PowerChute™ Network Shutdown v4.3 Release Notes

The release notes provide important information about PowerChute Network Shutdown (PowerChute), including known software issues and their solutions. For any additional troubleshooting and background help, see the PowerChute Network Shutdown Product Center. The Product Center contains the most up-to-date troubleshooting and product information.

What's new in v4.3

Nutanix™ Support

- PowerChute supports shutting down and starting up virtual machines running on a single Nutanix cluster.
- PowerChute supports Nutanix with Acropolis Hypervisor (AHV) or VMware® vSphere as your hypervisor.

Enhanced VMware Support

- PowerChute can delay putting critical hosts into Maintenance Mode until later in the shutdown sequence, after VMs have been shut down and before host shutdown.
- PowerChute will issue a Maintenance Mode command for vSAN cluster hosts using the “No Action” or “Ensure Accessibility” mode, depending on current configuration and cluster state.
- Fault Tolerance Threshold (FTT) can be enabled for a vSAN cluster, and is used to put hosts into Maintenance Mode with the correct mode (“No Action” or “Ensure Accessibility”). This also provides the option of shutting down all VMs in a cluster if FTT is exceeded.
- PowerChute can delay (with a retry limit) shutting down a vSAN host if Active Synchronization tasks are in progress.
- Virtual Machines (VMs) and Virtual Appliances (vApps) are shut down in parallel during a shutdown sequence, and started in parallel during a startup sequence.
- vApps and the vCenter Server VM can be added to a VM Prioritization group.

Enhanced Hyper-V® Support

- PowerChute supports stopping a Hyper-V cluster as part of the shutdown sequence.

Additional Features

- PowerChute is now a 64-bit only application and support for 32-bit operating systems has been discontinued.
- An embedded Java Update tool in the PowerChute UI, which allows you to easily change the Java version used by PowerChute.
- PowerChute can be configured to execute commands on a remote host via an SSH connection.
- The PowerChute virtual appliance upgraded to CentOS 7.
- Support added for the Network Management Card 4.

Security Enhancements

- Updated to Java 11 for all operating systems except IBM AIX™, HP-UX, Mac OS® X, and Solaris SPARC. For more information on Java for these operating systems, see the PowerChute Network Shutdown Installation Guide.
- Updated to Jetty 9.4.12.
- 3DES cipher suites no longer supported.
- TLS 1.0 and 1.1 are no longer supported – except for IBM AIX that still requires it.

Issues Resolved in this Release

Visit the Knowledge Base to view more detail on the following documented issues that are now resolved in v4.3.

Issue	Details
Hosts are placed in Maintenance Mode at an early stage in the shutdown sequence, before VMs are powered off.	This issue has been resolved in PowerChute Network Shutdown v4.3 with the Delay Maintenance Mode feature.
One host in a vSAN cluster does not enter Maintenance Mode before host shutdown.	This issue has been resolved in PowerChute Network Shutdown v4.3 with the Delay Maintenance Mode feature.
VxRail Stretch Cluster with Witness Appliance and Management Host does not shut down in the correct order.	This issue has been resolved in PowerChute Network Shutdown v4.3 with the Delay Maintenance Mode feature.
vSAN hosts are placed into Maintenance Mode at the same, and not sequentially.	This issue has been resolved in PowerChute Network Shutdown v4.3 with the Delay Maintenance Mode feature.
PowerChute attempts to start vSAN cluster VMs before the cluster is ready.	This issue has been resolved in PowerChute Network Shutdown v4.3 with the Fault Tolerance Threshold feature.
PowerChute does not consider “No Action” or “Ensure Accessibility” option when putting a vSAN host into Maintenance Mode.	This issue has been resolved in PowerChute Network Shutdown v4.3. with the Delay Maintenance Mode and Fault Tolerance Threshold features.
Master/Parent vApps are not supported by VM Prioritization.	This issue has been resolved in PowerChute Network Shutdown v4.3, 1 level of vApp nested is now supported.

