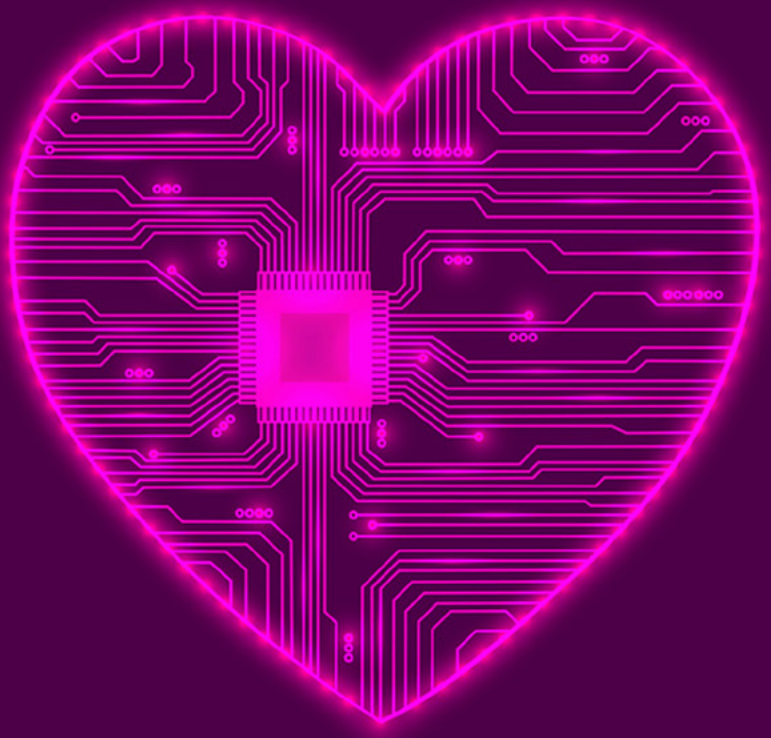
# YOUR **HARD DRIVE:** **THE HEART** OF YOUR **DATA**



## **DELL POWEREDGE** SERVERS 5 HARD DRIVE **INSTALLATION ISSUES** AND HOW TO **SOLVE THEM**

**WORKDONE – SUCCESS TODAY**

# Index

# Introduction

You probably think you know everything there is to know about **Dell servers**, but when you hit a snag, you might have to admit to yourself how rudimentary your knowledge really is. Different people have different levels of knowledge about Dell servers, usually based on experience. No matter what your level of experience is, this ebook will help prevent some of the hassle most people who own PowerEdge servers face when trying to add hard drives. This ebook will explore, in detail, five of the most common issues you might face when installing hard drives to your Dell server. **This is the ebook our clients have been asking for to help them solve problems, save time, and get their work done.**

# 1. The Many Variations of Dell Server Models: Which One Is Right for You?

Only decades ago, computers were so massive that they filled entire rooms and took multiple people to operate. Now, we carry highly advanced computers in our pockets and wear them on our wrists. Technology is always changing, and it's never going to stop.

As technology advances, it evolves to fulfill different functions and needs. Dell server generations renew every three to four years. With each generation, the chassis **frame stays the same**, but the servers are updated with **faster processors** and **better expansion cards.**

Different models of Dell servers are used for different things; there's no "one size fits all" server.

**There are five main types of Dell servers:**

- **C = Cloud:** Modular server nodes for hyper-scale environments
- **F = Flexibility:** Hybrid rack-based sleds for rack-based FX2/FX2s enclosure
- **M = Modular:** Blade servers and other items for the M1000e and/or VRTX enclosure
- **R = Rack**-mountable servers
- **T = Tower** servers

There is in these days more different purpose on Dell servers like latest DELL EMC Data Domain and Data Protection -servers.

T and R servers, the more traditional product lines, are equipped with **hot-plug hard drive bays** with many variations. Dell PowerEdge T640 can even have 32 x 2.5" HDD drives, max. 122TB disk- space. While C, F, and M models typically only have a few drive slots built to RAID-1 volume. Nineteen inch rack-mountable servers come in different heights, with most modern servers at heights of 1U or 2U.

## With so many different server models, who has time to be an expert on all of them?

There are **seven generations** of Dell servers, and approximately 191 individual server models. Most models have two or three different backplane types, and there are three different sizes of drive bays. **That's hundreds of possible variations.**

But don't worry! It's not as scary as it seems. When it comes to long-term compatibility, Dell is probably one of the best server suppliers out there. For example, not every new server model requires a new hard drive carrier frame. Once you choose the right server model for you, you'll be able to stick with it for a long time.

