IBM

IBM TotalStorage Productivity Center Support for the IBM TotalStorage SAN Volume Controller:
Managing in a Virtualized Storage Configuration

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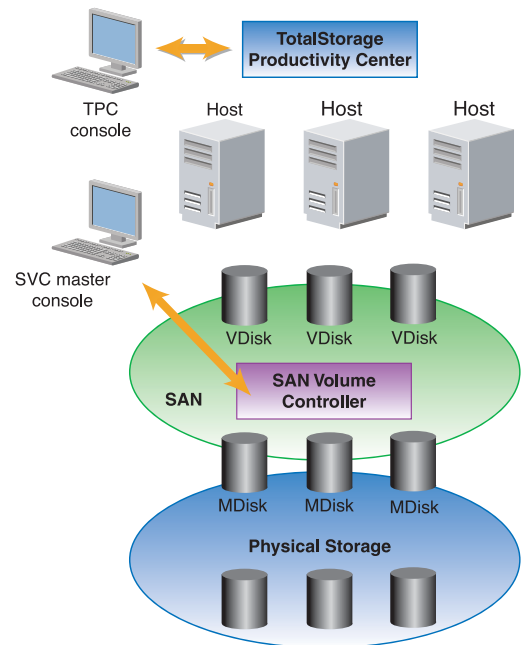*russell.warren@us.ibm.com*

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1.0 IBM TotalStorage Productivity Center Support for the IBM TotalStorage SAN Volume Controller

This document provides a summary of how IBM® TotalStorage® Productivity Center supports the IBM TotalStorage SAN Volume Controller. This information is intended to describe the management capabilities of TotalStorage Productivity Center in a virtualized storage configuration.

1.1 SAN Volume Controller Overview

The IBM TotalStorage SAN Volume Controller is a SAN storage controller that provides storage virtualization capability. Hosts and applications have visibility to the "frontend" storage presented by the SAN Volume Controller, called VDisks. From a host/ application perspective, VDisks have equivalent function to actual physical or logical storage. The exception is that they can be migrated easily to other "backend" storage, and they can be expanded and shrunk—all the features that make VDisks virtual.

The "backend" storage, called MDisks, consist of physical or logical storage provided by one or more storage devices. Connectivity between hosts and the SAN Volume Controller and the backend storage is provided through Fibre Channel fabric connections (the SAN). The backend storage connectivity must be segregated from hosts which access the SAN Volume Controller's VDisks, either by zoning or by physically separate switches or SANs. This segregation prevents hosts or applications from conflicting with SAN Volume Controller's management of MDisk storage.
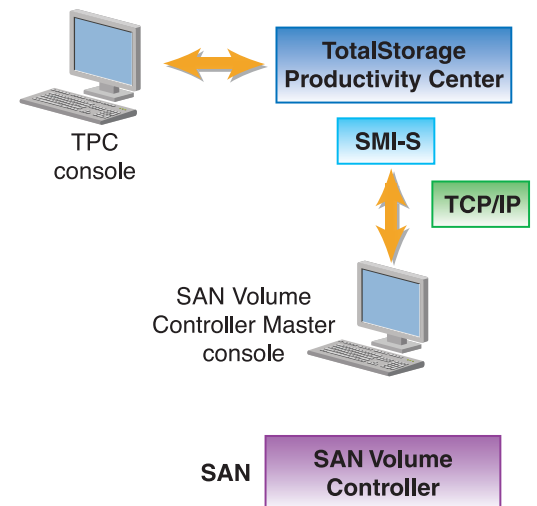
1.2 IBM TotalStorage Productivity Center Support for SAN Volume Controller

The IBM TotalStorage SAN Volume Controller provides support for the Storage Networking Industry Association's (SNIA) Storage Management Initiative Specification (SMI-S). SAN Volume Controller provides an SMI-S Common Information Model (CIM) agent on the SAN Volume Controller master console. This agent is used by the IBM TotalStorage Productivity Center to manage the SAN Volume Controller.

