Optimize your investments with IBM Tivoli Storage Productivity Center and IBM SmartCloud Virtual Storage Center

IBM Redbooks Solution Guide

IBM® SmartCloud® Virtual Storage Center V5.2 enables easy migration to agile, cloud-based storage environments. This solution comprises the advanced functions available in IBM Tivoli® Storage Productivity Center, IBM System Storage® SAN Volume Controller, and IBM Tivoli FlashCopy® Manager, as well as the advanced analytics provided by the IBM SmartCloud Virtual Storage Center V5.2 license. By integrating these separate products, Virtual Storage Center provides a combined storage virtualization platform and storage management solution. It provides more room for data growth and simplifies the administration of storage.

This IBM Redbooks® Solution Guide gives you an overview of how to use Virtual Storage Center, with the features of Tivoli Storage Productivity Center, to help optimize your storage infrastructure. This solution enables organizations to optimize provisioning, capacity utilization, reporting, and management for storage and to enable application aware data protection through advance snapshot capabilities of storage subsystems. These benefits can help an organization to realize management efficiencies and cost benefits. Virtual Storage Center enables you to virtualize your storage infrastructure. As an end-to-end storage management solution included in Virtual Storage Center, Tivoli Storage Productivity Center provides a single point of control that helps administrators to manage every aspect of the storage infrastructure, between the hosts, through the fabric, and down to the physical disks for multi-site storage environments (as illustrated in Figure 1).

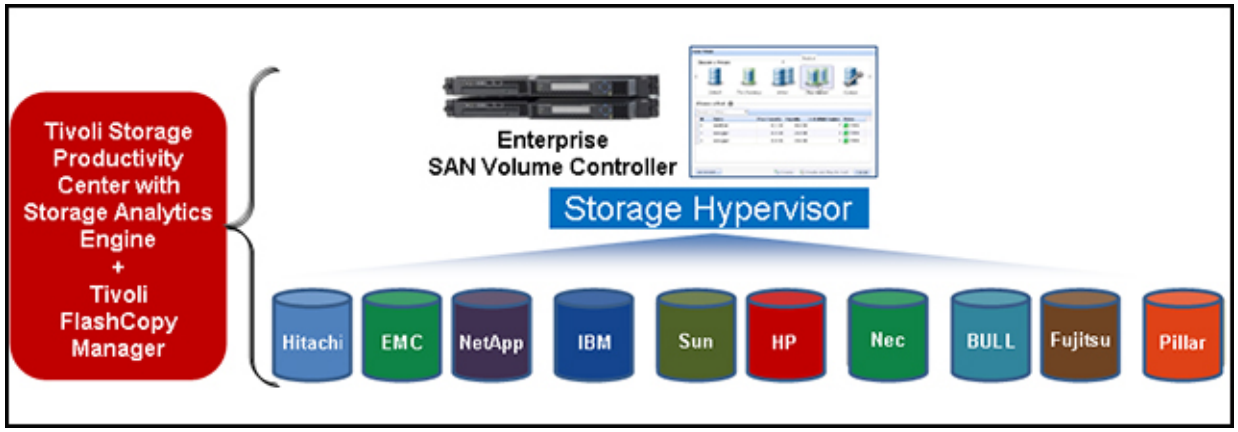

Figure 1. Virtualize your storage infrastructure

Note: Virtual Storage Center V5.2 delivers, under one licensed software product, the set of functions that are available in IBM Tivoli Storage Productivity Center, as well as the advanced analytics that are provided with Virtual Storage Center, the functions and capabilities that are associated with IBM System Storage SAN Volume Controller (including copy services), and the capabilities of IBM Tivoli Storage FlashCopy Manager. The only way to get all of the advanced capabilities of what used to be Tivoli

Storage Productivity Center Standard Edition is through the Virtual Storage Center V5.2 license, which provides all of the advanced functions of the Storage Analytics Engine.

Did you know?

Implementing Virtual Storage Center can address new workloads that require massive scale and rapid pace and can accelerate business insight. This solution offers both a storage virtualization platform and capabilities for storage virtualization management. Virtual Storage Center delivers the following capabilities in one licensed software product:

- The complete set of advanced functions available in the Tivoli Storage Productivity Center
- The set of functions available with the virtualization, remote mirroring and FlashCopy capabilities of the SVC
- All the capabilities of the Tivoli Storage FlashCopy Manager

Implementing Virtual Storage Center with all the advanced functions of Tivoli Storage Productivity Center can save you money because you can maximize the storage that you already purchased. In addition, you can virtualize your infrastructure by using an advanced analytics function, such as Storage Management API for cloud. Virtual Storage Center can also help you to achieve key performance indicators (KPIs) by using advanced reporting features, such as storage capacity, performance monitoring, automated status, and problem alerts--all from a single dashboard provided within the Tivoli Storage Productivity Center web-based GUI. Also, Virtual Storage Center uses Tivoli FlashCopy Manager and includes application-aware data protection. So, snapshot technologies are available for online, near instant backups with minimal performance impact and high performance, near instant restores. Finally, users who have IBM SmartCloud Virtual Storage Center licensing (also referred to as *VSC*) can perform advanced analytics tasks, such as optimization of storage volumes and storage pools, provisioning of server storage, and provisioning of hypervisor storage for both file shares and block storage.