Known Issues

General Issues on all Operating Systems

↑ Known Issues

Issue	Solution
Following an upgrade from v4.2 to v4.3, the v4.2 powernet.mib file is not removed from the group1 directory.	Delete the old powernet.mib file after upgrade.
A PowerChute Network Shutdown (PowerChute) Parallel-UPS Configuration is shutting down on only one critical event	PowerChute should not shut down for critical events when they occur on only one UPS in a Parallel Redundant Configuration. This is a known issue that occurs when the Configuration Wizard is run again after the initial configuration for a Parallel UPS. If you run the Configuration Wizard again after the initial configuration you should re-start the PowerChute service.
PowerChute does not support Parallel Smart-UPS VT, prior to firmware v5.0.	Contact APC to obtain the latest UPS firmware for Parallel Smart-UPS VT.
After a power outage has been resolved, PowerChute shuts down the Operating System every time it is started. This happens with a Redundant-UPS configuration and when using the Network Management Card (NMC) firmware v3.2.x through v3.5.5.	Upgrade the firmware on the Network Management Card to the latest version, see downloads. To resolve the issue once it has started happening: 1. Temporarily remove the network cable from the PowerChute machine before powering it on (this will prevent PowerChute from communicating with the NMC and triggering a shutdown). 2. Power on your PowerChute machine. 3. Upgrade the firmware on the NMC. The upgrade tool will automatically reboot the NMC during the upgrade process. 4. Re-attach the network cable to the PowerChute machine and ensure communication is established with the NMC.
When several actions are selected for the same event, and the actions all have the same delay time, some actions do not occur.	Threading issues in Java occasionally cause the actions to interfere with each other. Use different delay times for each action.

Issue	Solution
PowerChute does not recognize a temperature or humidity probe on the AP9631 Network Management Card.	Switch the probe from the AP9631 Universal I/O port on the right (labelled **2**) to the port on the left (labelled **1**). PowerChute will then recognize the probe.
PowerChute does not support an SMX or SMT UPS device that is part of a Synchronized Control Group (SCG). An SCG is set up using the Network Management Card (NMC) user interface.	Disable the SCG option for these devices using the NMC UI.
The PowerChute user interface is not available immediately after restarting a service or daemon. The delay is caused by PowerChute carrying out background validations and checks.	Wait a few minutes.
PowerChute does not allow you to log on again if you exit the Setup Wizard by closing the Web browser. A message is displayed that another user is already logged in.	If you accidentally close the browser, re-start the PowerChute service or daemon. Open the User Interface and complete the Setup.
If you change an existing command file path for an event in the pcnsconfig.ini file (e.g. event_PowerFailed_commandFilePath) by typing an invalid path, PowerChute will subsequently log an error message in relation to an invalid value in the ini file when it starts. It does not restore the previous valid path from the pcnsconfig.ini.bak file.	Change the path to the correct value, in the INI file or by using the PowerChute web user interface.
After an initial configuration, if you subsequently change the IP address of any NMC using the Setup Wizard: **a. the establishment of communications with the card is not recorded in the event log, and** **b. when the IP address is for a different UPS model type, the PowerChute list of events does not automatically update.**	For a) no workaround. For b) you need to re-start the service or daemon.
When the PowerChute service or daemon starts, it validates the Pcnsconfig.ini value named localHostAddress. (This is the PowerChute IP address that is registered with the NMC). If PowerChute has not already acquired an IP address when this check occurs, PowerChute will report an invalid value. PowerChute will report this as an invalid value in the ini file.	Run the Setup Wizard again to set the correct PowerChute IP address.

Issue	Solution
In a Parallel Redundant UPS configuration, PowerChute might incorrectly report Lost communications while on Battery when communications are lost and only one UPS has been on battery. The event log does not record the On Battery event prior to this.	No workaround.
Following silent installation using IPv6, the Network Management Card shows two entries for the PowerChute client unicast address. This occurs if a short format IPv6 address is entered in silentInstall.ini for UNICAST_ADDRESS e.g. **UNICAST_ADDRESS=fe80::80e9:7d49:2793:3616** **This can result in the NMC sending unnecessary packets.**	1. Use the full format address when entering IPv6 address e.g.: UNICAST_ADDRESS=fe80:0:0:0:80e9:7d49:2793:3616 before running the silent install. 2. If installation is already completed, the short format IPv6 address can be removed from the Network Management Card via **Configuration** > **PowerChute clients**.
When PowerChute is installed on an IPv6 only machine the CN (Container Name) value in the self-signed SSL Certificate is set to 127.0.0.1.	Replace the Self-Signed SSL cert using the steps outlined in Kbase FA176886. 1. Re-enable IPv4 on the machine and stop the PowerChute Service. 2. Delete PowerChute-Keystore file from group1 folder where PowerChute is installed. 3. Re-start the service. On Linux/Unix/Mac OSX: 1. Stop the PowerChute service. 2. Add the IPv6 addresses and the Fully Qualified Domain Name of the machine to /etc/hosts file. 3. Re-start the Service.
IPv6 support for PowerChute is only available for NMC Firmware v6.0.X or higher	Upgrade the NMC firmware to v6.0.X or higher for IPv6 support.

