



**INSTALLATION AND USERS' MANUAL
FOR KAYO FILE SYSTEM**

Version 1.0

August 2008

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Kayo File System Installation and Users' Manual

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About Kayo FS

Kayo FS is a 64-bit shared file system designed to extend the capabilities of Microsoft's Hyper-V server virtualization technology by allowing multiple host servers to access virtual machine files stored on Storage Area Network (SAN) volumes simultaneously.

Requirements

- Windows Server 2008 x64
- 5MB free disk space
- TCP/IP networking
- SVGA (min. 800x600 resolution, 256 colors)
- SAN storage (host servers connected via Fiber Channel, SCSI or iSCSI)

Prerequisites

The following steps should be performed on the host servers prior to installing Kayo FS:

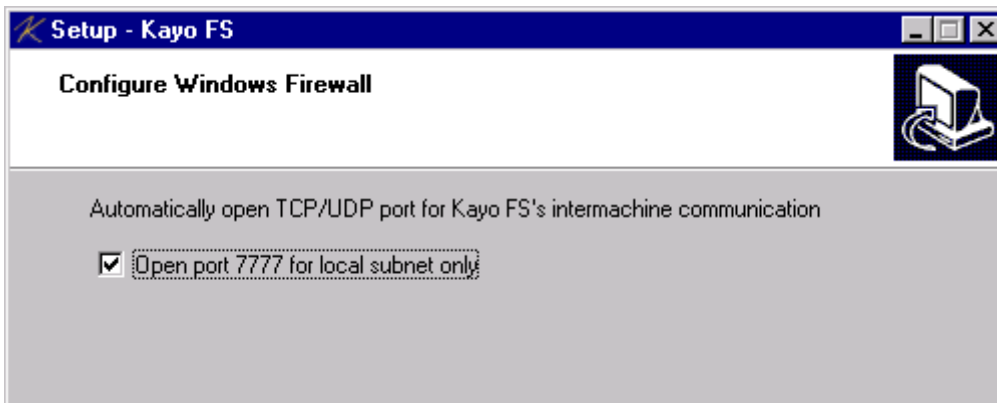
1. Install and connect your storage hardware following the instructions provided by the respective hardware manufacturer(s) and verify the newly installed hardware is operating correctly.
2. Check the event logs on the host servers to ensure there are no errors.
3. Open the Windows Services applet and verify that the Windows Management Instrumentation™ (WMI) service is running.

Preinstallation notes

- Kayo FS formats entire partitions, i.e., you cannot format a part of a partition with Kayo FS.
- When a partition is formatted with Kayo FS, all data residing on the partition is destroyed.
- Multiple partitions may be formatted with Kayo FS.
- Since Kayo FS is a shared file system, it is preferable to use shared central storage such as a Fiber Channel disk array.
- While it is possible to use Kayo FS on a machine's local storage, in this case, it will perform strictly as a standalone file system.
- When multiple partitions need to be formatted with Kayo FS, a volume manager such as Sanbolic's LaScala should be used to simplify management of the volumes.

Installation and Configuration

Using an account with administrator privileges, log on to each machine that will run Kayo FS. Run the setup program in the Kayo FS installation package to install and start the Kayo FS driver. During the installation of Kayo FS, a configuration utility is also installed that allows an administrator to modify Kayo FS TCP/IP settings as well as configure additional parameters for Kayo FS. If you have Windows Firewall enabled and running, an additional step is required during the installation. In this case, the installation prompts for permission to add TCP and UDP ports 7777 in the Ports Exceptions of Windows Firewall.



This option must be selected to allow Kayo FS communications amongst all servers participating in the cluster. Leaving this option unchecked will prevent Kayo FS from exchanging cluster administration information, leading to its inability to establish a functional SAN cluster.

If a third party firewall is being used, make sure it is configured to allow both inbound and outbound connections on TCP and UDP port 7777 (port used by Kayo FS).

Trial or Full version

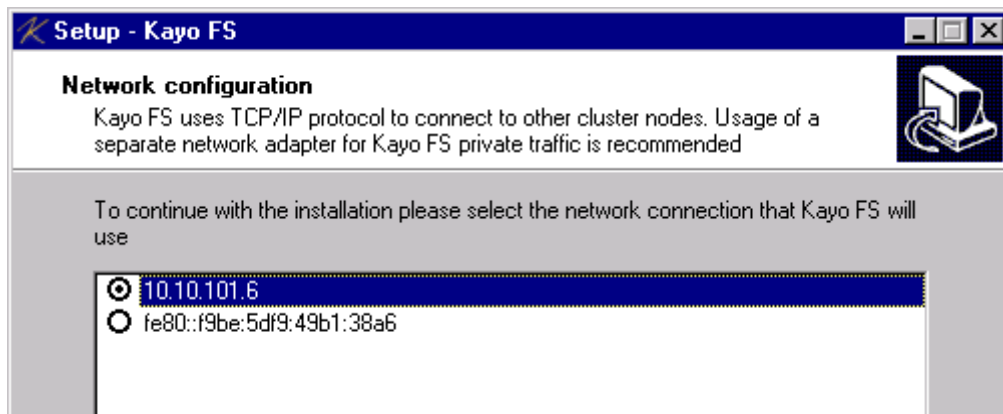
During installation you must select if you wish to run Kayo FS in trial mode or as a full version. In trial mode, Kayo FS offers a fully functional file system with no limitations in its functionality. The trial version is time limited, expiring 15 days after installation. After the expiration date you will no longer be able to write data to any Kayo FS-formatted volume(s); however, all the data residing on the volume(s) will continue to be available for read-only access. Upon upgrading to the full version, the write protection is removed, allowing both read and write access to data on the volume(s).

