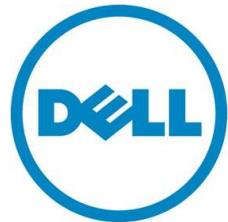


Beyond five nines availability: Achieving high availability with Dell Compellent storage center

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Dell Storage Product Group



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Introduction

The goal of this paper is to address the origin and meaning of the five nines standard, explore what 99.999% availability can do for an organization and examine how highly available Dell Compellent products offer a different approach to building high availability and data accessibility into enterprise storage environments.

High availability: What matters most?

What matters most to today's businesses? At a very basic level we all want to grow and move our organizations forward. We all want to deliver a positive experience for our customers. And we all want to enable our employees to do their jobs without interruption and add value to the organization. These may all seem like obvious goals, but in order to achieve them, customers, employees, partners and others must have access to the data and the applications they need. And we don't want to compromise the functionality of application environments tailored to meet our users' requirements and business needs. In other words, the applications shouldn't have to be altered to meet the requirements of the storage environment; the storage should be fluid to fit the application.

Five nines or 99.999% availability standard has its origins in the telecom industry. It characterizes the technical capabilities of an individual system. It does *not* characterize the capability of an organization to use the technology to meet its goals. To measure the impact of technology on an organization requires consideration of the entire IT environment and its effectiveness as a whole in providing access to data.

A good example of the limitations of a non-holistic approach to data availability is disaster recovery. Traditionally, data availability and disaster recovery efforts have focused on the importance of the application to the organization. For example, a disaster recovery plan might classify applications by importance to the organization and model recovery plans accordingly. For example, top-tier applications would be backed up within one or two hours, mid-tier applications in 8 to 12 hours and low priority applications in days or weeks. The problem with this approach is that it ignores application interdependencies. A top-tier application might need to access data from an application that has been classified as a lower priority, in which case the disaster recovery model fails.

In most organizations, the traditional view of 99.999% availability is somewhat narrow and is not as important as the organizational impact of data availability. The emphasis is on creating an IT environment in which users have access to the data they need to operate and to move the organization ahead—regardless of where the data resides and regardless of issues with network, storage or servers anywhere in the environment.

This isn't just relevant to large organizations, but also the smallest of companies; we're all global and at any given time customers or employees continuously need access to data. It could be a manufacturing facility that operates around the clock, it could be a customer in a different part of the world accessing a website to make a purchase or it could just be day-to-day internal operations that keep a business moving forward—continuous access to data is critical.

What 99.999% availability really means

The five nines standard originated in the telecom industry as a part of an effort to minimize downtime. 99.999% availability indicates that an environment will have five minutes or less of downtime per year (see Table A). Achieving five nines availability involves removing all single points of failure from a system. However, the five nines availability model considers only downtime related to system failure—that is to say, only unplanned downtime. An organization could have systems that deliver five nines availability and still have hours, days or even weeks of planned downtime.

Availability%	Downtime per year
90% ("one nine")	36.5 days
99% ("two nines")	3.65 days
99.9% ("three nines")	8.76 days
99.99% ("four nines")	52.56 minutes
99.999% ("five nines")	5.26 minutes

Table A: Availability is usually expressed as a percentage of uptime in a given year. The following table shows the downtime that will be allowed for a particular percentage of availability, presuming that the system is required to operate continuously and shows the translation from a given availability percentage to the corresponding amount of time a system would be unavailable per year.

Consider, too, that five nines does not actually measure availability beyond a single device. In a world of virtualized and distributed computing, it would be almost impossible to compound the availability of all the individual devices in the environment and arrive at a meaningful measure of overall data availability.

These are the real-world limitations of the five nines metric. Any time you don't have access to your data, you're down, whether it's planned downtime or not. Lack of access to the data has a negative impact on customers, employees are less able to do their jobs as intended and your organization's growth is restrained. And tallying the individual 99.999% availability systems in your environment will not yield a meaningful measure of data availability as all systems within the data center must be considered as part of the aggregate computing environment.

A worthwhile approach to data availability should consider data accessibility and planned downtime. How do you accomplish those management and maintenance tasks that traditionally require downtime—adding or reconfiguring storage, changing RAID levels, moving data from one type of RAID or one tier of disk to another, or from one array to another—without limiting the ability to access data?

Dell Compellent: Going beyond five nines

By virtualizing physical resources, Dell Compellent Storage Center achieves a higher level of abstraction that overcomes the limitations of traditional storage, allowing you to perform routine management and maintenance without taking down the applications users rely on to keep business moving.

At Dell, we're addressing data accessibility issues with a 24x7x365 mentality. The Dell Compellent family offers 99.999% availability¹ by the standard measure, but we go beyond the concept of five nines. We take planned data downtime into consideration in our approach to building our hardware, the technologies behind our software and in our unique, award-winning support.

Building high availability into hardware

The foundation of continuous data availability is based on a hardware environment in which users can access the data during activities that traditionally require downtime, both unplanned and planned.