User Interface Web Browser Issues

↑ Known Issues

Issue	Solution
If the browser window remains open during an upgrade to PowerChute v4.2 the PowerChute user interface does not display correctly following the upgrade, and a notification to delete the log file appears.	Close and re-open the affected web browser and access the PowerChute user interface. The user interface will display correctly.
Mozilla Firefox does not load the PowerChute web interface when the Fully Qualified Domain Name is used.	Use the short hostname in Mozilla Firefox to load PowerChute the web interface. View the Mozilla Firefox Support - Server Not Found issue for more information.
A security warning is displayed when launching the PowerChute User Interface in a browser stating that the Web Server SSL cert is not trusted. This occurs because PowerChute uses a self-signed SSL cert by default.	There are two possible solutions: 1. You can choose to add the PowerChute self-signed SSL cert as a trusted cert and ignore the warning. 2. You can replace the default self-signed SSL cert with a trusted SSL cert. See the Product Center.
PowerChute is not compatible with IE 10 Metro Version.	Use the desktop version of IE 10 to access the PowerChute UI on Windows 2012 and Windows 8. The start menu item for PowerChute will launch using the desktop version of IE for these operating systems .

Network Configuration

↑ Known Issues

Issue	Solution
PowerChute Network Shutdown web interface will not load using the Fully Qualified Domain Name in a private network using a static IP address - FQDN cannot be resolved. This issue only occurs if there is no DNS server configured for the network card.	On a private network using a static IP address, use http://localhost:6547 to load the PowerChute web interface.
After you uninstall PowerChute Network Shutdown, the Network Management Card (NMC) still lists the IP address on the PowerChute agents page.	Delete the IP address from the list of PowerChute agents in the NMC User Interface.
On a machine with multiple network cards, when PowerChute issues a UPS/Outlet Turn off command, the Network Management Card (NMC) may show the IP address of one of the other network cards instead of the IP address that was used to register with the NMC.	None. There is no functional impact caused by this issue.

SSH Settings

↑ Known Issues

Issue	Solution
Configured SSH actions are not removed from the SSHAction section in the pcnsconfig.ini file when switching from Advanced to Single to UPS Configuration, and the following event appears in the Event log: **WARNING: The invalid section advanced_ups_setup_X should be removed from the ini file**	Remove the SSH actions from the pcnsconfig.ini file.
If you edit an SSH action to change the authentication method by removing the SSH key file path and key password and replace it with password authentication, the UI does not reflect the change, though the SSH key file path and key password are no longer used to communicate with the remote host.	Do not edit an SSH action to change the authentication method – delete the SSH action and recreate it.
You cannot configure SSH actions On Startup for a physical UPS Group in Advanced Configuration. SSH actions On Startup are triggered when associated hosts are taking out of Maintenance Mode. As there are no hosts associated with a physical UPS Group, the SSH actions will not be triggered.	On startup SSH actions are not applicable to this configuration.
SSH actions configured to execute on startup on a standalone VMware host are not executed.	On startup SSH actions are not applicable to this configuration.
The "SSH Action <Action Name> has already run" event may appear in the Event Log after the SSH action has already been executed.	No workaround.

SNMP Configuration

↑ Known Issues

Issue	Solution
PowerChute reports a failed SNMPv3 connection attempt in the Event Log, though the SNMPv3 connection has been successful. **Certain MIB browsers attempt initial connections before using the correct user name specified in PowerChute.**	SNMPv3 connection has been successful, and Event Log reports indicating a failed connection attempt can be disregarded in this scenario.