TotalStorage Productivity Center discovers the SAN Volume Controller via the CIM agent. A service called the Service Level Protocol (SLP) is used by storage management applications to discover the storage to be managed. A TotalStorage Productivity Center administrator can also enter the address of the CIM agent. Once TotalStorage Productivity Center has discovered the SAN Volume Controller, an inventory discovery is run to determine the asset and capacity information. There are two TotalStorage Productivity Center management applications that provide management support for SAN Volume Controller: TotalStorage Productivity Center for Data and TotalStorage Productivity Center for Disk.

TotalStorage Productivity Center for Data provides asset and capacity management reporting. TotalStorage Productivity Center for Disk provides LUN allocation and assignment, and it can launch the SAN Volume Controller administrator user interface. TotalStorage Productivity Center for Disk also manages the performance of the SAN Volume Controller.

1.3 TotalStorage Productivity Center for Data

TotalStorage Productivity Center for Data is designed to provide:

- **Automated identification** *of the storage resources in an infrastructure and* **analysis** *of how effectively those resources are being used.*
- **File-system and file-level evaluation** *uncovers categories of files that, if deleted or archived, can potentially represent* **significant reductions in the amount of data** *that must be stored, backed up and managed.*
- **Automated control** *through policies that are customizable with actions that can include centralized alerting, distributed responsibility, and fully automated response.*
- **Ability to predict future growth and future at-risk conditions** *with historical information.*

TotalStorage Productivity Center for Data provides asset and capacity reporting for the SAN Volume Controller. These reports can be divided into two areas:

1. Reports on the SAN Volume Controller asset and the virtualized storage capacity managed by SAN Volume Controller

2. Reports on any file systems and databases that are using virtualized disks via SAN Volume Controller.

SAN Volume Controller asset and capacity reports provided by TotalStorage Productivity Center for Data include:

- **Asset Reporting:**
  — *Reports on SAN Volume Controller physical characteristics such as the manufacturer, model, serial number, capacity, etc.*
- **Configuration Reporting:**
  — *Reports on SAN Volume Controller's virtual disks, the storage allocated to logical host volumes and the SAN Volume Controller's managed disks, and physical storage*
  — *Displays the SAN Volume Controller's physical managed disks*
  — *Lists all SAN Volume Controller VDisks which have been allocated but aren't in use*
  — *Shows which hosts have access to a given SAN Volume Controller VDisk*
  — *Shows which hosts have access to a given disk drive VDisk*
  — *Shows which SAN Volume Controller hosts have access to a given MDisk*

- **Capacity Reporting**
  - *Shows the allocated and free capacity of every SAN Volume Controller cluster on the network*
- **Historical Reporting**
  - *Historical SAN Volume Controller Cluster and I/O group occupancy data are maintained (e.g., assigned/unassigned space within the SAN Volume Controller).*

These reports can give storage administrators information on SAN Volume Controller configurations and utilization of SAN Volume Controller resources over time. These reports can support capacity planning, chargeback, and information lifecycle management capabilities. They help storage administrators ensure that the resources allocated to the SAN Volume Controller are utilized effectively. TotalStorage Productivity Center for Data also provides feedback on file system capacity, database storage utilization, and how often files have been accessed and backed up. Customers using SAN Volume Controller as a central point of control for heterogeneous classes of storage can leverage TotalStorage Productivity Center for Data to provide reports on various classes of service for their users. Flexible reporting capabilities enable a storage administrator to report on groups of users by storage subsystem type, by database or file system type via an automated process, or by request from a storage administrator.