## Here are a few things you should know about your server when adding hard drives:

- *What type and size of drive bay does your server have?*
- *Is your drive bay hot-plug or standalone (cabled)?*
- *What hard drive standards does your Dell PERC RAID Controller support?* (For example, older Dell PERC Raid Controllers don't support a new type of NVMe drive.)

Inserting Hard Drive into PowerEdge Modular Blade server

## What are hot-plug and hot-swap hard drives, and how do they work?

Most modern hot-swap methods use a specialized connector with staggered pins that ensure certain pins are connected to others. On most staggered-pin designs, the ground pins will be longest, so no sensitive circuitry can be connected before the system is grounded. That's what makes hot-plug hard drives possible.

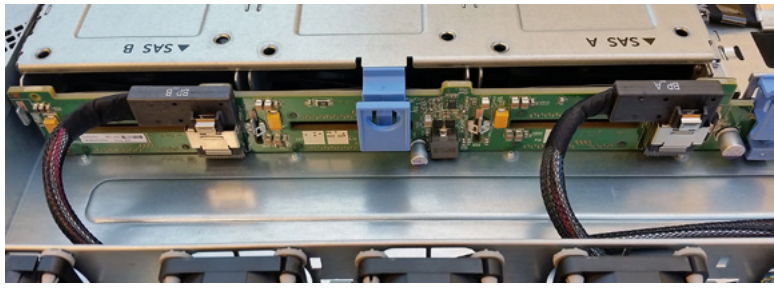
Hard drives are installed into a Hot-Plug **PowerEdge carrier frame.** The frame with the installed drive slides into the server drive bay and connects the hard drive data and power connectors to the server backplane. The server backplane is then connected to a Dell PERC RAID Controller inside the server.

When you boot your server, the hard drives will spin, and the RAID Controller will use the drives. Once you've installed all the hard drives you need, you should be able to see them in the RAID menu.

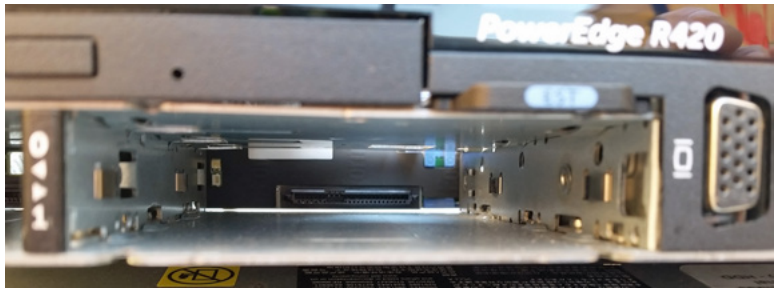
## So, what do you do when you have to install something new?

Go to the RAID menu and create a new Virtual Disk. The Virtual Disk will consist of the hard drives you've physically installed. Usually, two hard drives are configurated as RAID-1 for operating system use, and configuring a set of drives as RAID-5 for data volume use.

To be safe, you can also install and configure a drive as a "Hot Spare." If any of your other physical drives fail, your Hot Spare will save the day. The Dell PERC RAID Controller will automatically rebuild the Hot Spare to replace the target volume of the failed drive.



