

# Deploy SAP Application

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# Contents

Introduction .....	3
FlexPod system overview .....	4
FlexPod benefits .....	5
SAP application landscapes .....	6
SAP NetWeaver application platform.....	7
Cisco UCS servers .....	7
NetApp AFF A400 storage .....	8
NetApp ONTAP data management.....	9
Installing the Microsoft SQL Server database server for SAP application servers .....	10
Installing an SAP application server: SAP NetWeaver Application Server .....	10
NetApp SnapCenter data protection .....	18
Best practices .....	20
SAP Landscape Management software .....	21
Conclusion .....	22
For more information.....	23

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## Introduction

The current IT industry is witnessing a dramatic transformation in data center solutions. In recent years, there has been a considerable interest in prevalidated and engineered data center solutions. Introduction of virtualization technology in critical areas has had a major impact on the design principles and architecture of these solutions. It has allowed many applications running on bare-metal systems to migrate to new virtualized integrated solutions.

FlexPod is one such prevalidated and engineered data center solution designed to address the rapidly changing needs of IT departments. Cisco and NetApp have partnered to deliver FlexPod, which uses best-in-class computing, networking, and storage components as the foundation for a variety of enterprise workloads, including databases, enterprise resource planning (ERP), customer relationship management (CRM), and web applications.

The consolidation of IT applications, particularly databases, has generated considerable interest in recent years. The most widely adopted and deployed database platform over the past several years is Microsoft SQL Server. SQL Server databases frequently have become subject to database sprawl, leading to IT challenges such as underutilized servers, incorrect licensing, security concerns, management concerns, and huge operational costs. Hence, SQL Server databases are good candidates for consolidation on a more robust, flexible, and resilient platform. This document discusses a FlexPod reference architecture for deploying and consolidating SQL Server databases.

### Audience

The audience for this document includes sales engineers, field consultants, database administrators, professional services staff, IT managers, partner engineers, and customers who want to take advantage of an infrastructure built to deliver IT efficiency and enable IT innovation. The reader should have prior knowledge on FlexPod Systems and its components.

### Purpose of this document

The goal of this document is to share how SAP application servers can be installed with a SQL Server database on the FlexPod Datacenter solution.

This document assumes that the FlexPod solution is already set up and that SQL Server databases are configured and running. SAP NetWeaver Application Server 7.5 for Advanced Business Application Programming (ABAP) is discussed as an example.

This document does not describe the installation or configuration of the FlexPod Datacenter solution for Microsoft SQL Server 2019. For this information, refer to the Cisco® Validated Design at [https://www.cisco.com/c/en/us/td/docs/unified\\_computing/ucs/UCS\\_CVDs/mssql2019\\_flexpod.html](https://www.cisco.com/c/en/us/td/docs/unified_computing/ucs/UCS_CVDs/mssql2019_flexpod.html).

## FlexPod system overview

FlexPod is a best-practices data center infrastructure architecture that includes these components:

- Cisco Unified Computing System™ (Cisco UCS®)
- Cisco Nexus® Family switches
- NetApp FAS or AFF storage; NetApp E-Series storage systems

These components are connected and configured according to the best practices of Cisco and NetApp and provide an excellent platform for running multiple enterprise workloads with confidence. The reference architecture explained in this document uses Cisco Nexus 9000 Series Switches.