1.4 TotalStorage Productivity Center for Disk

TotalStorage Productivity Center for Disk is designed to provide:

- **Centralized point of control for disk configuration**
  - *Device grouping services*
  - *Logging*
  - *Storage association support (logical to physical mapping)*
- **Automated management and provisioning**
  - *Scheduled actions*
  - *Creation and assignment of LUNs*
  - *Integration with Fabric management for basic automated provisioning*
- **Performance trending**
  - *Performance thresholds and notification*
  - *Automated status and problem alerts*
  - *Integrated with third-party system management via SNMP*

TotalStorage Productivity Center for Disk can discover the SAN Volume Controller and provide configuration management and performance management. It can launch into the SAN Volume Controller administrator console to allow a storage administrator to perform device-specific configuration tasks. From the TotalStorage Productivity Center for Disk user interface, a storage administrator can perform:

1. SAN Volume Controller Configuration—allocate and assign SAN Volume Controller VDisks to hosts. TotalStorage Productivity Center for Disk works in conjunction with TotalStorage Productivity Center for Fabric and can zone the SAN Volume Controller VDisk. It is able to display the logical and physical connectivity of the SAN Volume Controller to the backend storage arrays, enabling an administrator to see the backend storage.

2. SAN Volume Controller Performance Management—performance metrics are collected for the SAN Volume Controller VDisks and MDisks. Performance metrics collected on the disks include response time and transfer rates of data that SAN Volume Controller reads/writes to the backend storage arrays. Thresholds can be set to identify performance exception conditions. Performance metrics can be displayed so that a storage administrator can view the SAN Volume Controller metrics over a time period to identify any bottleneck or contention issues.

The performance counters collected by TotalStorage Productivity Center for Disk are divided into two categories; VDisk metrics and MDisk metrics. These are the performance counters that are collected from the SAN Volume Controller and that are saved in the TotalStorage Productivity Center database:

- *Read/write I/O counts for MDisks*
- *Read/write block (byte) counts for MDisks*
- *Read/write external service times for MDisks*
- *Read/write queued service times for MDisks*
- *Read/write I/O counts for VDisks*
- *Read/write block (byte) counts for VDisks*

These are the performance metrics that are computed from these counters, which are presented to the storage administrator:

- *For SAN Volume Controller Virtual Disks:*
    - *Read I/O Rate (number of I/Os per second), for the sample interval*
    - *Write I/O Rate (number of I/Os per second), for the sample interval*
    - *Total I/O Rate (number of I/Os per second), for the sample interval*
    - *Read Data Rate (number of MBs per second), for the sample interval*
    - *Write Data Rate (number of MBs per second), for the sample interval*
    - *Total Data Rate (number of MBs per second), for the sample interval*
    - *Average Read Transfer Size (number of bytes per I/O) for the sample interval*
    - *Average Write Transfer Size (number of bytes per I/O) for the sample interval*
    - *Average Overall Transfer Size (number of bytes per I/O) for the sample interval*

- *For each SAN Volume Controller Managed Disk*
  - *Read I/O Rate (number of I/Os per second), for the sample interval*
  - *Write I/O Rate (number of I/Os per second), for the sample interval*
  - *Total I/O Rate (number of I/Os per second), for the sample interval*
  - *Read Data Rate (number of MBs per second), for the sample interval*
  - *Write Data Rate (number of MBs per second), for the sample interval*
  - *Total Data Rate (number of MBs per second), for the sample interval*
  - *Read Response Time per read I/O, for the sample interval*
  - *Write Response Time per write I/O, for the sample interval*
  - *Overall Response Time per I/O, for the sample interval*
  - *Read Queued Time per read I/O, for the sample interval*
  - *Write Queued Time per write I/O, for the sample interval*
  - *Overall Queued Time per I/O, for the sample interval*
  - *Average Read Transfer Size (number of bytes per I/O), for the sample interval*
  - *Average Write Transfer Size (number of bytes per I/O), for the sample interval*
  - *Average Overall Transfer Size during the sample interval*

