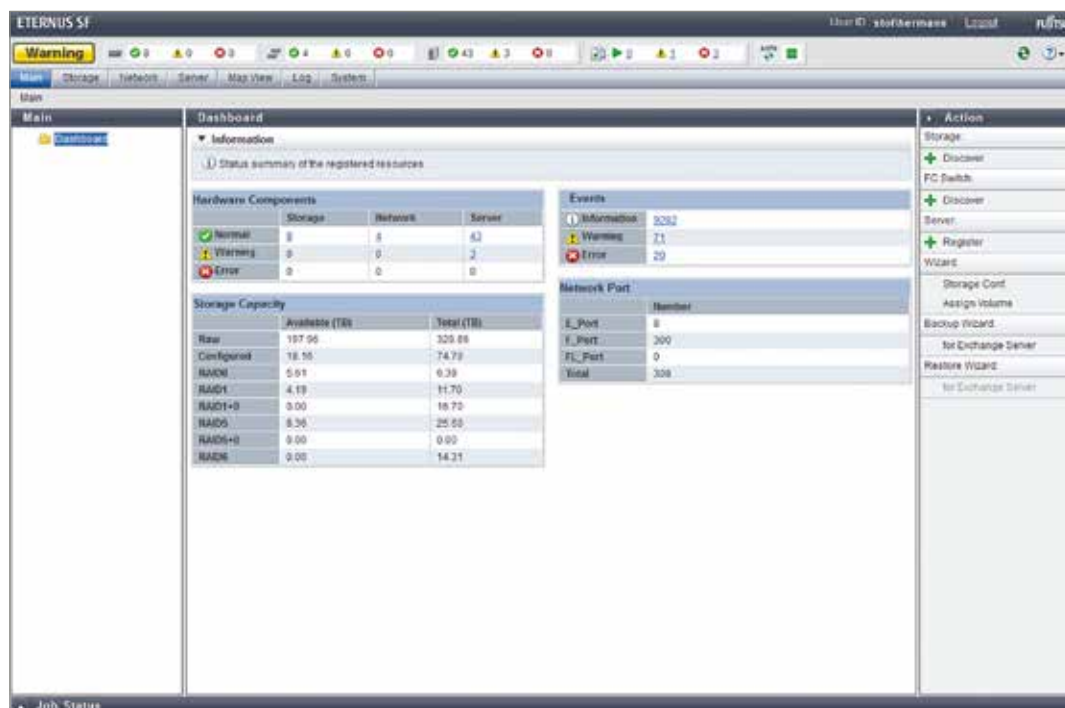
While the ETERNUS DX Web GUI's intended use is for initial setup and complex settings of the single array the ETERNUS SF storage management software is the umbrella solution for daily work.

The uniform management enables stable operation of multi-vendor storage networks, SAN, DAS, and NAS with integrated management of storage-related resources for the entire storage infrastructure:

- All generations of ETERNUS DX disk storage systems from entry up to the high end
- Storage network components
- Hosts
- Virtualized server infrastructures

### The uniform cross-model user interface

The user friendly graphical ETERNUS SF Web Console enables administrators to implement storage environments with ease and without high-level skills. An easy-to-understand resource tree structure displays all relevant status overviews and detailed information on components and events, with an intuitive focus on the objects and tasks relevant to users. The unified cross-model consistent GUI visualizes the status of multiple ETERNUS DX disk storage systems with one single centralized console. Once mastered for a single system, the learning curve for administrators can be extended to the entire storage infrastructure within an enterprise. This results in improved availability, stable operation, and reduced operation management costs. In addition to the cost savings resulting from ergonomic and unified storage management, customers can avoid unnecessary vendor services cost because they are able to execute complex storage management operations themselves, without the expensive high-level skills associated with vendor intervention.



## Easy configuration and operation of storage systems and datacenter infrastructures

A high degree of automation and the easy-to-learn, easy-to-handle graphical user interface make management tasks easier. Storage resource optimization (including implementation of policies for enhancing storage integration and operation, error discovery, health monitoring, capacity management, provisioning, cloning, backup, restore, and disaster recovery) are displayed with a consistent, user friendly look and feel.

The user interface is based on a three-step operational concept: Select the type of action you want to perform from a well-structured menu,

check the status and execute the task. Helpful wizards, system data visualization and automated routine administration tasks reduce the monitoring and management workload. The supplied web-based startup wizard is all what is needed for initial installation. Ongoing changes and system expansion are then supported by equally intuitive wizard-based operations. Administrators no longer need to spend hours poring over unfamiliar setup instructions and technical terminology. Anybody can perform the wizard-based configuration, and operations can be carried out without specialized storage expertise. Both block and file operations are seamlessly managed from the same interface.

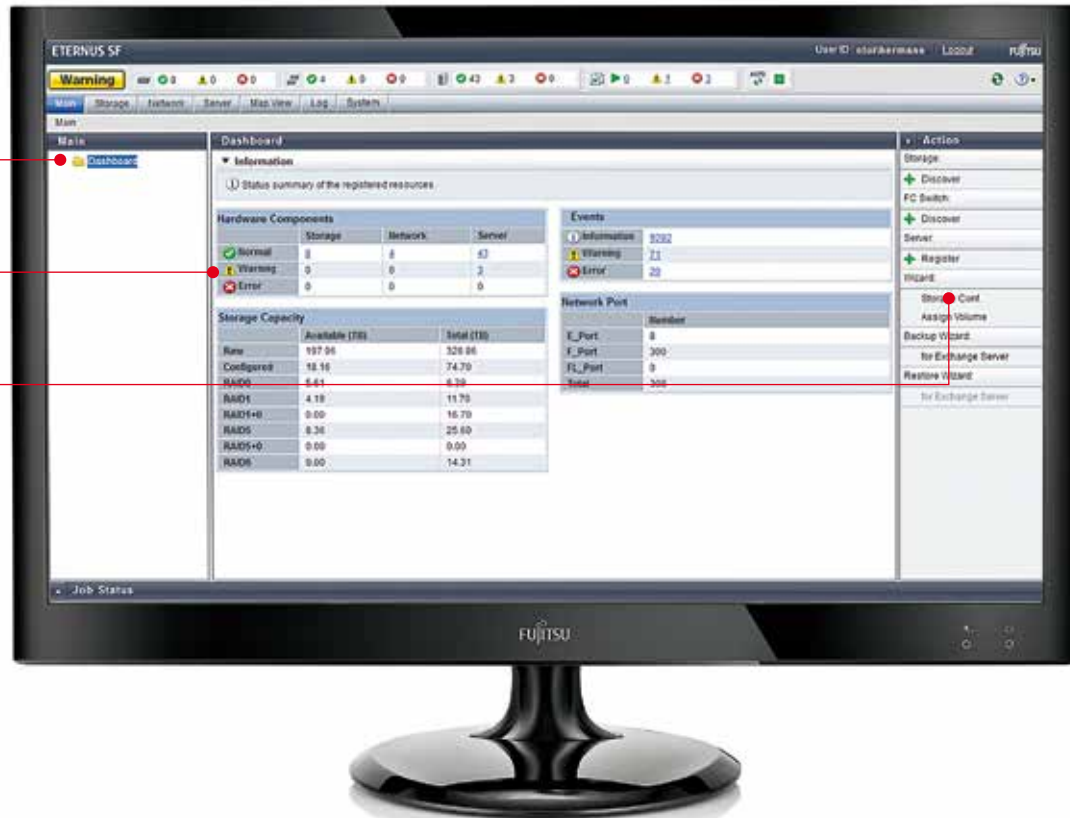
1 Choose from menu



2 Check status



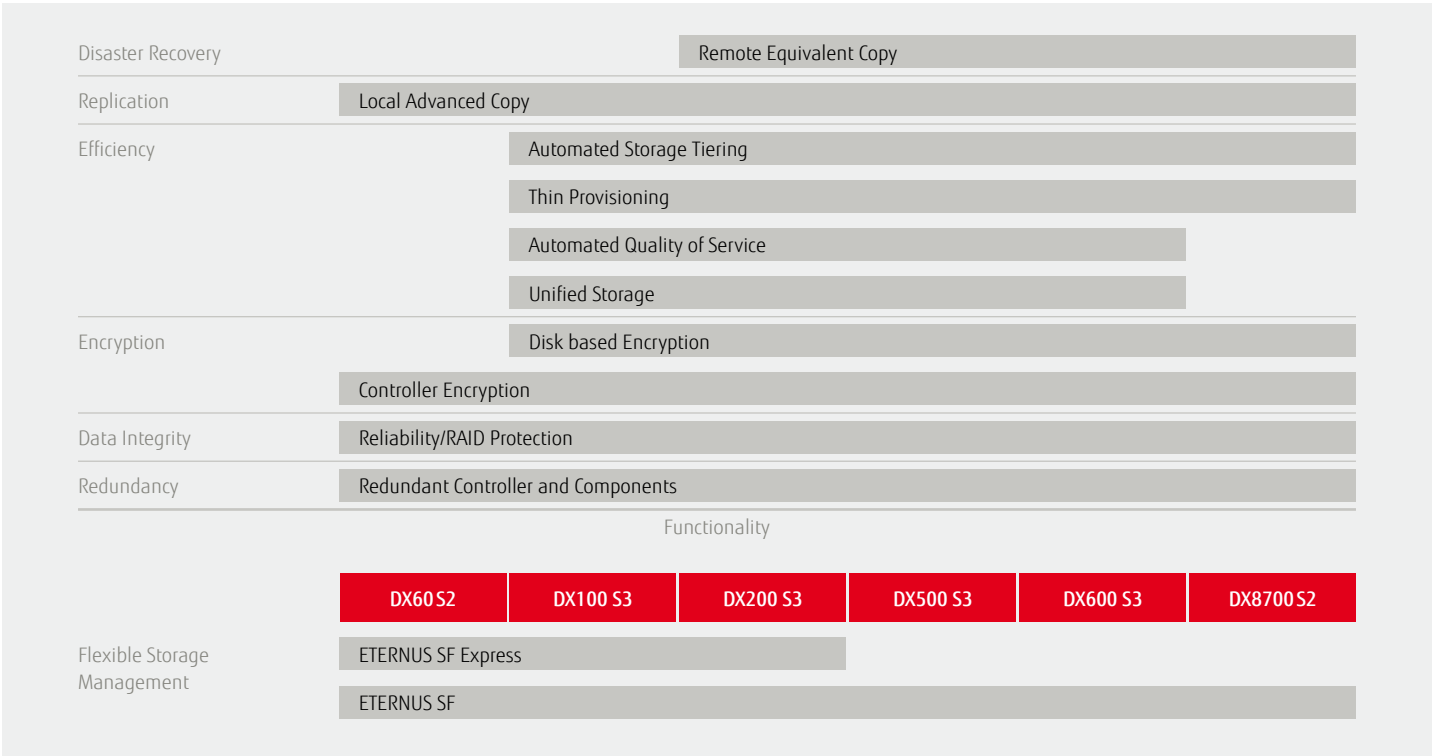
3 Define action



Start easy and grow with your needs

ETERNUS DX entry level disk storage systems are bundled with ETERNUS SF Express, which is adapted for simplified storage system management and maintenance. For users installing storage systems for the first time, ETERNUS SF Express provides an easy to use wizard setup panel. This ensures that all settings including connection of the disk storage systems with all application servers are simple and straightforward.

With an additional license ETERNUS SF Express manages also limited AdvancedCopy functions of the storage system for internal disk-to-disk snapshots and clones. In business continuity scenarios, the management software also supports remote replication between ETERNUS DX entry, midrange and high-end systems even of different ETERNUS DX generations.



Within a single GUI window, ETERNUS SF storage management offers various specific functions that cover different administrative operations. If the ETERNUS DX storage infrastructure grows or customer demands become more complex, upgrading the management software is easy. For example, by simply entering a license key, the upgrade from ETERNUS SF Express to the enterprise-level ETERNUS SF storage management software is smooth and seamless. This helps reduce the workload and protects the IT investment. A flexible and transparent license model guarantees that customers pay only for the functional-

ities they need, and thus can expand in step with rising requirements. The license key protection function for ETERNUS SF is structured according to functional and upgradable modules for each individual customer need. Each module and additional dedicated features can be activated by entering a license key in the ETERNUS SF integrated manager. When adding a license to an existing software installation, the current environment can be used without modification. This framework eliminates the need for separate and isolated tools to manage each class of storage device.

# ETERNUS SF Product Features at a Glance

---

ETERNUS SF is purpose built to manage and control the entire storage infrastructure and was designed solely for the ETERNUS DX family. It maximizes the benefits of the "Business-centric Storage" concept and improves operational efficiency. All essential operations for storage resource management, monitoring, reporting, storage tiering, performance management, resilience and business continuity are integrated.

## Configuration management

Using an easy to understand graphical display of the status of storage infrastructure devices – storage arrays, networking components, and hosts – is visualized. The status of physical connections or logical relationships between these devices can be displayed as well. Both SAN and NAS environments can be configured and monitored based on a unified view.

## Correlation Management

This function manages the configuration within the storage devices (RAID groups, LUNs, Pools, Volumes etc.) It also automatically acquires information about the physical paths from servers, both physical and virtual, down to the disk level. This information is displayed on a single window giving administrators a quick view on all networked relationships helping in fast detection of configuration errors.