PowerEdge R420 backplane, inside the server




Drive Bay with Hot-Plug backplane

# 2. Is Your Hard Drive Missing a Few Screws?

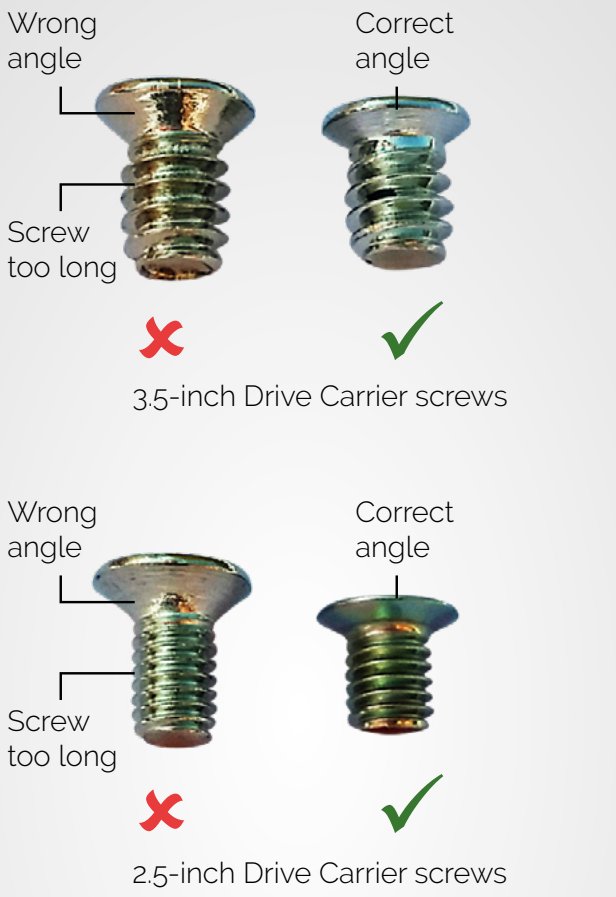
Dell Optiplex, Precision, and "non hot-plug" standalone server models have a flexible blue plastic 3.5 inch hard drive frame – with no screws required. The rest of the Dell PowerEdge server models require screws to attach the hard drive to the hard drive frame, which makes life a little more difficult for us.

It might sound ridiculous, but one of the most common problems we see is **missing mounting screws**, or screws that are simply the **wrong size.** And, obviously, without the proper screws, you can't install your hard drive.

Hard drives need to be screwed to the hard drive carrier frame with four mounting screws. Of course, 2.5-inch hard drives need smaller screws than 3.5-inch hard drives. However, there is a special converter you can use to install a 2.5-inch hard drives into a 3.5-inch drive bay – but in that case, you'll need even more screws. Eleven, instead of four.

We've found that there are some SSD drive suppliers that don't supply the right size screws, and that can cause a lot of problems. It's vital to have the correct screws to save the hard drive from future complications, and to save you a few headaches down the road.

Generally, you should use the shortest screws needed to reach through whatever brackets hold the HDD. If the screws are too long and you tighten them all the way, you could damage the drive, but screws that are too short won't hold things in place properly.




Hard Drive mounting screws

## What type of hard drive should you choose?

In the past, hard drives were very storage size-focused. Now, hard drive manufacturers are trying a different tactic, focusing on storage speed and performance.

In order to get the maximum speed of the hard drive, backplane, cables, and controller all have **to support same speed.** Example - plugging a 6Gb/s hard drive into a 3Gb/s backplane will result finally in the speed being 3Gb/s.

The Dell PERC RAID Controller and other RAID/SAS/SATA controllers can support a variety of hard drives. There are five main drive types used in Dell servers. (Keep in mind that the physical size of your hard drive will always be either **3.5 inches, 2.5 inches, or 1.8 inches**.)

When you read the terms "consumer drive" and "enterprise drive," just keep in mind that lower-priced consumer drives will not have been tested as thoroughly as more expensive enterprise drives.

SSD, SATA and SAS hard drives ready to install

## So, what are the five types of hard drives?

**Serial ATA (SATA):** These are the basic hard drives in Dell PowerEdge servers. These have a few advantages over the older parallel ATA, including reduced cable size and cost, native hot-swapping, and faster, more efficient data transfer. SATAs are the cheapest drives, but their MTBF (mean time between failures) isn't great. Most of the time SATAs fail on basic Dell server systems.

**Near Line SAS:** These are enterprise SATA drives with an SAS interface, head, and media, and the rotational speed of traditional enterprise-class SATA drives with the fully capable SAS interface typical for classic SAS drives. SATA drives provide better performance and reliability than SATA drives. Basically, this drive is a hybrid between SATA drives and SAS drives.

**Serial Attached SCSI (SAS):** SAS is a point-to-point serial communication protocol used in enterprise hard drives and tape drives, replacing the older parallel SCSI bus technology. SAS drives have higher RPM and are equipped with a bigger cache memory. These are the top-end in performance for electromechanical drives, but also much (much!) more expensive than SATA hard drives.

**Solid-State Drive (SSD):** An SSD is a data storage device that uses integrated circuit assemblies as memory to store data persistently. The development and increased use of SSDs has been driven a rapidly expanding need for higher I/O performance. SSDs have much lower random access and read access latency than HDDs, making them ideal for both heavy read and random workloads. High-performance servers, laptops, and desktops, or any applications that need to deliver information in real-time, can benefit from SSD technology.

**Non-Volatile Memory express (NVMe):** NVMe is a communication interface developed specially for Solid State Drives (SSD). NVMe allows host hardware and software to get the most out of the parallelism made possible by modern SSDs. NVMe reduces I/O overhead and improves performance. NVMe is dramatically fast – the fastest drive that you can add to your server.