- *For each SAN Volume Controller I/O Group (aggregation of individual VDisk data)*
  - *Read I/O Rate for all VDisks in the I/O group, for the sample interval*
  - *Write I/O Rate for all VDisks in the I/O group, for the sample interval*
  - *Total I/O Rate for all VDisks in the I/O group, for the sample interval*
  - *Average Read I/O Rate among all the VDisks in the I/O group, for the sample interval*
  - *Average Write I/O Rate among all the VDisks in the I/O group, for the sample interval*
  - *Average Total I/O Rate among all the VDisks in the I/O group, for the sample interval*
  - *Maximum Read I/O Rate among all the VDisks in the I/O group, for the sample interval*
  - *Maximum Write I/O Rate among all the VDisks in the I/O group, for the sample interval*
  - *Maximum Total I/O Rate among all the VDisks in the I/O group, for the sample interval*
  - *Read Data Rate for all the VDisks in the I/O group, for the sample interval*
  - *Write Data Rate for all the VDisks in the I/O group, for the sample interval*
  - *Total Data Rate for all the VDisks in the I/O group, for the sample interval*
  - *Average Read Data Rate among all the VDisks in the I/O group, for the sample interval*
  - *Average Write Data Rate among all the VDisks in the I/O group, for the sample interval*
  - *Average Total Data Rate among all the VDisks in the I/O group, for the sample interval*
  - *Maximum Read Data Rate among all the VDisks in the I/O group, for the sample interval*
  - *Maximum Write Data Rate among all the VDisks in the I/O group, for the sample interval*
  - *Maximum Total Data Rate among all the VDisks in the I/O group, for the sample interval*
  - *Average Read Transfer Size among all the VDisks in the I/O group, for the sample interval*
  - *Average Write Transfer Size among all the VDisks in the I/O group, for the sample interval*
  - *Average Total Transfer Size among all the VDisks in the I/O group, for the sample interval*

- *For each SAN Volume Controller MDisk Group (aggregation of individual VDisk and MDisk data)*
  - — *Read I/O Rate for all VDisks in the MDisk group, for the sample interval*
  - — *Write I/O Rate for all VDisks in the MDisk group, for the sample interval*
  - — *Total I/O Rate for all VDisks in the MDisk group, for the sample interval*
  - — *Average Read I/O Rate among all the VDisks in the MDisk group, for the sample interval*
  - — *Average Write I/O Rate among all the VDisks in the MDisk group, for the sample interval*
  - — *Average Total I/O Rate among all the VDisks in the MDisk group, for the sample interval*
  - — *Maximum Read I/O Rate among all the VDisks in the MDisk group, for the sample interval*
  - — *Maximum Write I/O Rate among all the VDisks in the MDisk group, for the sample interval*
  - — *Maximum Total I/O Rate among all the VDisks in the MDisk group, for the sample interval*
  - — *Read Data Rate for all the VDisks in the MDisk group, for the sample interval*
  - — *Write Data Rate for all the VDisks in the MDisk group, for the sample interval*
  - — *Total Data Rate for all the VDisks in the MDisk group, for the sample interval*
  - — *Average Read Data Rate among all the VDisks in the MDisk group, for the sample interval*
  - — *Average Write Data Rate among all the VDisks in the MDisk group, for the sample interval*
  - — *Average Total Data Rate among all the VDisks in the MDisk group, for the sample interval*
  - — *Maximum Read Data Rate among all the VDisks in the MDisk group, for the sample interval*
  - — *Maximum Write Data Rate among all the VDisks in the MDisk group, for the sample interval*
  - — *Maximum Total Data Rate among all the VDisks in the MDisk group, for the sample interval*
  - — *Average Read Transfer Size among all the VDisks in the MDisk group, for the sample interval*
  - — *Average Write Transfer Size among all the VDisks in the MDisk group, for the sample interval*
  - — *Average Total Transfer Size among all the VDisks in the MDisk group, for the sample interval*
  - — *Read I/O Rate for all MDisks in the MDisk group, for the sample interval*
  - — *Write I/O Rate for all MDisks in the MDisk group, for the sample interval*
  - — *Total I/O Rate for all MDisks in the MDisk group, for the sample interval*
  - — *Average Read I/O Rate among all the MDisks in the MDisk group, for the sample interval*
  - — *Average Write I/O Rate among all the MDisks in the MDisk group, for the sample interval*
  - — *Average Total I/O Rate among all the MDisks in the MDisk group, for the sample interval*
  - — *Maximum Read I/O Rate among all the MDisks in the MDisk group, for the sample interval*
  - — *Maximum Write I/O Rate among all the MDisks in the MDisk group, for the sample interval*
  - — *Maximum Total I/O Rate among all the MDisks in the MDisk group, for the sample interval*
  - — *Read Data Rate for all the MDisks in the MDisk group, for the sample interval*
  - — *Write Data Rate for all the MDisks in the MDisk group, for the sample interval*

