EonStor DS High-Density Storage: Key Design Features and Hybrid Connectivity Benefits

White Paper

Abstract

This white paper introduces the key design features and hybrid FC/iSCSI connectivity benefits of EonStor DS high-density storage solutions.

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EonStor DS

EonStor DS is Infortrend's entry-level family of storage solutions. Featuring advanced hardware design and comprehensive data services at affordable price points, EonStor DS is an ideal solution for small and medium businesses (SMBs).

EonStor DS provides excellent data protection to ensure the highest data availability for storage area network (SAN) and direct attached storage (DAS) configurations. Combined with modular architecture, thin provisioning, easy and intuitive management and exceptional price-performance, EonStor DS offers price-conscious businesses a decisive competitive edge by making IT efficiency keep up with growing storage needs.

For more information about Infortrend's EonStor DS storage systems, please visit our website: http://www.infortrend.com/.

EonStor DS High-Density Solution: Introduction

Infortrend's ESDS S48F-R2842 (dual-redundant controller) and ESDS S48F-G2842 (single controller) models are high-density storage solutions featuring a 4U form factor that accommodates 48 drive bays.

The solutions offer hybrid connectivity of 8Gb/s Fibre Channel and 1GbE iSCSI in a single enclosure, enabling users to deploy cost-effective remote replication via the iSCSI ports or deploy SAN tiering, assigning mission-critical applications to FC SAN and secondary applications to IP SAN.

As with all EonStor DS systems, the high-density solutions offer advanced data services to help users get even more out of their solution. Standard available snapshot and volume copy/mirror, as well as remote replication, help users effectively protect their data and implement comprehensive disaster recovery plans. Thin provisioning enables dynamic capacity provisioning to optimize storage resource utilization.

High-Density Features

The high-density EonStor DS systems offer extremely large storage capacities, reduce the required amount of floor space, lower power consumption and simplify management.

Extremely Large Capacity

48 drive slots in a 4U form factor offer extreme capacities. Traditional 2U/12-bay systems need 8U rack space to reach the same number of disk drives that the high-density solution can achieve in only a 4U form factor. 3U/16-bay systems need 9U rack space to reach 48 disk drives.

With the high-density solution in the future supporting drive capacities of up to 3TB, a single enclosure can accommodate up to 144TB. In addition, the solution can be further expanded with 48-bay expansion enclosures (JBODs), to achieve a maximum of 240 drives, or a capacity of 720TB.

Reduced Floor Space, Power Consumption

By cutting the required space to accommodate 48 disk drives by half or even more as mentioned above, companies can optimize the use of their datacenter space. Maintaining datacenters requires large amounts of electrical power and extensive cooling equipment, and by limiting the size of their datacenters companies can save significant amounts of power consumption and cooling needs.

Simplified Storage Management

By storing more data in a single system instead of having data spread out over multiple hardware systems, management can be simplified. IT administrators can manage their data through a single interface and deal with a single set of hardware components instead of having to monitor multiple enclosures, possibly from different vendors.

Reduced Costs

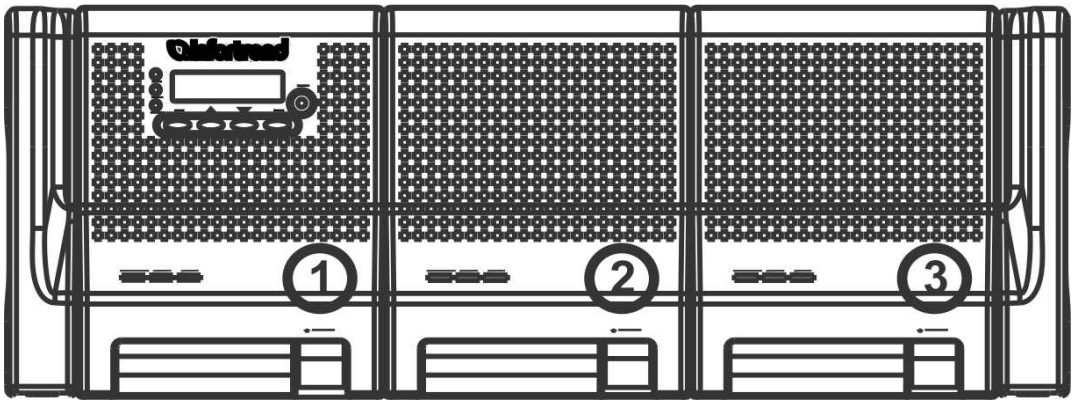
The abovementioned features can lead to considerable cost savings. Less power consumption and cooling equipment lowers electrical power costs, while simplified management can lower human resource costs. The competitive prices of the high-density solution further contribute to cost advantages.