Dell removes the potential for a single point of failure from the whole environment rather than merely moving that single point of failure around within the environment. Our approach is to provide a hardware environment in which accessing data uses no shared components.

Clustering dual storage controllers with no shared backplanes or midplanes, and then connecting that fully redundant cluster to storage devices in a multi-loop or multi-chain configuration, provides redundancy at all points and allows for a hardware environment that is highly available. Providing reliability and redundancy in components most likely to fail—power supplies, fans, spinning disk drives—contributes to this infrastructure of availability. Wherever possible, components are designed to be hot swappable, eliminating downtime for maintenance and repair.

Data management traditionally requires planned downtime. Virtualization can help change that. Dell Compellent virtualizes storage at the drive level, enabling you to create high performance, highly efficient virtual volumes in seconds, without allocating drives to specific servers and without complicated capacity planning and performance tuning. Read/write operations are spread across all drives in your virtualized pool of storage, so multiple requests are processed in parallel, accelerating data access.

In addition, you can change and scale your virtualized storage dynamically without disruption or downtime. Start with a single controller, add a second controller, join the two into a cluster, all while allowing access to the data. Add drives and drive enclosures, replace fans and power supplies—even go inside a controller and replace interface cards to upgrade or fix hardware issues, with your data accessible to users all the while.

A hardware environment built on this blueprint can keep data accessible during activities that traditionally had a negative impact on business, and keep the organization moving forward.

Building high availability into software

Software that contributes to data availability includes automated data placement, virtualization, and data protection solutions. Again, the Dell Compellent approach is holistic, and focused on keeping data optimally accessible for users—in any circumstance, and at every stage in its lifecycle.

Dell Compellent storage software features built-in automation that optimizes the provisioning, placement and protection of data throughout its lifecycle. For example, storage tiering enables an organization to keep data available cost effectively. Data Progression, Dell Compellent’s patented tiering technology, automatically classifies and migrates data to the optimum storage tier and RAID level based on actual usage. As shown in Figure 1, all new data is written to Tier 1, RAID 10 and snapshots cascade to the lowest available tier within 24 hours. Then, the most active blocks of data remain on high-performance drives, while less active blocks automatically move to lower-cost, high-capacity drives. Under this approach, your storage is optimally utilized, data is easily recoverable and users and applications have fast access to the data they need.

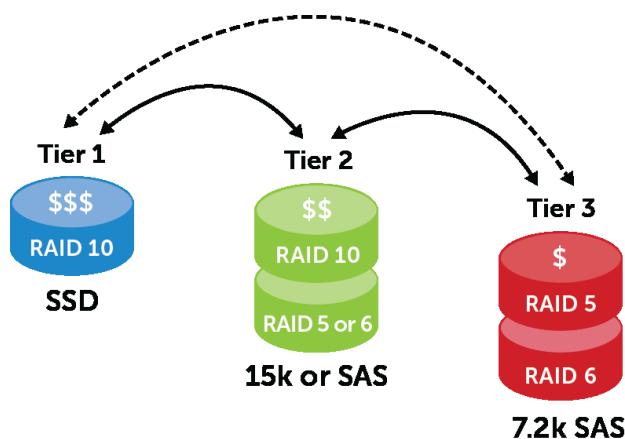


Figure 1: Dell Compellent automated tiered storage dynamically classifies and migrates data to the optimum tier based on frequency of access.

Another way Dell Compellent builds high availability into storage software is Dell Compellent Data Instant Replay, sometimes referred to in the industry as “snapshot technology” or “continuous data protection.” A Replay, see Figure 2, is similar to a snapshot in that it captures a point-in-time copy of data; however, it has intelligence that lets you access read-only data without having to make a copy of that data. You can take continuous, space-efficient snapshots to speed local recovery of lost or deleted files. Once an initial snapshot of a volume is taken, only incremental changes in the data need to be captured. Every Replay is a readable and writable volume that is automatically stored on lower-cost drives, and can be used to recover any size volume to any server in less than 10 seconds.

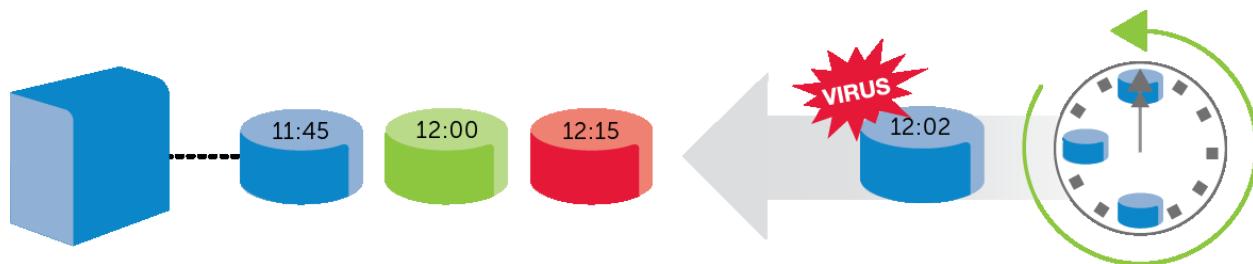


Figure 2: Dell Compellent Instant Replay captures incremental changes in data for real-time protection with instant recovery to any point in time.

