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OVERVIEW

This paper provides an overview of Lenovo ThinkServer RAID 100 on the TS430, and gives basic instructions for using the pre-boot Configuration Utility to setup and manage RAID storage configurations on the server.

EMBEDDED RAID 100 FEATURES ON TS430

ThinkServer RAID 100 provides the following features:
- RAID 0, 1, and 10 Support
- RAID 5 with optional upgrade key
- Mixed capacity drives in RAID array
- Patrol Read (Sector scan and repair)
- Global Spares with Auto rebuild
- Auto Rebuild
- Auto Verify & Repair (Consistency check)
- > 2TB HDD Support for data volumes
- Bad block management
- Staggered HDD spin-up

RAID OVERVIEW

The first step to creating a RAID configuration is to configure the drives into an array, which holds one or more partitions known as virtual drives. The virtual drive will be assigned a RAID level, which is seen by the host computer system as a single drive volume.

CHOOSING THE RAID LEVEL

The RAID level selected should be based on consideration of several factors, the most important being performance, fault tolerance, and storage capacity. Not all of these factors can be optimized at the same time. These factors are discussed in each of the following RAID level descriptions.

RAID 0

RAID 0 combines hard drives so that all data is divided into manageable blocks called stripes. The stripes are distributed across all the drives in the RAID array.

However, data stored in a RAID 0 volume is not redundant. Therefore, if one hard drive fails, all data on the virtual drive is lost.

Read/write performance is generally improved, especially for sequential access, because adjacent data can be accessed from more than one hard drive simultaneously.

The RAID 0 volume appears as a single physical hard drive with a capacity equal to the size of the smallest hard drive multiplied by the number of drives in the array.

RAID 1

RAID 1 combines even numbers of hard drives so that all data written to one drive is simultaneously written to another drive in the array.

This provides complete, real-time redundancy of all data on the first drive, also called a mirror. Performance is minimally impacted by the overhead associated with duplicating the data.

The RAID 1 volume appears as a single physical hard drive with a capacity equal to half that of the total drive capacity.
RAID 5

RAID 5 uses disk striping and parity data across all drives (distributed parity).

RAID 5 provides redundancy, protecting against a single drive failure with the smallest reduction in total storage capacity.

High data throughput can be achieved, especially for small random read transactions. Read performance is almost as good as RAID 0 for the same number of disks. Random write performance, however, can suffer due to the overhead of updating parity for each write.

The RAID 5 volume appears as a single physical hard drive with a capacity equal to the total drive capacity less the capacity of one drive, which is used to hold the parity data.

RAID 10

RAID 10 is a combination of RAID 0 and RAID 1, and consists of striped data across mirrored spans. An even number of drives in each RAID 1 span must be used. RAID 10 provides full redundancy within each span.

By striping data across spans, performance is increased by enabling access to multiple drive groups simultaneously. In most cases, RAID 10 provides better throughput and latency than all other RAID levels except RAID 0 (which can have greater throughput). It is the preferable RAID level for I/O-intensive applications.

The RAID 10 volume appears as a single physical hard drive with a capacity equal to \( \frac{1}{2} \) of the total drive capacity in the configuration.
Configure BIOS for RAID operation. The SATA controller must be set to RAID mode.

1. Power on the TS430.

2. Press the F1 key to enter the BIOS Setup Utility.

3. In the BIOS Setup Utility, go to the "Advanced" tab and select "SATA Configuration."

4. Set "SATA Mode" to "RAID Mode."
5. To accept the changes press F10 and select “Yes” when prompted to “Save Configuration and Exit.”

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RAID CONFIGURATION

Configure RAID using the pre-boot LSI Software RAID Configuration Utility.

The Configuration Utility allows the creation, management, and deletion of RAID arrays from the available physical drives on the TS430. If RAID volumes have already been configured, the Configuration Utility does not automatically change their configuration.

The basic steps to create a RAID configuration are as follows:

a. Select a configuration method from the Configuration menu (Easy Configuration, New Configuration, or View/Add Configuration).
b. Create arrays using the available physical drives.
c. Define the virtual drive(s) using the space in the arrays.
d. Initialize the new virtual drive(s).

1. Reboot the TS430.

At the prompt, type CTRL-M or press the ENTER key to launch the LSI Software RAID Configuration Utility.

The “Management Menu” will be displayed.

2. Use the up and down cursor keys to select from the menu.

Select “Configure” from the Management Menu, and press the ENTER key to enter the “Configuration Menu.”
3. To create a new RAID array, select “New Configuration” from the menu and press ENTER. This will clear any previous configuration and start a new configuration.