Innovative Drawer Design

Accommodating a large number of drives in a 4U form factor requires special design features to ensure that the systems are easy to use and maintain and have access to reliable power supply and cooling.

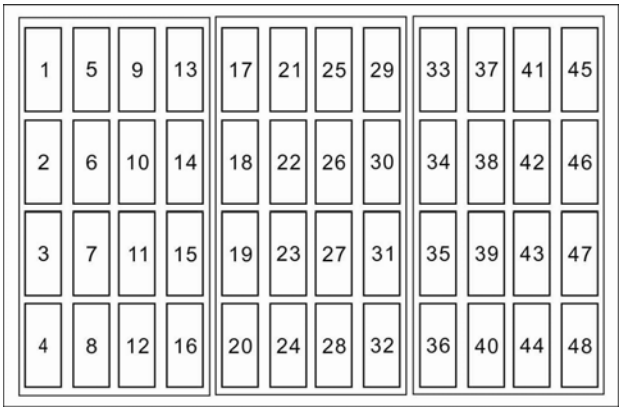
Three Drawers Accommodate Disk Drives

The system features three drawers that accommodate 16 disk drives each, for a total of 48 drive bays.



When viewed from the top, the first drawer on the left contains drive bays numbering 1~16, the second drawer in the middle contains drive bays 17~32 and the third drawer on the right contains drive bays 33~48. The diagram below shows the drive bay numbering:

Rear panel



Front panel

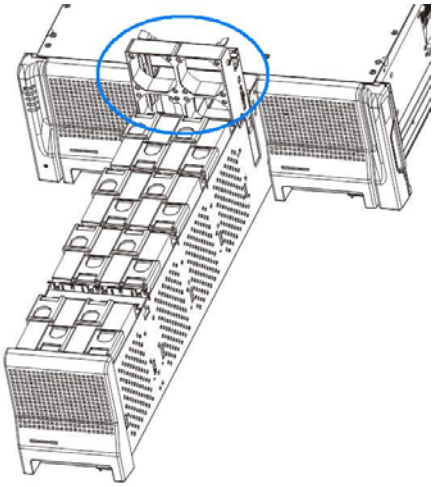
These drawers can be opened and closed while the system is online, making it easy to replace disk drives when necessary. When one of the drawers is pulled out from the enclosure, the other two drawers are not affected in any way.

Each drawer is connected to the backplane with a power cable and signal cable in a flexible manner so that power and data signals are not interrupted when a drawer is pulled out. Disk drives in a drawer that is pulled out can continue to serve I/O requests. Disk drives are hot-swappable, meaning they can be replaced while the system is online.

Disk drives are installed into brackets, which are then installed into the drawers. To optimize use of available space, the high-density solution adopts a vertical design for these brackets. To install or remove disk drives, users can simply open one of the drawers and use handles on the drive brackets to insert drives into the system or pull them out, as shown below.

Drawer Cooling

Each drawer has its own cooling fan module at the back, as shown in the figure below. These cooling fan modules contain four fans each. Fans pull in air through the convection holes on the front panel. This air cools the hard drives and other internal components in the system, and exits at the back.



Why Three Drawers?

Different options exist for the design of high-density storage solutions, as evidenced by the variety of designs available on the market. The EonStor DS solution adopts a three-drawer design to optimize the user experience. The following factors make a three-drawer design the best possible option:

- Compared to products offering access to drives by opening the enclosure from the top, the horizontal drawer design is much more user-friendly. As high-density systems are mostly installed into racks, having the opening on top of the system would require users to remove the whole system from the rack when disk drives need to be replaced. Multiple people would be necessary to do so. In a drawer design, the system does not need to be removed from the rack, and drive replacements can be completed by a single person.