Note: No data is destroyed during the upgrade process.

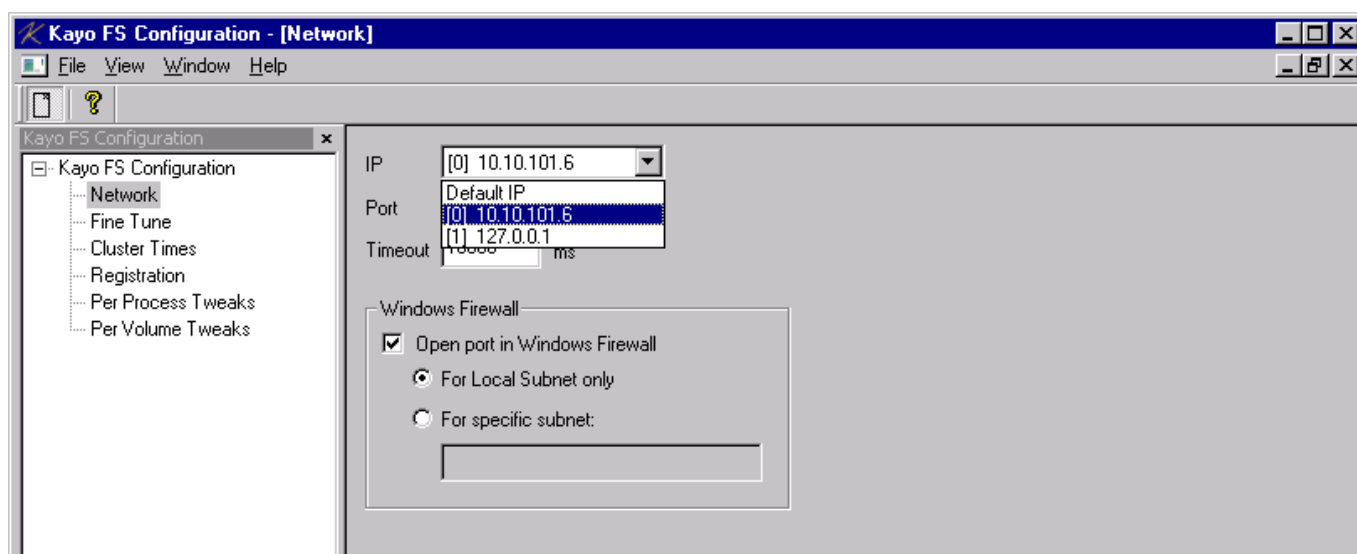
If you choose the full version, you will need to enter the serial number provided when you purchased your copy of Kayo FS. Please note that the serial number is linked to the company name and user name, so you will need to fill in these fields with the correct information as well.

TCP/IP communication settings

During installation you will be asked to select a TCP port and IP address for communications between Kayo FS instances on different machines.



Note: You can change the IP address used for Kayo FS communications at any time after the installation using the Kayo FS configuration utility:



The port number must be the same on all Kayo machines in the network for the file system to operate properly.