## 3. Is Your Drive Bay or Hard Drive Simply the Wrong Size?

The two most common hard drive sizes are **2.5-inch and 3.5-inch.** 1.8-inch hard drives are also available for some server models. That's the physical size of the drive – how big they are when you hold them in your hands, not their internal capacity. When you pick up a Dell brochure and see "8 x 2.5-inch bay," that means that server can hold eight 2.5-inch hard drives. So, don't try to install 3.5-inch hard drives.

The capacity of the hard drives depends on the available server space and how much capacity you actually *need*. Why are you installing new hard drives to your server in the first place? What are you using them for? That's one of the main things you should consider when determining hard drive capacity.

Now, it's important to note that the same server model can be configured in a variety of ways. Take a look at this table. A Dell PowerEdge R730 can have eight 2.5-inch drive bays or 16 2.5-inch drive bays, or, you can order that same server to fit eight 3.5-inch drives. You can use these variations to your advantage to suit your individual size needs.


| Server model | Storage Options | Supported DELL PERC RAID |
|---|---|---|
| R730 | 8 or 16 x 2.5" SATA, SAS, NL-SAS HDD's or SATA, SAS SSD's | H330, H730, H730p |
| | 8 x 3.5" SATA, NL-SAS HDD's | H130, H330, H730, H730p |
| R730xd | 18 x 1.8" SATA SSD's + 8 x 3.5" SATA, NL-SAS HDD's | H330, H730, H730p |
| | 24 x 2.5" SAS, SATA, NL-SAS HDD's and SATA, SAS SSD's with or without optional flex bay: 2 x 2.5" SAS, SATA, NL-SAS HDD's and SATA, SAS SSD's | H330, H730, H730p |
| | 12 or 16 x 3.5" SATA, NL-SAS HDD's with or without optional flex bay: 2 x 2.5" SAS, SATA, NL-SAS HDD's and SATA, SAS HDD's | H330, H730, H730p |

## Understanding Hard Drive Indicator Codes

Help! Why is my hard drive indicator light switching from green to amber?

Each hard drive carrier has an activity indicator and a status indicator to provide information about the current status of the hard drive. The activity LED indicates whether or not the drive is currently in use, while the status LED indicates the condition of the hard drive.

| Drive-status indicator pattern (RAID only) | Condition |
|---|---|
| Flashes green twice per second | Identifying drive or preparing for removal. |
| Off | Drive ready for insertion or removal |
| Flashes green, amber, and turns off | Predicted drive failure |
| Flashes amber four times per second | Drive failed |
| Flashes green slowly | Drive rebuilding |
| Flashes green for three seconds, amber for three seconds, and turns off after six seconds | Rebuild stopped |

**NOTE:** The drive status indicator will remain off until all hard drives are initialized after the system is turned on. Drives are not ready for insertion or removal during this time.



# 4. Choose the Correct Hard Drive Size for the Server Bay Size

You can't choose the correct hard drive or the correct drive carrier until you actually know **what size drive bay your server has.** You should know that before you start ordering hard drives. How can you check this? Simple: press the release button, open the release handle, and slide the hard drive with its drive carrier out of the server. Just measure it. Do you have 2.5-inch or 3.5-inch drives?

Dell server with 3.5-inch Drive Bay

Dell server with 2.5-inch Drive Bay

**The hot-plug hard drive needs a drive carrier** to connect the hard drive to the server backplane. The backplane is connected to a DELL PERC RAID Controller, and RAID volume can be created or adjusted from the RAID controller menu after installation.

But what about **standalone backplanes?** Not all entry-level Dell PowerEdge servers have hot-plug backplanes. With a standalone backplane, hard drives are complete inside the server, and cables are connected directly to the hard drive connectors. On smaller Dell servers with basic controllers, hard drives are cabled one-by-one. Cabled hard drives aren't hot-swappable.

3.5-inch and 2.5-inch SAS Hard Drives

## What's the purpose of a hard drive carrier?

Hard drive carriers are multipurpose. The hard drive carrier/frame/removable hard drive enclosure is just a modified drive bay that allows a standard hard drive in a carrier assembly to be removed and inserted with little effort. The carriers have a release handle that can be used to push the drive out of the server. Basically, a hard drive carrier converts an internal hard drive into a removable hard drive.