## Fault Management

All failures are indicated from any screen of the graphical user interface in an easily understandable way. Just with a few mouse clicks the affected device or component can be examined further on. Interfaces to all major management software suites and remote support tools are implemented as well.

## Performance Management

The performance information of all managed devices can be managed and displayed. Both real-time and historical performance and load information can be accessed and evaluated using easy to understand graphics.

By setting threshold values all critical performance parameters can be monitored, triggering local or remote alarms in case of exceeding. Critical components then can be identified with a few clicks helping to take immediate action

## Optimization Management

Automated tiering is realized by setting policies to automatically place data with the best balance of needed performance and lowest cost to the right media at the right time.

Thin provisioning pools are supported by graphical visualization of available and used capacity and threshold management of the virtual pools.

Power saving management incorporates the control of eco-mode that powers down disks during periods of inactivity e.g. when used for back-up. In addition it visualizes and provides long term statistics regarding the power consumption of the systems.

## Reporting

The reporting feature collects information regarding such as used capacity and usage time and generates customizable reports that can be further processed easily by 3rd party statistical or billing applications.

## Quality of Service Management

Quality of Service (QoS) enables the consolidation of multiple tiers of applications in a single storage system. Basic improvements can be achieved by utilizing the array based ETERNUS DX QoS feature for setting I/O performance limits. The ETERNUS SF QoS automation feature enhances and automates this process by automatically maintaining, controlling and balancing the response times of the application specific volumes.

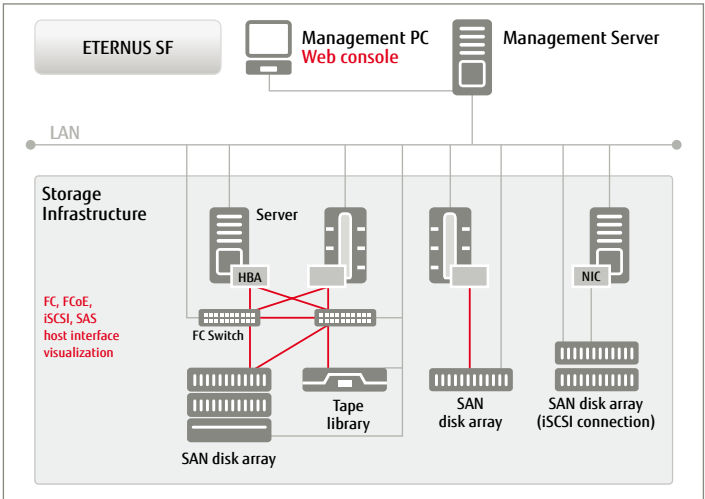
## Advanced Copy Management

Controls and manages high speed back-up and local replication such as clones and snapshots and enables the setup of remote replication between multiple arrays at multiple locations.

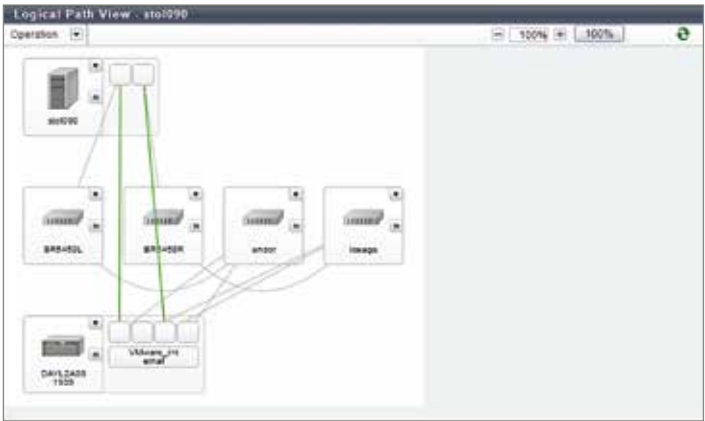


# ETERNUS SF Operations

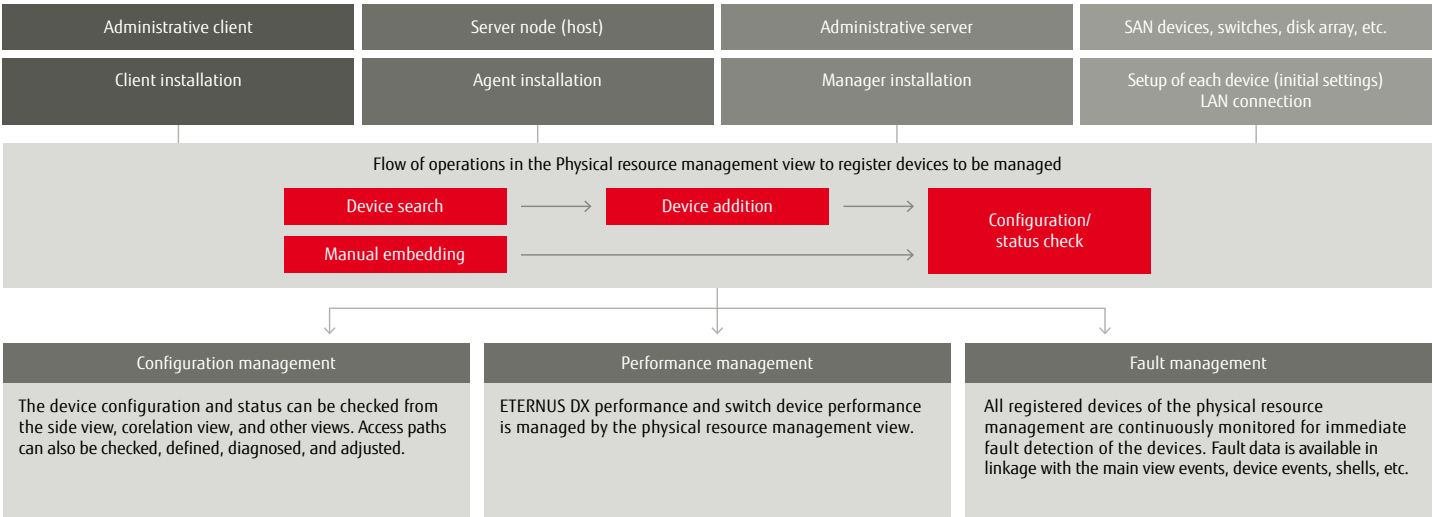
ETERNUS SF supports stable system operation and provides all essential storage system lifecycle functions, such as improving end-to-end administrative efficiency for the setup, operation and monitoring of complex storage network infrastructures, including the installed servers, tape libraries, Fibre Channel switches and virtualized server environments.



The user friendly web console simplifies the setup of ETERNUS DX disk storage systems and the management of the environments. ETERNUS SF displays the relationships and linkages between disk drives and other resources, such as application server file systems, connection paths, mirrored disks and databases. This provides administrators with an accurate understanding of all resource relationships. It also allows them to more accurately proceed with storage expansions, resolve failures and recover operational status without problems. The ability to manage complex storage configurations and settings enables customers to implement storage environments with ease and without the need for high-level skills.



Whether installing a new storage system or using this software for an existing storage system, setting up the environment and operations follows the same procedure illustrated in the figure shown below. Software can be installed and set up on individual devices in any sequence.



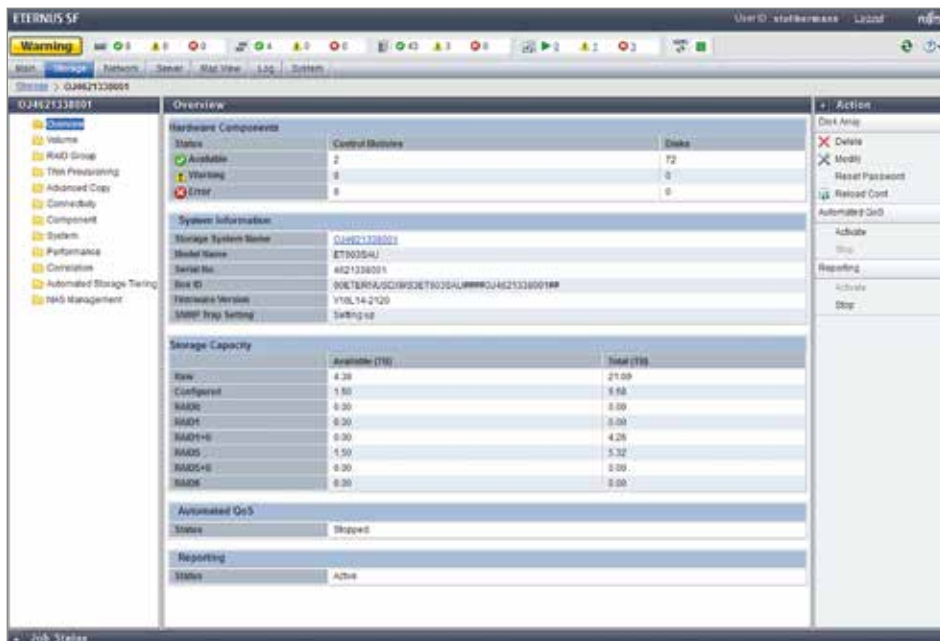
# ETERNUS SF Operations Configuration Management

The main task of ETERNUS SF is the consolidated management of multiple storage arrays and their relationship with servers and network components in a data center.

## Storage management

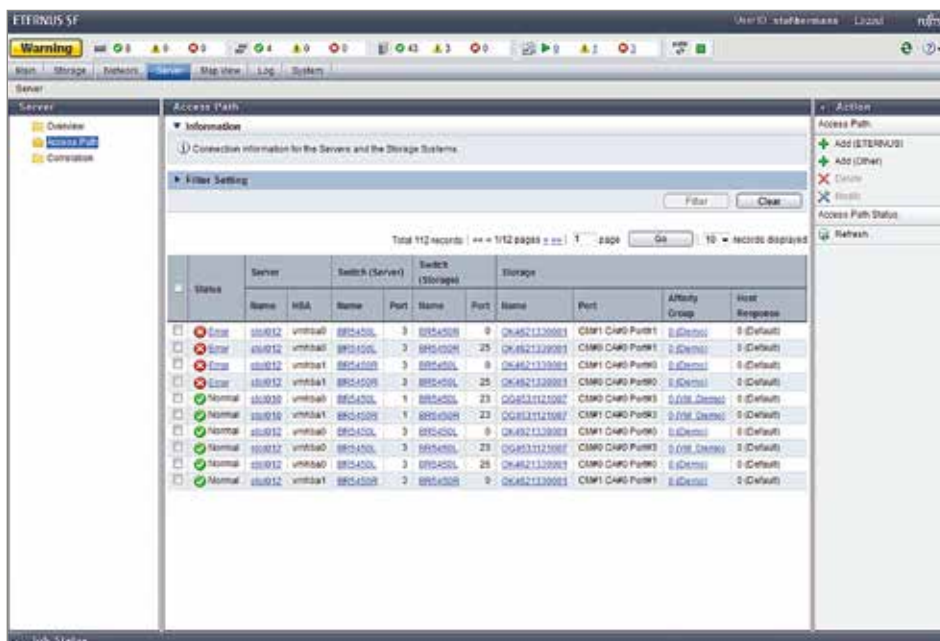
All major tasks which can be administrated by the array immanent Web GUI can also be executed via ETERNUS SF- setup for volumes, raid groups thin provisioning pools replication like snapshots etc.

In addition it is mandatory to use ETERNUS SF for all tasks with regards to automated storage tiering and the setup of NAS shares and NAS interface settings. It offers also a single pane-of-glass view on all monitored ETERNUS DX arrays.



## Connection status management

The web console displays the connection and device status in the Storage Area Network (SAN). This includes all physical connections for each storage device, and for each device connection to network components and servers, including VM guests.



# ETERNUS SF Operations

## Correlation Management

### Access path management

The access path management of ETERNUS SF supports easy setup, consistency verification and failure prevention. An access path (logical path) definition feature ensures easy and secure access path configurations.

Based on the connectivity/zoning information that has already been set in a device, an access path can be recognized automatically. In addition, devices can be registered manually if automatic detection is not possible. When devices are registered, their device information and the entire connection relationships between server nodes, Fibre Channel switches and disk storage systems are displayed. The intuitive overview helps prevent misuse and incorrect settings during SAN installation and operation.

For managed access paths, the configuration definition of a device can be changed automatically as well as manually. Consistency checks verify the accuracy of the manual configuration changes. ETERNUS SF automatically notifies the administrator of any problems, such as incorrect security definitions, or access path anomalies caused by faults or unplugged cables. If the physical Fibre Channel cable or a complete SAN route is disconnected, the access path is displayed as an error. This enables pre-failure detection and service level improvements.