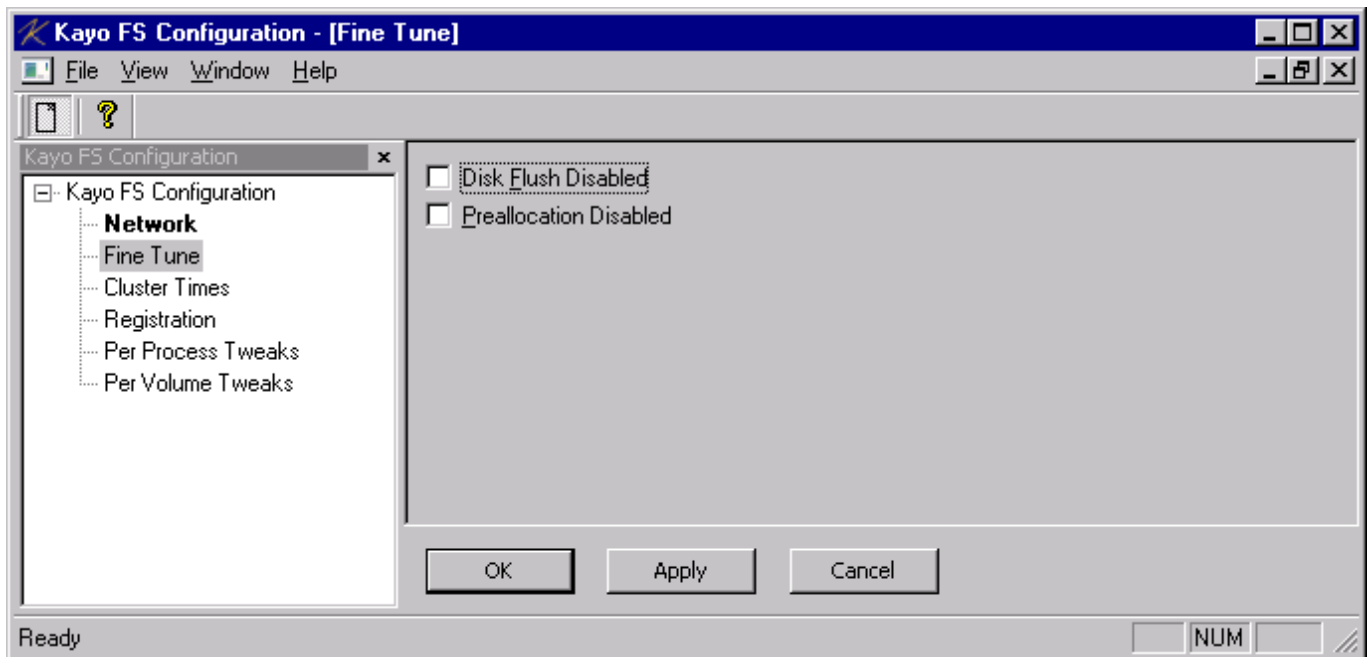
Kayo FS automatically reconfigures Windows Firewall to accommodate any settings change. If you are using a third party firewall, you'll need to modify the configuration manually.

Please note that Kayo FS uses both TCP and UDP for inter-machine communication.

Additional tuning

Using the Kayo FS configuration utility, additional parameters may be configured.

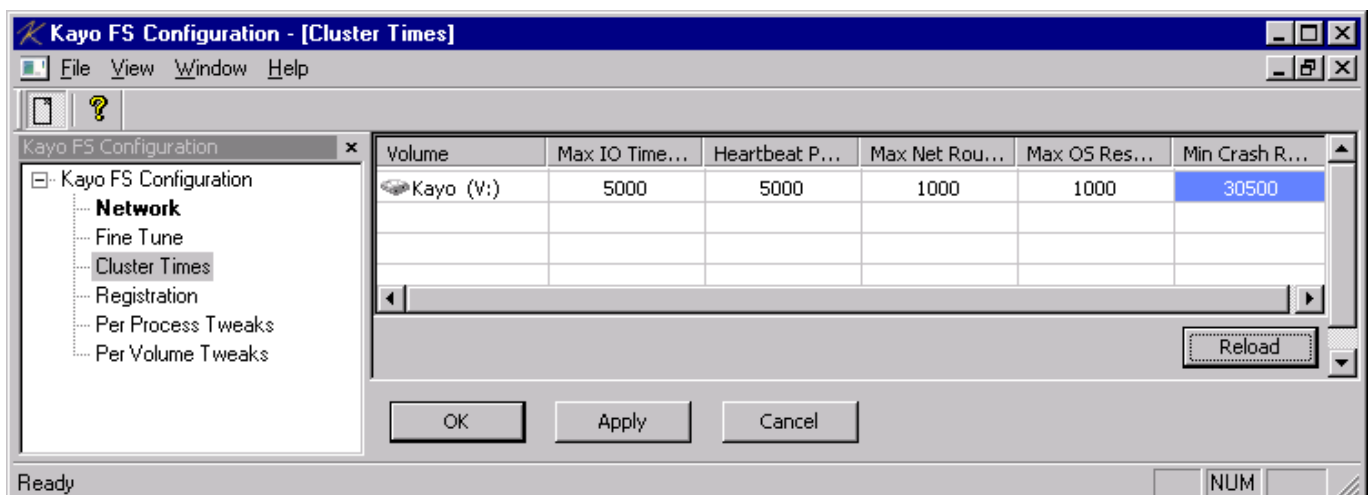
Disk Flush Disabled - Setting this option may help in situations where hardware issues exist. Certain disk storage arrays do not support this command or do not support it correctly (i.e., when the command is issued it may take an extended period of time for the operation to be completed by the storage hardware). When this parameter is checked, Kayo FS will *not* issue disk flush commands. If unsure, leave unchecked (default setting).



Cluster-wide Times

Cluster Times affect the operation of all machines participating in the cluster. The parameters are volume-specific and once changed, are written to the respective volume and propagated throughout the entire cluster.