Business value

Implementing Virtual Storage Center couples your storage layer with server and VMware information, enabling you to gain the following benefits:

- Gain an overview of your entire storage environment by maximizing the utilization through the advanced analytics engine.
- Perform end-to-end reporting, from your server over one or more vitualizers through the SAN Fabric to physical disks in the storage system.
- Allow users to provision storage for their servers or hypervisors.
- Apply powerful performance troubleshooting, implementing storage correlation, and simplified graphs with multiple metrics.

You can obtain this information either through the Tivoli Storage Productivity Center web-based GUI or through IBM Cognos® Reporting, which enables reports in various formats to be run or scheduled.

Virtual Storage Center provides the data foundation for making decisions, achieved through data collection of the entire storage environment. It also provides the recommendations for moving storage, by either moving heavily used volumes to faster pools of disks, by using *VSC optimization*, or to an IBM Easy Tier® pool. Less frequently used volumes can be moved to less expensive disks, thereby gaining the most and best usage of the storage already available on the floor.

To summarize the business value, Virtual Storage Center takes the most advantage of existing storage investments. It optimizes storage usage and performance and provides storage administrators unified

tools for performing work across vendor products and platforms. The end result is maximizing and gaining the most from already purchased storage. Therefore, you can realize significant cost savings and transform your environments to the next generation storage operations.

Solution overview

When your environment has been configured using the Tivoli Storage Productivity Center web-based GUI, with Virtual Storage Center storage optimization, your company can define from Tier 1 storage (usually the fastest) up to Tier 10 (the slowest or least expensive). The tiering analysis and balancing features from within the Tivoli Storage Productivity Center web-based GUI are part of advanced optimization analytics that are provided by the Virtual Storage Center license. By assigning a tier level to your storage, your environment is ready for running an analysis on your SVC and the IBM Storwize® storage. You don't need to set I/O capabilities. Tivoli Storage Productivity Center, working together with Virtual Storage Center, already knows what SVC and the Storwize storage is capable of in the way of performance. The result of the run is a set of recommendations, which can be executed now or later.

The recommendation can be to move volumes from one pool to another and, therefore, more efficiently balance the load so that a single pool is not overloaded while others are idling.

Figure 2 illustrates some scenarios of storage optimization and balancing. You might move less used volumes to less expensive or slower storage (*down-level* tiering) or move heavily-used volumes to faster disks or solid-state drive (SSD) disks, such as Easy Tier (*up-level* tiering). By balancing the load and using the fastest disks possible with the heaviest loaded volumes, you gain the maximum performance from the resources already on the floor.

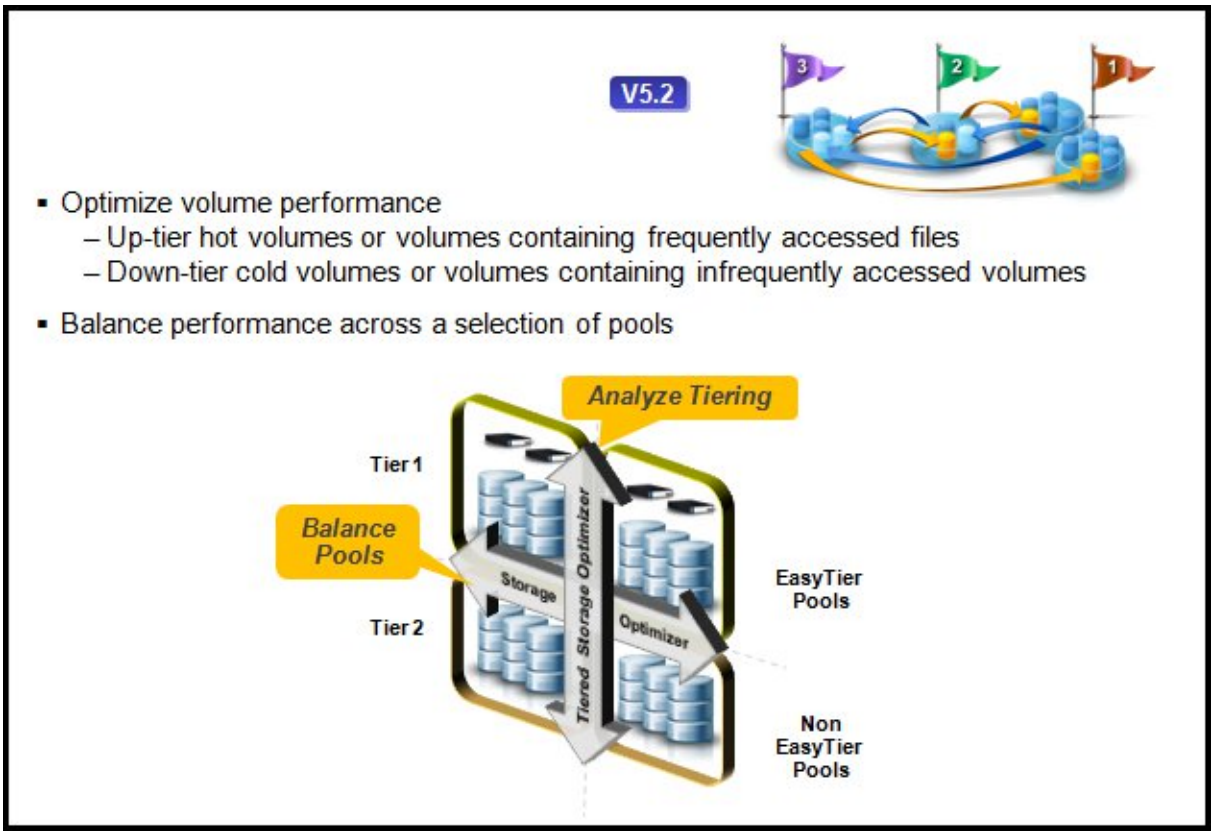

Figure 2. Virtual Storage Center V5.2 Advanced analytics, storage optimization, and balancing