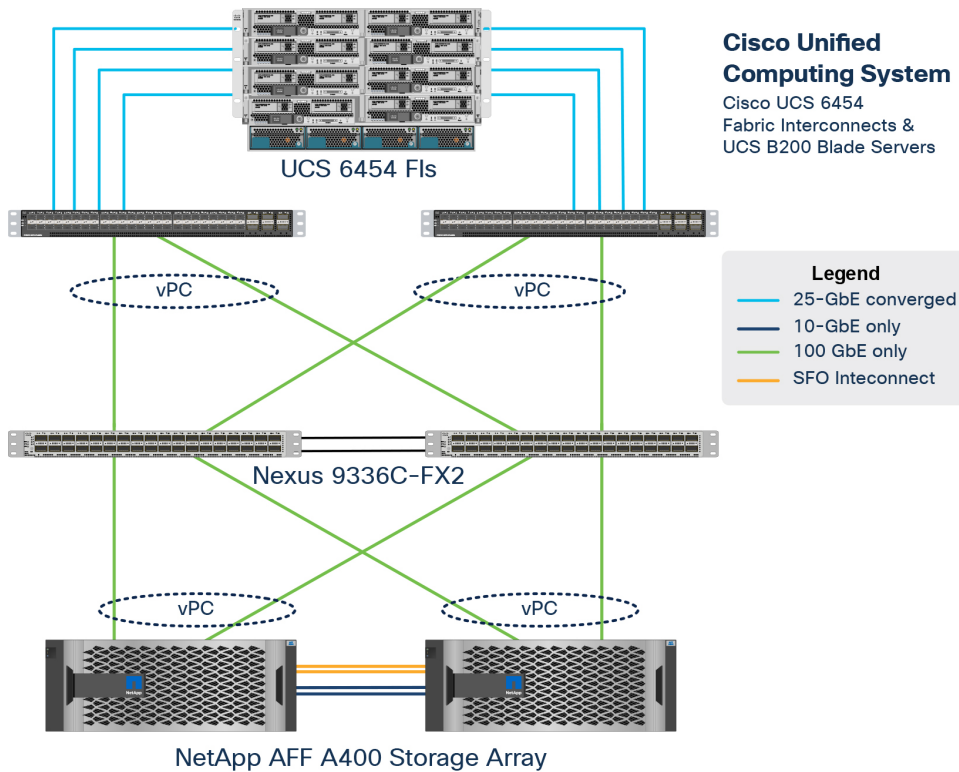
One of the main benefits of FlexPod is the capability to maintain consistency while scaling, including when scaling up and scaling out. Each of the component families used in the architecture (Cisco UCS, Cisco Nexus Family, and NetApp storage systems) offers platform and resource options to scale the infrastructure up or down, while supporting the same features and functions that are required by the configuration and connectivity best practices of FlexPod.

Figure 1 provides an overview of a FlexPod system.



**Figure 1.**  
FlexPod system overview

One benefit of the FlexPod architecture is the capability to customize, or flex, the environment to meet a customer's requirements. A FlexPod solution can easily be scaled as requirements and demands change. The unit can be scaled both up (adding resources to a FlexPod unit) and out (adding more FlexPod units). This document focuses on the resiliency, cost benefits, and ease of deployment of SAP application landscapes using FlexPod (Figure 2).



**Figure 2.**  
FlexPod solution design example

## FlexPod benefits

As customers transition to shared infrastructure or cloud computing, they face several challenges, such as initial transition setbacks, and issues related to return on investment (ROI) analysis, infrastructure management, and future growth plans. By introducing standardization, FlexPod helps customers mitigate the risk and uncertainty involved in planning, designing, and implementing a new data center infrastructure. The result is a more predictable and adaptable architecture capable of meeting and exceeding customers' IT demands.

The unique features and benefits that the FlexPod system provides for consolidating SQL Server database deployments are summarized here:

- Support for 2<sup>nd</sup> Gen Intel® Xeon® Scalable processor family CPUs and Cisco UCS B200 M5 Blade Servers, enabling consolidation of more SQL Server virtual machines and thereby achieving higher consolidation ratios, lower total cost of ownership (TCO), and quick ROI
- 100 Gigabit Ethernet connectivity and storage connectivity using fourth-generation Cisco UCS fabric interconnects, Cisco Nexus 9000 Series Switches, and NetApp AFF A400 storage Arrays
- Nondisruptive policy-based management of infrastructure using Cisco UCS Manager
- Fast I/O performance using NetApp All Flash Storage Arrays and complete virtual machine protection using NetApp Snapshot technology and direct storage access to SQL Server virtual machines using an in-guest Small Computer System Interface over IP (iSCSI) initiator
- Resource utilization reports and cost optimization recommendations with Cisco Workload Optimization Manager

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## SAP application landscapes

An SAP application landscape has three tiers:

- Presentation layer
- Application layer or business logic layer
- Database layer

Scalability is critical for a successful implementation of an SAP solution. SAP provides scaling using two- and three-tier deployment architectures, depending on the scope of business growth:

- A two-tier architecture uses a single server for all SAP applications except those on the presentation layer. In this design, the presentation layer is installed as one tier, and the application and database layer is mapped to the second tier.
- In three-tier architecture, each of the three logical tiers maps to an individual set of one or more physical servers.