Hard drive connectors have to hit backplane connectors precisely, or the entire installation won't work. That's another purpose of the hard drive carrier – it physically holds the hard drive in the correct position, so the connectors meet.

It's important to have the correct carrier for the hard drive. One hard drive should be installed per drive carrier. If the server bays aren't full, a plastic drive "blank" cover can be used, which also helps the cooling process work properly so hard drives won't overheat.

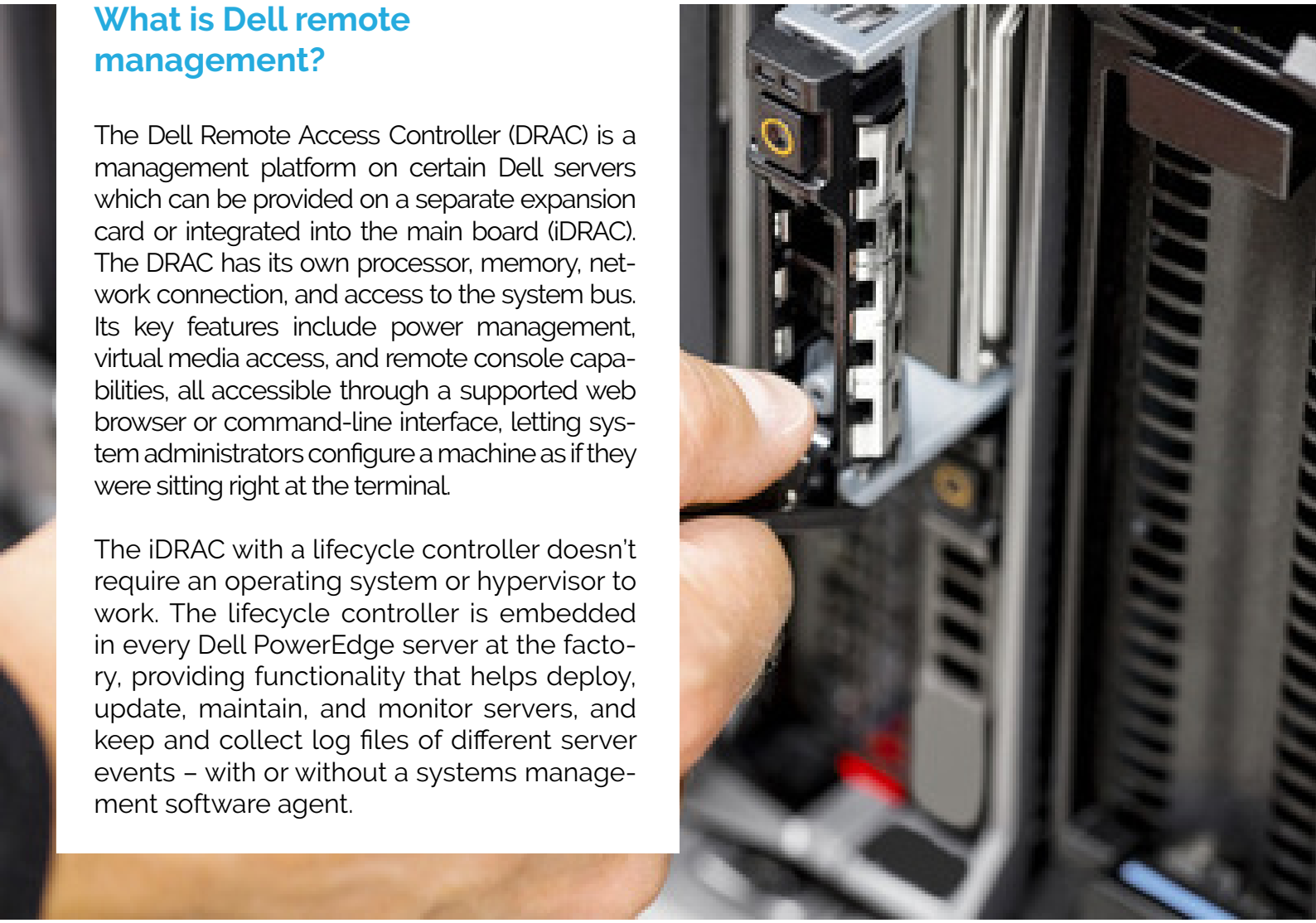
3.5-inch Hot-Plug Drive Carrer to 11, 12 and 13th Generations DELL servers

Press the release button to open the release handle and slide hot plug caddy for inside or outside of your server. The Hot-Plug WORKDONE Caddy is for connecting a hard drive to a server backplane. Your server backplane is connected to a DELL PERC RAID controller. After installation, you can adjust or create RAID Volume from the RAID controller menu.