Yet another possibility for optimization, is letting Virtual Storage Center and Tivoli Storage Productivity Center take advantage of the features provided by SVC and Storwize V7000 by allowing already provisioned volumes to be transformed seamlessly. You can use functions such as transforming volumes to thin provisioned, which allows addressable storage capacity to be provisioned without consuming or reserving physical capacity. With thin provisioning, volumes take up only the capacity they use instead of what is allocated. Volumes can also be transformed to compressed data, which uses less capacity.

Figure 3 illustrates the available volume transformation features available with Virtual Storage Center.

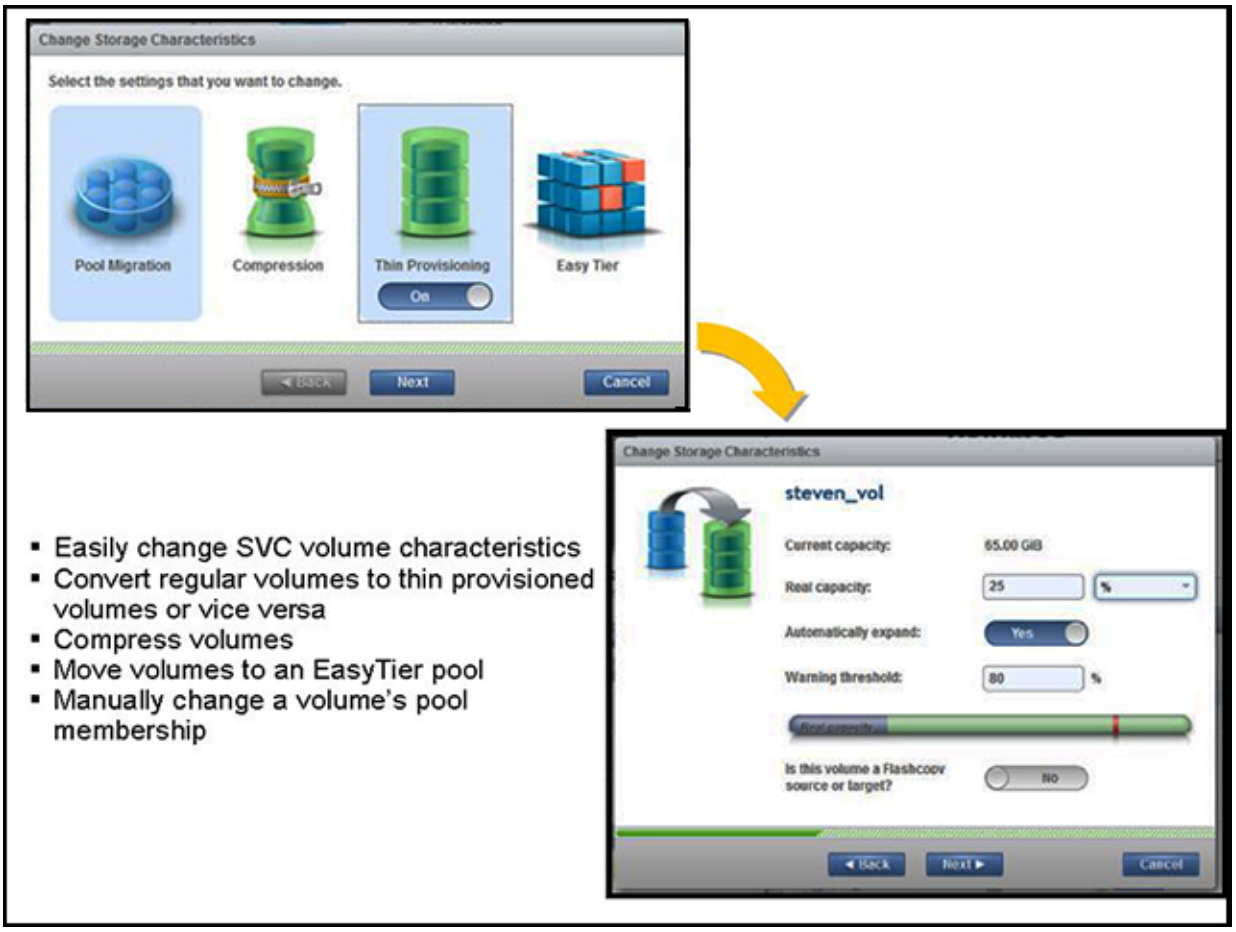

Figure 3. Virtual Storage Center volume transformation features

Solution architecture

Virtual Storage Center includes core functionality from the following IBM offerings:

- IBM Tivoli Storage Productivity Center, including its advanced functions, Virtual Storage Center Advanced Analytics, as well as Tivoli Storage Productivity data and storage management
- External virtualization found in IBM System Storage SAN Volume Controller and the IBM Storwize family
- Application-aware snapshot backup and restore capabilities from IBM Tivoli Storage FlashCopy Manager

Figure 4 shows an example configuration of a Tivoli Storage Productivity Center server and Virtual Storage Center, its interfaces, and examples of monitored objects. The Tivoli Storage Productivity Center server represented at the center of the drawing shows a single server installation on which IBM DB2®, the Tivoli Storage Productivity Center server, and the Cognos reporting function are installed on a single system. Multi server installations are also supported.