Remote Instant Replay leverages Replays between local and remote sites for cost-effective disaster recovery and business continuity solutions. After initial site synchronization, only incremental changes in data are replicated on an ongoing basis, cutting hardware, bandwidth and administration costs. You can replicate over Fibre Channel or native IP as your business requires.

Dell Compellent Live Volume, see Figure 3, enables dynamic business continuity by letting you move storage volumes between Dell Compellent arrays on demand. All migration occurs transparently while applications remain online. Live Volume functionality is fully integrated in the Dell Compellent platform and requires no additional hardware, server agents or costly appliances. It supports any virtualized server environment and complements leading virtual machine movement engines.

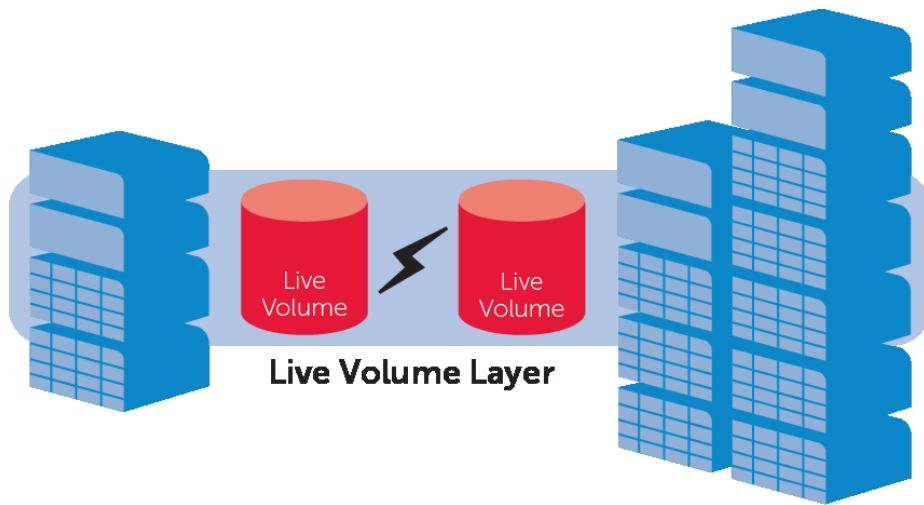


Figure 3: Dell Compellent Live Volume acts as a storage hypervisor, actively mapping one volume to two Dell Compellent arrays at the same time.

Building high availability into support

Consistent, sophisticated, and proactive technical support contribute to high availability by keeping your hardware and software operating optimally. Copilot Support is Dell Compellent's award-winning interactive and comprehensive enterprise storage support. When you call Copilot Support, you have the benefit of a single point of contact who understands your product thoroughly and will own your hardware or software problem until the issue is resolved. Copilot's multi-tier support organization enables quick escalation when needed.

Copilot PhoneHome technology proactively monitors your storage environment for potential problems, reviews the data gathered and provides system recommendations and proactive issue resolution. Copilot's proactive approach to issues both great and small has been demonstrated to pay off—Dell has actually been the first to alert customers to air conditioning failures, based on high temperature readings in a controller.

Customers have compared Copilot to having a Dell Compellent expert on staff, and have given Copilot a 96.77% customer satisfaction rating.²

Copilot Optimize is an option that takes that award-winning support to the next level. You are teamed with a highly-trained system analyst skilled at providing proactive support tailored to your specific environment. You get a range of in-depth expertise and customized deliverables, including lifecycle planning, architecture configuration and software advice, technology upgrades and best practice recommendations. Regularly scheduled system reviews and health checks help maximize performance

and optimization of your Dell Compellent Storage Center SAN and align storage initiatives with business requirements. This combined understanding of your complete storage environment, along with the knowledge of current technology trends, further contributes to creating a highly available environment.

Summary

Together, the components of the Dell Compellent storage solution—hardware redundancy, advanced software capabilities and award-winning support—help eliminate downtime formerly necessitated by a wide range of planned administrative and maintenance activities. This approach lets Dell Compellent achieve a level of availability that goes beyond five nines in keeping organizations moving toward their goals.

Footnotes:

¹Results based on January 2012 internal Dell testing with actual MTBF calculated from a run time total of 26 million+ hours (accumulated by 6,724 systems). Run time and availability impacting failures for a 6 month period from 8/2011 thru 1/2012. Estimated weighted average MTTR of 7.2 hours for 12 hour part SLA, 4.5 hours for 4 hour part SLA.

² Based on Dell customer survey, April 2012

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