- Cabling in a three-drawer design is much less complex than in a single-drawer design. In a single-drawer design, each time the drawer is pulled out, a large set of cables has to slide out as well, increasing the potential for cabling mishaps. In a three-drawer design, cabling is simplified. Each drawer has its own cabling, consisting of a power cable and data signal cable. When pulling out a drawer, only one set of cables is moved, minimizing cabling issues.

- In a design featuring a larger number of drawers, for example five or six, system performance will be compromised, as bandwidth is divided up by the large number of drawers and cannot be fully optimized. Three drawers offer a balance between user-friendly maintenance and system performance.

- Material costs in a three-drawer design are relatively low, leading to attractive price points for the customer. Combined with the abovementioned factors, a three-drawer design offers the best cost efficiency.

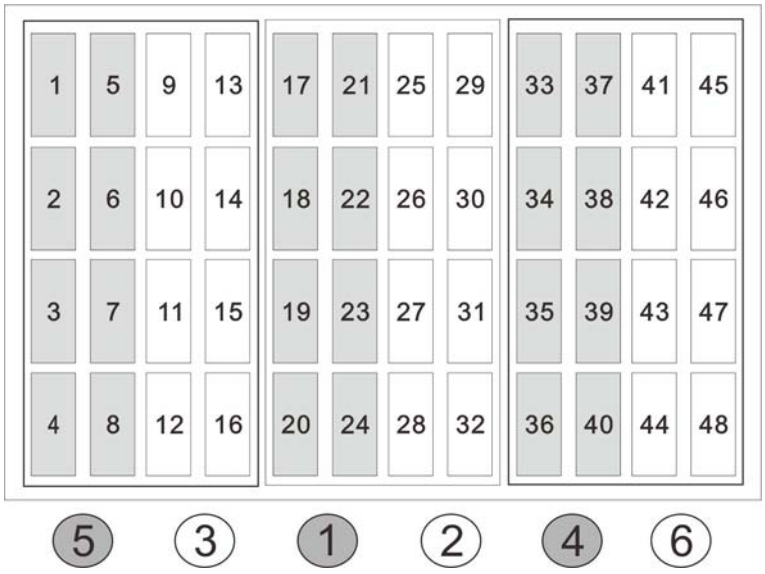
Disk Drive Installation and Logical Drive Deployment

Disk Drive Installation

Due to the weight of the EonStor DS high-density solutions, it is strongly recommended that hard drives are installed after the enclosure has been rack mounted. If drives are installed before rack mounting the enclosure, it might become too heavy to handle properly.

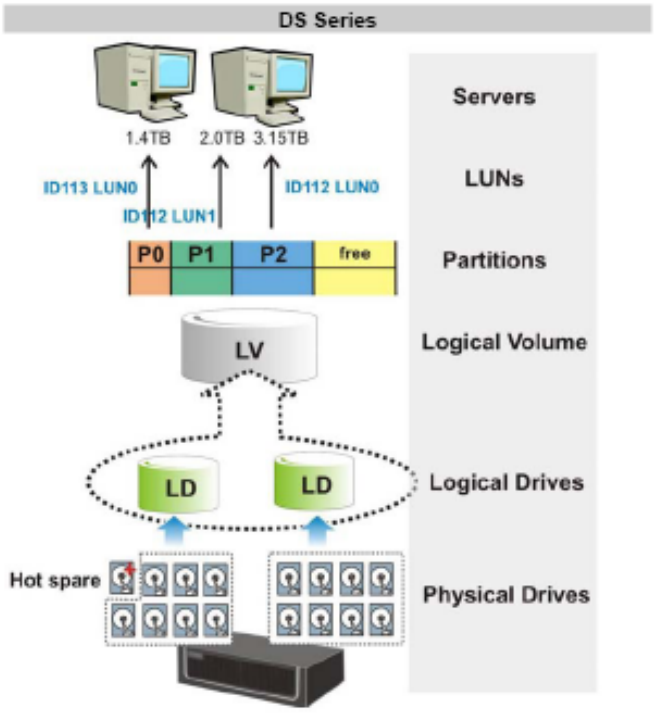
When installing hard drives, it is recommended to install eight hard drives as a set. It is also recommended to install hard drives according to the following sequence, as shown in the diagram below:

- First set: hard drive positions 17~24
- Second set: hard drive positions 25~32
- Third set: hard drive positions 9~16
- Fourth set: hard drive positions 33~40
- Fifth set: hard drive positions 1~8
- Sixth set: hard drive positions 41~48



Logical Drive Deployment

Logical drives (LD) are a collection of physical drives and form a basic building block in partitioning storage capacity for use by host applications, as shown in the figure below.



On the EonStor DS high-density solutions, the drawer design adds some extra variables to LD deployment. In particular, LDs should not exceed the size of one drawer, i.e. 16 disk drives.

Besides these drawer factors, another important element in determining optimal LD size is potential recovery time following disk drive failures. The time that LDs need to rebuild and regenerate parity following a disk drive failure can be calculated based on the following: 1TB of storage capacity requires 1.5 hours of rebuild time.

The following table offers an overview of system recovery time according to different capacities of individual disk drives installed in the storage system:

Recovery Time (1TB=1.5 hours rebuild time)			
LD Size / Disk Drive Capacity	4 Drives	8 Drives	16 Drives
1TB	6 hours	12 hours	24 hours
2TB	12 hours	24 hours	48 hours
3TB	18 hours	36 hours	72 hours

This table provides recovery indicators to be considered together with the particular application characteristics of the user. Ideally, LD recovery can take place in off-peak hours, for example a 12-hour period in nighttime hours or a 48-hour period during the weekend.

Based on their own environments, users can make a decision as to the size of LDs they wish to deploy. A general recommendation for the EonStor DS high-density systems is to deploy 8-drive LDs as they offer an optimal balance between potential recovery time, RAID protection and capacity management.

Hybrid Connectivity Benefits

Cost-effective Remote Replication

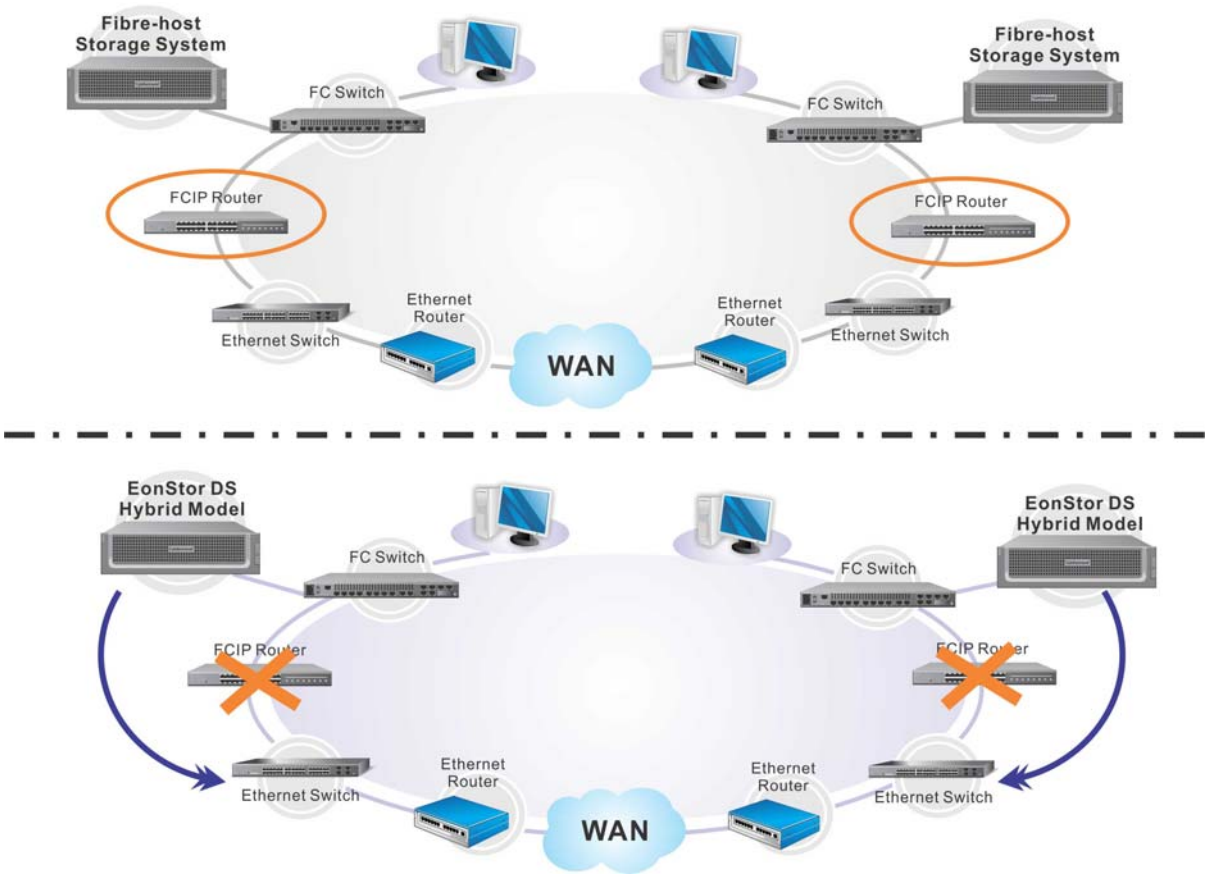
The EonStor DS high-density storage solution supports data replication, which can be conducted either in synchronous mode or asynchronous mode. The hybrid FC/iSCSI connectivity of the solution offers more options when planning data replication.