From both the storage and the server aspects ETERNUS SF offers a comprehensive, table based view on end-to-end correlations of storage, network components and servers including end-to-end-view for virtual machines in both VMware and Hyper-V environments

Status		Server		Storage	Interface	HBA WWN	HBA LUN	Switch (Connected to Server)	Switch to S
		Name	Type	Mount Point	Driver Device			Name	Port
Unknown	Unknown	ECLSFV001	Stand-alone	-	-	FC	10000000C872280E	Brocade_3100	0
Unknown	Unknown	ECLSFV002	Stand-alone	-	-	FC	10000000C872280E	Brocade_3100	0
Unknown	Unknown	ECLSFV003	Stand-alone	-	-	FC	10000000C872280E	Brocade_3100	0
Unknown	Unknown	ECLSFV004	Stand-alone	-	-	FC	10000000C872280E	Brocade_3100	0
Unknown	Unknown	ECLSFV005	Stand-alone	-	-	FC	10000000C87224A2	Brocade_3100	1
Unknown	Unknown	ECLSFV006	Stand-alone	-	-	FC	10000000C87224A2	Brocade_3100	1
Unknown	Unknown	ECLSFV007	Stand-alone	-	-	FC	10000000C87224A2	Brocade_3100	1
Unknown	Unknown	ECLSFV008	Stand-alone	-	-	FC	10000000C87224A2	Brocade_3100	1
Warning	Warning	adbcv100	Stand-alone	U	Class	FC	10000000C87224A2	Brocade_3100	1

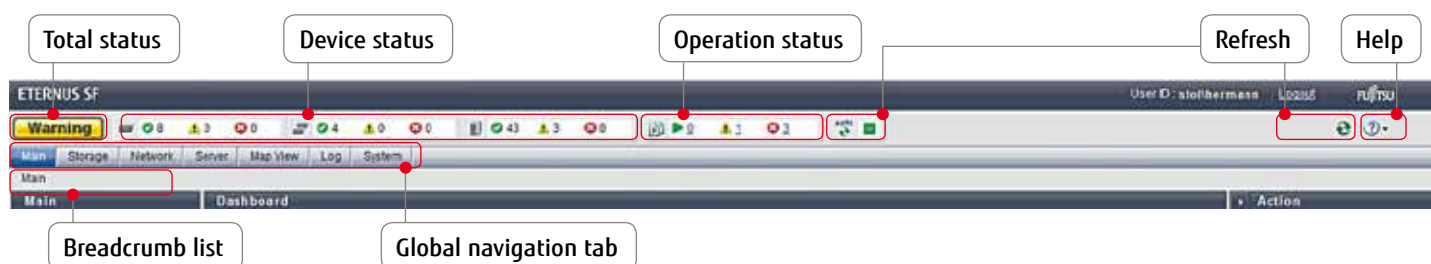
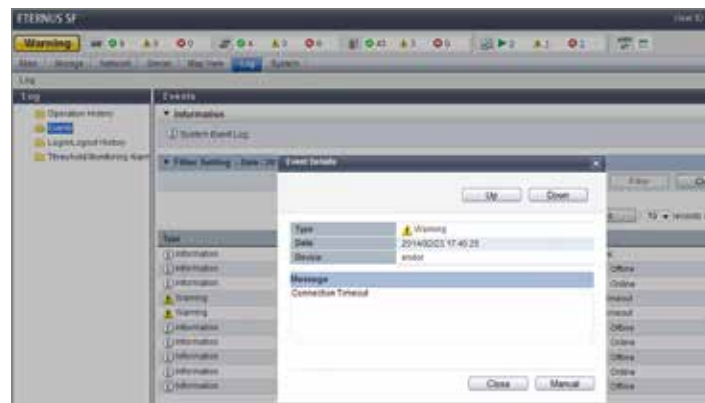
ETERNUS SF – table based view on end-to-end correlations

# ETERNUS SF Operations

## Fault Management

The system monitoring and fault management of ETERNUS SF, with permanent monitoring for detecting early signs of malfunction, enable immediate corrective actions when a fault is detected. A troubleshooting assistant provides explanations of corrective actions. As fault monitoring is performed via LAN, monitoring for non LAN connected devices is not possible.

The icon color of a device changes depending on the current status of the device. If a problem occurs, the device status changes the display corresponding to its status. Failure event notification happens in the event of failure, by decoding and transforming the content to a more readable form. It also can be forwarded via e-mail.



Depending on the capabilities of the devices the fault management function itself can be executed in three different ways:

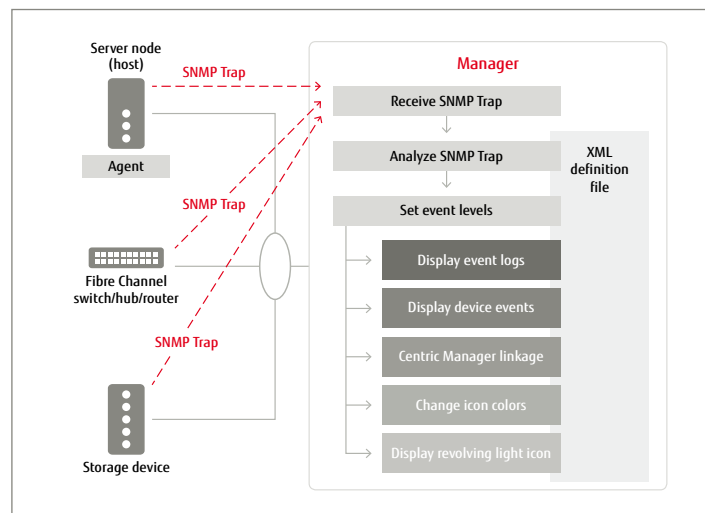
### Asynchronous fault event monitoring by using event notification traps from devices

The asynchronous fault event monitoring processes SNMP traps, decodes them, and displays them as an asynchronous event. The manager thus supports smooth operations because the displayed contents of the event are more detailed and easier to understand than decodes generated by a normal SNMP MIB compiler.

The customized content and the display format (show, hide) for events can be adapted in detail. Therefore, operation can be flexibly customized for specific operational environment requirements. Integration with various other management software products is also possible.

### Fault monitoring by polling devices

Fault monitoring using the device polling function regularly monitors the status of all devices connected via LAN by using SNMP, ping or unique protocol and can be customized using definition files. Fault monitoring can also be executed by checking the current status of devices through manual operations. The icon color of a device changes depending on the current status of the device. If a problem occurs, the device status changes the display corresponding to its status. Failure



event notification happens in the event of failure, by decoding and transforming the content to a more readable form. It also can be forwarded via e-mail.

### Fault monitoring by checking the current status of devices

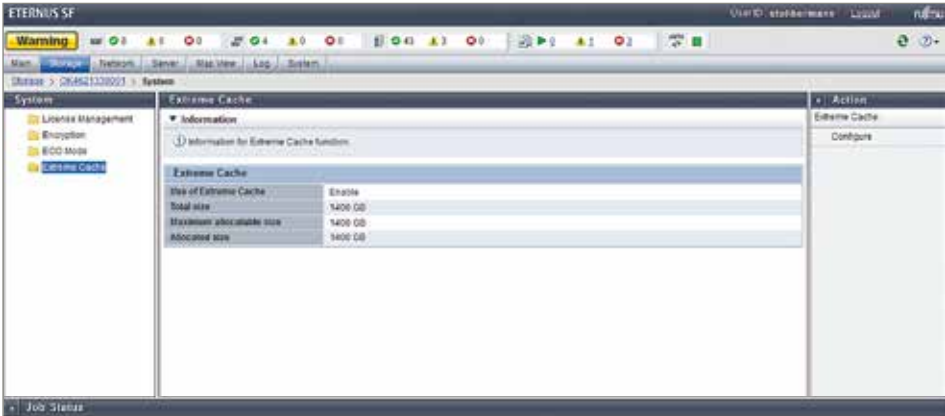
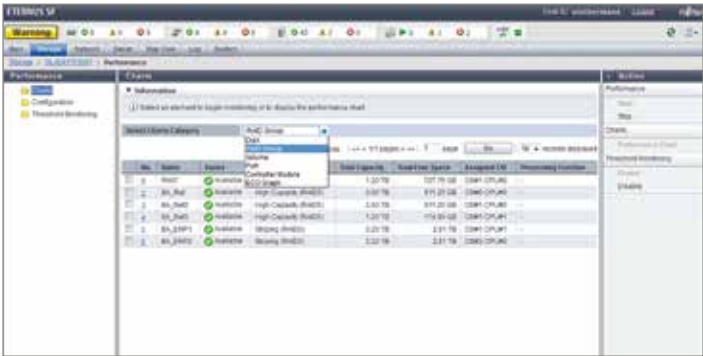
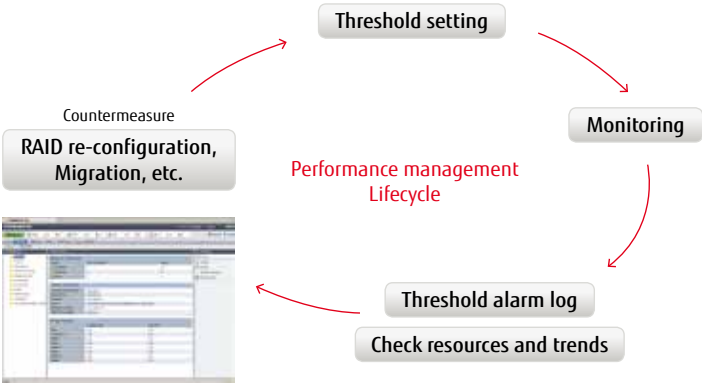
Fault monitoring can also be executed by checking the current status of devices through manual operations.

# ETERNUS SF Operations Performance Management

## Performance monitoring and reporting

ETERNUS SF monitors the performance of ETERNUS DX storage devices and the managed Fibre Channel switches to get the information relevant for configuring a performance optimized environment. Performance information is obtained from the devices based on SNMP and stored on the management server. This information can be referenced for current and recorded information. Customizable, comprehensive graphics help administrators to identify resource bottlenecks and resolve performance issues at an early stage. Flexible settings (like excluding backup volumes from monitoring, etc.) and thresholds related to volume utilization provide further details for practical operation. These threshold settings also enable ETERNUS SF to sound an alarm when set limits are met.

The performance information store on the management server also can be used to generate periodic and historical reporting.



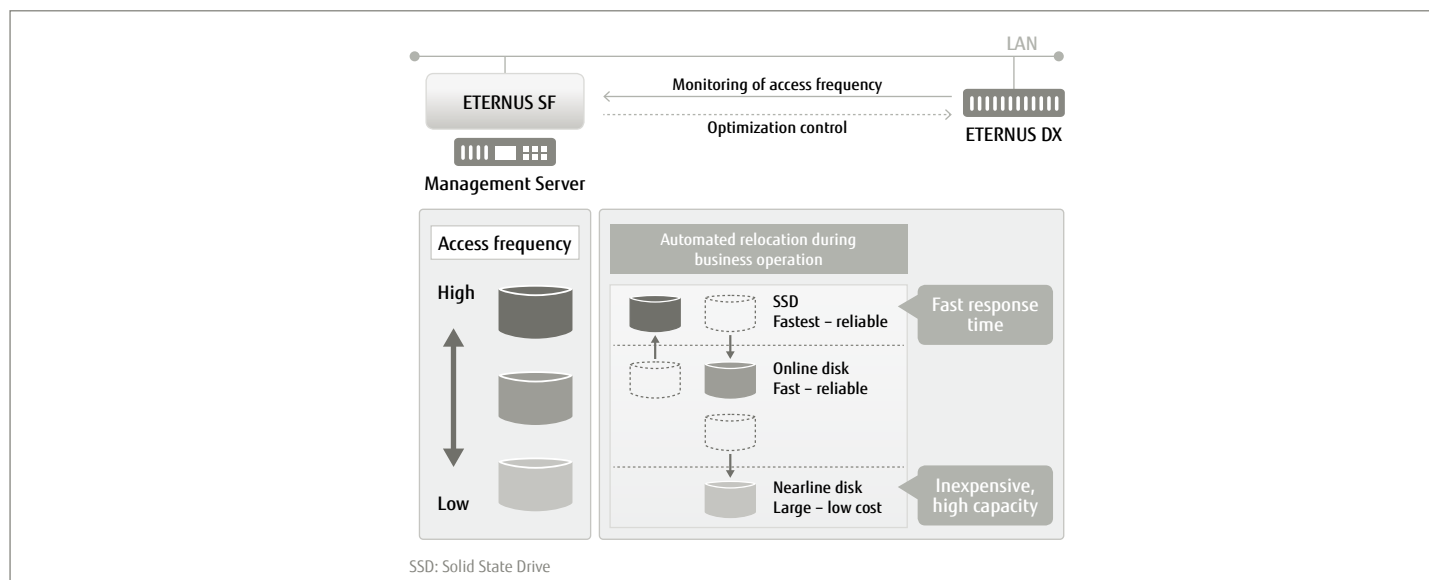
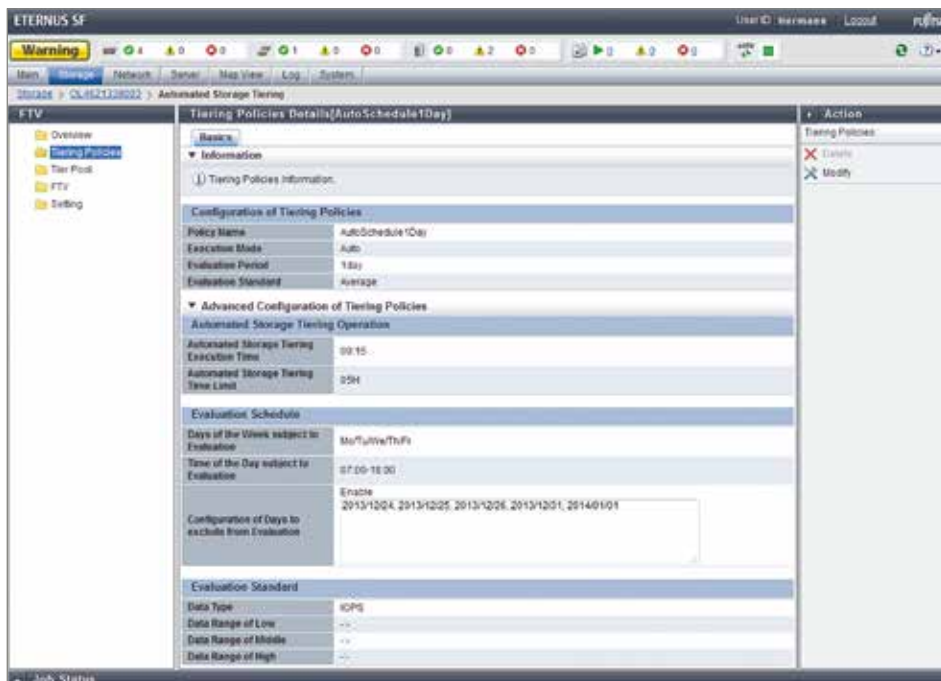
**Extreme Cache operations**

With the ETERNUS DX S3 series an additional storage tier, called Extreme Cache was implemented in the mid-sized storage arrays. It consists of flash memory located directly in the controller modules offering low latency access to cache data. With ETERNUS SF with just a few clicks the usage of Extreme Cache can be enabled or disabled globally for the array or very granularly for single volumes. The read cache hit ratio is constantly monitored and can be visualized on the performance graph for RAID groups and volumes.