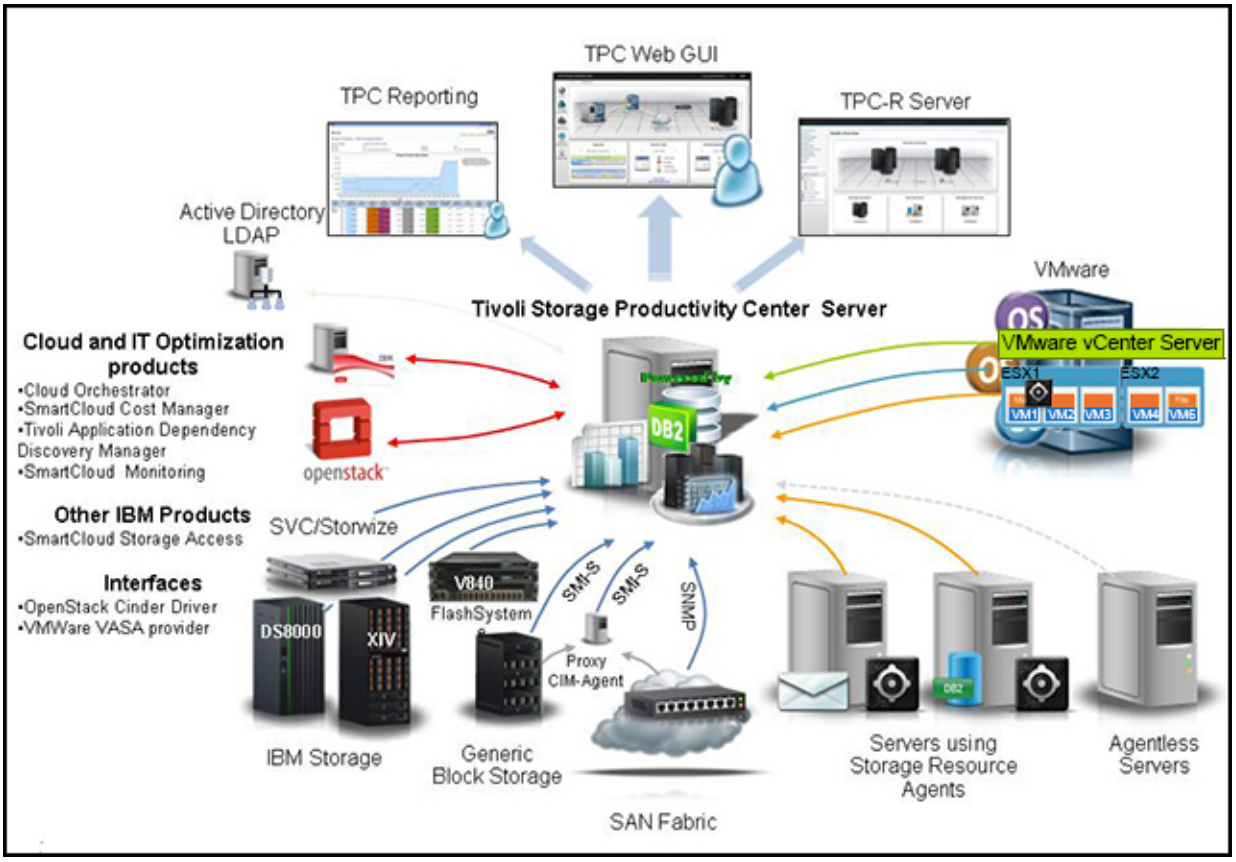

Figure 4. Tivoli Storage Productivity Center and Virtual Storage Center architecture

The following components are illustrated in Figure 4:

- Web-based GUI

  Starting at the top of Figure 4, the Tivoli Storage Productivity Center web-based GUI is the primary interface for configuring, monitoring, and reporting results for the Tivoli Storage Productivity Center server and the Virtual Storage Center environment.

- Tivoli Storage Productivity Center for Replication

  Moving clockwise in Figure 4, Tivoli Storage Productivity Center for Replication is a component of Tivoli Storage Productivity Center and Virtual Storage Center that manages *copy services* in storage environments. Copy services are features that are used by storage systems to configure, manage, and monitor data replication functions. These copy services include FlashCopy, Metro Mirror, Global Mirror, and Metro Global Mirror data replication.

- VMware monitoring

  On the right in Figure 4, Tivoli Storage Productivity Center can monitor multiple facets of a VMware environment including storage usage by ESX servers, identification of individual virtual machines (VMs), and storage usage of individual VMs. Because Tivoli Storage Productivity Center is a vSphere

Storage APIs for Storage Awareness (VASA) provider, you can provision storage using Tivoli Storage Productivity Center from the VMware Web Client interface.