One of the main benefits of the hybrid connectivity is that users are able to implement highly cost-effective remote data replication via the iSCSI ports on the system.

Traditionally protocol converters, or FC/IP routers, are required when users want to replicate data sets on a FC-host storage system onto another FC-host storage system at a remote site over Ethernet. One router needs to be installed at the local site, while a second one needs to be installed at the remote site. These FC/IP routers require significant investments, with average prices approximately US$9,000 per router.

Remote replication can be implemented via the iSCSI ports of the EonStor DS high-density storage solution, which can be directly connected to the IP network. This allows users to skip the protocol conversion step described above and directly send the data over Ethernet to the remote site. In this way, users do not need to separately buy two FCIP routers, amounting to cost savings of up to US$18,000.

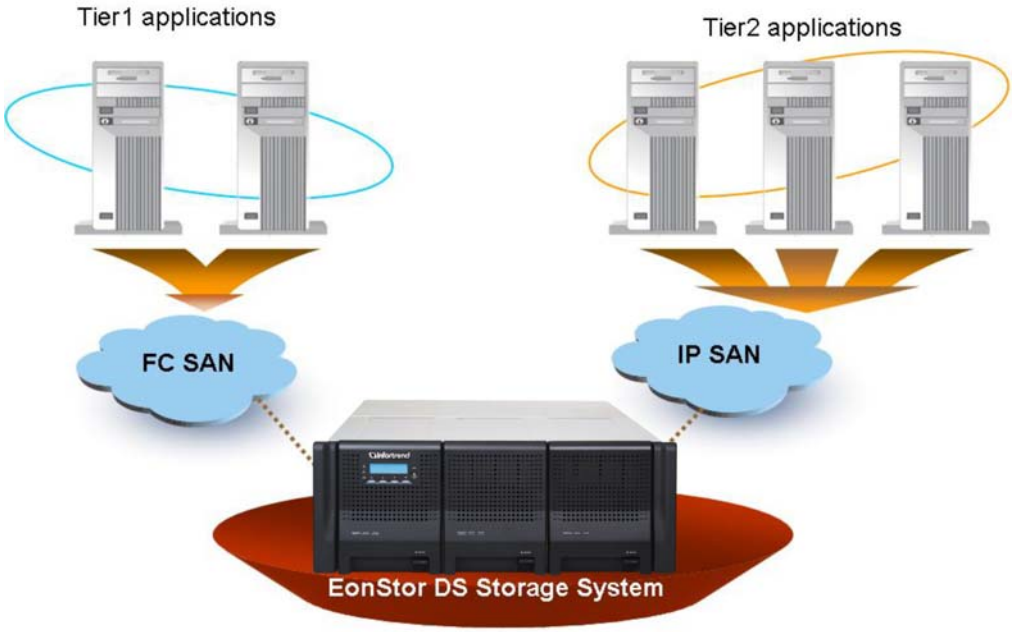
The figure below shows two remote replication set-ups: one using FC-only systems and one using the hybrid connectivity.



