PowerScale All-Flash F210 and F710

AI Ready Data Platform

February 2024

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White Paper

Abstract

This document describes the PowerScale All-Flash F210 and F710 nodes.

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Executive summary

Overview

PowerScale OneFS is the operating system that powers the Dell PowerScale scale-out NAS storage solutions. It is designed to handle large-scale, unstructured data with high performance, efficiency, and security. OneFS provides a unified, scalable file system that integrates data protection, eliminates volume management, and supports multiple protocols and workloads. OneFS also enables data mobility across edge, core, and cloud environments. OneFS 9.7.0.0 introduces support for the next generation of PowerEdge-based all-flash nodes.

Revisions

Date	Description
February 2024	Initial release

We value your feedback

Dell Technologies and the authors of this document welcome your feedback on this document. Contact the Dell Technologies team by email.

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Introduction

Overview

The Dell PowerScale portfolio is a family of scale-out NAS storage solutions that can handle any type of unstructured data, such as files, images, videos, and analytics. PowerScale combines the performance, flexibility, and efficiency of the OneFS operating system with the latest hardware innovations from Dell Technologies, such as NVMe, all-flash, hybrid, and archive nodes. PowerScale enables customers to run diverse workloads across multiple protocols, clouds, and locations while ensuring data security, protection, and management at scale. PowerScale is designed to help customers unlock the potential of their data and accelerate their AI, ML, and big data projects.

PowerScale offers all-flash, hybrid, and archive hardware platforms to suit various performance, capacity, and cost requirements. The current all-flash hardware platforms are:

- **PowerScale F900**: An all-NVMe node that provides the highest performance and scalability for demanding workloads. It has 24 NVMe SSDs and can scale from 46 TB to 368 TB per node.
- **PowerScale F600**: An all-NVMe node that provides high performance and capacity in a compact form factor. It has 4 NVMe SSDs and can scale from 15.36 TB to 122.8 TB per node.
- **PowerScale F200**: An all-flash node that provides cost-effective performance for a wide range of workloads. It has 4 SAS SSDs and can scale from 3.84 TB to 30.72 TB per node.
- **Isilon F800 and F810**: All-flash nodes that provide high throughput and low latency for unstructured data. The F810 also includes deduplication for higher efficiency. They have 60 SAS SSDs and can scale from 96 TB to 924 TB per node.

The next-generation PowerScale platform is based on the PowerEdge platform, providing massive performance improvements across reads, writes, and throughput.

Generative AI storage requirements

Overview

Generative AI systems thrive on vast amounts of unstructured data, which is essential for training algorithms to recognize patterns, make predictions, and generate new content. Unstructured data, such as text, images, and audio does not follow a predefined model, making it more complex and varied than structured data. For generative AI, the requirements for this data include diversity to avoid biases, high quality to ensure accurate outputs, and large volumes to improve the model's robustness. Additionally, the data must be preprocessed and cleaned to enhance the learning process. Ethical considerations are also paramount, ensuring that the data used does not infringe on privacy and is sourced responsibly. Ultimately, the unstructured data serves as the creative fuel that powers the generative capabilities of AI, enabling it to produce innovative and coherent outputs that mimic human-like creativity.

Preprocessing Unstructured data

Preprocessing unstructured data for generative AI is a crucial step that involves preparing the raw data for use in training AI models. This process includes several tasks such as cleaning, normalizing, and transforming the data into a format that the AI can understand and learn from. The goal is to enhance the quality and structure of the data to improve the performance of generative models. This can involve removing noise, handling missing values, labeling data for supervised learning, and augmenting the dataset to increase its size and diversity. By doing so, the AI models can generate more accurate and coherent outputs.

Leveraging PowerEdge

Overview

Dell PowerEdge servers are the latest generation, offering superior performance, versatility, and efficiency for various workloads and environments. Compared to previous releases, Dell Servers have several advantages, such as:

- Supporting the new 4th-gen Intel® Xeon® Scalable Sapphire Rapids processors, which deliver higher core counts, faster memory speeds, and improved security features.
- Featuring PCIe 5.0 technology, which doubles the bandwidth and reduces the latency of the previous generation, enabling faster data transfers and more efficient use of accelerators.
- Introducing the first PowerEdge servers with CXL 1.1 (Compute Express Link) capabilities, a new interconnect standard that allows high-speed communication between the CPU and devices such as GPUs, DPUs, and memory.
- Offering more storage capacity and flexibility, with up to 60% more density in the 1U chassis of the R660, taking advantage of the new E3.S form factor SSDs that are smaller and cooler than the previous U.2/U.3 SSDs1.
- Incorporating the Smart Flow design, which is a new feature within the Dell Smart Cooling suite that allows for more airflow through the systems than previous generations, keeping them cool while performing at the highest levels for long periods of time.
- Designed with a focus on environmental sustainability, reducing power consumption and carbon footprint.