# ETERNUS SF Operations Optimization Management

## Tiered Storage

Automated storage tiering (AST) is a technology that monitors data access frequency in mixed environments containing different storage classes and disk types. The storage administrator does not need to classify data or define policies. Once the tiers are configured, the ETERNUS DX storage system does all the work, freeing up the storage administrator to focus on other storage-related responsibilities. The automation of tiered storage enables the management of multiple storage tiers as a single entity and ensures that the right data is in the right place at the right time.



ETERNUS SF controls the destination and the arrangement of data, monitors the access frequency of data and automatically relocates the data between drives to the most appropriate storage devices. This storage hierarchy control offers significant investment optimization and reduces storage costs by matching storage system capabilities and application sensitivity to performance, availability, price and functionality.

Infrequently used data and non-essential copies of primary application data, i.e., point-in-time snapshots, replication copies and data mining are automatically located on nearline drives, which have large capacities, but are less expensive. For high priority applications, the performance and response times of important information is improved by automatically locating frequently-accessed data on high-performance SSDs.



By e.g. defining the SSD storage as the highest tier, ETERNUS DX uses this storage for the data which is most active, and it moves data with lower activity to lower tiers. This means that data is always migrated to the appropriate tier based on usage frequency. Already a small number of high performance SSDs can significantly improve the storage system performance

The overall arrangement of data on the different drive types has an impact on storage costs. The relocation of data is completely transparent to the server and applications, and is performed without making changes in server settings. As data is relocated in very small chunks of 252 MBytes each the number of expensive SSD's can be minimized further.

Besides the classical tiers used by almost all which consist of different disk classes - SSD/SAS/SATA with ETERNUS SF tiers can also be defined as different types of RAID protection within the system. The tiering policies can be set in a very flexible way regarding automatic or manual execution, evaluation periods, evaluation schedules and evaluation methods.

In particular by using extensive scheduling options AST can be fine-tuned to collect data for business relevant periods only and to postpone relocation processes in periods of low array activity.

## Benefits of tiered storage

### Reductions of management cost by automated relocation of volumes

- Preventing performance issues requires a lot of work of administrators from the initial design phase during the tests and when going live. Periodical monitoring and analysis are required. Automated Storage Tiering reduces the cost of administration.
- When the performance requirement estimation is difficult, Automated Storage Tiering allocates/ relocates space to an adequate tier according to the actual access workload, plus it automatically and continuously adjusts the data location according to the changes in access frequency

### Performance improvement with efficient usage of SSD

- Hot spot blocks can be allocated on SSD
- SSD technology results in better overall performance
- Improved response time
- Fewer bottlenecks

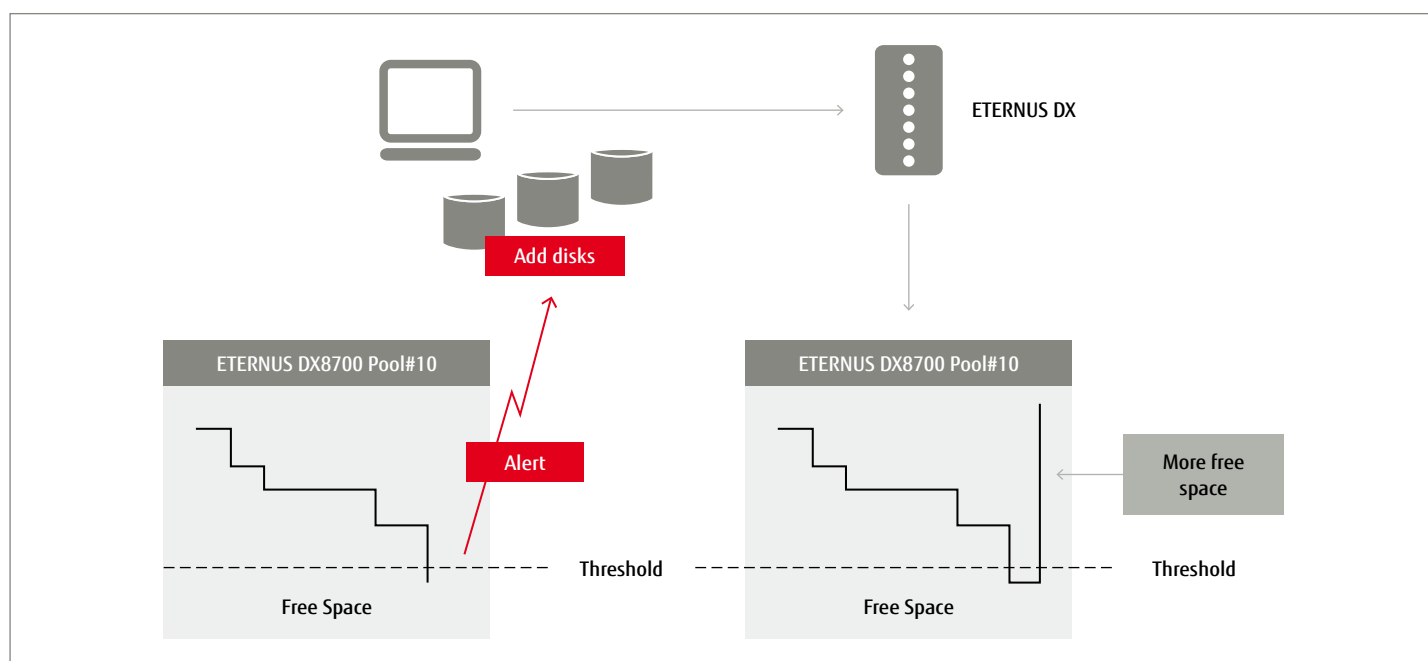
### Reduction of storage cost with Nearline SAS

- Low access blocks can be migrated to low-cost Nearline-SAS storage according to the reduction in access frequency
- Relocation of access-less blocks to Nearline-SAS will not negatively impact performance
- The amount of storage floor space is decreased, and the cost of storage ownership is greatly reduced

### Thin provisioning

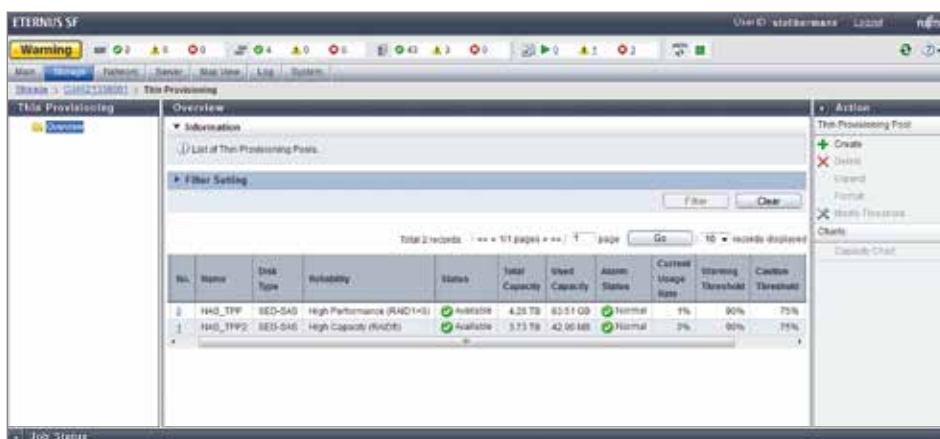
Provisioning of storage capacity has traditionally been a costly, time consuming and often contentious process for IT administrators. Business users complain about the lack of responsiveness to their needs. Executives become anxious when customer facing applications are impacted by storage capacity shortages—however temporary they may be. Thin provisioning is a way to add capacity to applications as well as virtual machines in a matter of minutes spent on the ETERNUS SF management console. Administrative time is made available for more value-oriented tasks and application users productivity is enhanced. This kind of storage capacity virtualization technology has been devel-

oped to enable effective use of available storage capacity for better return on investment. Storage virtualization based on thin provisioning improves disk resource utilization and reduces the size, cost and complexity of the enterprise storage environment. Physical disks are managed as a common disk pool, and allocations to servers are treated as allocations to a virtual volume. The administrator assigns virtual capacity to applications and the real, existing capacity can thus be pooled. When writing to a virtual volume, physical disks are allocated from the disk pool in accordance with the size of the data being written. Such thin provisioning reduces the amount of unused physical disk capacity and creates a much more effective storage operation.



ETERNUS SF provides following functionalities for thin provisioning:

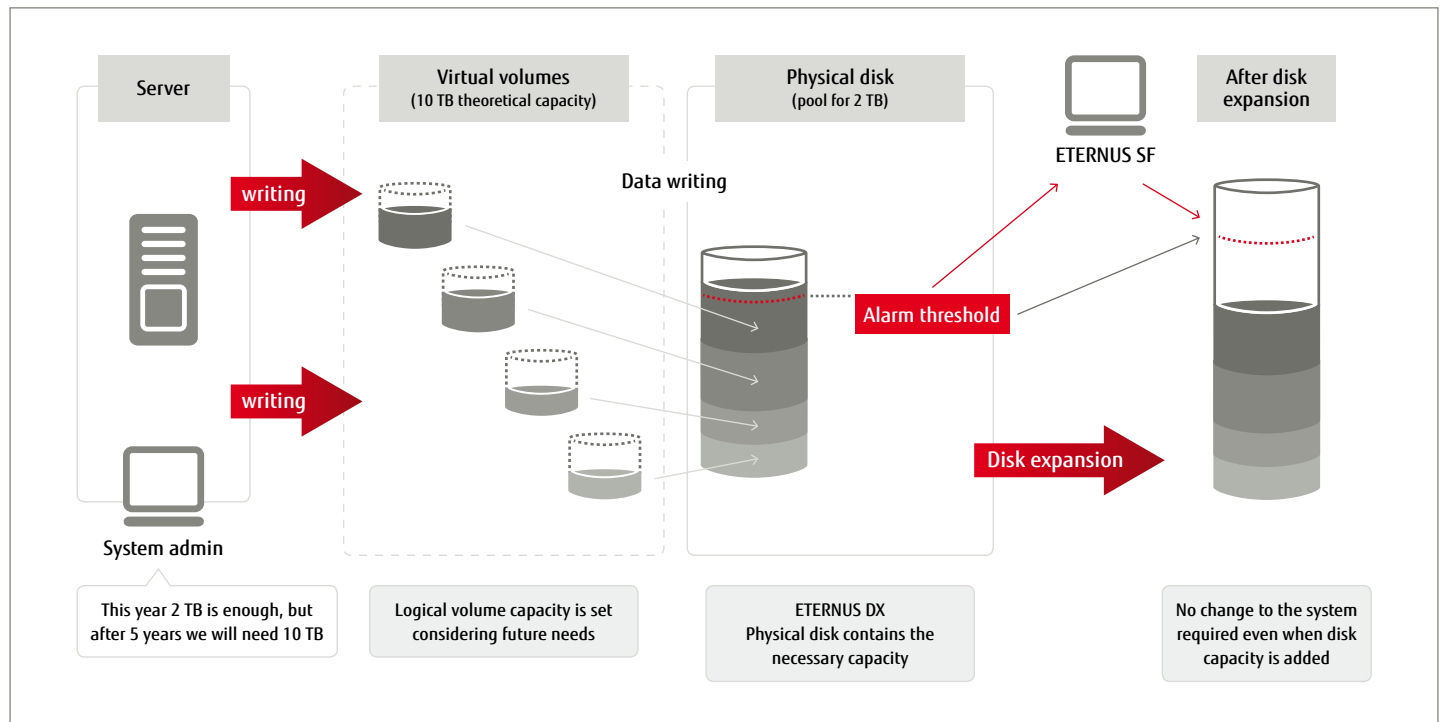
- Configuration management makes the associations between virtual volumes and physical disks visible. The Web Console displays the associations between the configuration that is virtualized by means of thin provisioning (disk pool and virtual volumes) and the physical configuration (RAID groups and physical disks). This function makes it easy to check the affected location when a physical disk fault or other problem occurs.





