Network Attached Storage (NAS) Solutions with Hardware RAID. High Data Backup and Reliability without Loss of Performance.

Hardware RAID, RAID 6, and Windows Storage Server
Introduction

RAID is an acronym for Redundant Array of Independent Disks and describes a technology that allows multiple independent hard disks to be combined in one or more arrays in order to improve performance, capacity, and data backup. When the first RAID solutions were implemented at the start of the 1990s, they were exclusively hardware-based. The hard disk array was controlled by boards with high-performance I/O processors. And due to the high cost of the RAID controller, this solution was only used in expensive enterprise servers.

Later with the introduction of software-based RAID, this data storage technology became an interesting option for more cost-effective servers, network attached storage (NAS), external storage devices, desktop computers, and even mobile devices. Today RAID is found Business and Consumer devices alike.

Buffalo now brings RAID technology full circle by reintroducing hardware RAID. But unlike devices from the 1990s, this time the cost, physical size, complexity, and available populated capacities are cutting-edge and ready to take on the role of ‘Work Horse’ in any Windows network.

This white paper first discusses the advantages of implementing a hardware RAID solution in an NAS and then addresses the question of why companies should store their data in RAID 6. The second part of this paper considers the new Buffalo TeraStation WSH with Windows Storage Server 2016 and hardware RAID in more detail.

Software RAID vs. Hardware RAID

Operating System Software RAID

In a pure software RAID solution, the hard disk array of the NAS is controlled by an application that is built into the operating system. This application is normally provided free of charge as a feature of the operating system and does not require any additional hardware.

The greatest advantage of software RAID is therefore already clear: It is a low-cost solution. The only costs for the user are the purchase of additional mass storage devices for data redundancy.
However, software RAID has a range of disadvantages, primarily in terms of performance and data reliability:

- Negative impact on the performance of the storage solution: The more complex the RAID solution, the greater the system usage. With RAID 5, for example, NAS performance is hugely impaired. The user is forced to choose between high performance with low data reliability or impaired performance with high data reliability.

- No protection during booting: The RAID software is not active when the system starts up and cannot manage or protect the stored data. Should a hard disk fail or data get corrupted during booting, the RAID will no longer be operable.

- Loss of data due to system crash
Hardware RAID

Hardware RAID means that the hard disk array is controlled by a separate controller. This relieves the main CPU, allowing it to work unhindered by RAID processes. The system can therefore maintain high performance even with complex RAID levels such as RAID 5 or 6 and run data-intensive applications at the same time. Even the high system usage required by a RAID rebuild does not cause any noticeable decline in performance. Separating the control of the RAID from the operating system also eliminates the other disadvantages of software RAID:

- Protected during system startup: If the boot drive generates errors or totally fails during booting, this does not negatively affect the data stored in the RAID array.
- Data remains intact if the host system crashes.
- A host system crash caused by a virus does not affect the RAID array or data integrity.

Nevertheless, because of the additional and not insignificant costs, hardware RAID controllers are rarely implemented in NAS solutions. In most cases, a software RAID solution is completely sufficient.

Backup Speed & Time Comparison
During anti-virus and backup software are used at the same time

<table>
<thead>
<tr>
<th>Hardware RAID</th>
<th>Software RAID</th>
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<tbody>
<tr>
<td>WS5610DN96 Intel Celeron J1900 Quad Core</td>
<td>WS5600DN6 Intel Atom Dual Core</td>
</tr>
<tr>
<td>Backup Speed</td>
<td>49 MB/s</td>
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<tr>
<td>Backup Time</td>
<td>5h 36min</td>
</tr>
</tbody>
</table>

5h 36min
1TB (19GB x 52) backup

66% Time Saving with Hardware RAID
RAID 5 and RAID 6

In contrast to RAID 1 where data is mirrored one-to-one, with RAID 5 and RAID 6 more complicated methods of data storage and distribution are used on the drives in the array. RAID 5 requires at least three drives, while RAID 6 needs four drives – but RAID 6 is not supported by Windows and is therefore not an option for many users.

With both RAID levels, the RAID controller generates checksums from the data blocks to be written – known as parity – and writes the data separately on a neighboring drive. The data and checksums are therefore distributed evenly on all drives through a special process. If one drive in the array fails, the lost data is restored from the data blocks and parity data that still exists and written to a new drive. This reconstruction process can take anywhere from hours to days. While RAID 5 only allows for one drive to fail, users of RAID 6 can survive the failure of (any) two drives without losing data, so they are protected from data loss even during the RAID reconstruction process after a drive has failed. This “two-dimensional” parity provided by RAID 6 does require more computing time than RAID 5, however. “Non-recoverable read errors” present a further risk. These errors can occur even on modern and very reliable hard disks or SSDs.