- *For each SAN Volume Controller MDisk Group (aggregation of individual VDisk and MDisk data) - (Continued)*
- *Total Data Rate for all the MDisks in the MDisk group, for the sample interval*
- *Average Read Data Rate among all the MDisks in the MDisk group, for the sample interval*
- *Average Write Data Rate among all the MDisks in the MDisk group, for the sample interval*
- *Average Total Data Rate among all the MDisks in the MDisk group, for the sample interval*
- *Maximum Read Data Rate among all the MDisks in the MDisk group, for the sample interval*
- *Maximum Write Data Rate among all the MDisks in the MDisk group, for the sample interval*
- *Maximum Total Data Rate among all the MDisks in the MDisk group, for the sample interval*
- *Average Read Transfer Size among all the MDisks in the MDisk group, for the sample interval*
- *Average Write Transfer Size among all the MDisks in the MDisk group, for the sample interval*
- *Average Total Transfer Size among all the MDisks in the MDisk group, for the sample interval*
- *Total Read Response Time among all the MDisks in the MDisk group, for the sample interval*
- *Total Write Response Time among all the MDisks in the MDisk group, for the sample interval*
- *Total Overall Response Time among all the MDisks in the MDisk group, for the sample interval*
- *Average Read Response Time among all the MDisks in the MDisk group, for the sample interval*
- *Average Write Response Time among all the MDisks in the MDisk group, for the sample interval*
- *Average Overall Response Time among all the MDisks in the MDisk group, for the sample interval*
- *Maximum Read Response Time among all the MDisks in the MDisk group, for the sample interval*
- *Maximum Write Response Time among all the MDisks in the MDisk group, for the sample interval*
- *Maximum Overall Response Time among all the MDisks in the MDisk group, for the sample interval*
- *Total Read Queued Time among all the MDisks in the MDisk group, for the sample interval*
- *Total Write Queued Time among all the MDisks in the MDisk group, for the sample interval*
- *Total Overall Queued Time among all the MDisks in the MDisk group, for the sample interval*
- *Average Read Queued Time among all the MDisks in the MDisk group, for the sample interval*
- *Average Write Queued Time among all the MDisks in the MDisk group, for the sample interval*
- *Average Overall Queued Time among all the MDisks in the MDisk group, for the sample interval*
- *Maximum Read Queued Time among all the MDisks in the MDisk group, for the sample interval*
- *Maximum Write Queued Time among all the MDisks in the MDisk group, for the sample interval*
- *Maximum Overall Queued Time among all the MDisks in the MDisk group, for the sample interval*

TotalStorage Productivity Center for Disk provides predefined thresholds for the SAN Volume Controller

- *Virtual Disk I/O Rate*
  - *total number of I/Os per second for all VDisks in an I/O group (the same threshold applies to all I/O groups per device)*
- *Virtual Disk Transfer Rate*
  - *total number of MBs transferred per second for all VDisks in an I/O group (the same threshold applies to all I/O groups per device)*
- *Managed Disk I/O Rate*
  - *total number of I/Os per second for all MDisks in an MDisk group (the same threshold applies to all MDisk groups per device)*
- *Managed Disk Transfer Rate*
  - *total number of MBs transferred per second for all MDisks in an MDisk group (the same threshold applies to all MDisk groups per device)*

A storage administrator can set values for these thresholds and define event actions to be taken if these thresholds are exceeded. Two levels of thresholding are provided, a warning level and an error level. Events can be raised for when the threshold conditions are triggered. A special class of event, called the exception event, can also be defined. The exception event counts the number of times a specific threshold exception has been raised. It then triggers an event based on the number of exceptions raised over a period of time (i.e., send an event if the I/O rate exceeds 300 writes 5 times within an hour).