- Defining thresholds avoid storage capacity shortages through warnings and alarms when additional physical disks are needed. Physical disks can then be extended in accordance with the disk pool

busy rate. The new drives can be added without stopping the system, ensuring continuous system operation.



#### Benefits:

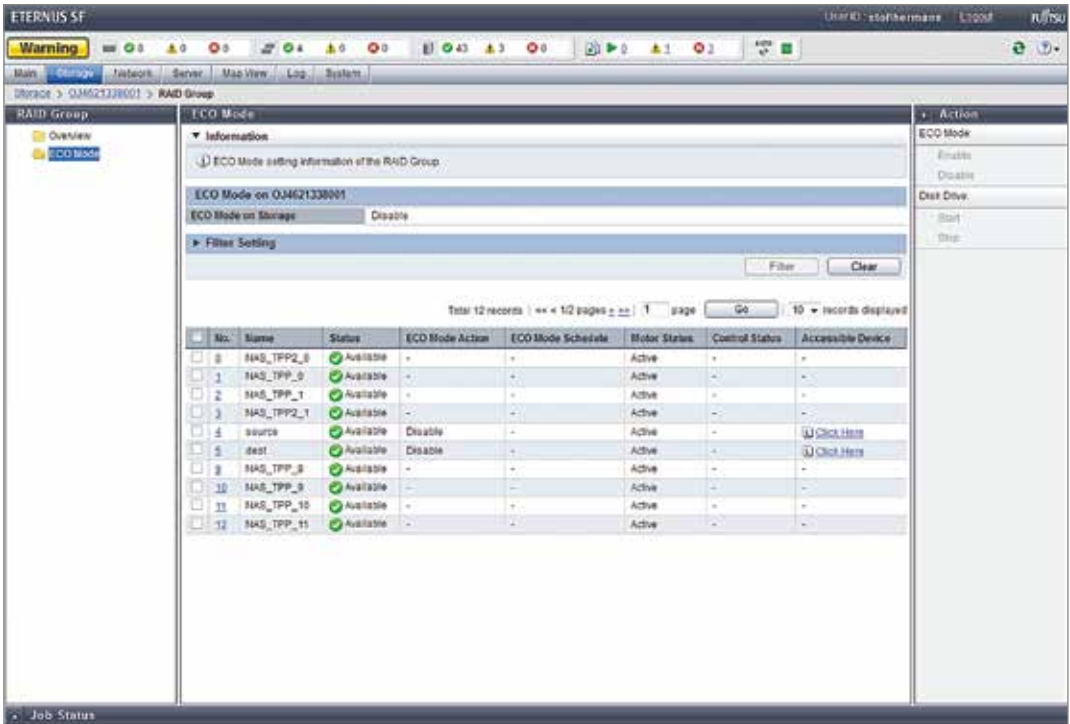
- Smaller initial investment through efficient use of resources
- Adapting storage capacity to changing needs
- Reduces operational costs by integrating storage with virtualization.
- Reduces overall power consumption by reductions in over-provisioning.

Power saving management

Eco-mode settings

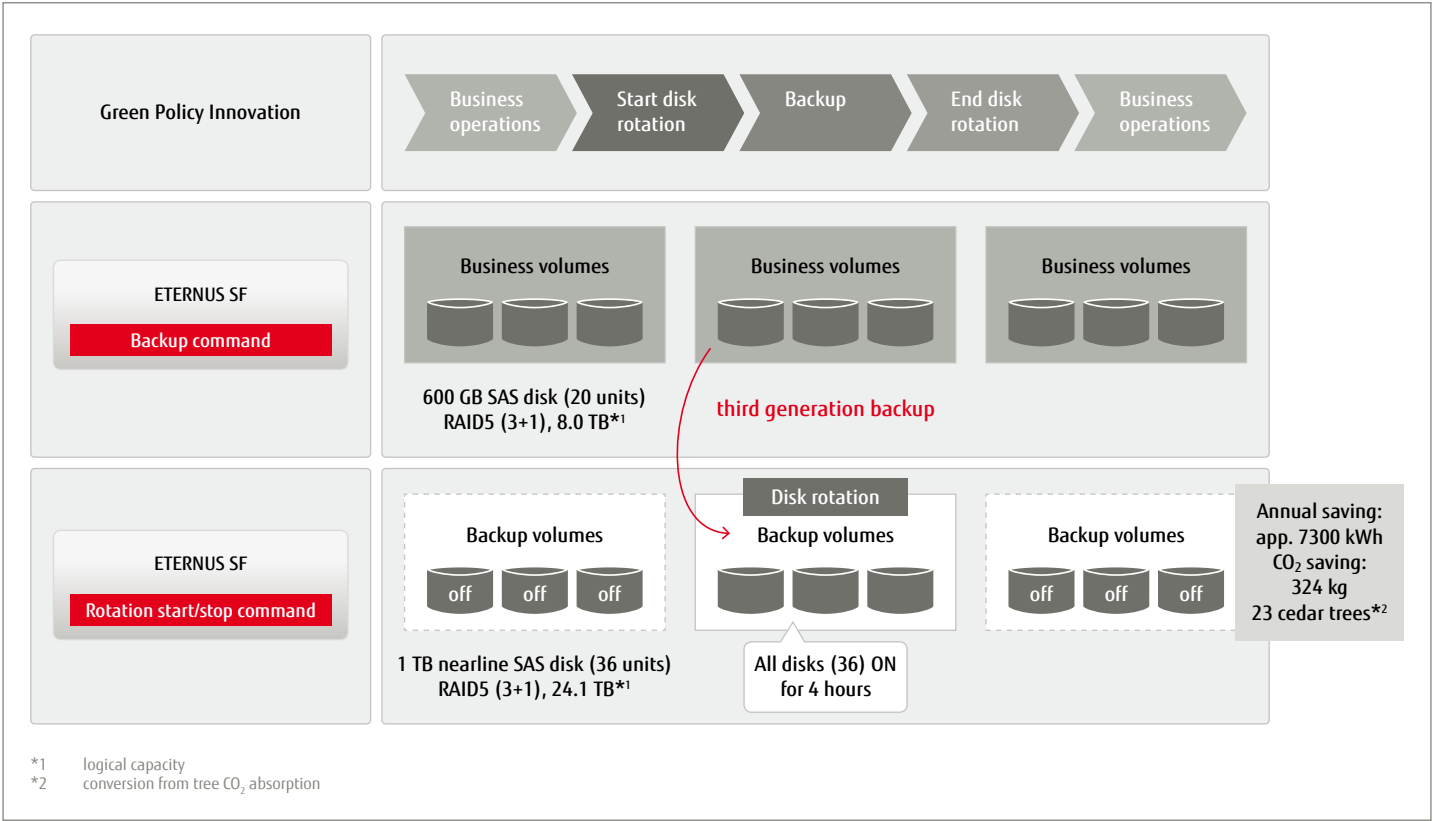
To achieve low power consumption for storage, ETERNUS DX systems are equipped with Eco-mode setting functions. Using MAID (Massive Array of Idle Disks) technology, ETERNUS DX disk drives have Eco-mode support to manage the on/off state of the disk drive. Eco-mode stops disk rotation at specified times based on customer’s usage patterns. There are two variants: “System Eco-mode” and “RAID Group Eco-mode”. Once System Eco mode is enabled Raid group Eco-mode can be set ON or OFF separately for each RAID group, so it is possible to achieve high energy savings.

When Eco-mode is activated, ETERNUS SF monitors the activity between servers and storage devices to get a full picture of server and disk storage system requirements. Energy consumption efficiency and system temperature can be displayed and checked or written to file. By turning off unused disks, energy consumption can be reduced. Data tracking also enables optimized use of electricity and air conditioning.



Backup with reduced power consumption

In conjunction with AdvancedCopy, the time-controlled Eco mode is used to reduce energy consumption by only powering the backup drives during the backup window. Such scheduled use of specific disks can be set up for individual RAID groups and backup operations. Power usage is reduced outside specified backup windows by stopping the rotation of the backup disks. Rotation stops if the disks are not accessed within specified time periods. When a data access command is received, rotation starts again. Full rotation is restored in about one minute.



# ETERNUS SF Operations

## Automated Quality of Service

A prerequisite for any storage consolidation strategy is the ability to host multiple applications on a single storage platform, without allowing the actions of one set of users to affect the quality of service of others.

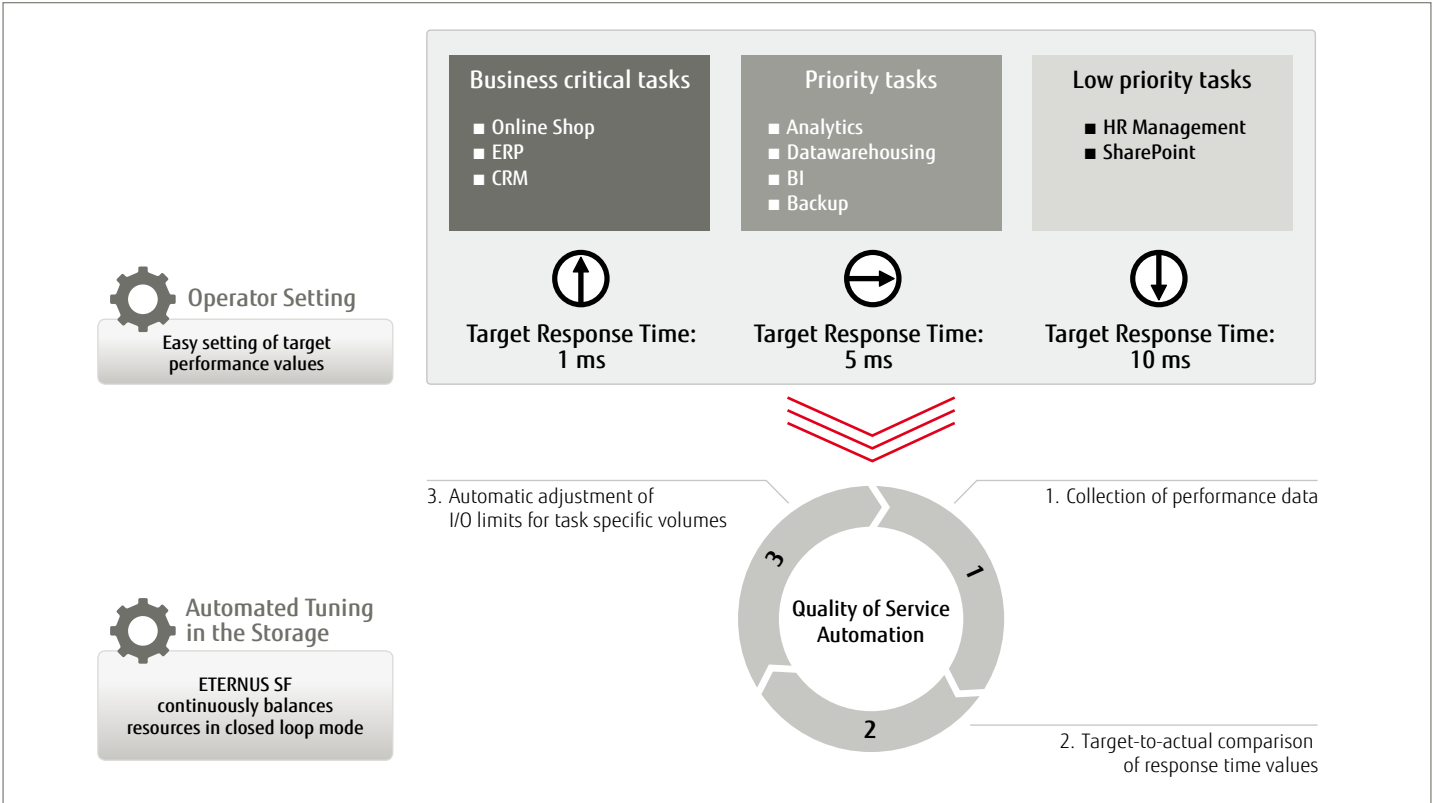
Potential problem areas for shared storage access include:

- Workloads with I/O and cache conflicts, such as online transaction processing (OLTP) and data warehousing
- Tiered storage access restrictions, such as development and production applications
- Peak processing demands of critical applications versus maintenance activities like backup or a database reorganization

The ETERNUS DX QoS feature with application I/O prioritization enables consolidation of multiple tiers of applications on a single storage system. By prioritizing data access and dynamically managing any I/O contention, capacity can be used more efficiently, thus increasing storage utilization without sacrificing performance. The QoS policies allow the user to specify the expected I/O patterns of each application (random, sequential, read- or write-based, and mixed).