Please note that since the values are written to the volume, the volume needs to be locked for exclusive use by one machine. This will make the respective volume inaccessible to all other machines for a short time while the changes are written. Also, you must make sure there are no open files and/or handles for this volume on the other machines as this will prevent the volume from being locked and force an error message to be displayed.



Note: Timing for the following parameters is in milliseconds.

Max IO Time - This is the maximum time that an operation to or from the shared disk can last.

Heartbeat Period - This is the time interval at which the heartbeat check is invoked.

Max Net Roundtrip - This is the maximum time in which a machine expects to receive a response from other machines participating in the cluster to its request over the TCP/IP network.

Max OS Response Delay - The interval between the expected start of a system operation in the machine and its real start. Unless the machine is constantly under 100% load, this value should not be modified.

Min Crash Recovery Delay - This is the minimum time it takes for the cluster to determine that a machine is not responding, causing the unresponsive machine to be evicted from the cluster. While this process takes place, I/O operations *may* be disrupted (depending on the file system's read/write pattern) because machines must refrain from changing data on the disk in order to ensure its integrity. As the value of this parameter is calculated based upon the values defined for all other parameters in this section, it cannot be modified manually.

Reload - Clicking on this button will cause rereading of the values from the volumes. After you apply the changes made to a volume, it is recommended that you press the Reload button to confirm the changes.

Per Process Tweaks

There are nine settings that can affect the way a process behaves.

Report fs as NTFS – Specifying a value other than zero enables this setting, which may be necessary in order for some applications to work properly with Kayo FS.

Disable Access Time Update - Specifying a value other than zero enables this setting, which suppresses the "Date accessed" property of files. With this parameter enabled, a significant increase in performance may be observed when working with files and/or directories, i.e., viewing directory contents, reading files, opening multiple files, etc.

Disable Cache Back - Specifying a value other than zero enables this setting, which may result in an increase in performance for some applications.

Warning: *This parameter should **only** be enabled when instructed by Sanbolic technical support!!! Enabling this parameter on your own accord may present undue risk.*

Block application access - Specifying a value other than zero enables this setting, preventing the specified application from accessing the file system.

Ignore Write Through - Specifying a value other than zero enables this setting, causing the file system to ignore the FILE_FLAG_WRITE_THROUGH.

Warning: *This parameter should **only** be enabled when instructed by Sanbolic technical support!!! Enabling this parameter on your own accord may present undue risk.*

Ignore No Buffering - Specifying a value other than zero enables this setting, causing the file system to ignore the FILE_FLAG_NO_BUFFERING.

Warning: *This parameter should **only** be enabled when instructed by Sanbolic technical support!!! Enabling this parameter on your own accord may present undue risk.*

Enforce Write Through - Specifying a value other than zero enables this setting, which enforces the FILE_FLAG_WRITE_THROUGH. This setting may fix fluctuations in the performance of certain applications, i.e., video applications.

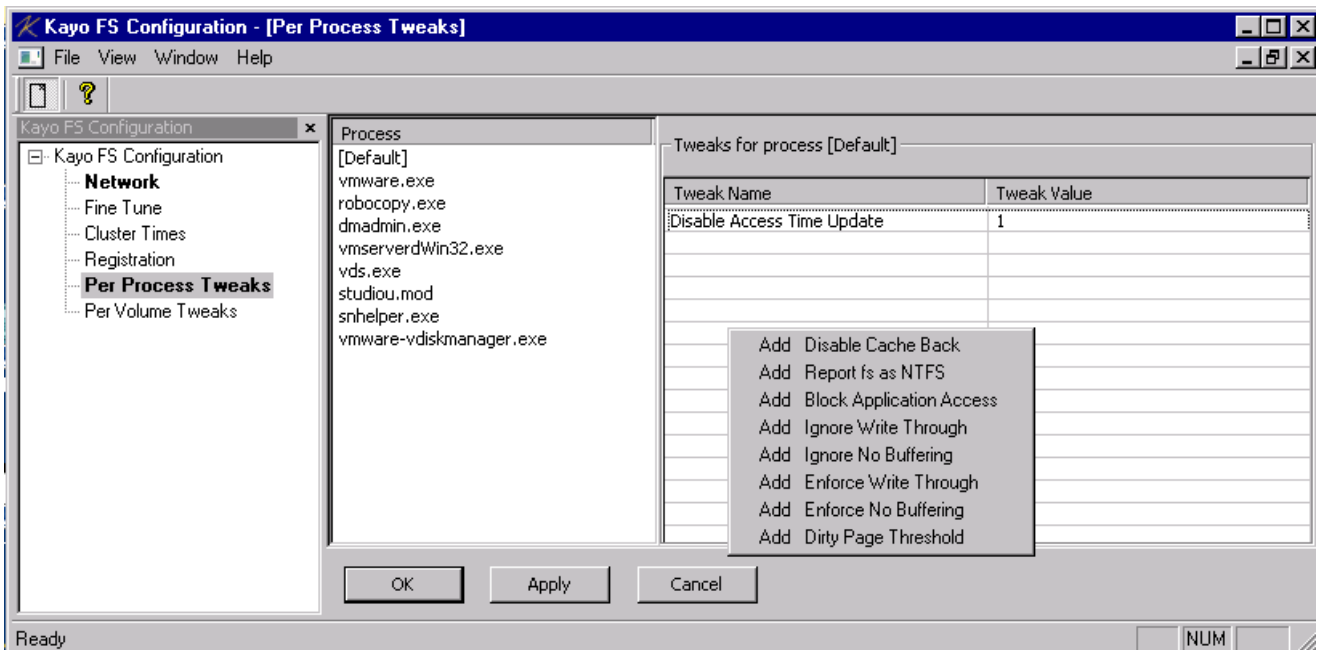
Warning: *This parameter should **only** be enabled when instructed by Sanbolic technical support!!! Enabling this parameter on your own accord may present undue risk.*