TotalStorage Productivity Center for Disk provides flexibility to help manage events. A storage administrator can define event action plans to determine what TotalStorage Productivity Center for Disk should do, including sending a page, email and/or SNMP trap to a higher level management application.

1.5 Advanced Provisioning Support for SAN Volume Controller

Combining TotalStorage Productivity Center with IBM Tivoli® Provisioning Manager, storage administrators have a powerful way to simplify the provisioning of storage. Automated workflows can be created that can utilize custom scripts, customer processes (including storage administrator and/or systems administrator sign off), and TotalStorage Productivity Center (which does the actual storage configuration changes).
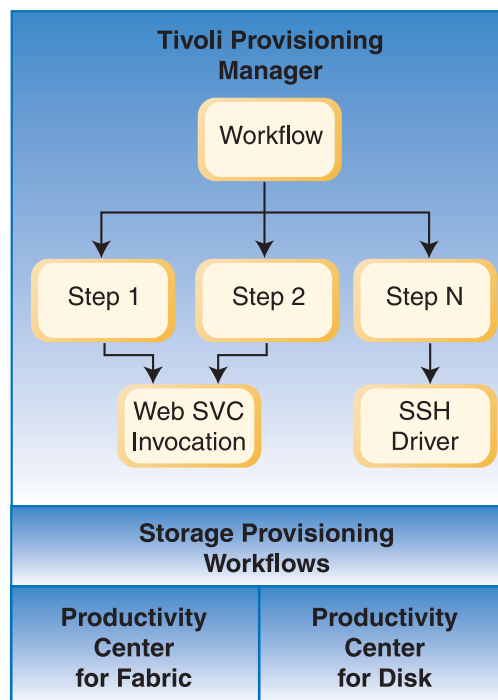
1.6 SAN Configurations

When TotalStorage Productivity Center discovers the SAN Volume Controller, asset, capacity and perform-ance metrics are collected and presented to the storage administrator. If the physical storage that is virtual-ized by SAN Volume Controller has support for SMI-S, further management information is provided by TotalStorage Productivity Center. The following configurations describe what management information TotalStorage Productivity Center provides to a storage administrator based on the physical storage's SMI-S capabilities.

Physical storage can be partially to fully virtualized (all available physical storage is assigned to SAN Volume Controller). If the physical storage supports SMI-S, TotalStorage Productivity Center can provide the storage administrator with the full picture of how the physical storage is allocated and configured across both the virtualized and non-virtualized storage area network.

1.6.1 Configuration 1: Physical storage does not support SMI-S

The first scenario is where the backend storage and storage subsystems are visible only to the SAN Volume Controller, and hosts and management appli-cations (i.e., TotalStorage Productivity Center) only have visibility to the VDisks (frontend storage).

In this scenario, TotalStorage Productivity Center is configured to interface only to the SAN Volume Controller and not to discover any of the backend storage.
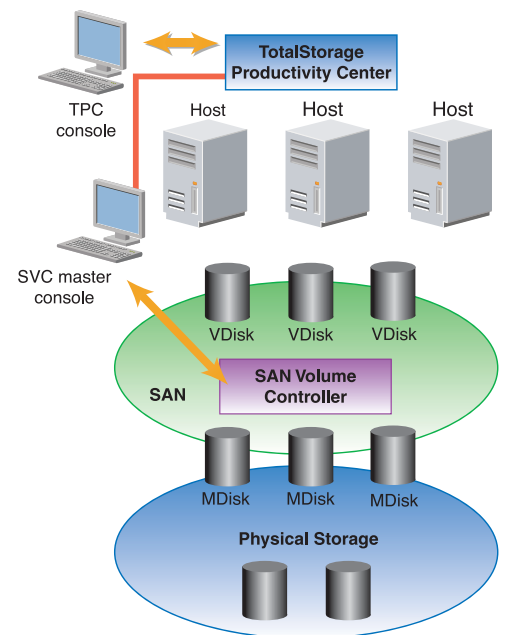
1.6.1.1 Implications for TotalStorage Productivity Center

The backend storage to SAN Volume Controller is not directly visible to TotalStorage Productivity Center for Data nor to TotalStorage Productivity Center for Disk. (The backend storage is reported to TotalStorage Productivity Center as MDisks by the SAN Volume Controller.) TotalStorage Productivity Center for Fabric may see the backend SAN if it has been configured with the Fibre Channel switches that provide connectivity for the backend storage.