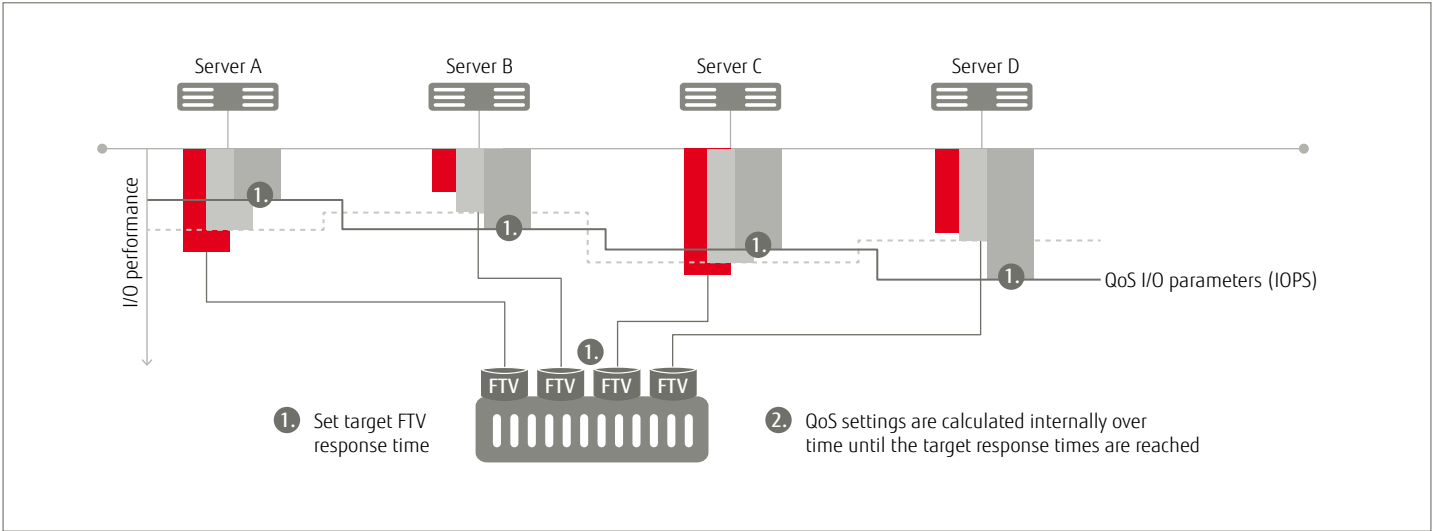
ETERNUS SF enhances the QoS feature with QoS Automation, automatically adjusting the response time in accordance with the priority level of business applications and thus realizing stable activity of the system.

ETERNUS DX S3 systems together with ETERNUS SF's automated Quality of Service management option set values based on performance requirements and dynamically adjust the values along with the result of performance monitoring. This is done by simply configuring target response times for single volumes. While maintaining a balance between business applications, storage resources (IOPS or bandwidth allowances) are automatically adjusted to provide the optimal response. The Auto QoS feature makes it easier for the user to start the settings and schedule it according to business needs. Furthermore, the automatic tuning ensures that the values used are more accurate, resulting in better service level fulfillment.

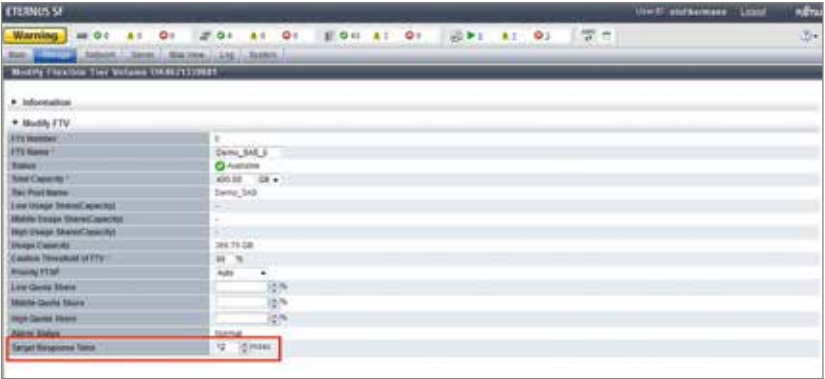


Administrators can configure target values (Target Response Time in milliseconds) in the setup section for Flexible Tier Volumes (FTV). Values can be set independently for each FTV.

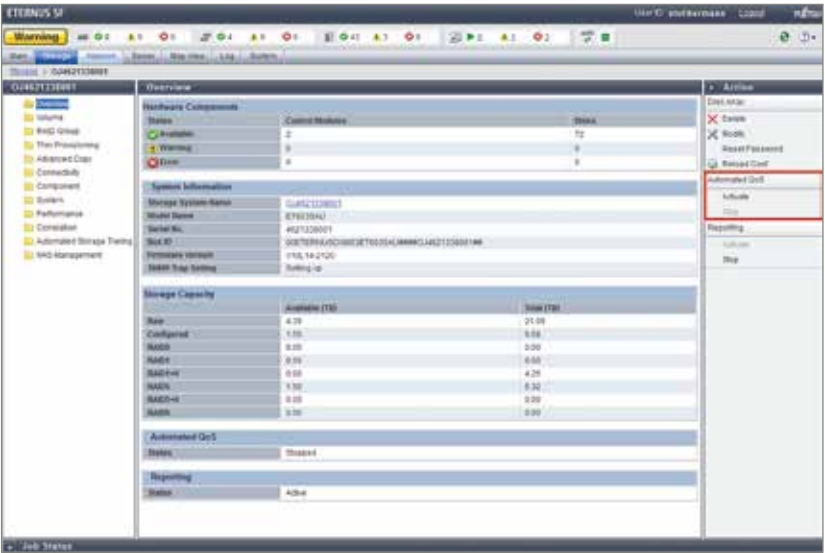
According to the priority of tasks the automatic tuning of performance is executed by automatically adjusting the bandwidth which is necessary to maintain the target response time.



In particular ETERNUS SF will monitor the volumes IO performance and adjust the hardware QoS limits needed to meet the user expectations. Over time the response time will get closer to the target not needing additional user intervention.



The Automated QoS function can be activated and stopped for each storage array in total by a simple click in the main screen's action pane of the array. It can only be executed as long as performance measurement is enabled

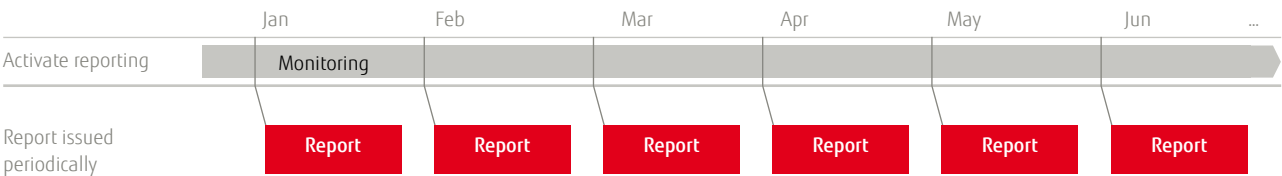


# ETERNUS SF Operations Reporting

Tracking the use of storage resources over time gets more and more important when storage environments get more complex and are used by many different users. ETERNUS SF provides a reporting function that issues regular reports of the volume allocation activity. Built in monthly standard reporting policies can be also customized using CLI commands.

Once activated for the array the reporting function collects capacity and usage time information for volumes connected to servers. This provides the required information to charge fees based on volume utilization and usage time.

Reports include information regarding physical servers, virtual server hosts and virtual machines, the individually allocated volume types with indication of physical and logical capacity, the usage period and service level indicators like disk type, RAID level or volume encryption.



The reports, issued in XML format, can be easily transformed and integrated in documents or imported in an accounting application to charge the server operations individually on storage usage.

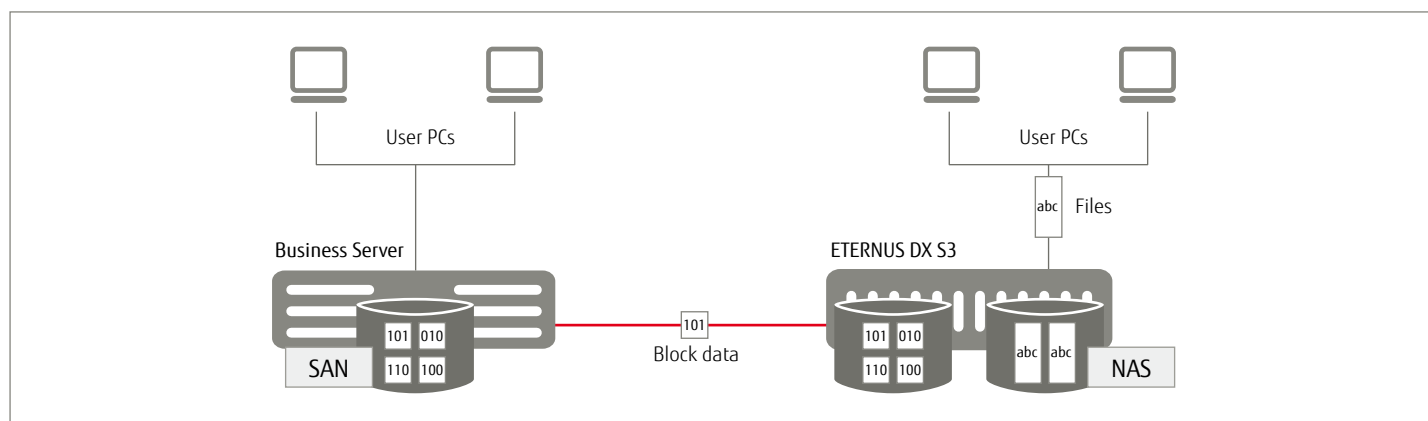
Information collectable by the reporting function	
Volume type and capacity	Physical capacity of standard volume
	Physical capacity of WSV
	Logical capacity of SDV
	Logical capacity of TPV
	Logical capacity of FTV
Usage period	Start date and time of use
	End date and time of use
Volume information	RAID level
	Disk type: SAS, SSD, SED-SAS
	Volume encryption

# ETERNUS SF Operations

## NAS Management

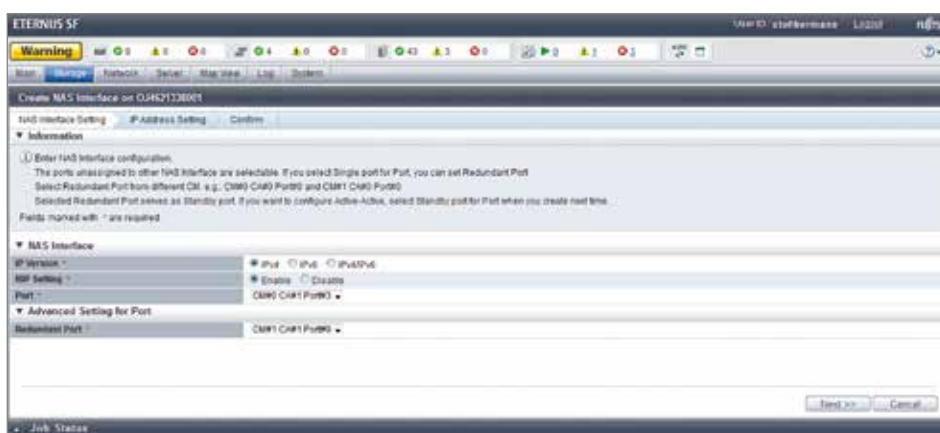
ETERNUS DX S3 series also offers a unified option enabling both block access via SAN and file access via NAS on the same array. This unified storage function adds NAS resources in addition to SAN resources letting them benefit from all the efficiency and reliability features of the ETERNUS storage systems.

The integrated NAS resource management of ETERNUS SF provides the interface to manage NAS on ETERNUS, in particular the creation and management of network interfaces, shared folders and access permissions. Administrators experience common ease of use features for configuring and controlling both the SAN and the NAS environment.



The physical NAS interfaces are easily configured just determining physical port and IP addresses.

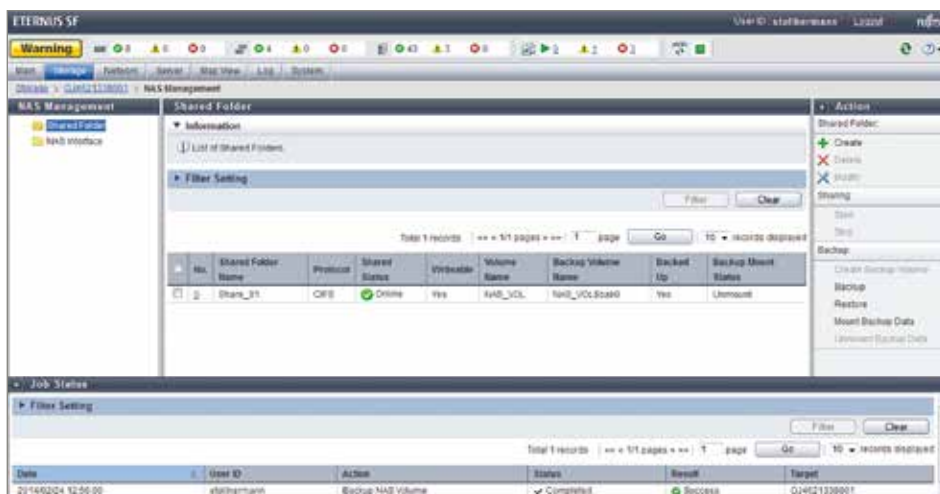
Basically the NAS resources are thin provisioned volumes on a dedicated thin pool. An easy to understand wizard supports the creation of shared folders within such a volume for both CIFS and NFS environments. With creation of the first shared folder the wizard automatically creates the NAS volume in the thin pool.



Further steps are the setup of a respective backup volume in a different thin pool. The backup method is based on QuickOPC.

Finally the access rights for both users and hosts are set up. CIFS and NFS authentication use the Kerberos network authentication protocol.