To keep any existing data on an previously defined storage configuration, use “View/Add Configuration” instead of New Configuration.

4. A warning message will be displayed. Select “Yes” to confirm that any previous storage configuration will be erased, and to continue with the configuration (data is not actually erased until the newly defined configuration is initialized at the end of the creation process). The “Array Selection” menu is displayed.

5. The “Array Selection” menu displays all disk drives on the TS430 and their status. Select the drives to be added to the RAID array.

Use the cursor keys to select the first drive with READY status and press the SPACEBAR. This will change the status from READY to ONLIN (on line).

The cursor will automatically move to the next available drive with READY status. Press the SPACEBAR, which will change the status from READY to ONLIN. Repeat this step for all drives to be included in the new RAID array.
Text next to ONLIN indicates the array number and the drive number inside the array. For example, A00-00 indicates array 0 and drive 0.

Press ENTER to complete the selection of drives for the current array. The “Array Selection” Menu is displayed.

To define multiple arrays, complete the steps to configure the first array, then select all the drives for the next array.

6. Press the SPACEBAR which will display the “SPAN-1” message in the “A-0” text area as shown, to configure the array.

Press F10 to continue. The “Virtual Drive Configuration menu” is displayed.

7. The “Virtual Drive Configuration Menu” is used to select the RAID level, stripe size, read policy, and other attributes for the new virtual drives.

Using the cursor keys, move between line items on the “Virtual Drive Configuration Menu” to select options. Press ENTER to select an option.

8. The RAID drop-down menu lists the possible RAID levels for the virtual drive.

In this example, use the cursor keys to select RAID 5 and press ENTER.
9. The “Units” drop-down menu lists the unit of measure for defining the size of the virtual drive (MB, GB, or TB). Use the cursor keys to select the desired Units and Press ENTER.

10. Use the cursor keys to select “Size” and Press ENTER. Type the size of the Virtual Drive for this array.

   The default value displayed is the maximum capacity that can be used given the physical disks involved. Entering a lower value will allow the creation of multiple virtual drives on these disks (for example, a RAID 0 and RAID 1 virtual disks on the same drives).

   For RAID 10 arrays, only one logical drive can be defined for the entire array.

11. Use the cursor keys to select “DWC” and Press ENTER. Select the “Disk Write Cache” setting (see Disk Write Ahead Cache in Understanding Options for more information).

12. Use the cursor keys to select “RA” and Press ENTER. Select the “Read Ahead” setting (see Read Ahead Policy in Understanding Options for more information).
13. Use the cursor keys to select “Accept” and press ENTER to accept the configuration and create the specified Virtual Drive, and return to the “Array Selection Menu.”

Configure additional virtual drives in the same array, if desired.

14. Configure additional arrays if desired, otherwise, press ENTER to end the array configuration.

15. At the prompt, select “Yes” to save the RAID configuration, or select “No” to cancel the operation.

16. After the Virtual Drives on the array are created, information about the virtual drives in the array is displayed. This information includes Virtual Drive ID, RAID Level, Volume Size, Number of Stripes, Stripe Size, and Virtual Drive Status.

Confirm the RAID array has been configured properly.

Press any key to continue, then press ESC to return to the “Management Menu.”
17. Select “Initialize” and press ENTER to finalize the configuration.

The “Virtual Drives” menu is displayed.

18. From the “Virtual Drives” menu, press the SPACEBAR to select the virtual drive to initialize. The virtual drive name is highlighted in yellow. To deselect it, highlight the logical drive and press the SPACEBAR again.

Press F10.

This will perform a “fast initialization” in which zeroes are written to the first and last 8 Mbyte regions of the new logical drive.

19. Select “Yes” at the prompt and press ENTER to begin the initialization.

At this point selecting “Yes” will cause any previous data on the drives to be lost.
20. Initialization will begin.  
A graph shows the progress of the initialization until it is complete.

After the initialization is complete, press ESC to return to previous menus.

21. Press ESC to exit the Configuration Utility and select “Yes” at the prompt.  
Press CTRL-ALT-DEL to reboot the system.

22. The system will reboot and display the status of the RAID array that was created.

### CONFIGURING ADAPTER PROPERTIES

The pre-boot LSI Software RAID Configuration Utility allows properties for adapters, logical drives, and physical drives to be managed.

1. To view or change adapter properties select “Objects” from the “Management Menu.”

2. Select “Adapter” from the “Objects” menu.”
3. Select the default adapter from the “Select Adapter” menu.

4. The following list of adapter properties is displayed. To change a value, use the cursor keys to select and highlight the entry and press ENTER. Select or type a different value for the property and press ENTER. Press ESC to return to the “Management Menu.”