## What is Dell remote management?

The Dell Remote Access Controller (DRAC) is a management platform on certain Dell servers which can be provided on a separate expansion card or integrated into the main board (iDRAC). The DRAC has its own processor, memory, network connection, and access to the system bus. Its key features include power management, virtual media access, and remote console capabilities, all accessible through a supported web browser or command-line interface, letting system administrators configure a machine as if they were sitting right at the terminal.

The iDRAC with a lifecycle controller doesn't require an operating system or hypervisor to work. The lifecycle controller is embedded in every Dell PowerEdge server at the factory, providing functionality that helps deploy, update, maintain, and monitor servers, and keep and collect log files of different server events – with or without a systems management software agent.



## What do Dell server names mean?

If a computer salesman tells a customer, "This is a dual core 2.4 GHz with an i5 processor, 16 GB Ram, and a 256 GB solid state hard drive," the average layman will probably respond with bewilderment.

You'll see the world in a whole new light once you're familiar with Dell PowerEdge server naming standards. Starting with the tenth generation of PowerEdge servers, Dell decided to switch up their naming conventions. Now, sever names generally consist of a single letter followed by either three or four numbers, and these letters and numbers aren't arbitrary.

We talked about the letters earlier. The letter indicates what type of server it is:

- **C** = Cloud
- **F** = Flexible
- **M** = Modular
- **R** = Rack-mountable
- **T** = Tower

From there, the numbers tell you more about the system.

## If the server name has three numbers...

The first number after the letter indicates the system's CPU architecture class.

- **1-3** = 1 CPU
- **4-7** = 2 CPUs
- **8** = 2 or 4 CPUs
- **9** = 4 CPUs

The second number indicates the generation, starting with 0 for tenth generation, 1 for eleventh, and so on.

The third number indicates the supplier of the CPU, with 0 for Intel and 5 for AMD.

Here's a practical example: an R710 is a **rack-mountable** server with a maximum of two CPUs from **the eleventh generation** with **Intel processors.**

## If the server name has four numbers...

The first number indicates the class of the system, with 1-5 being iDRAC Basic and 6-9 being iDRAC Express.

The second number indicates the generation, just like with three-number server names.

The third number indicates the number of CPUs – either 1 or 2.

The fourth number, as with three-number server names, indicates the supplier of the CPU.

Here's a practical example: an R6415 is a **rack-mountable** server with a maximum of **two CPUs** from **the fourteen generation** with **AMD processors.**

Here's a shortlist of some models that fall outside of these naming conventions:

## PowerEdge M1000E

This is a blade-based server node integrating servers, storage, networking, and management in a single chassis design, introduced during the tenth generation. The enclosure supports up to 16 half-height blade server modules, eight full-height blade server modules, eight sleeves with quarter-height blade server modules – or a customizable mix of all three server module heights. The server modules are designated Mxxx.

PowerEdge M1000e
back view

## PowerEdge VRTX

Like the M1000E, the PowerEdge VRTX integrates servers, storage, networking, and management into a single chassis. Introduced during the twelfth generation, the PowerEdge VRTX enclosure holds up to four half-height server modules, two full-height server modules, or a mix of both.

## PowerEdge FX2 / FX2s

The PowerEdge FX2/FX2s was introduced during the thirteenth generation as a hybrid rack-based computing platform. The enclosure takes up to two full-width compute sleds, four half-width compute sleds, eight quarter-width compute sleds, or a mix of sled types. The enclosure can also support half-width storage sleds mapped to the compute sleds. The compute sleds are designated FCxxx and FMxxx, while the storage sleds are designated FDxxx.

## Dell PowerVault

This is a line of data storage and backup products from Dell, launched as a less expensive product line after Dell acquired EqualLogic in 2008 and Compellent Technologies in 2011.

# 5. You've Installed Dell PERC RAID, But the Controller Can't See and Use the Installed Hard Drives!

This issue can cause support workers to grow a lot of gray hairs. Everything might look perfect, but for some reason, it's not working. When you boot the server, there doesn't seem to be a problem – until the disks don't spin and there are no indicator lights to be seen.

How can you avoid this headache? Check the carrier frames. **Make sure the hard drive is in place properly.** If there's no connection between the hard drive and the backplane, there might as well be no hard drive.