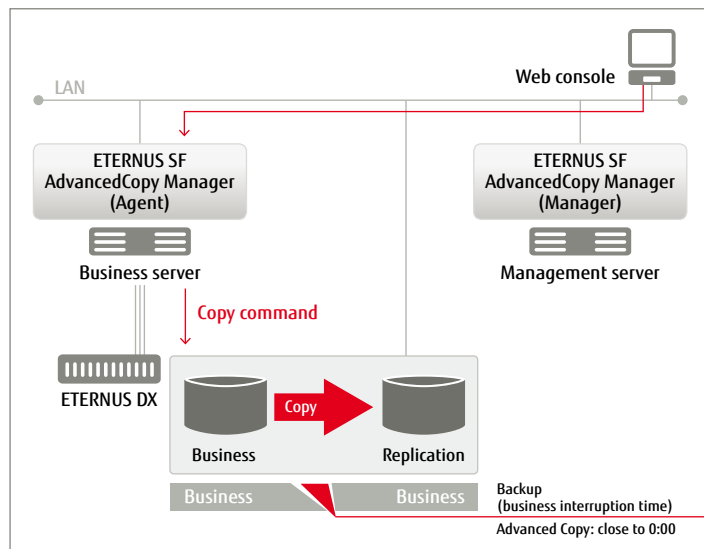
Via the action pane ETERNUS SF administrators can start and stop sharing of the shared volumes, trigger NAS backup and restore operations and easily mount/unmount the backup data.



# ETERNUS SF Operations

## AdvancedCopy

While data is growing exponentially, its importance is also growing from regulatory compliance and business continuity standpoints. Thus efficient and easy replication and backup of large data volumes is becoming a critical issue.



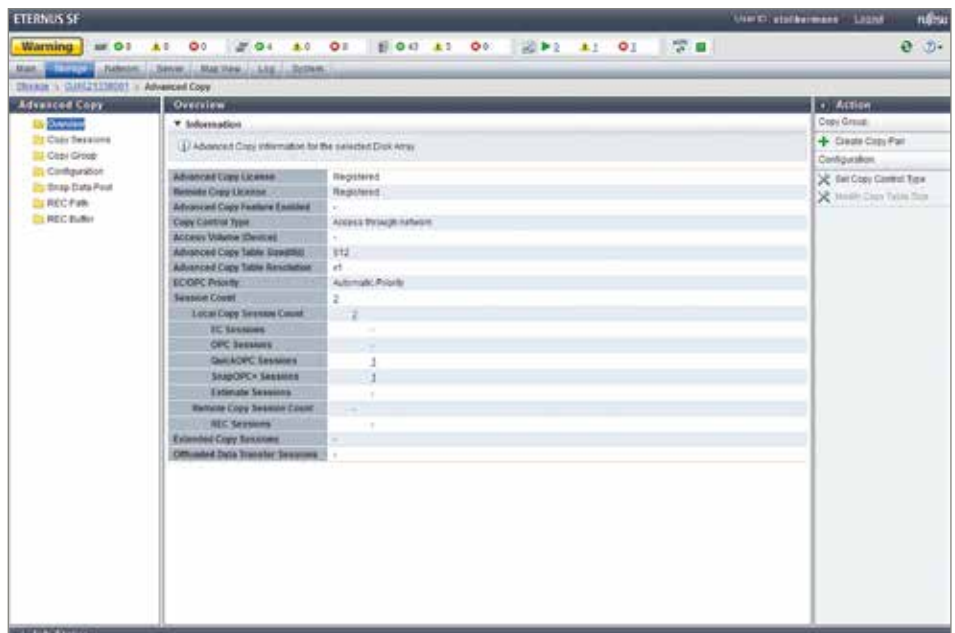
ETERNUS SF, together with the hardware-embedded AdvancedCopy of the ETERNUS DX storage systems, enables high-speed and high-reliability backup/restore and replication operations. To achieve continuous 24 x 7 business continuity, ETERNUS SF takes over all the tasks required for implementing a disaster-resilient storage infrastructure. Thus ETERNUS SF significantly reduces operational downtime, especially in large-volume, transaction-intensive environments. The software can be deployed in conjunction with a wide range of mainstream database environments, including Oracle Database, SQL Server, DB2 and Exchange Server, to provide reliable high-speed data copying without going offline and without downtime.

With these capabilities data center managers achieve the following targets:

- High speed backup operation
- Short Backup-Restore time regardless of data volume
- Disaster recovery with remote copy
- Fast recovery of business operations
- Database backup without interruptions or heavy loads
- VMware environment backup/restore
- Hyper-V guest online backup

The embedded AdvancedCopy functions of ETERNUS DX supports the copying of data from a business volume to another volume, both within the same ETERNUS DX storage system and across multiple ETERNUS DX storage systems in the storage network. Remotely located storage systems can be connected to this infrastructure via high-speed technologies. A wide range of advanced copy features are supported for:

- Local volume replication of data
- Local NAS volume replication of data
- Synchronous and asynchronous data replication
- Automated failover
- Recovery of host based data
- Support of various data protection and backup or archiving policies
- Support of data migration to physical and virtual tape libraries
- Support of a rich set of snapshot functionalities
- Support of virtual server environments





Embedded AdvancedCopy functions of ETERNUS DX

ETERNUS DX systems support two distinct data copy modes: Snapshot high-speed copy and Synchronous high-speed copy.

**Snapshot high-speed copy** creates a snapshot of data. The copy types available with this function are:

OPC (One Point Copy)

This **Background Copy** function creates a copy of the business data volume at any point in time. Data on the business volume is copied logically to a copy volume, quickly, as and when required. The copy volume can be used for backup operation to a tape device, while business operations can continue on the business volume.

QuickOPC

This **Background Copy** function creates a copy of all the business data volume, but copies only data that has been updated since the previous update and subsequently only copies updated data. This is suitable for large database operations where backup times must be reduced.

SnapOPC

This **Copy-on-Write** function creates a copy of the data prior to it being updated. As it requires less copy volume capacity when compared with full backup, SnapOPC is ideal for backup operations for systems such as file servers, with relatively few updates.

SnapOPC+

Like SnapOPC, SnapOPC+ is a **Copy-on-Write** function and copies the data only prior to it being updated on the business volume. In addition, SnapOPC+ enables generations management of the updated data. As SnapOPC+ does not actually store duplicate data, but manages it as history information (unlike SnapOPC), disk-based generation backup can be achieved using less copy volume capacity.

With these AdvancedCopy functions (with the exception of OPC), once an initial copy has been made, it is possible to perform differential copying, which copies only the modified portions. **Synchronous high-speed copy** maintains the equivalent status for a transaction volume and backup volume. The two copy types available are:

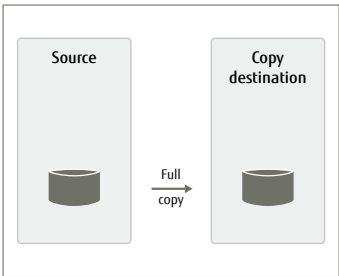
EC (Equivalent Copy)

EC is a mirror/suspend function that always creates a **synchronized copy** of a business data volume on a copy volume (mirroring). The business volume and copy volume are synchronized, but can be separated at any required time (mirror suspend). The copy volume can then be backed up to a tape device while business operations continue on the business volume. Suspend/Resume functions can be used to re-establish the mirror by copying only data updated since the mirror was suspended.

REC (Remote Equivalent Copy)

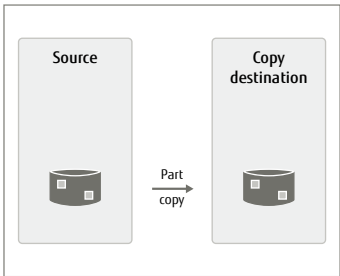
REC performs **synchronous high-speed replication** from one ETERNUS DX storage system to another ETERNUS DX storage system at campus, metro or global remote locations.

OPC (One Point Copy)



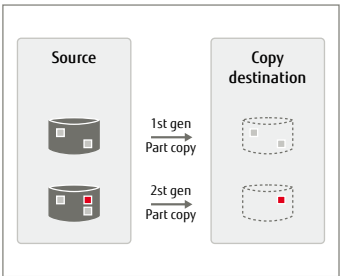
Full copy of the original data (Point in time copy)

QuickOPC



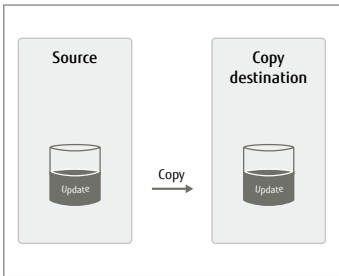
Point in time full copy, then copy of updated data only

SnapOPC+



Copy of updated data only

EC/REC



Full copy of original data, then original data changes automatically reflected to copy destination

AdvancedCopy function	Description
<b>OPC: Clone</b>	Internal function for performing a full copy of the original data. Optimized replication and backup operation.
<b>QuickOPC: Clone</b>	Internal function for performing a full copy of the original data once, then copying only updated data subsequently for the further copy operations. As backup duration is short, this is optimal for database systems, etc.
<b>SnapOPC+: Snapshot</b>	Internal function for performing a partial copy of original data parts right before they get updated. Only the part to be updated is copied. Uses limited disk capacity and allows several backup generations. Optimal for file server backup.
<b>EC: Clone</b>	Internal function for performing a full mirrored replication of data. Optimal for getting a data copy without interfering with heavy load business processing.
<b>REC</b>	Function for performing a full mirrored replication of data between systems. Optimal for backup to a different storage system.

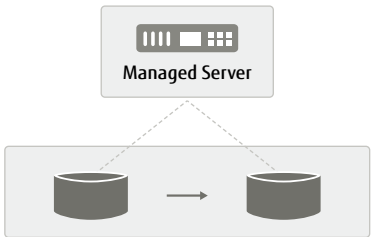
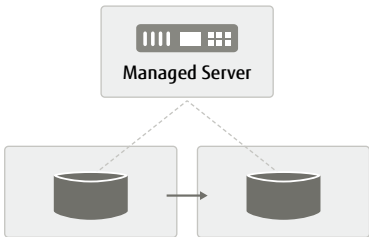
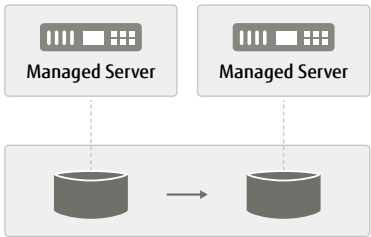
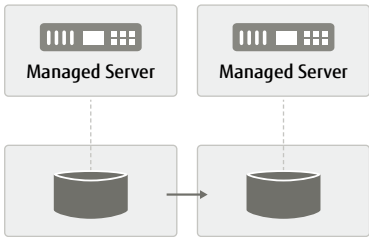
The server-independent snapshot and clone functionality of ETERNUS DX provides simple data protection options with minimal impact on business applications. The snapshot function in particular allows multiple snapshot generations to be stored on a small amount of drive space, while full drive clones can also be generated and managed.

AdvancedCopy with ETERNUS DX has several advantages:

- Backup is performed internally by the ETERNUS DX storage system, minimizing the CPU usage on the host system.
- The physical copying takes place in the background, in parallel with normal operations.
- I/O is limited to within ETERNUS DX, where high-speed data copy can be maintained. Where Remote Equivalent Copy (REC) is used, there may be some additional overhead, but the copy can still be maintained at a very high copy speed.
- Backup can be performed in a much shorter time frame using the differential copy capability of the One Point Copy (OPC) and Equivalent Copy (EC) methods.
- Restorations can be performed at high speeds using the same AdvancedCopy functionality, depending on the type of backups originally performed.

Usage of AdvancedCopy for Backup or Replication

The following table shows the available data copy modes which can be used for backup or replication:

		Intra-ETERNUS	Inter-ETERNUS
Intra-Server (Managed Server)	Functionality	Backup and replication	Only replication
	Copy Mode	OPC/EC/QuickOPC/SnapOPC/SnapOPC+	REC
	Diagram		
Inter-Server (Managed Servers)	Functionality	Only replication	Only replication
	Copy Mode	OPC/EC/QuickOPC/SnapOPC/SnapOPC+	REC
	Diagram		

Backup/restore management functions

Backup/restore management functions support maintaining multiple generations of the copied data. When performing a restoration, any one of the backup generations can be chosen and restored. Backup management functions deliver storage configuration management for the configurations of source volumes (to be backed up) and target volumes (where backup data is stored) during copying. Unlike the data copied with the replication function, the data copied with backup cannot be used outside this function. By setting a backup policy, the backup can be performed according to that policy, for example, according to the number of backup storage generations and number of backup interval days. The log data management displays the history of the backed up generation as a log. The ETERNUS SF Copy Control Module (CCM) for local copy and remote copy administration supports backup/restore functions without agents or the utilization of external backup applications.

Backup can only function within a single ETERNUS DX storage system connected to a single managed server, whereas replication can be performed across multiple managed servers or multiple ETERNUS DX storage systems. Backup does not support data copy to a different ETERNUS DX storage system. The replication function is needed to copy data over to a different ETERNUS DX storage system.

Replication management functions

Replication supports using the copy data differently from a backup. As multi-generation data management is not supported, several pairs must be defined for one data source and multiple data destinations. Copying to a different ETERNUS DX storage system, including a remote location, is possible. A replication data source and a destination area are defined as a pair, and data is copied inside this pair.