PowerScale all-flash F210 and F710 platform

Overview

PowerScale’s continuous innovation extends into the AI era with the introduction of the next generation of PowerEdge-based nodes, introducing the PowerScale F210 and F710. The new PowerScale all-flash nodes leverage Dell PowerEdge R660 from the 61PowerEdge platform, unlocking the next generation of performance. On the software front, the F210 and F710 take advantage of significant performance improvements in PowerScale OneFS 9.7. Combining the hardware and software innovations, the F210 and F710 tackle the most demanding workloads with ease.

The F210 and F710 offer greater density in a 1U platform, with the F710 supporting 10 NVMe SSDs per node and the F210 offering a 15.36 TB drive option. The Sapphire Rapids CPU provide 19% lower cycles-per-instruction. PCIe Gen 5 doubles throughput when compared to PCIe Gen 4. Further, the nodes take advantage of DDR5, offering greater speed and bandwidth.

OneFS 9.7

From a software perspective, PowerScale OneFS 9.7 introduces a significant leap in performance. OneFS 9.7 updates the protocol stack, locking, and direct-write.

Thread lock contention has been significantly reduced through the implementation of a round-robin distribution strategy across thread groups. Moreover, the optimization of thread group numbers is based on core count, which leverages higher core counts to enhance parallelism. This leads to an increase in the overall efficiency and performance of OneFS.

Contention on turnstile locks has been reduced by increasing the value of Read-Write (RW) Lock retries. This adjustment permits locks to adaptively spin for an extended duration. It is particularly noteworthy that contention on turnstile locks for Non-Uniform Memory Access (NUMA) nodes incurs a high cost, making these improvements even more valuable in optimizing system performance.

In the context of NVMe storage nodes, writing operations are strategically executed around the journal for newly allocated blocks. This method circumvents potential bottlenecks associated with journal flushers, thereby enhancing the efficiency and reliability of the storage system. Such an approach is crucial for maintaining high performance and preventing delays in data processing and access.

Combined, all of the software updates provide tremendous performance improvements across workloads. The software improvements are further expanded with the hardware upgrades.

Licensing

The new all-flash nodes are part of a single license with a new tier identifier, “Tier 16”. The single license applies to the F210 and F710.

Journal enhancements

The OneFS journal in the F210 and F710 nodes uses a 32 GB configuration of the Dell Software Defined Persistent Memory (SDPM) technology. Previous platforms used NVDIMM-n for persistent memory, which consumed a DIMM slot. The BIOS-managed SDPM is a vault solution with a single module comprised of the Battery Backup Unit (BBU) and the Vault Optimized Storage Solution (VOSS) NVMe M.2 drive. During power loss, data is copied from DDR5 DIMMs to the VOSS module.

Fault LEDs

The F210 and F710 nodes take advantage of the “Fault” LEDs available on the PowerEdge platform. The “Fault” LEDs are part of the front panel with one at each end. A failed drive is indicated by an amber LED. For more information on the other LED indicators, refer to the *Dell PowerScale F210 and F710 Field Replaceable Unit Guide*.

Cooling

The Power Supply Units (PSU) on the F210 and F710 nodes are strategically split on both ends of the node for maximum cooling optimization.

Performance

The introduction of the PowerScale F210 and F710 nodes capitalizes on significant leaps in hardware and software from the previous generations. OneFS 9.7 introduces tremendous performance-oriented updates, including the protocol stack, locking, and direct-write. The PowerEdge servers offer a substantial hardware leap from previous generations. The hardware and software advancements combine to offer enormous performance gains, particularly for streaming reads and writes.

Networking

The F210 and F710 nodes provide options for the ConnectX-6 Dx dual port 100GbE PCIe Gen4.0 x16 and the ConnectX-6 Lx dual port 25GbE PCIe Gen3 and Gen4 x8.

PowerScale F210

Overview

The PowerScale F210 is a 1U chassis based on the PowerEdge R660. A minimum of three nodes is required to form a cluster and a maximum of 252 nodes. The F210 is node pool compatible with the F200. For more details, see the Brownfield Clusters section.

Figure 1. PowerScale F210

The following table lists the F210 specifications.

Table 1. PowerScale F210 node specifications

Attribute	PowerScale F210 Specification
Chassis	1U Dell PowerEdge R660
CPU	Single Socket – Intel Sapphire Rapids 4410Y (2G/12C)
Memory	Dual Rank DDR5 RDIMMs 128 GB (8 x 16 GB)
Journal	1 x 32 GB SDPM
Front-end networking	2 x 100 GbE or 25 GbE
Infrastructure networking	2 x 100 GbE or 25 GbE
NVMe SSD drives	4

The following figure illustrates the F210 node interfaces.