Event Configuration and Logging

↑ Known Issues

Issue	Solution
PowerChute reports Communications established with the NMC, and then reports that PowerChute cannot connect to the NMC. This issue occurs when PowerChute is configured to use IPv6, when PowerChute is installed on a vMA and the vMA is restarted following configuration.	There is no loss of communications with the NMC and this issue does not impact the functionality of the vMA in any way.
A UPS Critical event is reported twice with a delay between each event logged. This issue can occur in the following scenarios: • **When a host has been removed from the Host Protection page in any UPS configuration, or** • **When a host has been linked to a different UPS/Outlet group on the Host Protection page, or** • **When ESXi hosts have Multiple Kernel Adapters with multiple IPs associated for each Kernel Adapter.**	There is no workaround to this issue. This issue may cause a slight delay in starting the shutdown sequence, as PowerChute checks if the target ESXi hosts are available in the inventory.
Hostlist key is not removed from HostConfigSettings section in the pcnsconfig.ini file when switching from Single to Advanced UPS Configuration, and the following event appears in the Event log: **WARNING: The invalid key hostlist should be deleted from section HostConfigSettings in the ini file**	Restart the PowerChute Service.
The Multiple Critical Events Occurred event is logged with "On Battery" displaying twice: "Multiple Critical Events occurred: On Battery, On Battery, UPS Turn Off Initiated".	You can ignore the second instance of "On Battery" in this logged event.
Clicking on the Export button on the Event Log page does not save a copy of the Event Log on the local machine.	Click on Tools - Internet Options in Internet Explorer and click on the Advanced tab. Disable the option "Do not save encrypted pages to disk". For more information see http://support.microsoft.com/kb/2549423.
When you switch PowerChute to connect to a different type of UPS device the list of configurable events is not updated in the UI. (Different UPS devices can have different configurable events).	Restart the PowerChute service to display the correct list of events.

Issue	Solution
On MGE Galaxy 300/ 7000 UPS devices: sometimes the Runtime: Exceeded event is incorrectly cleared in the event log.	With the MGE Galaxy 300/ 7000 devices, on the NMC user interface ensure that the Maximum Required Delay is always equal to or greater than the Maximum Negotiated Delay.
After the PowerChute service or daemon start, PowerChute does not log the communications established event for a Parallel system until all of the NMCs are in communication with PowerChute. It should report communication established when at least one NMC is communicating with PowerChute.	No workaround.

Windows

↑ Known Issues

Issue	Solution
Command files do not run properly when called by PowerChute. The command file stops before all of the statements have executed.	The command file must use the @START command to run executable programs, and use the full path name of the program. Path names that include spaces must be enclosed in quotes. Arguments for the executable must be outside the quotes. See FA159586 to check correct syntax usage.
A PowerChute client that acquires its IP address through DHCP will lose communications with the Network Management Card when the client renews its DHCP address lease and acquires a different IP address.	Each system using PowerChute must have a permanent IP address. Reserve IP addresses in DHCP by using the MAC address, so that they never change for specified machines.

Issue	Solution
After a graceful shutdown by PowerChute, the server does not turn on when utility power is restored. **Due to changes in the power management feature in Windows XP SP1, some servers with an ACPI (Advanced Configuration and Power Interface) BIOS will not turn on when utility power is restored after an outage.** **The following is an example of what may occur:** • **A server is attached to a UPS and running PowerChute. PowerChute is configured to shut down the operating system when the UPS has been on battery for a specific time.** • **With a utility power outage, causing the on-battery event, PowerChute commands the operating system to shut down gracefully.** • **Because ACPI power management is controlled by the operating system rather than by the BIOS, when the operating system completes its graceful shutdown, it commands the server to turn off.** • **The UPS remains on battery until its shutdown delay time has expired. When utility power is restored, the UPS provides power; the server does not turn on.**	At this time, there are no updates available for this issue. Check Windows Update for the latest updates and service packs for your operating system.
The UDP and TCP exceptions for PowerChute are only applied to the active profile in the Windows Firewall (and only one profile can be active at a time). If the active profile is changed you will need to manually add exceptions for TCP ports 3052 and 6547 and UDP port 3052.	See Microsoft TechNet.

VMware

↑ Known Issues

Issue	Solution
PowerChute Web UI is inaccessible via vSphere Web Client plug-in on first launch. The following error message is displayed: “Content was blocked because it was not signed by a valid security certificate. ”	In the information bar select the option to display blocked content or install the PowerChute SSL certificate to the Trusted Root Certification Authority Store, or replace the default self-signed SSL cert with a trusted cert per the instructions in **FA176886**.
The PowerChute vCenter plug-in is not compatible with HTML5-based vSphere client. The plug-in can only be viewed using the Flex-based vSphere Web client.	No workaround.