- Application server monitoring

  Continuing clockwise through Figure 4, the next part of the image demonstrates the ability of Tivoli Storage Productivity Center to monitor the local and remote storage capacity and usage on multiple server types and operating systems. With agentless servers, you can view usage and performance of mapped storage for that server. Where storage resource agents are installed, you can collect local file usage, including individual file metadata, such as file type and owner. You can monitor usage of storage reserved for databases also.

- Device monitoring

  The bottom of Figure 4 illustrates how to use Tivoli Storage Productivity Center to monitor the configuration of SAN switches and both IBM and supported third-party storage subsystems. You can monitor SMI-S compliant devices using local and proxied CIM agents. You can use SNMP with the CIM agent, and for some devices you can use SNMP as the sole method of communication with the device. Tivoli Storage Productivity Center communicates with IBM DS8000®, XIV®, SVC, FlashSystem™ V840, and Storwize systems using the native API (NAPI).

- Tivoli application interaction

  Continuing clockwise through Figure 4, use Tivoli Storage Productivity Center to provide data to other Tivoli applications, or use the server an interface so that other applications can provision storage.

- Lightweight Directory Access Protocol (LDAP) configuration

  The left of Figure 4 shows how you can configure Tivoli Storage Productivity Center to use LDAP authentication and configure Tivoli Storage Productivity Center for single sign-on.

- Cognos reporting

  Finally, Figure 4 illustrates how to use the Cognos reporting features to define, schedule, and distribute both pre-defined and user-defined reports.

Usage scenarios

In addition to IBM Tivoli Storage Productivity Center, external virtualization found in SVC and the IBM Storwize family, application aware data protection found in Tivoli FlashCopy Manager, and advanced analytics, Virtual Storage Center bundles the following components and can be installed on either AIX®, Linux®, or Windows® operating systems:

- IBM DB2 database, which is used as the backend for storing the collected information, from which Cognos and the web-based GUI can retrieve and present the information.
- IBM WebSphere® Application Server, which is used for hosting the difference GUIs that allow access for users to view the information collected

Also, through the VMware vCenter Web Client extension and VASA, VMware can gain access to Tivoli Storage Productivity Center and Virtual Storage Center information about the storage environment. Virtual Storage Center retrieves information about the storage environment, and it uses either Native API for IBM Storage systems or SMI-S proxies for other vendors' storage.

Information from servers is collected using a *storage resource agent*. A *serverless agent* can be created and used to correlate information and can provide an end-to-end view for reporting from the storage

environment. When storage systems information is collected, storage administrators can assign tiers to storage, which then is used for analyzing, reporting, and provisioning.

Using the Tivoli Storage Productivity Center web-based GUI, you can view performance statistics and relationships (as shown in Figure 5).

Figure 5. Performance statistics and related resources internal resources, such as disks and controllers

The storage system is identified in Figure 5 as *DS8K-73RA271*. In the four panels on the right in Figure 5, key metrics display for DS8K-73RA271, such as capacity, overall IOPS, and utilization. You can modify each view for the format that best suites your needs. The left menu includes internal resources, such as disks and controllers, and their status.

Selecting any of the available options lets you drill down further and get more specific information. The related resources shows information such as which SAN switches the storage system is connected to and what hosts have been created. There is also an menu named **Data Path** that provides a graphical view of the relationship (shown in Figure 6), from the back-end storage system, over switches and vitualizers, to the servers that use the storage.

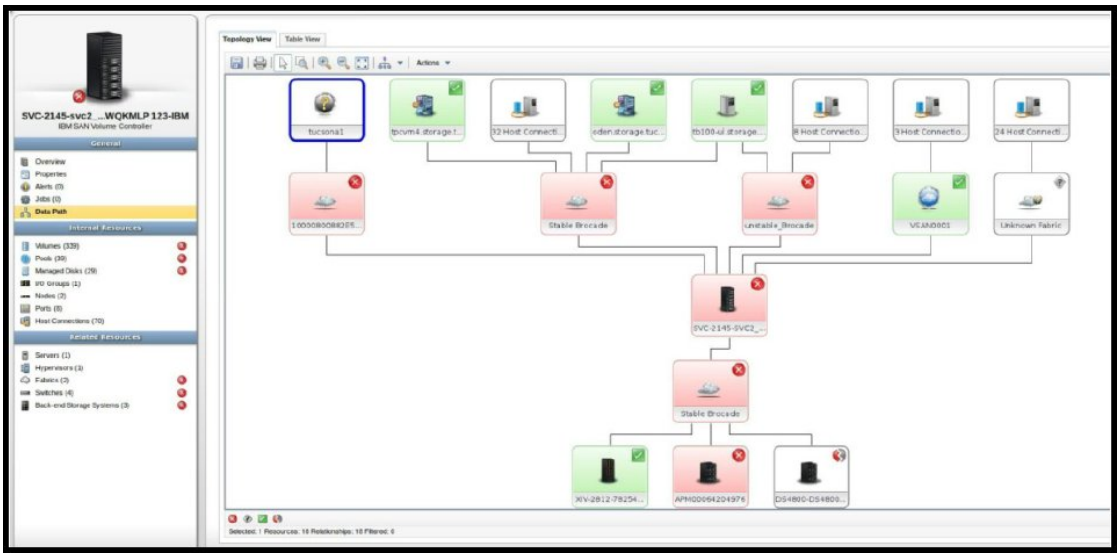

Figure 6. Data Path, graphical view of connectivity between hosts, server, storage systems, and fabrics

As of Tivoli Storage Productivity V5.2.2, performance collection is enhanced. You can collect performance data every minute, allowing for finer granularity and determining the cause of bottlenecks in your storage environment. As of SVC V7.3, you can now show real-time performance analysis by accessing and opening the window from the SVC interface. Performance analysis is enhanced so that you can correlate information for multiple storage systems with a single mouse click, bringing the pictures in sync. Now, it is easier to see the cause and effect of an event, as illustrated in Figure 7.