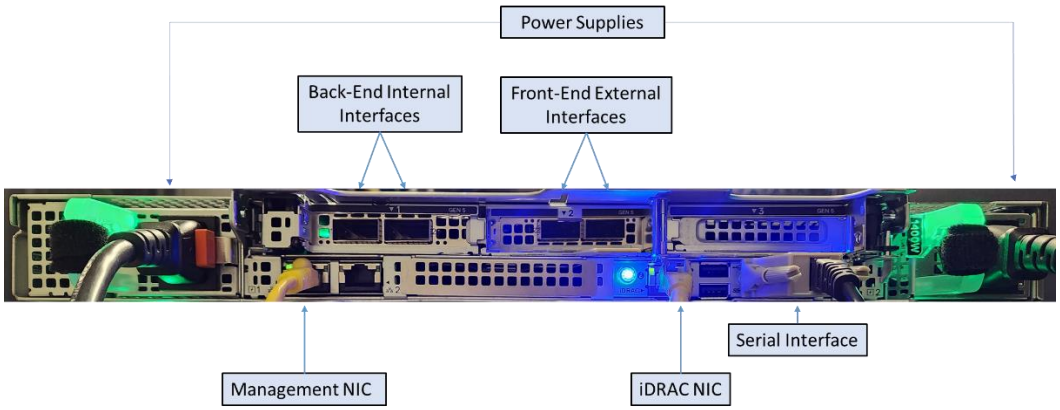

Figure 2. PowerScale F210 interfaces

Drive support & capacity

The F210 nodes use NVMe SSDs, where the previous generation F200 used SAS SSDs. Utilizing NVMe SSDs allows the F210 the advantage of the 15.36 TB QLC drive option. The F210 offers a 100% density improvement over the F200 with 2x the performance over the F200. In a 3U rack configuration of 3 nodes, the F210 raw capacity spans a minimum of 23 TB to a maximum of 184 TB. The available drive capacities for the F210 are listed in the following table.

Table 2. PowerScale F210 drive support & capacity

Non-SED Drive Capacities	SED-FIPS Drive Capacities	SED-Non-FIPS Drive Capacities
960 GB*	960 GB*	15.36 TB QLC
1.92 TB	1.92 TB	
3.84 TB	3.84 TB	
7.68 TB	7.68 TB	
15.36 TB QLC	15.36 TB QLC**	

*Short formatted 1.92TB SSDs for F200 node compatibility **Future availability

PowerScale F710

Overview

The PowerScale F710 is a 1U chassis based on the PowerEdge R660. A minimum of three nodes is required to form a cluster and a maximum of 252 nodes.

Figure 3. PowerScale F710

The following table lists the F710 specifications.

Table 3. PowerScale F710 node specifications

Attribute	PowerScale F710 Specification
Chassis	1U Dell PowerEdge R660
CPU	Dual Socket – Intel Sapphire Rapids 6442Y (2.6G/24C)
Memory	Dual Rank DDR5 RDIMMs 512 GB (16 x 32 GB)
Journal	1 x 32 GB SDPM
Front-end networking	2 x 100 GbE or 25 GbE
Infrastructure networking	2 x 100 GbE
NVMe SSD drives	10

The following figure illustrates the F710 node interfaces.

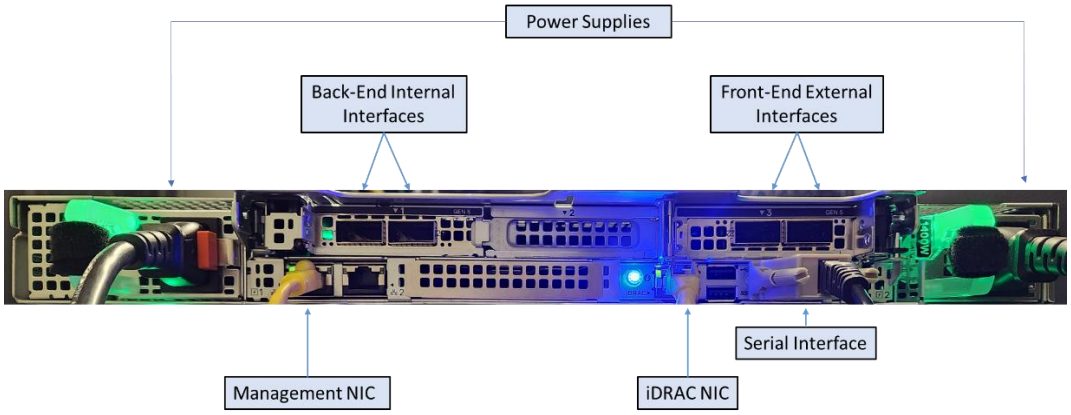

Figure 4. PowerScale F710 interfaces

Drive support & capacity

The F710 nodes use NVMe SSDs. The F710 offers a 25% density improvement over the F600 with 2x the performance over the F600. In a 3U rack configuration of 3 nodes, the F710 raw capacity spans a minimum of 115 TB to a maximum of 922 TB. The available drive capacities for the F710 are listed in the following table.