In this configuration the type of backend storage does not have any impact on TotalStorage Productivity Center, and it does not matter whether TotalStorage Productivity Center supports these devices.

TotalStorage Productivity Center for Disk is able to monitor and manage these disks via SAN Volume Controller. Using the SAN Volume Controller GUI, the disks must be zoned and assigned to the SAN Volume Controller as part of an MDisk group. TotalStorage Productivity Center for Disk can then assign these disks to hosts (VDisks) and can provide performance management via SAN Volume Controller statistics (which include I/O rates and response times on the physical disks).

Combined with TotalStorage Productivity Center for Fabric and for Disk, TotalStorage Productivity Center for Advanced Provisioning can provision SAN Volume Controller storage to hosts requiring more storage. For this scenario, the physical storage must already be assigned to SAN Volume Controller.

1.6.2 Configuration 2: Physical storage does support SMI-S and is completely virtualized

In this configuration, TotalStorage Productivity Center discovers the physical storage and the SAN Volume Controller. The entire physical disk is virtualized (all of the physical storage is assigned to SAN Volume Controller).

TotalStorage Productivity Center can gather asset, capacity and performance metrics from both the physical storage and the SAN Volume Controller. A storage administrator is able to generate reports from both the SAN Volume Controller and from the physical storage as well as configure the SAN Volume Controller and physical storage. A storage administrator can also manage the performance of the physical storage and SAN Volume Controller.
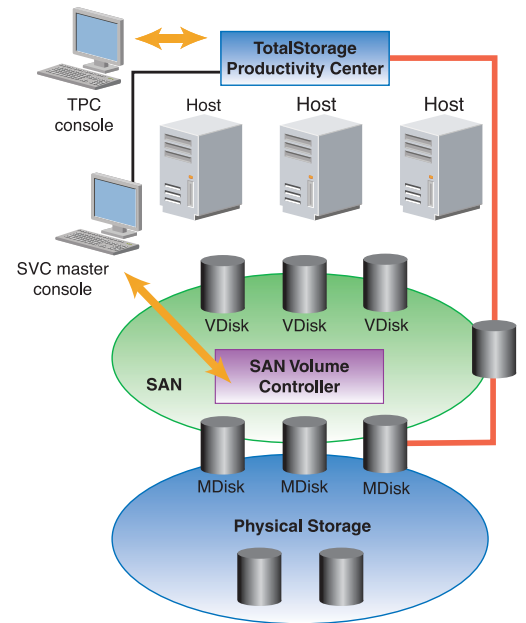
1.6.2.1 Implications for supported devices

TotalStorage Productivity Center for Data provides consolidated reporting of all storage in a data center. It is able to recognize that SAN Volume Controller's VDisks consist of storage that may also be discovered by physical storage's SMI-S support. It can remove duplicate capacity and utilization totals in reports which include both the SAN Volume Controller and its backend storage.

If the backend storage device is supported by TotalStorage Productivity Center (i.e., IBM TotalStorage Model DS4000, IBM Enterprise Storage Server®), TotalStorage Productivity Center for Data and TotalStorage Productivity Center for Disk can provide asset, capacity and configuration management for backend storage, including LUN assignment and masking. Asset and capacity reports may be obtained for an entire physical storage array, including third-party storage (i.e., EMC, HP, Hitachi) supported by TotalStorage Productivity Center for Data. Users with this configuration can assign/unassign storage to the SAN Volume Controller (i.e., virtualize it) via TotalStorage Productivity Center, providing a mixed storage environment. Asset and capacity reports show full storage array capabilities, including identification of physical storage (manufacturer, version, release).