## RAID

A RAID (Redundant Array of Independent Disks) is simply a group of physical disks that provides high performance by multiplying the number of drives used to save and access data. A RAID subsystem improves I/O and data availability, as well as data storage and fault tolerance. However, keep in mind that RAID shouldn't be used as a backup solution (and we'll talk more about backup later!).

RAID subsystems can be implemented with either hardware or software. A system using hardware has a DELL ERC RAID Controller that implements RAID levels, processes and reads the data, and writes it to the physical hard drives. When using basic software RAID, the operating system implements the RAID levels, so using software RAID by itself can slow system performance.

## Is RAID the First Level of Data Protection?

If we believe that data loss can be covered by rectifying the hard drive failures by rebuilding the missing data from the remaining physical disks, RAID is only one building block in the grander scheme of data recovery. In accordance to our thoughts and beliefs, data loss can be covered because we have rectify the hard drives failures by rebuilding the missing data from the remaining physical disks containing data or parity. RAID is only one building block, a brick among the walls of data recovery scheme because it cannot replace a backup plan.

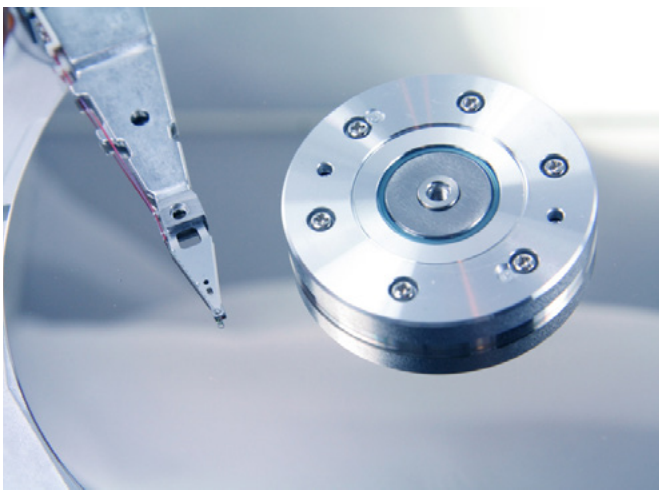
Most RAID levels are strong, and they can protect you against data loss and help in recovery from hardware defects, but what they *can't* protect you from is data loss from sources outside the system – such as fire, water damage, or theft. They also won't protect the system against soft errors, such as user error, software malfunction, and malware infections.

So, if you want to include RAID as part of your data protection plan, that's fine. But, remember, RAID is only the *first level* of protection. You'll need more than that to keep your data safe.

## Which RAID is Right for You?

Are you using a RAID for performance, for fault tolerance – or for both? Are you implementing a RAID with hardware or software? These are important questions to ask when choosing the RAID that's right for you.

Software supports fewer levels than hardware-based RAID. Most hardware-based RAID controllers have battery backup, but different controllers have different processors, cache memory, and support different levels of RAID.




## RAID Levels and What You Can Use Them For?

**RAID 0** is also known as "disk striping." With RAID 0, data is written across multiple hard drives, meaning that the computer's work is handled by multiple disks, which increases performance. A minimum of two hard drives is required for RAID 0. What's the downside? There's no fault tolerance; if one disk fails, the entire setup is affected, upping the chances of data loss or corruption.

RAID 0 is ideal for things like image retouching or video editing – working with data that has to be read or written at high speeds.

**RAID 1** is also known as "disk mirroring." This a fault-tolerance configuration where data is copied, or "mirrored," from one hard drive to another in real time. If one hard drive fails, the other will keep working. This is a relatively low cost configuration, and it's one of the simplest ways to improve fault tolerance. Unfortunately, there's always a downside. RAID 1 causes performance to drag slightly, and it halves disk capacity.

RAID 1 is ideal for critical storage, such as in accounting systems, where data storage is vital. RAID 1 is also good for small servers that only have two hard drives.

**RAID 5** is, for business servers and enterprise NAS devices, the most common RAID by far, providing better performance and fault tolerance than disk mirroring. With RAID 5, data and parity are striped across three or more hard drives. If a hard drive starts to fail, data is recreated from the distributed data and can eventually be rebuilt to new disks when failing disks are replaced. The downside to RAID 5 is that servers that perform a lot of writing will take a performance hit.

RAID 5 is ideal for file and application servers with a limited number of data drives, mixing efficient storage with strong security and good performance. It's a balanced system that gives you the best of both worlds.