Issue	Solution

Upgrade of PowerChute Network Shutdown v4.2 using the ESXi installer is only supported for CentOS 7. Upgrading PowerChute on earlier versions of CentOS may result in the following error:
 	
`Error: dl failure on line 597`
`Error: failed /opt/APC/PowerChute/jre-11.0.1/lib/server/libjvm.so, because /opt/APC/PowerChute/jre-11.0.1/lib/server/libjvm.so: ELF file OS ABI invalid`
	You can check the version of CentOS running in your virtual appliance by running this command:
	
	`cat /etc/redhat-release`
	
	If you are running an earlier version of CentOS, do not attempt to upgrade, and instead install the latest virtual appliance. See the PowerChute Network Shutdown Installation Guide for more information.

Upgrading a standalone VMware host in single UPS configuration from PowerChute Network Shutdown v4.1 to v4.3 may result in warning messages related to the INI file.	No workaround.
VMs that are part of a vApp will be migrated as part of un-prioritized group when VM Prioritization is enabled. This occurs even if the vApp has been added to a higher priority group. vApp Shutdown/Startup will still occur for the assigned priority group.	No workaround.
If the vCenter Server Appliance (VCSA) is not shut down by PowerChute during a shutdown sequence (e.g. if it's already offline), the subsequent VM start-up on each host will be delayed, as PowerChute will makes repeated attempts to connect to vCenter Server during startup.	No workaround.
If the vSAN Witness Appliance VM is turned off when changes to its host mapping are attempted via the Host Protection page or PowerChute Setup page, PowerChute will no longer identify the vSAN Witness host.	Ensure that the vSAN Witness Appliance is turned on when host mapping changes are made.
If the vSAN Witness Appliance is running on a protected host and it is turned off, it will incorrectly appear available for VM prioritization.	Ensure that the vSAN Witness Appliance is turned on when configuring VM prioritization. If turned on, the vSAN Witness Appliance will not appear available for VM prioritization.
On the VM Prioritization screen, PowerChute does not identify the primary and secondary VMs for which Fault Tolerance is configured.	No workaround.
On the Virtualization Settings page, the vCenter Server VM Shutdown Duration field is displayed, even when the VCSA VM is in a priority group, and the shutdown duration is not used.	Ignore the vCenter Server VM Shutdown Duration field shown on the Virtualization settings page when the VCSA VM is assigned to a priority group.
Following an upgrade to v4.3, vApps and the vCenter Server VM are automatically mapped to the Un-prioritized priority group.	After completing the upgrade, review the VM Prioritization settings and add the vCenter Server VM and vApps to a priority group.
The vSAN Settings section in the Virtualization Settings page does not display if PowerChute is not connected to vCenter Server.	No workaround.

Issue	Solution
No warning message displays on the VM Prioritization page if vApps and the vCenter Server VM are added to the same priority group.	No workaround.
In a vSAN environment, the correct Maintenance Mode action is only considered if Delay Maintenance Mode is enabled.	Ensure that Delay Maintenance Mode is enabled in the Virtualization Settings page.
The VM inventory on the VM Prioritization page does not load successfully and a message displays indicating that vCenter is inaccessible. **This issue can occur if there is a slow network connection between the machine accessing the PowerChute UI and the hardware (e.g. vCenter Server) it is connecting to.**	Access the PowerChute UI from a machine with a faster network connection. Alternatively, the pcnsconfig.ini file can be edited. VM Prioritization can be enabled/disabled in the [HostConfigSettings] section under the `vm_prioritization_enabled` value. VMs/vApps and durations within different priority groups can be changed in the [VMPrioritization] section.
If vCenter Server becomes inaccessible after a critical event occurs but before VM Migration or VM Shutdown has begun, PowerChute will not shut down VMs or vApps.	No workaround.
The vSAN Witness Appliance is considered for VM Shutdown if the Fault Tolerance Threshold is exceeded and PowerChute is configured to shut down all Cluster VMs. **This occurs even though the vSAN Witness Appliance does not contain any VMs to shut down.**	No workaround.
For a vSAN cluster with a Witness Appliance in a Single UPS configuration, if SSH actions are configured to run on startup, the action is incorrectly executed after VMs/vApps have started.	No workaround.
If VM shutdown is enabled but the duration value is set to 0 seconds the shutdown sequence will not proceed.	Set a non-zero value for VM shutdown duration.
In an Advanced UPS configuration, if the vCenter Server IP address is changed on the Communication Settings page, the VMware hosts that were previously associated with UPS's are not removed from the target host list.	Re-start the PowerChute service and associate the VMware hosts in the new vCenter Server Inventory with the UPS's.
When there are multiple vApps in different clusters, PowerChute may log events for vApps that are not running on the VMware Hosts being protected.	None. PowerChute does not perform any operations on these vApps.
If the ESXi Host running vCenter Server VM is not added on the Host Protection page during the Setup Wizard, or if the Setup Wizard is exited without applying the vCenter Server VM Shutdown duration on the Virtualization Settings page, the vCenter Server VM shutdown duration is not applied correctly when the Host is added on the Host Protection page and Virtualization Settings are updated in the Main UI.	Run the Setup Wizard again, ensure that the vCenter Server VM Host is added to the Host Protection page and complete the Setup Wizard.