If TotalStorage Productivity Center provides performance management support (i.e., IBM Enterprise Storage Server), additional performance metrics are available. TotalStorage Productivity Center for Disk provides the following performance metrics for the ESS:

- **Array Level**
  - *Number of writes, reads*
  - *Total time to satisfy reads, writes*
  - *Average subsystem I/O rate*
  - *Average response time (millisecond)*
  - *Utilization*
  - *Total I/O issued to volumes*
  - *Total sequential I/Os issued to volumes in this array*
- **Volume Level**
  - *Number of writes, reads*
  - *Number of cache hits (reads, writes)*
  - *Disk-to-cache transfers, cache-to-disk transfers*
  - *Cache hit ratio (reads, writes, overall)*
  - *Fast writes*
- **Cluster Level**
  - *Average cache holding time*
  - *Percent of total I/O requests delayed*

1.6.2.2 Implications for devices not in supported products list

If the backend storage device is not in the support devices list, TotalStorage Productivity Center provides some basic SMI-S support. Asset and capacity reports show full storage array capabilities, including identification of physical storage (manufacturer, version, release).

1.6.3 Configuration 3: Physical storage does support SMI-S and is partially virtualized

This configuration describes the case where storage from an SAN Volume Controller backend device is also visible to a host. Note that the only storage from a backend device that can be configured to a host are Logical Units that are not already configured as MDisks. This also implies that the Logical Units are not included in the SAN Volume Controller storage zone. (Otherwise, this would be an unsupported configuration.) This also implies that the backend storage device must provide a connection to a separate SAN or zone that is not part of the backend SAN (again, otherwise this would be an unsupported configuration).
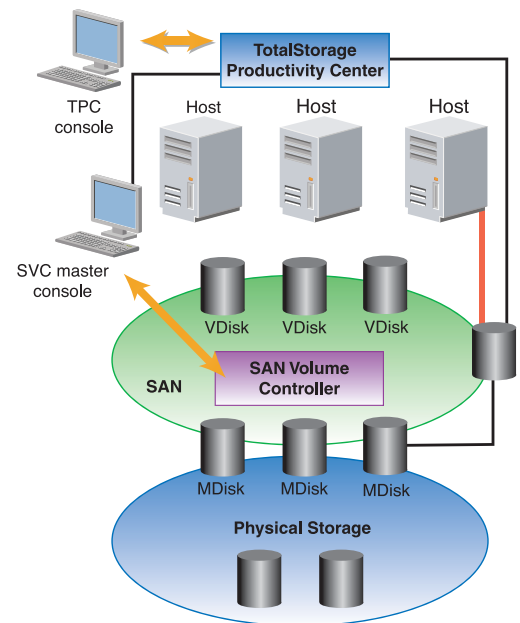
1.6.3.1 Implications for TotalStorage Productivity Center

TotalStorage Productivity Center for Data is able to recognize that SAN Volume Controller's VDisks consist of storage that may also be discovered via physical storage's SMI-S support. TotalStorage Productivity Center for Data is able to remove duplicate capacity and utilization totals in reports that include both the SAN Volume Controller and its backend storage. TotalStorage Productivity Center for Data can also report on complete physical disk capacity and allocation.

For supported backend devices, TotalStorage Productivity Center for Disk has the ability to report and manage volumes for backend devices. It is critical that the user avoid any TotalStorage Productivity Center for Disk operations which can impact SAN Volume Controller backend storage volumes. TotalStorage Productivity Center for Disk is able to allocate storage to the SAN Volume Controller and provide a single management control point for both virtualized as well as non-virtualized storage.

The user can determine if a storage volume is assigned as a VDisk by displaying the "LUN to HBA Assignment" report under TotalStorage Productivity Center for Data (Reporting/Storage Subsystems/LUN to HBA Assignment/By Storage Subsystem) and displaying those LUNs assigned to the SAN Volume Controller WWN. This information may also be displayed in the TotalStorage Productivity Center for Disk GUI.

For more information:

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ibm.com/storage.