A two-tier architecture offers these advantages:

- Because the application and database layers are on the same host, this architecture provides excellent performance, because no additional overhead is needed for database connections and network traffic, and no shadow processes consume resources.
- The two-tier approach simplifies administration for small installations.

A three-tier architecture offers these advantages:

- The application tier can be scaled separately from the database tier to provide both load sharing and high availability in each tier. Temporary workloads can be easily managed by temporarily adding more application servers. Enterprise SAP application implementations typically use a three-tier or multiple-tier architecture to allow smoother deployment of high availability for an individual component or tier.
- Larger installations can benefit from the additional performance that can be achieved from a three-tier deployment.

The flexibility of the SAP software allows organizations to choose the best approach: whether to use a two-, three-, or multiple-tiered architecture.

An SAP application landscape is a group of two or more SAP systems. An SAP system has one or more SAP instances across one or more servers. A traditional SAP landscape consists of one or more of the following types of SAP instances:

- Production (PRD) systems
- Development (DEV) systems
- Test and quality assurance (QA) systems

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## SAP NetWeaver application platform

The SAP NetWeaver platform is the base for many SAP solutions, including the popular SAP Business Suite. It enables the composition, provisioning, and management of SAP applications across a different software environment.

NetWeaver applications use three instances: an application server (AS) instance, an application server central services (ASCS) instance, and a database (DB) Instance. The application server instance handles most of the processing workload, along with the application server central services system. The database instance stores the results. All three parts are required, and organizations should plan for high availability. Multiple instances of the application servers can be used to provide high availability and handle additional load. Similarly, organizations can protect the application server central services and database instances as needed. These instances can all share the same server or operating system instance, or they can be separated, with each on its own server. They can run physically on the server, or they can run on virtual servers through the use of a hypervisor.

The SQL Server database instance referred to in the Cisco Validated Design for the FlexPod Datacenter solution for SQL Server 2019 runs on virtual servers.

## Cisco UCS servers

Cisco UCS servers can be placed on all three layers of the SAP landscape to provide a complete Cisco UCS server infrastructure for the landscape. According to the workload calculated using the SAP Quick Sizer, the following Cisco UCS servers can be used:

- The enterprise-class Cisco UCS B480 M5 Blade Server delivers market-leading performance, versatility, and density without compromise for memory-intensive mission-critical enterprise applications and virtualized workloads, among others. The Cisco UCS B480 M5 is a full-width blade server supported by the Cisco UCS 5108 Blade Server Chassis.
- The Cisco UCS C480 M5 Rack Server brings the power and automation of unified computing to enterprise applications, including Cisco SingleConnect technology, drastically reducing switching and cabling requirements. Cisco UCS Manager uses service profiles, templates, and policy-based management to enable rapid deployment and help ensure deployment consistency. It also enables end-to-end server visibility, management, and control in both virtualized and bare-metal environments. The Cisco UCS C480 M5 is a storage- and I/O-optimized enterprise-class rack server that delivers industry-leading performance for information management databases (IMDBs), big data analytics, virtualization workloads, and bare-metal applications.
- The Cisco UCS C240 M5 and C220 M5 Rack Servers are high-density 2-socket rack servers that deliver industry-leading performance and efficiency for a wide range of workloads, including virtualization, collaboration, and bare-metal applications. The Cisco UCS C-Series Rack Servers can be deployed as standalone servers or as part of Cisco UCS to take advantage of Cisco's standards-based unified computing innovations that help reduce customer TCO and increase business agility. These servers incorporate Intel Xeon Scalable processors, supporting up to 20 percent more cores per socket, twice the memory capacity, and five times more Non-Volatile Memory Express (NVMe) PCIe solid-state disks (SSDs) than the previous generation of servers. These enhancements deliver significant performance and efficiency gains that will improve your application performance.

Each of these servers allows a variety of configurations for memory, CPU, storage, and I/O. Although you can use many of these variations to support SAP applications, a specific optimized subset is recommended for simplicity.

## NetApp AFF A400 storage

With the new NetApp AFF A-Series controller lineup, NetApp provides industry-leading performance together with a full suite of enterprise-class data-management and data-protection features.