Enforce No Buffering - Specifying a value other than zero enables this setting, which enforces the FILE_FLAG_NO_BUFFERING. This setting may fix fluctuations in the performance of certain applications, i.e., video applications.

Warning: *This parameter should **only** be enabled when instructed by Sanbolic technical support!!! Enabling this parameter on your own accord may present undue risk.*

Dirty Page Threshold – Specifying an integer value informs the system of the threshold for dirty pages within the system’s cache before they are flushed. For example, if there are multiple files opened by the specified process, this setting will affect the dirty pages of each file. The default value is 0, indicating that there is no threshold. This setting is on a per file basis.

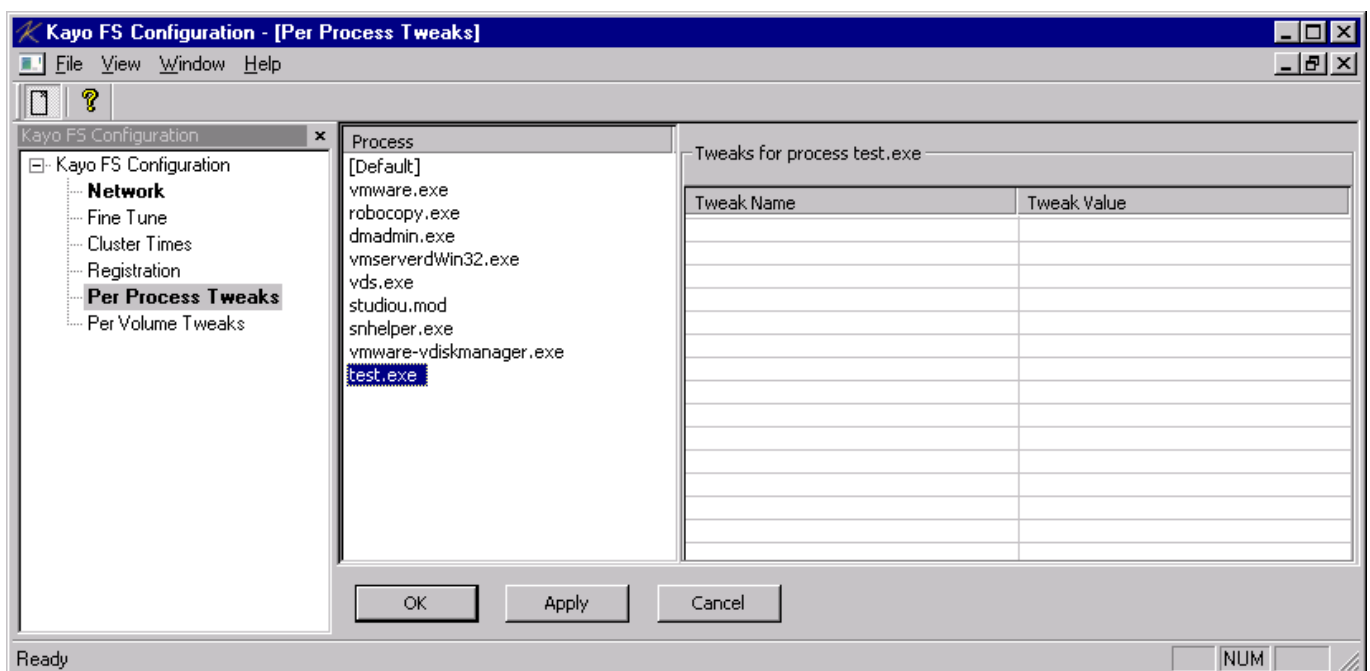
Warning: *This parameter should **only** be enabled when instructed by Sanbolic technical support!!! Enabling this parameter on your own accord may present undue risk.*



The settings that correspond to the [Default] process are global settings*, affecting all processes. If a process is added, its individual settings will override the global settings.