Figure 7. Correlate performance information for SVC storage systems with a single mouse click

Provisioning storage can now be done from the Tivoli Storage Productivity Center web-based GUI, transforming storage management into a “storage as a service” organization. Users can either provision or request storage themselves, based on policies set by storage management, as shown in Figure 8.

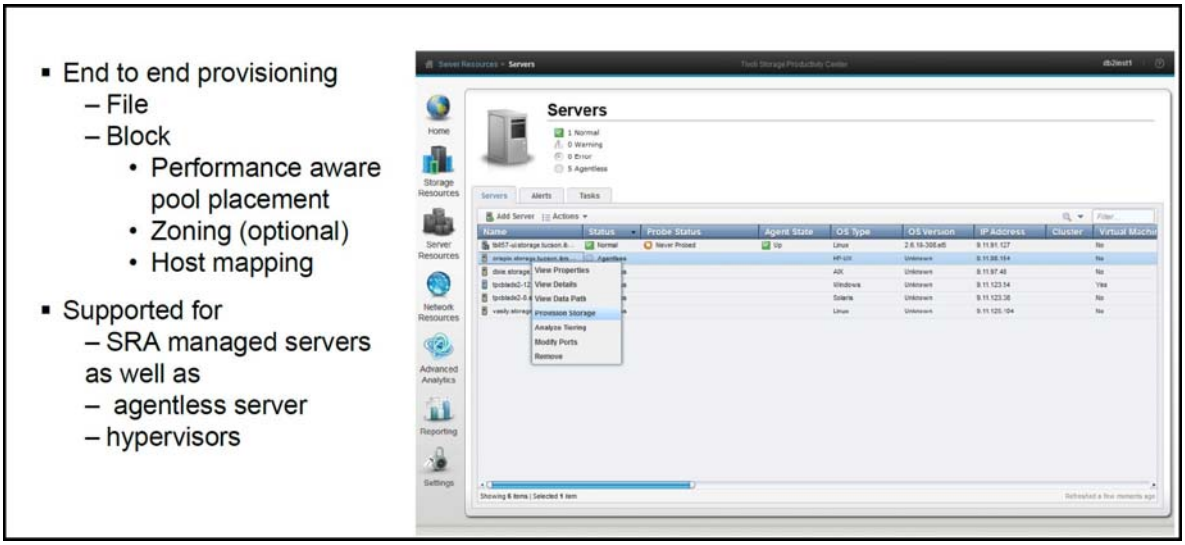

Figure 8. Service-class-based provisioning

Using Capacity pools, you can segment storage so that authorized users can provision the appropriate storage. Storage can be categorized by different departments or customer types, where it is ensured that the appropriate data is assigned only to authorized users. Another possibility is to allow for provisioning only to midrange storage and then let Virtual Storage Center advanced analytics, over time, to determine whether the storage should be optimized to be moved up or down a tier.

Integration

Virtual Storage Center includes integration with all of the components illustrated in Figure 4 on page 6. This solution can provide data to other Tivoli applications or can use the Tivoli Storage Productivity Storage Center interface so that other applications, for example VMware, can provision storage.

The following IBM Tivoli applications can be integrated into your Virtual Storage Center environment:

- **IBM SmartCloud Cost Manager**: This application provides visibility into the usage and cost of your infrastructure and other non-IT resources. The software helps you track and assess shared computing resource usage accurately and better manage the cost of your cloud and IT services with the following features:
  - Provides insight into virtualized and physical IT assets so that you can discover who is using shared resources and what is being used to help quantify how departmental and project behavior contributes to overall IT total cost of ownership.
  - Includes advanced analytics by using Cognos reporting and usage metering coverage for virtual and cloud computing resources, storage resources, and network resources.
  - Provides user visibility into the cost implications of services, which can help bring down costs while delivering IT services more efficiently.
  - Supports cloud show-back and charge-back processes to provide an accurate metering and cost rating tool for tracking business processes against budgets.
  - Integrates more secure cloud usage reporting with cloud provisioning and management products to allow users to better manage the infrastructure cost of cloud offerings.

- **IBM Cloud Orchestrator:** This application gives you access to ready-to-use patterns and content packs, helping to speed configuration, provisioning and deployment. It integrates management tools, such as metering, usage, accounting, monitoring, and capacity management into your cloud services. You can go live as quickly as you develop and test applications. IBM Cloud Orchestrator helps you to realize the following benefits:
  - Quickly deploy and scale on-premise and off-premise cloud services.
  - Provision and scale cloud resources.
  - Reduce administrator workloads and error-prone manual IT administrator tasks.
  - Integrate with existing environments using application program interfaces and tooling extensions.
  - Deliver services with IBM SoftLayer®, existing OpenStack platforms, IBM PowerVM®, IBM System z®, VMware, or Amazon EC2.