Issue	Solution
Following a service re-start on a vMA or PowerChute Virtual Appliance, VMs which contain High ASCII or DBCS characters in their name may be stored in pcnsconfig.ini file using a different encoding. This can cause issues for VM Prioritization and VM startup, as the name stored in the INI file will not match what appears in the vCenter Server inventory.	No workaround.

Nutanix

↑ Known Issues

Issue	Solution
PowerChute cannot shut down Acropolis File Services (AFS) VMs if there are multiple AFS clusters in your Nutanix cluster.	This is not a supported configuration. Ensure that there is only one AFS cluster in your Nutanix cluster.
VMs that do not have Nutanix Guest Tools (NGT) installed are shut down at the end of the shutdown sequence, irrespective of their assigned priority groups.	Install NGT on VMs in your Nutanix cluster. For more information, see the Enabling and Mounting Guest Tools article published by Nutanix.
The Nutanix cluster will always wait for all hosts to be online before the cluster is started, even if the "All Hosts online prior to startup" checkbox is not selected on the Virtualization Settings page.	Select the "All Hosts online prior to startup" checkbox if Nutanix support is enabled.
PowerChute may report Host Maintenance Mode was unsuccessful even if hosts are successfully placed into Maintenance Mode.	Increase the duration for Delay Maintenance Mode in the Virtualization Settings page.
The PowerChute Setup wizard can take a long time to launch. **This issue can occur if there is a slow network connection between the machine accessing the PowerChute UI and the hardware it is connecting to.**	Access the PowerChute UI from a machine with a faster network connection.
When the Next button is clicked twice in the Nutanix CVM/Cluster Details page, you may be logged out of the UI. **This issue can occur if there is a slow network connection between the machine accessing the PowerChute UI and the hardware it is connecting to.**	Access the PowerChute UI from a machine with a faster network connection.
PowerChute attempts to power on a Nutanix CVM at the end of a shutdown sequence after hosts have been shut down. **The CVM does not start, as the host has already shut down, but the attempt is incorrectly logged to the Event Log.**	No workaround.

Linux

↑ Known Issues

Issue	Solution
HP-UX	
PowerChute fails to shut down HP-UX machine when installed via iLO/MP Console. This can also occur if the PowerChute daemon is restarted via iLO/MP Console.	Do not install or restart the PowerChute daemon using the iLO/MP Console. Either log on directly or use SSH/rlogin to connect remotely.
Solaris	
When configuring the "Notify User" option in PowerChute, if a Single User is chosen, the user does not receive the notification.	Specify All Users when configuring the "Notify User" option.

Mac OS X Issues

↑ Known Issues

Issue	Solution
Following silent installation using IPv6 on MAC OSX the event log reports the following error: "ERROR: The ini contains an invalid value for localHostAddress in section Networking."	In SilentInstall.ini add the IPv6 address of the PowerChute machine to the key: "LOCAL_IP_ADDRESS=000.000.000.000" and remove the comment symbol: #. This needs to be done in addition to specifying the IPv6 address in the #UNICAST_ADDRESS= key.

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