**RAID 6** is identical to RAID 5, except it uses an additional parity block. Because of this, your system will remain operational even if two disks die.

RAID 6 is ideal for the same uses as RAID 5, except it's better for servers that use many large drives to store data.

**RAID 10,** often referred to as RAID 1+0, is a combination of RAID 1 and RAID 0. RAID 10 gives the best performance, combining the mirroring of RAID 1 with the striping of RAID 0 – but you'll be paying more for great performance, because RAID 10 requires twice as many hard drives as the other RAID levels. RAID 10 can be implemented as hardware or software, but a lot of the performance advantages are lost when you go the software route.

RAID 10 is ideal for heavily used database servers or servers that are doing a lot of writing. It's both secure because it mirrors your data, and fast because the data is striped across multiple disks.

## Whatever You Do, Remember to Back Up Your Data!

Again, RAID is only the first level of protection when it comes to keeping your data safe. No matter how big or small your company is, or even if your computer is only for personal use, there's no technological mishap worse than the irrecoverable loss of data.

Data backup has always been a vital issue in the world of technology, and it's come a long way from being limited to physical devices like floppy disks, CDs, thumb drives, and external hard drives. Now, we have cloud storage. And as the popularity of cloud storage increases, you have a choice to make – should you back up everything through cloud storage, or do you store data locally?

## When Backing Up Your Data, Use the 3-2-1 Rule!

**The 3-2-1 rule** is pretty simple: have at least three copies of your data, keep those copies on at least two different types of storage, and have at least one of those copies offsite. For example, if you have a file full of irreplaceable family photos, have three copies of that file. You could put one copy on a flash drive, back the photos up to the cloud, and keep another copy offsite.

The 3-2-1 method is cost-effective, flexible, and gives you easy access to your files. If your system fails, don't worry! The 3-2-1 rule is now widely hailed as an industry best practice. This rule states that you should have three (3) copies of your data at all times, that you keep it backed up on at least two (2) different types of storage, and that you have at least one (1) copy of the data offsite.

However, even the best plan has disadvantages. Depending on what backup methods you use, the 3-2-1 system might not be the fastest way to recover your files. There's also some security risk involved with putting your files in cloud storage and having offsite copies. But, in this case, the benefits of backing up irreplaceable data might just outweigh the risks.


## Acquisition by Dell

On October 12, 2015, Dell Inc. announced its intent to acquire EMC in a cash-and-stock deal valued at $67 billion, which has been considered the largest-ever acquisition in the technology sector. Dell CEO Michael Dell explained that the purchase was meant to "evolve the company into the most relevant areas where IT is moving," combining Dell's enterprise server, personal computer, and mobile businesses with EMC's enterprise storage business.

DELL EMC has a wide range of new servers like traditional Rack and Tower models, Modular servers like blade, ready node servers like VMware and vSAN, and Data Center servers and disk arrays. Almost all of these servers have hard drive slots. Starting with the 14th Generation, the Dell server name is DELL EMC PowerEdge.

## Fire suppression failure brings down Nordic Nasdaq

A gas-based fire suppression system was triggered at the data center north of Stockholm, taking a data hall occupied by the Nasdaq Nordic stock exchange offline. DigiPlex has contacted DCD to tell us no other customers were affected - and there was no actual fire. Nasdaq Nordic migrated its operations to the site in 2015 as part of a plan to diversify the technology services it offers to the global financial services industry.

Fire suppression systems are often guilty of bringing down data centers.

Gaseous, inert fire suppression systems can cause issues as the eruption of gas sends a shockwave, which can damage a data center's equipment.

This happened at ING Bank's data center in Romania in 2016, in an unnamed university in London (UK) last year, and at Glasgow City Council's data center in 2015.

Microsoft suffered a similar incident last year during a routine maintenance operation. In this instance, it wasn't the gas itself that caused the outage. When the system was triggered, it set a series of automated safeguarding functions in motion: first, the facility's air handler units shut down, as they would in the case of an actual fire, to prevent their absorbing residue, and then, as the temperature in the data center rose, the IT systems' thermal health monitoring functions shut down to prevent overheating.

# Conclusion

Just as all the parts of a computer needs to function properly to provide a smooth experience when in use, the servers, hard disk and frames also need to function properly all together. The naming of your server is more important than you think, find out all about it. Furthermore, the purpose of a hard disk determines its use and would also tell on the kind of server to be used. Know what you want and always seek for help. That is the first step into achieving a problem-free installation.

Lastly, always have a BACKUP!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