- **IBM Tivoli Application Dependency Discovery Manager :** This application is a configuration management tool that helps IT operations personnel ensure and improve application availability in their environments. By providing top-down, cross-tier views of how the IT infrastructure actually delivers applications, IT organizations can gain the following benefits:
  - Understand the structure of interdependent applications.
  - Rapidly isolate configuration-related application problems by reducing troubleshooting time from hours and days to minutes.
  - Understand the impact of component-level changes in order to sort their issues based on application and service impact.
  - Plan effectively for application changes to minimize or eliminate unplanned disruptions.
  - Create a shared topological definition of applications for use by other management applications such as service level managers and provisioning tools.

- **IBM SmartCloud Monitoring:** This application can help you to optimize IT infrastructure performance and availability. This proactive system monitoring software manages operating systems, databases and servers in distributed and host environments. By providing preferred practices for identifying and resolving infrastructure problems, SmartCloud Monitoring can help maximize the efficiency of your IT department. Tivoli Monitoring helps you identify and fix outages and bottlenecks that threaten key applications before they impact customer satisfaction via the following:
  - Proactively monitors system resources to detect potential problems and automatically respond to events. By identifying issues early, Tivoli Monitoring enables rapid fixes before users notice any difference in performance.
  - Provides dynamic thresholding and performance analytics to improve incident avoidance. This "early warning" system allows you to start working on an incident before it impacts users, business applications, or business services.
  - Improves availability and mean-to-time recovery with quick incident visualization and historical look for fast incident research. You can identify and take action on a performance or service interruption in minutes rather than hours.
  - Collects data you can use to drive timely performance and capacity planning activities to avoid outages from resource over-utilization. The software monitors, alerts and reports on future capacity bottlenecks.
  - Facilitates system monitoring with a common, flexible and intuitive browser interface and customizable workspaces. Also includes an easy-to-use data warehouse and advanced reporting capabilities

Functions that help VMware administrators

As of Tivoli Storage Productivity Center V5.2, the following Virtual Storage Center functions help VMware administrators work with the data that Tivoli Storage Productivity Center has collected in the environment. The functions can be used independently:

- **VMware vCenter Web Client extension :** Tivoli Storage Productivity Center has created an extension that enables VMware administrators to view end-to-end information about storage and fabrics in new reports. The extension allows you to start the Tivoli Storage Productivity Center provisioning task from the VMware Web Client. This extension is also referred to as the Tivoli Storage Productivity Center Extension and the Tivoli Storage Productivity Center plug-in.
- **vSphere Storage APIs for Storage Awareness (VASA):** The Tivoli Storage Productivity Center VASA provider enables storage data to be accessible in the existing vCenter Server reports and views and to receive Tivoli Storage Productivity Center alerts.

Through the VMware vCenter Web Client extension, it is possible to allow VMware administrators to provision their own storage, which enables them to realize even faster response times when demands for new machines arrive. The VMware vCenter Web Client extension also gives VMware administrators access to see performance and asset related information about the storage usage, enabling them to better understand the environment, and to optimize the resources they use.

Figure 9 provides an overview of the following integrated activities that make up VMware connections with Tivoli Storage Productivity Center:

- **Probes**: Tivoli Storage Productivity Center collects information about VMware data sources
- **Reports and Provisioning**: Function of the Tivoli Storage Productivity Center extension
- **Storage Capabilities and Events /Alarms**: VASA provider functions