If this type of error occurs during a RAID reconstruction, it is highly likely that data will be lost if a RAID 5 solution is used. In most cases, the RAID cancels the rebuild due to the read error. If this occurs, the data must be backed up first and then the RAID set up again. RAID 6 eliminates the risk of data loss and the extremely tedious process of restoring the RAID array as far as possible. The second parity of the RAID 6 can be used here to reconstruct the sectors that are unreadable on the other drive.

Complex RAID levels pay for their data reliability with increased computing time. In the case of software RAID, this inevitably means impaired performance of the main CPU. Therefore, users and companies with high requirements in terms of data availability would find an NAS solution with RAID 6 and hardware RAID ideal. However, hardware RAID has previously been a rarity in network attached storage that is extremely cheap compared to enterprise servers.

<table>
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<tr>
<th>RAID Level Comparison</th>
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<tbody>
<tr>
<td><strong>Features</strong></td>
</tr>
<tr>
<td>Minimum # Drives</td>
</tr>
<tr>
<td>Data Protection</td>
</tr>
<tr>
<td>Read Performance</td>
</tr>
<tr>
<td>Write Performance</td>
</tr>
<tr>
<td>Read Performance (degraded RAID)*</td>
</tr>
<tr>
<td>Write Performance (degraded RAID)*</td>
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<tr>
<td>Capacity Utilization</td>
</tr>
<tr>
<td>Typical applications</td>
</tr>
</tbody>
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* “Degraded RAID” means that the RAID is no longer optimal (full redundancy) because of one or more drive failures but is also not (yet) “offline/failed” (data no longer operable).
Buffalo TeraStation™ WSH with Windows Storage Server 2016 and Hardware RAID

In addition to strong performance and a high degree of reliability, companies also want a network attached storage solution that can be easily integrated into the company network. NAS with Windows Storage Server is the optimal solution for networks with exclusively Windows policies and/or fully integrated Windows environments. It can be seamlessly integrated and is very easy to use with large and complex domain organizations (including sub-domains).

Additional advantages of a WSS-NAS include:
- Lower network complexity with higher efficiency, performance, and availability
- Resilient file system (ReFS) for maximum scalability and reliability
- Easy administration of computing centers and private clouds, plus convenient linking with public cloud services
- Easy connections between users and IT resources
- Compatibility with Windows Server 2016 applications: Since Buffalo™ Windows Storage Server 2016 has the same code basis as Windows Server™ 2016 devices, compatibility with applications does not have to be individually tested. Furthermore, antivirus and security applications that function with Windows Server operating systems can be used with Windows Storage Server 2016 without problems.

One disadvantage of the Windows Storage Server operating system is limited RAID level support: RAID 6 and RAID 10 are not supported. Implementing a hardware RAID controller solves this problem, but was previously only found in expensive Windows Server solutions. To meet customers’ demand, Buffalo has now launched the updated to 2016 and 8GB RAM version NAS with hardware RAID and Windows Storage Server for small to medium-sized businesses: the TeraStation™ WSH5610DNS6.
TeraStation™ WSH5610DNS6

The TeraStation™ WSH5610DNS6 with Windows Storage Server is equipped with a proprietary Buffalo hardware RAID controller and a separate SSD for the operating system. This approach improved both the reliability and stability as well as the performance and speed of the NAS, and the HDD array can be completely used for user data.

- Windows Storage Server 2016 Standard (unlimited number of users)
- Intel® Celeron™ Quad Core processor with 2 GHz and 8 GB DDR3 RAM
- Seamless integration in any Windows Server environment
- Support of Active Directory
- iSCSI Target optimizes storage-related tasks in development and test environments as well as in production environments for small to medium-sized business or branches
- RAID Striped/10/5/6
- Completely fitted with NAS drives with a total capacity of 12, 24 or 48 TB
- 2 x LAN, 1 x USB 3.0, 2 x USB 2.0, 1 x eSATA, 1 x HDMI, 1 x UPS Serial D-Sub 9, 1 x VGA
- Support of DFS (distributed file system)
- Pre-installed software: RAID builder, e-mail notification, Buffalo Dashboard, Buffalo replication and backup (remote backup possible)
- 3 year warranty

Summary

Companies and professional users with very high requirements for their NAS in terms of data reliability and protection against drive failures should choose RAID 6. This is the only RAID level that protects the system from data loss even during a RAID re-build after a hard disk has failed. Since restoring a RAID can take one or two days with the very large data amounts that are typical these days, the risk of a second hard disk failure or a „non-recoverable read error“ during this time is too high for a company to simply ignore. Windows software does not currently support RAID 6, however. Users who rely on Windows Storage Server for their NAS due to easy integration and/or company policies can work around this problem with the Buffalo TeraStation WSH with hardware RAID. Hardware RAID also provides additional advantages, primarily in terms of performance and stability, and is also now affordable for companies with lower budgets.

Further information on TeraStation Windows Storage Server and Buffalo’s entire product portfolio of network attached storage solutions for businesses here: www.buffalo-technology.com