See Adapter Properties in Understanding Options for more information.

5. To view or change Virtual Drive properties select “Objects” and “Virtual Drive.”

7. The only virtual drive properties that can be changed are Disk WC (Disk Write Cache) and Read Ahead (see Understanding Options for more information). The other properties are read-only.

8. To view physical drive properties, select “Objects” and “Physical Drive.”

9. Highlight the physical drive to view on the list that appears and press ENTER.

10. Select “Drive Properties” from the menu.
11. The drive properties are Device Type (Disk), Capacity, Product ID, Revision No., and Link Speed. These properties are read-only.

## CONFIGURING ADAPTER PROPERTIES

### DISK WRITE AHEAD CACHE

When the disk Write Cache is On, a write transaction is considered to be complete when all the data has been written to the disk cache, which can boost performance. When disk Write Cache is Off, the write transaction is complete only when the data has been written to the disk.

When the disk Write Cache is On, there is a danger that data could be lost if the power fails before the cached data is written to disk.

### READ AHEAD POLICY

When disk Read Ahead is On, extra data is read sequentially ahead of the data that is actually requested and is stored in a cache. If the additional read-ahead data is then requested, it can be read faster from the cache than from the disk directly.

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### ADAPTER PROPERTIES

The following table lists the properties that are applied to all arrays defined on the system.

<table>
<thead>
<tr>
<th>PROPERTY</th>
<th>DESCRIPTION</th>
<th>OPTIONS</th>
<th>DEFAULT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rebuild Rate</td>
<td>The percentage of CPU compute resources dedicated to rebuilding failed drives. A rebuild rate of 100 percent means that the system gives priority to rebuilding the failed drives.</td>
<td>0 to 100 (% of system resources)</td>
<td>30</td>
</tr>
<tr>
<td>Chk Const Rate</td>
<td>A consistency check is an operation that verifies that all stripes in a virtual drive with a redundant RAID level are consistent, and that automatically fixes any errors. The consistency check rate is the rate at which consistency check operations are run on the server.</td>
<td>0 to 100 (% of system resources)</td>
<td>30</td>
</tr>
</tbody>
</table>
| BGI Rate               | Background initialization establishes mirror or parity for a RAID virtual drive while allowing full host access to the virtual drive. BGI has these advantages:  
- The virtual drive is available for access immediately throughout while BGI is active.  
- Virtual drive is consistent. BGI has these disadvantages:  
- Initialization is slower when compared to Full FG1 as it involves reads for parity generation. | 0 to 100 (% of system resources)     | 30        |
| Disk WC (Disk Write Cache) | See Disk Write Ahead Cache                                                                 | Off, On                              | Off       |
| Read Ahead             | See Read Ahead Policy                                                          | On, Off                              | On        |
| BIOS State             | Not used                                                                     | Enable, Disable                      | Enable    |

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</tr>
</thead>
<tbody>
<tr>
<td>FGI Rate (Foreground initialization rate)</td>
<td>Foreground initialization (Full FGI) establishes a mirror or parity for a RAID virtual drive as rapidly as possible, but does not allow access to the virtual drive until initialization is complete. The initialization erases all previous data by writing zeros to every sector of the virtual drive. The virtual drive becomes available after the initialization is complete without requiring a controller restart or system reboot. FULL FGI has these advantages: • Considerably faster than BGI, as it involves no reads. • Virtual drive is consistent. • Virtual drive is cleared of any pre-existing user data. FULL FGI has the following limitation: • Virtual drive is not accessible while FGI is in progress.</td>
<td>0 to 100 (% of system resources)</td>
<td>30</td>
</tr>
<tr>
<td>Cont On Error</td>
<td>This option enables the boot process to continue when the RAID BIOS encounters an error during boot-up.</td>
<td>No, Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Auto Rebuild</td>
<td>Causes a rebuild to start with a new or spare drive automatically after a drive failure is discovered.</td>
<td>On, Off</td>
<td>On</td>
</tr>
<tr>
<td>Auto Resume</td>
<td>When Enabled, a consistency check, rebuild, or initialization can be stopped and resumed later where it left off, instead of aborting it &amp; starting over.</td>
<td>Enable, Disable</td>
<td>Enable</td>
</tr>
</tbody>
</table>