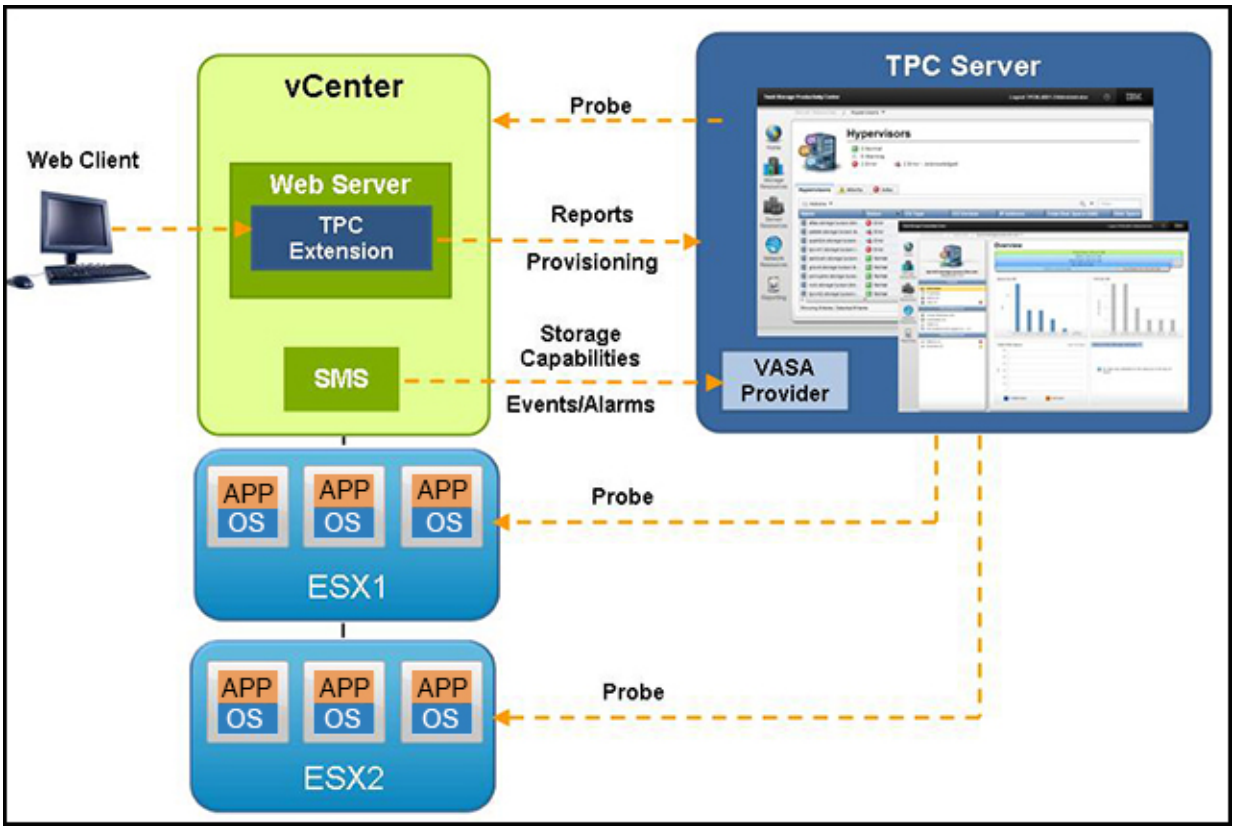

Figure 9. VMware connections with Tivoli Storage Productivity Center

Note that the arrows in Figure 9 indicate where a connection begins. For example, a probe begins with

Tivoli Storage Productivity Center and then moves to the vCenter or to an ESX server. The box labeled SMS is the VMware vCenter Storage Monitoring Service and enables the communication with a VASA provider. *Events* and *alarms* are VMware terms that correspond to alerts in Tivoli Storage Productivity Center.

Supported platforms

This section summarizes supported platforms and operating systems:

- Processor:
  - Windows and Linux:
    - Intel® Xeon® 4 processor cores at 2.5 GHz or greater
    - Two Intel Xeon L5520 8 processor cores at 2.27 GHz or greater
  - AIX:
    - IBM POWER5, IBM POWER6®, IBM POWER7® or later systems with 4 or 8 processor cores
- Recommended memory:
  - Evaluation environments
    - Four cores and 8 GB RAM
    - This could include: 10,000 volumes, 5 subsystems, 5 switches, 200 fabric ports, and 300 agentless servers.
  - Medium production environments:
    - Four cores and 12 GB RAM
    - Can include: 50,000 volumes, 20 subsystems, 15 switches, 800 fabric ports, and 1000 agentless servers.
  - Larger environments:
    - Eight cores and 16 GB RAM
    - Can include: 70,000 volumes, 30 subsystems, 20 switches, 1000 fabric ports, and 2000 agentless servers.

For more information about supported platforms:
http://www.ibm.com/support/docview.wss?uid=swg27039550

For the most up-to-date information about supported hardware and platforms for the IBM SmartCloud Virtual Storage Center server and client and associated IBM products, refer to:
http://www.ibm.com/systems/support/storage/ssic/interoperability.wss

Ordering information

For IBM SmartCloud Virtual Storage Center product details and pricing see refer to the following link, and click the **View US prices and buy** tab.
http://www.ibm.com/software/products/en/virtual-storage-center

Table 1 shows product ordering information.

Table 1. Ordering part numbers and feature codes

Program name and description	PID number (for PPA)	PID number (for AAS)
IBM Tivoli Storage Productivity Center V5.2	5725-F93	5608-PC1
IBM Tivoli Storage Productivity Center Select Edition V5.2	5725-G33	5608-AP1 5608-PC2
SmartCloud Virtual Storage Center V5.2	5725-F92	5608-AE1
SmartCloud Virtual Storage Center Entry V5.2	5725-P45	5608-AP1
SmartCloud Virtual Storage Center for Storwize Family V5.2	5725-P92	5608-ACL

For product announcement letters and support, refer to the **Related information** section, next.

Related information

For more information, see the following resources:

- IBM Offering Information page (to search on announcement letters, sales manuals, or both):
  http://www.ibm.com/common/ssi

  On this page, enter `SmartCloud Virtual Storage Center` or `Tivoli Storage Productivity Center`, select the information type, and click **Search**. On the next page, narrow your search results by geography and language.

- IBM Software, product page for IBM SmartCloud Virtual Storage Center:
  http://www.ibm.com/software/products/us/en/vsc

- For more details about IBM Tivoli applications and their integrations, see the following IBM Software Products website at:
  http://www.ibm.com/software/products/en

- Announcement letter for Tivoli Storage Productivity Center V5.2 and IBM Tivoli Storage Productivity Center Select Edition V5.2
  http://ibm.co/1s9wYtl

- Announcement letter for IBM SmartCloud Virtual Storage Center Entry V5.2 and IBM SmartCloud Virtual Storage Center for Storwize Family V5.2
  http://ibm.co/1x2Ayc3

- IBM Redbooks: *Tivoli Storage Productivity Center V5.2 Release Guide*, SG24-8204
  http://www.redbooks.ibm.com/redpieces/abstracts/sg248204.html?Open

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