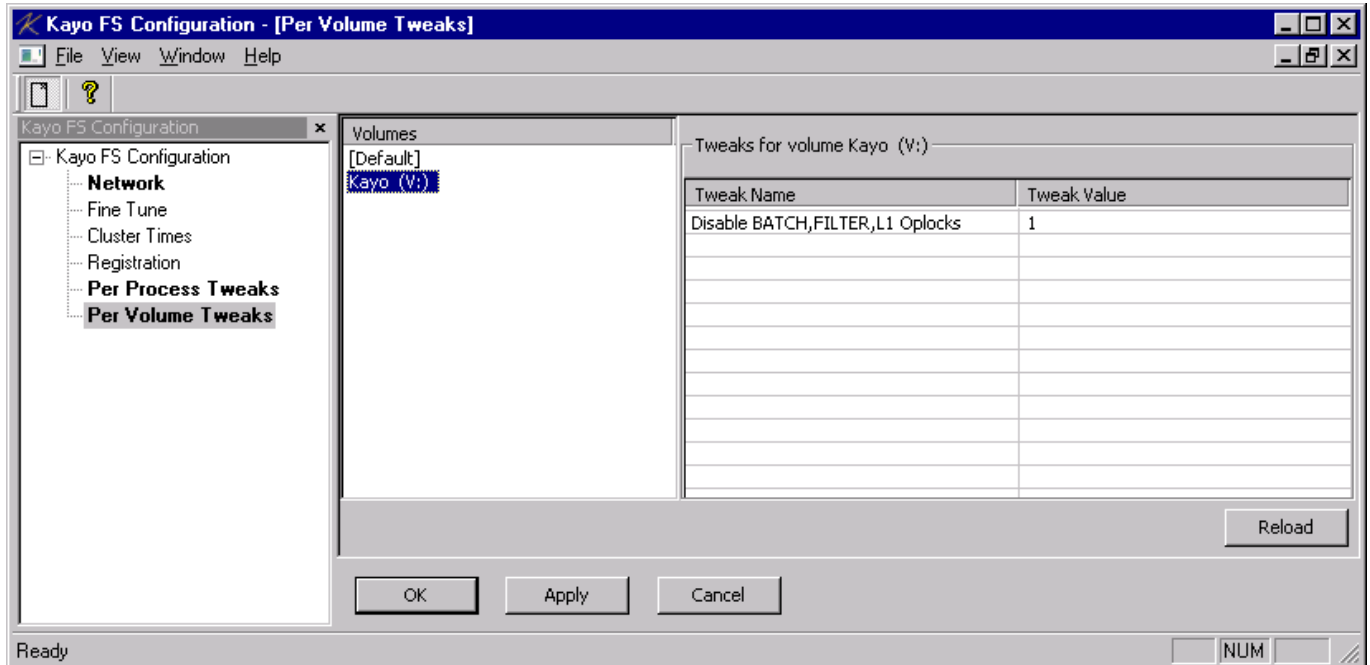
You can add a process by right-clicking in the Process pane, which will allow you to browse for the executable file. To add the preferred settings, you must select the desired process first and then right-click in the “Tweaks for process” pane. You will notice that the relevant process is displayed after “Tweaks for process.”

***Note:** *It is recommended **not** to change the global settings, since this may lead to unexpected behavior of the file system. Instead, any changes should be made on a per process basis.*



Per Volume Tweaks

These tweaks manage the behavior of the file system on a per volume basis. Per Volume Tweaks can be set globally for all Kayo FS volumes using the [Default] placeholder or individually per volume. With Kayo FS, there is one available volume tweak that commands the Level 1 batch oplocks. If you enable this tweak by specifying a value other than zero, Level 1 batch oplocks will be disabled per the volume specified or as a default.