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<th>PROPERTY</th>
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</tr>
</thead>
<tbody>
<tr>
<td>Fast Init</td>
<td>Fast initialization erases the first and last 8 MB of data area of the virtual drive by writing zeros to wipe out any remains of boot block or partition tables. This feature will also clear the MBR and GPT partition tables on a virtual drive. A background initialization operation launches automatically after fast initialization completes to ensure virtual drive consistency. Fast FGI has the following advantage: • This operation is extremely fast, hence the virtual drive is almost instantly accessible to the user. Fast FGI has the following limitation: • Virtual drive is not consistent as this requires BGI.</td>
<td>Enable, Disable</td>
<td>Enable</td>
</tr>
<tr>
<td>Read Ahead</td>
<td>See Read Ahead Policy</td>
<td>On, Off</td>
<td>On</td>
</tr>
<tr>
<td>Disk Coercion</td>
<td>Indicates the capacity to which the selected drive can be coerced to make it compatible with other drives that are nominally the same capacity.</td>
<td>None, 128MB, 1GB</td>
<td>1GB</td>
</tr>
</tbody>
</table>

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**MANAGEMENT TASKS**

**REBUILDING A DRIVE**

The LSI Software RAID Configuration Utility enables a drive of a redundant array to be manually rebuilt if the array has a failed drive. If the failed drive is still good (that is, if the drive is physically present and its size is greater than or equal to the defined size of the array) it will be rebuilt.

Follow these steps to rebuild a drive:

1. Select “Rebuild” from the “Management Menu.”
2. When the list of drives appears, highlight the FAILED drive to rebuild, and press SPACEBAR to select it.
3. After selecting the physical drive, press F10 and select “Yes” at the confirmation prompt.
   The rebuild process begins, and a graph shows the progress of the rebuild until it is complete. Although the Configuration Utility changes the disk drive state to Rebuild at this point, the change does not appear on the screen while the rebuild is in progress.
4. When the rebuild is complete, the following message is displayed:
   Rebuilding of Drive X Completed Successfully. Press ESC.
5. Press ESC to display the “Management Menu.” The state of the rebuilt disk drive changes from FAIL to ONLIN.

If ESC is pressed while the rebuild is running, the following options display:

- **Stop** (available only if AutoResume is enabled in the adapter properties): The rebuild is stopped, and the percentage of the rebuild already completed is saved. If AutoResume is enabled, the rebuild resumes where it left off when it is restarted.
- **Continue**: The rebuild continues normally.
- **Abort**: The rebuild is completely aborted and the disk drive remains in the FAIL state. If it is restarted, it begins at 0 percent.

**CHECKING DATA CONSISTENCY**

The Check Consistency feature is used on RAID 1, RAID 5, or RAID 10 logical drives to verify the consistency of the data on the physical drives. The LSI Software RAID Configuration Utility automatically corrects any differences found in the data when a consistency check is run.

Follow these steps to check consistency:

1. On the “Management Menu” select “Check Consistency” and press ENTER. A list of configured virtual drives is displayed.
2. Highlight a virtual drive with the cursor keys.
3. Press the SPACEBAR to select the virtual drive to check for consistency.
5. At the prompt, select “Yes” to start the Check Consistency process and press ENTER.

A graph shows the progress of the Check Consistency operation until it is complete.

If any data inconsistencies are found while comparing the source and target drives, inconsistencies are fixed by writing the source data to the target drive. This is indicated by the following message:

The Data on the Drives is inconsistent. Repair done!

If a media error on the source drive is found, or if a hard media error on the target drive is found, the following message is displayed:

Error in Reading Sectors! Proceed Anyway (Y/N)?
Press “Y” to skip the bad block and continue. Pressing “N” causes the consistency check to abort.
If ESC is pressed while a Check Consistency is running, the following options are displayed:

- **Stop** (available only if AutoResume is enabled in the adapter properties):
  The Check Consistency is stopped, and the percentage of the task already completed is saved. If AutoResume is enabled, the Check Consistency resumes where it left off when it is restarted.
- **Continue**: The Check Consistency continues normally.
- **Abort**: The Check Consistency is completely aborted. If it is restarted, it begins at 0 percent.

### DRIVER INSTALLATION

A ThinkServer RAID 100 device driver must be installed before the operating system can use a RAID volume, or any hard drives connected to the controller when configured in RAID mode.

If ThinkServer EasyStartup is used to configure RAID and install the Operating System, the correct drivers will be installed automatically. ThinkServer EasyStartup can be downloaded from the following link:


If installing the Operating System manually, the driver must be provided during the Operating System installation. The correct driver for the Operating System being installed can be downloaded from the following link:


Instructions for installing the drivers are included with the driver download packages.

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