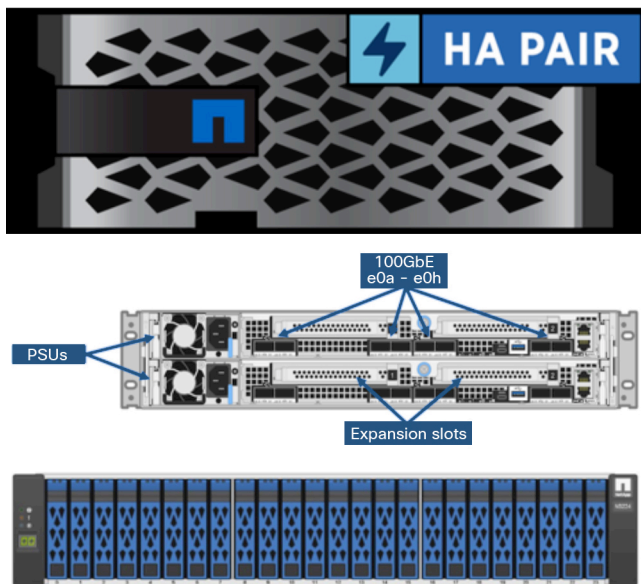
This architecture uses the NetApp AFF A400 all-flash array as the foundation for infrastructure storage. The AFF A400 controller provides the high-performance benefits of 100 Gigabit Ethernet and NVMe all-flash SSDs by using the external NetApp NS224 storage shelf (Figure 3). The shelf is connected through the NVMe and Remote Direct Memory Access (RDMA) over Converged Ethernet (RoCE) protocols and offers 24 bays for NVMe SSDs.

High-speed network connectivity is achieved with 100 Gigabit Ethernet and 32-Gbps Fibre Channel fabric connectivity. Multiple expansion slots per controller can support 10, 25, 40, and 100 Gigabit Ethernet connectivity as well as 8-, 16-, and 32-Gbps Fibre Channel networking.

The capability to scale out to 24 storage nodes makes the AFF A400 an excellent storage controller for shared workload needs in a converged infrastructure.

For more information about the NetApp AFF A400 and all the AFF A-Series controllers, see the [NetApp AFF product page](#).

You can view or download more technical specifications for the AFF A-Series controllers from the NetApp data sheet at [NetApp data sheet ds-3582](#).



**Figure 3.**  
NetApp AFF A400 and NS224 storage shelf



## NetApp ONTAP data management

NetApp ONTAP data management software is used with the NetApp AFF all-flash storage system in this solution design. ONTAP software offers unified storage for applications that read and write data over block- or file-access protocol storage configurations.

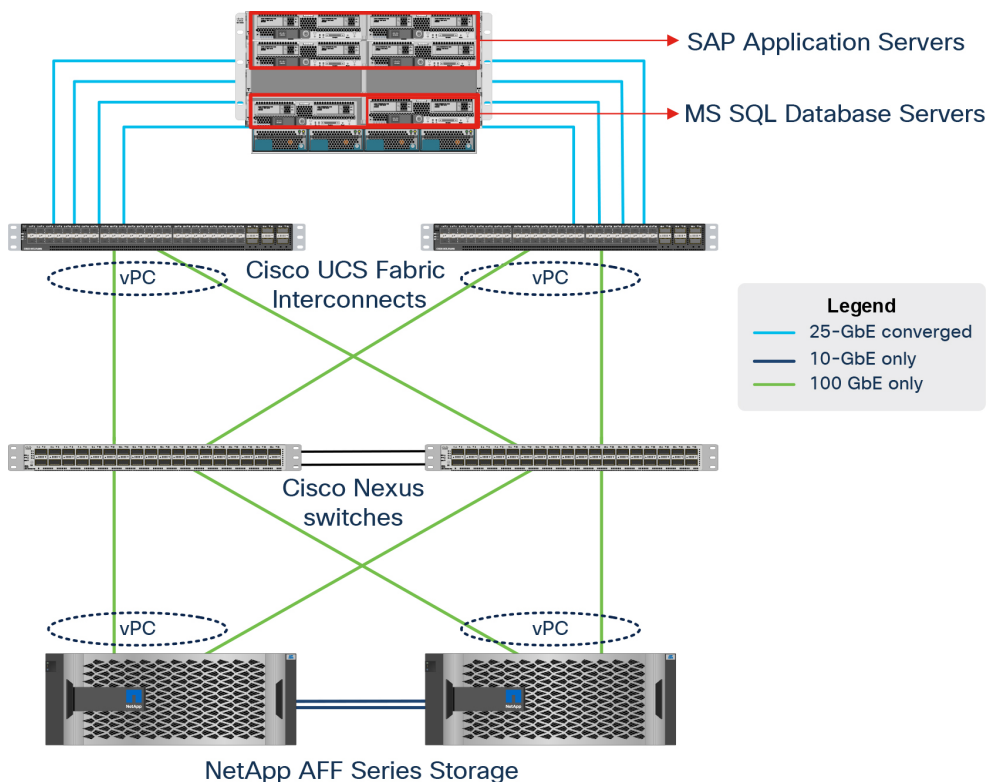
ONTAP implementations can run on NetApp-engineered FAS or AFF series arrays. They can also run on commodity hardware (NetApp ONTAP Select) and in private, public, or hybrid clouds (NetApp Cloud Volumes ONTAP and NetApp Cloud Volumes Service). Specialized implementations offer best-in-class converged infrastructure, used here as part of the FlexPod Datacenter solution, or access to third-party storage arrays (NetApp FlexArray virtualization).