Table 4. PowerScale F710 drive support & capacity

Non-SED Drive Capacities	SED-FIPS Drive Capacities	SED-Non-FIPS Drive Capacities
3.84 TB	3.84 TB	15.36 TB QLC
7.68 TB	7.68 TB	30.72 TB QLC
15.36 TB QLC	15.36 TB QLC*	
30.72 TB QLC	30.72 TB QLC*	

*Future availability

Greenfield clusters

Overview

As a greenfield cluster is a new cluster deployment, a minimum of 3 of the F210 or F710 nodes is required to form a cluster. All 3 of the nodes must be the same platform.

Brownfield clusters

Overview

Existing clusters in the field may add the F210 and F710 nodes for additional capacity and performance. A minimum of 3 nodes is required to create a new node pool for the F210 and F710.

However, for clusters that have F200s, they have the option to increase the same node pool by adding a single F210. In this case, the only supported drive is the short formatted 1.92 TB option, resulting in a 960 GB capacity per drive. While the F210 is node pool compatible with the F200, a performance degradation is experienced where the F210 is not at full performance. When a F210 is added to F200 node pool, the WebUI explains the soft restriction in the following image.

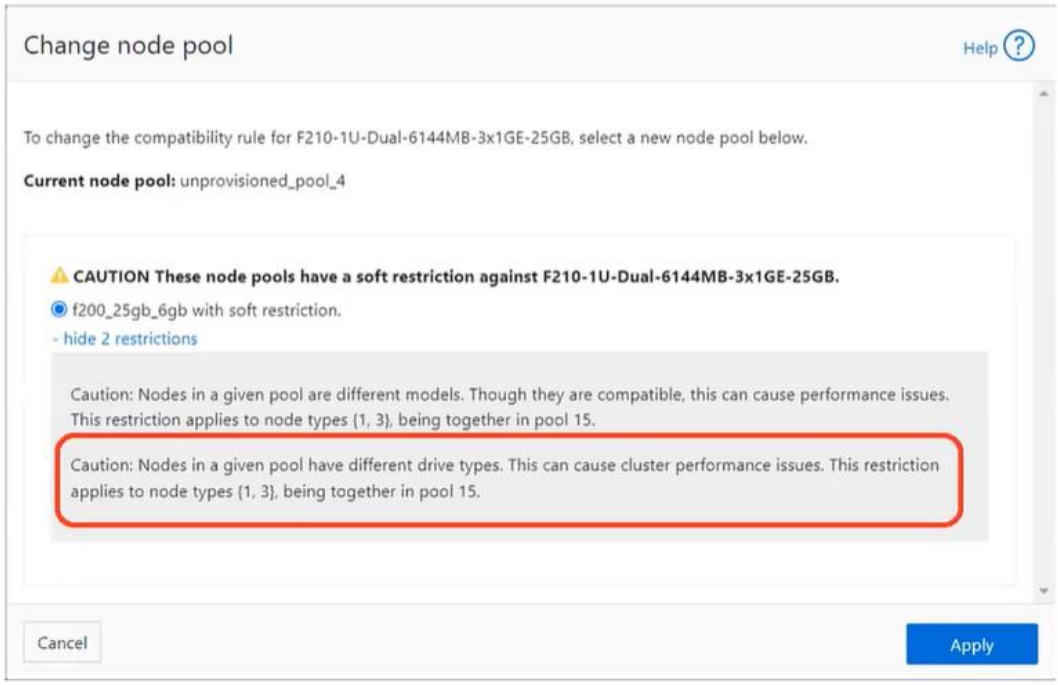

Figure 5. F210 WebUI node pool soft restriction

A similar soft restriction message is displayed in the CLI, as displayed in the following image.

```
Action can be performed successfully.
Caution: Nodes in a given pool are different models. Though they are compatible, this can cause performa
nce issues. This restriction applies to node types {1, 2}, being together in pool 13.
Caution: Nodes in a given pool have different drive types. This can cause cluster performance issues. Th
is restriction applies to node types {1, 2}, being together in pool 13.
Changing node pool membership from [1] to [1, 2].
Are you sure? (yes/[no]): yes
```

Figure 6. F210 CLI node pool soft restriction

Clusters that have F600s are not node pool compatible with the F710, requiring a separate node pool for the F710 with a minimum of 3 nodes.

References

Dell Technologies documentation

The following Dell Technologies documentation provides other information related to this document. Access to these documents depends on your login credentials. If you do not have access to a document, contact your Dell Technologies representative.

- Dell Technologies Info Hub
- PowerScale OneFS Info Hubs | Dell US