Replication is an excellent way:

- To use the copied data outside a backup dataset (for example, using the copied data in a business application).
- To copy between volumes that are connected to different servers
- To copy between volumes that are residing on different ETERNUS DX storage systems.
- To backup data from Microsoft Exchange Server (the standard backup/restore management functions of ACM cannot be used directly with Microsoft Exchange Server).
- To backup data from a Hyper-V Guest OS (the standard backup/restore management functions of ACM cannot be used directly with Hyper-V Guest OS).

# ETERNUS SF Operations

## AdvancedCopy Function Scenarios

### Archiving and disk to disk backup using Nearline-SAS disk drives

The use of data and its frequency of use changes over time. This can be roughly divided into "frequently accessed data" and "infrequently accessed data." Data having a high frequency profile will require immediate retrieval and should be stored on high-performance storage devices. However, storing infrequently accessed data on high-performance storage devices generates unnecessary costs. To meet the growing demand for cost-effective and high-capacity storage for less frequently accessed data, Fujitsu provides high-capacity, high-reliability, low-cost Nearline-SAS disk drive options in its ETERNUS DX storage systems. The combination of SAS Online disk drives and Nearline-SAS disk drives in the same cabinet enables ETERNUS DX storage systems to handle the following scenarios cost-effectively:

#### Disk-to-disk backup

Backup volumes on disks are generally used as both temporary storage and high-speed recovery storage following any unexpected storage event. Low-cost, high-capacity and reliable Nearline-SAS disk drives provide the most appropriate storage space for such activities. ETERNUS DX storage systems are highly accessible and cost-effective backup environments thanks to AdvancedCopy functions. Even more cost-effective space utilization and performance is supported by "QuickOPC." This function only copies data changed per update, thus minimizing the time required for copying.

#### Long-term storage of reference data

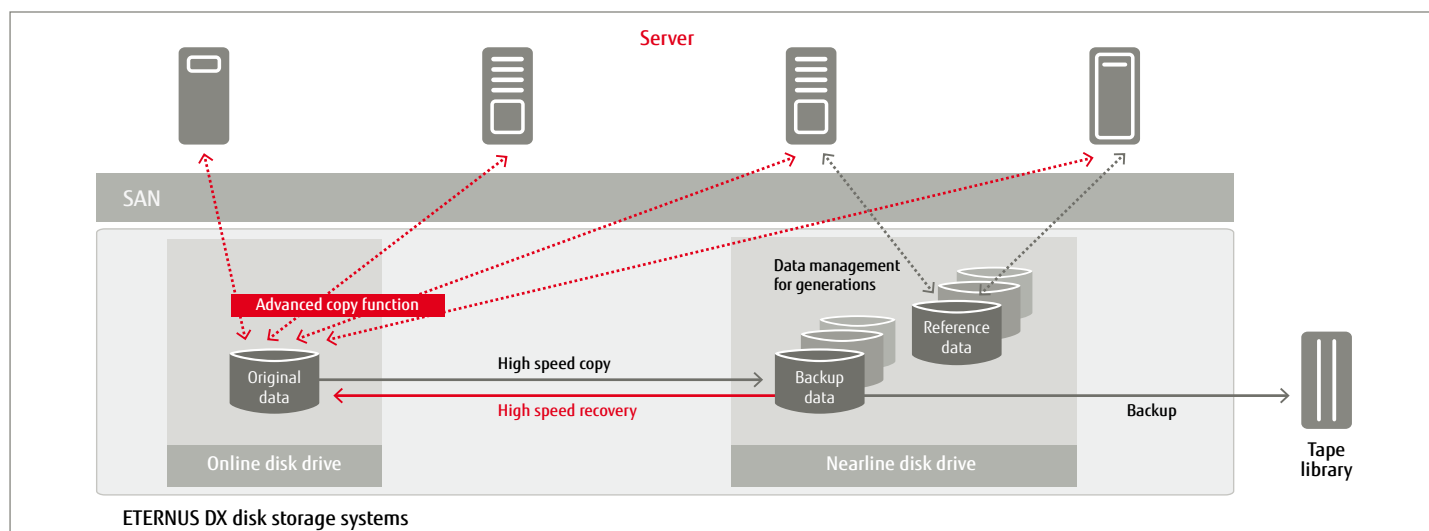
The data in e-mail archives, image and sound files, CAD, R & D documents, and in history or regulatory compliance documents, is subject to the same requirement: It needs to be retrieved easily on demand, despite having an infrequent access profile. This data is growing rapidly and also requires long-term retention. So when it comes to selecting the right storage medium, low-cost and high-capacity Nearline-SAS disk drives are a good choice.

### Disk to Disk to Tape integrated backup

The AdvancedCopy functions enable the disk storage system to carry out high-speed copying operations itself, with no need to draw on server CPU resources. With AdvancedCopy functions, a business data volume can be copied to a separate copy volume, quickly at any point in time, and within the disk storage system. Once the copy is complete, the copy volume can be separated from the business volume, ensuring that no further business volume updates are carried out for the copy volume. Thus the copy volume data can be backed up to an additional tape device, as a point in time copy of the business data, while normal operations continue. ETERNUS SF in conjunction with the AdvancedCopy of ETERNUS DX and an external tape backup software enables disk-to-disk-to-tape backup as a single consolidated operation by linking up the disk-to-disk and disk-to-tape backup processes. This consolidation of resource management and backup destinations also prevents backup/restore operation failures that can occur with less automated processes. In addition, high-speed backup is possible without stopping operations in conjunction with the DBMS.

#### Benefits:

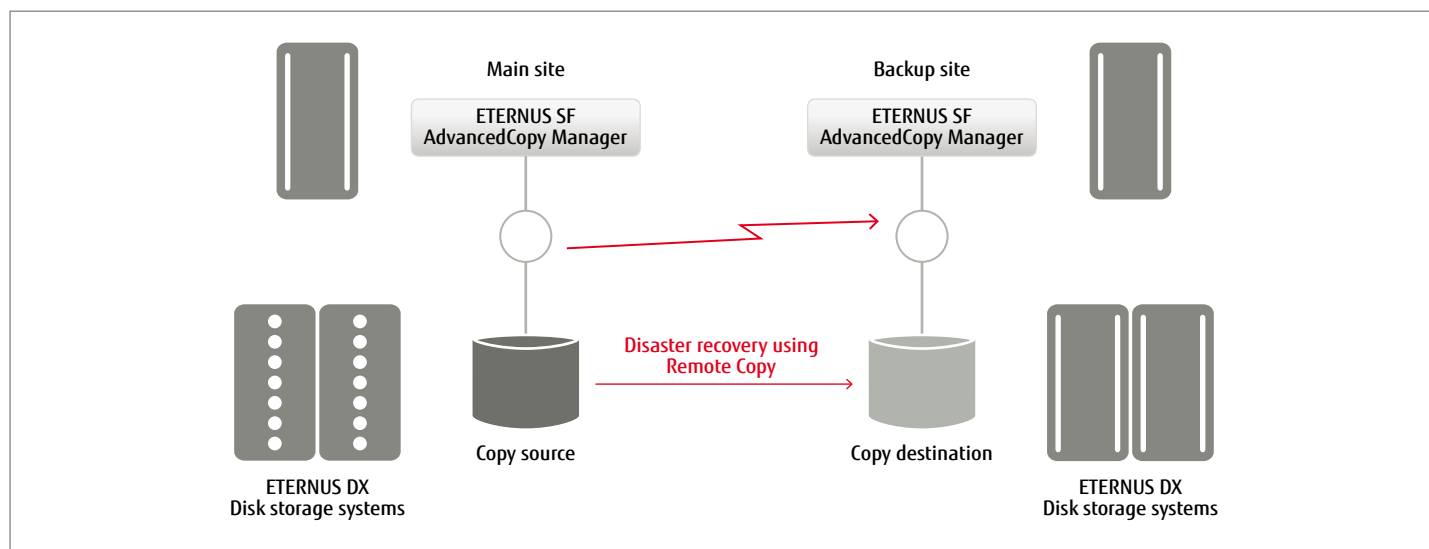
- Tape backup with reduced operation stoppages (with disk-to-disk-to-tape).
- High-speed backup with reduced application server stoppages using the AdvancedCopy function of ETERNUS DX.
- Backup operations put no load on application servers.



## Disaster Recovery with Remote Copy

Remote Copy (Remote Advanced-Copy function - REC) provides a server-less remote mirroring function which ensures fast recovery if the primary disk storage system site suffers an outage due to a disaster, such as fire, earthquake, flood, etc. ETERNUS SF supports remote copy capability using ETERNUS DX storage systems connected via FibreChannel or iSCSI interfaces. Secure disaster recovery can be achieved by allo-

ating ETERNUS DX storage systems for backup data storage at quake-proof and other disaster-proof sites. Depending on required service level and distance both synchronous and asynchronous replication is possible. REC is available over different system classes and multiple generations of ETERNUS DX, thus allowing most economic and flexible deployments.

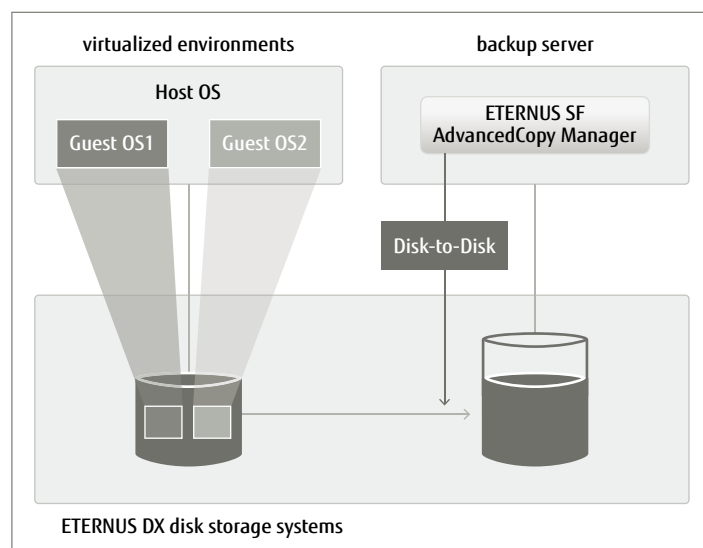


## Integrated Backup to Support Physical Environments and Virtualized Environments

In both physical environments and virtualized environments, disk-to-disk backup operations "per LUN" are available to back up resources. They are also applicable to virtual machine resources in a virtualized environment based on Windows Server Hyper-V or VMware VMFS. Since the operation does not need to be changed for each environment, the complexity and rising cost of operations can be kept under control, even when migrating from a physical environment to a virtualized environment.

In addition, with ETERNUS SF performing AdvancedCopy backup operations, the backups can be done without imposing loads or stopping the application server operating system for:

- Hyper-V guest OS via VSSHP.
- Database systems in cooperation with Oracle, Symfaware, Microsoft SQL Server, DB2 and Microsoft Exchange Server.



# Appendix

## Operational Functions Overview

ETERNUS DX Hardware	Web GUI /CLI
Operational Area	Function Overview
Single Storage System Management	Storage Configuration including NAS*
	Thin Provisioning
	Temperature and Power Consumption
	QoS by application prioritization control
	Eco mode configuration
Single Storage Device Management	Health and Status Overview, Eco Status
Basic internal AdvancedCopy Function	SnapOPC+

ETERNUS SF V16 Software	Web Console
Operational Area	Feature
Storage System Management	Storage Configuration
	Thin Provisioning visualization
	Storage hierarchy control / Automated Storage Tiering (requires Thin Provisioning)
	SAN Management (switch setting, access path mgmt., correlation mgmt.)
	NAS Management* (Port setting, shared folder management, backup management)
	Automated QoS Management*
	Performance monitoring, analysis, history view and alerts for ETERNUS DX, FC switches
	Temperature and Power Consumption visualization
Storage Device Management	Eco mode configuration
	Health and Status Overview (ETERNUS DX storage, 3rd vendor storage, FC/FCoE switches, Server multipath, Eco status, VM guest view)
	Capacity monitoring (Assigned/Free space)
AdvancedCopy Function	SnapOPC+, OPC/QuickOPC, EC, REC
Backup Management	Generation Management, backup destination pool, NAS Backup
Application Integration	Microsoft Volume Shadow Copy Service (VSS) support
	Exchange Server
	SQL Server
	Oracle
	Symfaware
	VMware consistent backup
	VMware SRM
	VMware VASA
	VMware VAAI

\*available for ETERNUS DX S3 series only

### Related Documents

- Business-centric Storage Fujitsu Storage ETERNUS DX Series ([Link to PDF](#))
- ETERNUS DX - Business-centric Storage for small and medium-sized enterprises ([Link to PDF](#))
- Technical White Paper: ETERNUS DX Feature Set ([Link to PDF](#))
- Technical White Paper : ETERNUS DX Optimization Feature and Automated Storage Tiering ([Link to PDF](#))
- Technical White Paper : Integration of ETERNUS DX Storage System in VMware Environments ([Link to PDF](#))

### Contact

Fujitsu Limited

All rights reserved, including intellectual property rights. Technical data subject to modifications and delivery subject to availability. Any liability that the data and illustrations are complete, actual or correct is excluded. Designations may be trademarks and/or copyrights of the respective manufacturer, the use of which by third parties for their own purposes may infringe the rights of such owner. For further information see [ts.fujitsu.com/terms\\_of\\_use.html](https://ts.fujitsu.com/terms_of_use.html)

Copyright © 2014 Fujitsu Limited