Together these implementations form the basic framework of a data fabric supported by NetApp with a common software-defined approach to data management and fast and efficient replication across systems. FlexPod and ONTAP can serve as the foundation for both hybrid-cloud and private-cloud designs.

The ONTAP industry-leading data management software is designed on the principles of software-defined storage.

Read more about all the capabilities of ONTAP data management software [at the NetApp website](#).

Figure 4 shows an example of SAP application server connectivity in the FlexPod Datacenter solution.



**Figure 4.** SAP application server connectivity in the FlexPod Datacenter solution

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## Installing the Microsoft SQL Server database server for SAP application servers

Before installing the SAP application servers, you must install the SQL Server database software.

For guidance in installing the SQL Server 2019 database software for SAP application servers, see [Upgrade to an Installation of SQL Server 2019 in an SAP Environment](#).

## Installing an SAP application server: SAP NetWeaver Application Server

This document uses SAP NetWeaver Application Server 7.5 for ABAP to illustrate the process for installing an SAP application server on the FlexPod Datacenter platform with a SQL Server database using Cisco UCS servers and NetApp AFF storage.

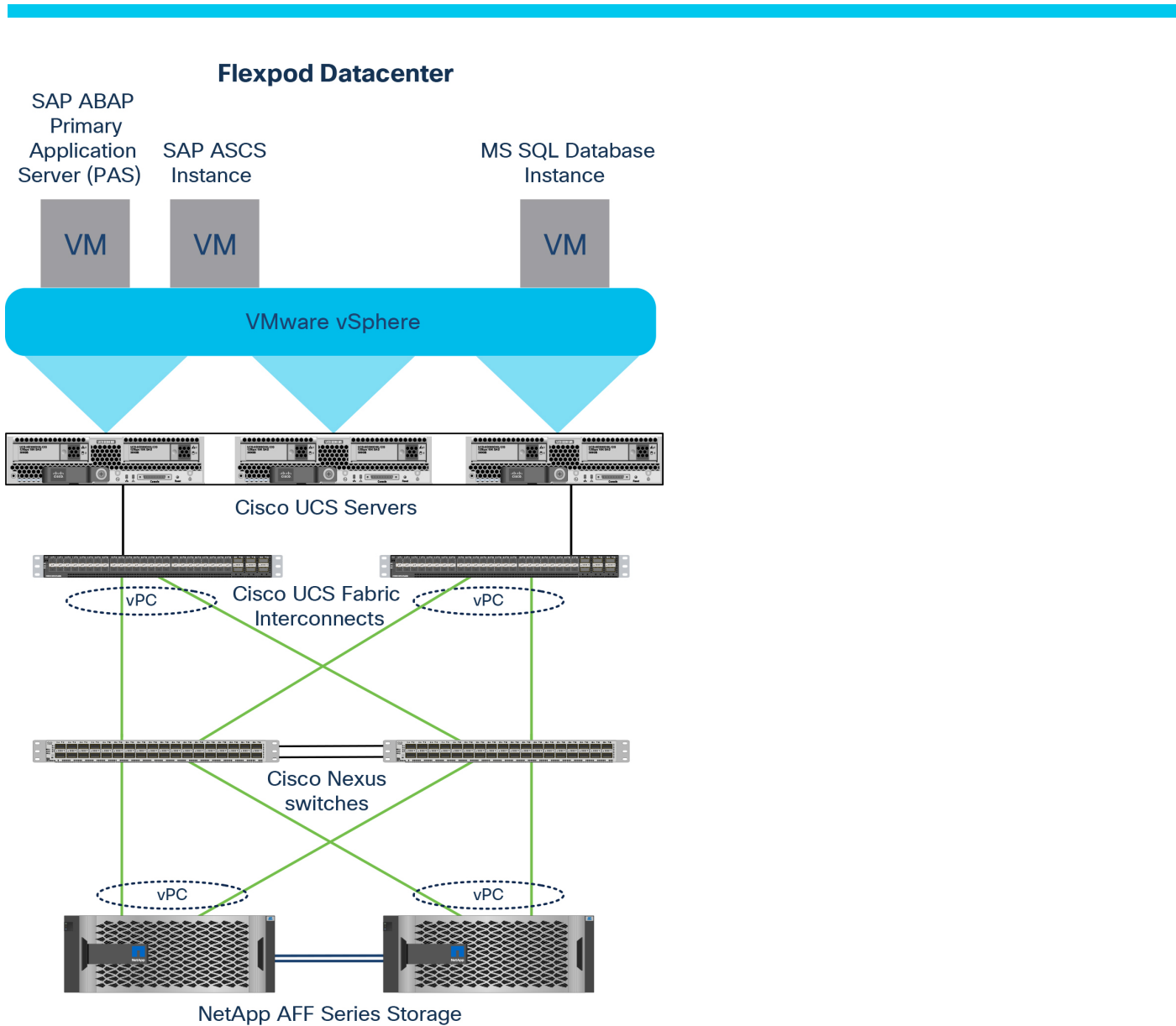
The servers used to run SAP NetWeaver Application Server depend on the choice of Cisco UCS servers.