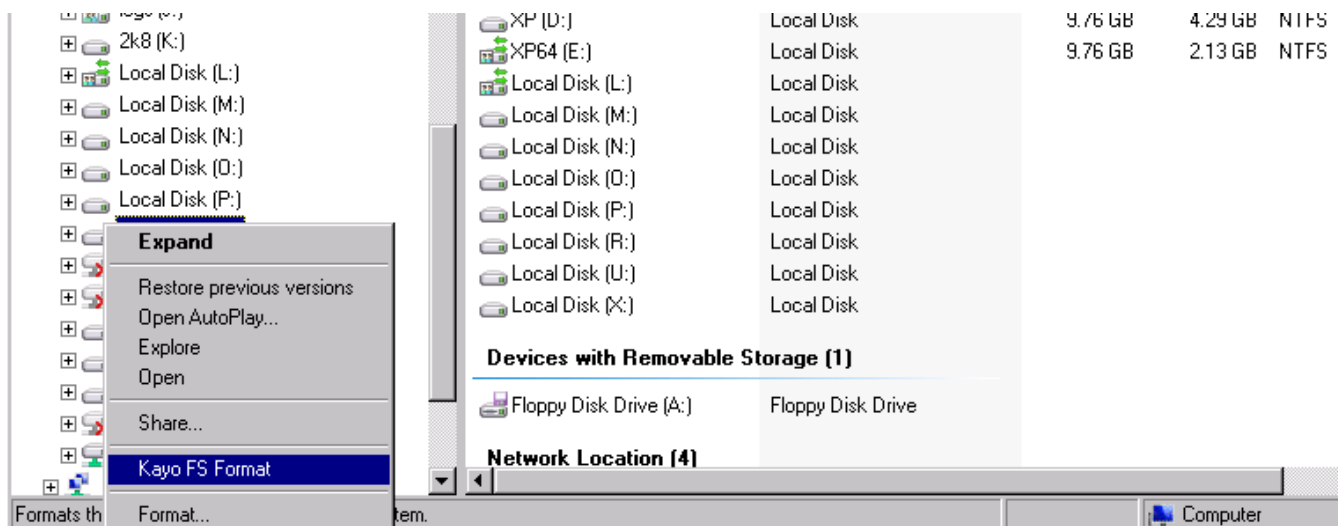


Formatting a volume with Kayo FS

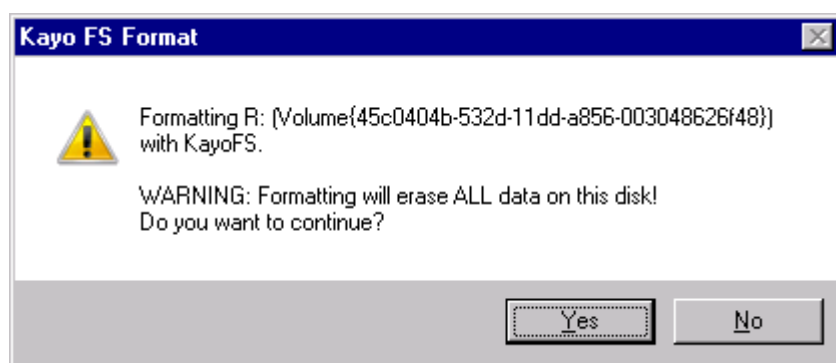
After the installation has completed, a new or previously existing volume can be formatted with Kayo FS. Formatting a volume must be performed from one machine only. Once a volume is formatted with Kayo FS, all the machines participating in the cluster will automatically discover it.

To format a volume with Kayo FS, perform the following steps:

1. Using the standard Windows management tools (Disk Management snap-in in the Windows management console), assign a drive letter to the partition to be formatted with Kayo FS.
2. Open Windows Explorer to view the partition with its newly assigned drive letter.
3. Right-click on the partition and select "Kayo FS format." (See figure on the following page.)



A message will appear asking you to confirm the formatting of the volume:



Note: Formatting a partition or dynamic volume with Kayo FS may take several minutes to complete. Please wait until a message appears indicating that the format process has completed before performing other tasks on the machine.

Note: Formatting destroys all data on the partition. If the partition was previously formatted with Kayo FS and there are other machines accessing it, the format process will not complete. In order to reformat a Kayo volume, you must make sure that it is not used by other machines and that no open handles to the Kayo volume exist.

Usage

Kayo is a shared file system. It supports all standard file system operations such as creating, copying, moving, renaming and deleting files and directories, reading from and writing to a file, changing of file and directory attributes, and locking files or sections of them. Since Kayo FS is designed based on the Melio FS cluster file system, all of these operations can be performed concurrently by different machines without the risk of data corruption. Kayo FS is fully integrated into Windows Server 2008 x64 editions and supports all the commands and API functions of the system transparently; allowing applications to work with Kayo FS in the same way they work with files on partitions formatted with NTFS or FAT.

There is no user interface in the core of the Kayo file system. Its functionality is accessed indirectly via Windows Explorer and with all user applications through operating system commands such as "copy" or "dir" or through the standard Win32 programming functions such as *CreateFile()*.

Kayo FS is a journaling file system, which means that every action on metadata is recorded in a special area on the disk called the journal (or log). If a machine crashes, the journal is checked and replayed,

which ensures that no data corruption occurs. However, this journal check takes some time, which will occur the first time the volume is accessed; thus it is natural to experience some delay under these circumstances. The journal may be replayed by any Kayo node on the network.

When reformatting an existing NTFS partition on the central storage with Kayo FS, make sure that all other machines are turned off. The reason is that NTFS is not SAN-aware, thus the other machines have no way of knowing that this particular NTFS partition has disappeared. If Windows tries to write data to the partition (which has been reformatted with Kayo FS), it would inevitably lead to data corruption.

The following is a list of some typical situations that may occur while working with Kayo FS.