Remote Replication without (above) and with (below) Hybrid Connectivity

SAN Tiering

If users do not require remote replication, the hybrid connectivity enables users to deploy both FC and IP SAN and take advantage of consolidated SAN tiering. SAN tiering means that a single storage system can meet service level requirements on FC SAN and on IP SAN.



The following table provides general guidance for how to deploy applications. These general principles can help businesses increase their SAN efficiency and improve productivity.

Application Characteristics Suited for FC SAN Deployment	**Application Characteristics Suited for IP SAN Deployment**
Mission-critical applications	Non-mission-critical applications
High-performance applications	Low-performance applications
No significant cost considerations	Significant cost considerations
High data security demands	Low data security demands
High reliability demands	Low reliability demands

Solution Applications

The high density and large capacities of the EonStor DS solutions, as well as their cost advantages, can generate significant benefits in many different application environments. In particular, data archiving and HPC are two areas in which the solutions stand out.

Data Archiving

The large capacities offered by the EonStor DS high-density solutions are ideal for data archiving. Companies often deploy one set of storage systems to serve current applications and another set to store archived data. The large capacities, excellent reliability and cost efficiency of the systems make them ideal choices for data archiving, helping users maintain access to older data through a single enclosure to serve their own business needs and comply with a growing number of laws and regulations mandating long-term data retention.

In addition, the cost advantages make it affordable for companies to maintain archived data on disk systems instead of often-used tape storage. If data is stored on tape storage systems, normally a significant amount of time and management effort is needed to retrieve data. In addition, tape tends to degrade over time, creating potential issues for long-term data storage. By storing archived data on disk-based storage systems, users can enjoy instant access to archived data in case the need arises, and ensure data retention over the long term with the reliability of disk drives.

High-Performance Computing (HPC)

HPC is another area in which the EonStor DS high-density solution can excel. HPC applications are characterized by the high frequency with which data is created and the large overall amount of generated data. The EonStor DS solution is ideally positioned to accommodate these characteristics.

With four 8Gb/s Fibre Channel (FC) ports per controller (eight 8Gb/s FC ports on the dual-controller model), the EonStor DS solutions offer large bandwidth to efficiently transmit large amounts of data to and from the storage array. HPC generates large amounts of data, and the capacity advantages of the EonStor DS solution help users easily manage these data amounts. If a single system is not sufficient, expansion enclosures (JBODs) can help users expand capacity up to 240 disk drives.

In addition, HPC applications require extremely reliable hardware to ensure applications can operate without any downtime and with the highest data availability. The EonStor DS solutions offer high reliability and availability with a large number of features:

- Redundant, reliable hardware components: Redundant power supplies, cooling modules, controllers (on the dual-controller model) and others make the solution highly fault-tolerant. Even if one component fails, the system can still operate with the remaining one until the faulty component is replaced.
- RAID technology: RAID technology offers protection against up to two simultaneous drive failures.
- Advanced data services: Standard available snapshot and volume copy/mirror, as well as remote replication, offer an added layer of protection.
    - Snapshots offer space-efficient differential copies of data to enable quick recovery to any point-in-time in the event of logical or human errors.
    - Volume copy/mirror helps users deploy full data copies in their system.
    - Remote replication offers the ability to deploy full data copies at remote sites to guard against major accidents or disasters at a primary storage site (see also the previous section on the solution's hybrid FC/iSCSI connectivity).