- **Behavior:** Cannot access a Kayo formatted volume.
Reason: There are mixed versions of Kayo - trial and full - in the same network. Upon starting, Kayo checks the other machines in the cluster. If they are running a different type of license, the machine won't be able to join the cluster and access the volume. This event is displayed with the appropriate message in the System event log.
- **Behavior:** Cannot delete a file (access denied), although the file is not used.
Reason: Kayo is a shared file system, allowing multiple machines to access the same data concurrently. Although this computer is not using this file, some other machine is holding a lock to it, preventing it from deletion.
- **Behavior:** It takes an extended period of time to access a Kayo formatted volume.
Reason: The volume was left in a non-consistent state. The first machine that discovers this takes measures to repair the volume. This happens automatically and takes tens of seconds. This event is recorded with the appropriate message in the System event log.
- **Behavior:** Volume operation is disrupted.
Reason: The machine has discovered an inconsistency on the volume. It has automatically undertaken the necessary steps to repair the volume. While this activity is occurring, there will be a delay and possible disruption to other I/O operations to and from that particular volume on this machine. Other machines are not affected.
- **Behavior:** A machine in the cluster unexpectedly stops reading from or writing to a volume.
Reason: Communications amongst machines may have failed. In order to ensure data integrity, a machine may not be allowed access to the volume until it establishes reliable communications with the other machines participating in the cluster. Check the System event log for error messages.
- **Behavior:** After formatting a volume with Kayo FS, the old volume label is still displayed in Windows Explorer.
Reason: This is based on Windows Explorer operations. A period of time elapses before Windows Explorer updates the volume information with the new label. The same behavior may be observed when formatting with NTFS.
- **Behavior:** Cannot label a Kayo volume with a label longer than 11 characters.
Reason: This is a limitation of the Windows shell. The shell will not allow entering a label longer than 11 characters for any file system other than NTFS. The command line utility "label," as well as the Win32 programming function *SetVolumeLabel()*, operate correctly and allow labels up to 32 characters in length.

Upgrading from trial to full version

You may install a trial version of Kayo FS for evaluation purposes. The trial version is a fully functional version of the software. The only limitation is that the trial version expires 15 days after installation. After the expiration date you will no longer be able to write data to any Kayo FS-formatted volume(s); however, all the data residing on the volume(s) will continue to be available for read-only access. Upon upgrading to the full version, the write protection is removed, allowing both read and write access to data on the volume(s). **Note:** No data is destroyed in the upgrade process.

Please note that it is not possible for a machine to join a cluster with a different license type. That is, if you have a cluster of machines running the full version of Kayo FS, a machine with the trial version will not be able to join the cluster.

Upgrading from trial to full version is performed using the Kayo FS configuration utility. After launching the configuration utility, select “Registration” in the left-hand window pane and enter the company name, user name, and serial number associated with the full version. After applying the change, the software automatically transitions to the full version.

Note: While the upgrade process takes place on the fly, there may be some cases in which a machine restart is required.

It is possible to have machines with different license types operate in the same cluster when an on-the-fly upgrade has been performed on one or more machines. However, if a machine is restarted or removed from the cluster for some other reason, it will not be able to rejoin the cluster due to the difference in license type. In this case an appropriate message is written to the System event log. The issue can be resolved by completing the upgrade process on all the machines participating in the cluster.

Note: This is expected behavior designed to maintain the integrity of the cluster file system.

Feature support

Feature support presented below applies to both the trial and full (registered) versions of Kayo FS:

Number of machines allowed simultaneous access to a volume: 5

Volume size limitation (all Kayo FS formatted volumes): 2TB

Modify security: Enabled

Extend volumes: Disabled

Reparse points: Disabled

Extended attributes: Disabled

Open by File ID: Disabled

Cluster Affinity: Disabled

Create sparse files: Enabled

Functions within a virtual machine: Disabled

Quality of Service: Disabled

Windows folder and file sharing: Enabled

Troubleshooting

The following items should be reviewed to ensure that Kayo FS functions properly.

- Verify that your storage hardware is working properly.
- Check the Event log for error messages. This is achieved through the Event viewer utility under the "Administrative tools" section of the "Programs" menu. If there are errors pertaining to your storage hardware, such as timeouts, controller or device errors, resolve them according to storage manufacturer guidelines.
- Check the Event log for messages generated by Kayo FS. The file system reports out of the ordinary events and logs them in the System log. The messages in the log offer guidance for determining the source of issues such as network connectivity or storage hardware.
- Confirm network connectivity between all the Kayo machines on the network. This is especially important on multi-homed systems (systems with more than one IP address). Make sure that Kayo uses the appropriate IP addresses on the machines so different Kayo instances can communicate across the network. Also, ensure that all Kayo machines are set to the same port number, which applies to both TCP and UDP.
- Check the version of Kayo FS you are using to find out if you need a newer version. Launch the Kayo FS configuration utility and select Help >About. This will show the version of the Kayo FS driver and allow you to determine if you need to download an update for Kayo FS.
- Verify that all machines on the network are running the same version of Kayo FS.

Contacting Sanbolic

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