The SAP Product Availability Matrix (PAM) points to the relevant SAP NetWeaver installation guides. Be sure that you are familiar with the relevant SAP NetWeaver master and installation guides and the SAP Notes referenced in them. To find planning, installation, patching, and operation documentation for your task, see the [SAP NetWeaver Guide Finder](#).

For a new installation of an SAP system, including an enhancement package, you can use the standard installation tool: Software Provisioning Manager 1.0. Software Provisioning Manager performs software provisioning processes such as installation, uninstallation, system copy, and system transformation. Software Provisioning Manager is the successor to product- and release-specific provisioning tools, such as SAPinst.

The SAP application server installation can be a standard system, which runs all three components of the application server on the same server and hardware; a distributed system, in which the three components reside on different servers and hardware; or a high-availability system, which is used for failover.

Figure 5 shows an example of an SAP NetWeaver Application Server 7.5 for ABAP distributed system running on Flexpod.



**Figure 5.** SAP NetWeaver Application Server 7.5 for ABAP distributed system in a virtualized environment

As a best practice, you should start the SAP installation manually using the SAP GUI. To start the installer, follow these steps:

1. Log on to the server on which SAP NetWeaver Application Server for ABAP is to be installed.
2. Log on to the virtual machine with Administrator rights.
3. Copy the installable files to a local directory on the server.
4. Run the SAP GUI installer: for example, C:\software\\sapinst.exe.



## SAP application monitoring with Cisco AppDynamics platform

The Cisco AppDynamics® application performance monitoring (APM) platform helps you understand and optimize the performance of your business applications, from your software to your infrastructure to your business processes.

The AppDynamics APM platform enables you to monitor and manage your entire application-delivery ecosystem, from a mobile app or browser client request through your network, back-end databases, application servers, and more. The AppDynamics APM gives you a single view across your application landscape, letting you quickly navigate from a global perspective of your distributed application down to the call graphs and exception reports generated on individual hosts.

The AppDynamics platform has an agent-based architecture. After the agents are installed, you see a dynamic flow map or topography of your application. The platform uses the concept of traffic lights to indicate the health of your application (green is good, yellow is slow, and red indicates potential problems), with dynamic baselining. The AppDynamics platform measures application performance based on business transactions, which essentially are the main processes of the application. When the application deviates from the baseline, the AppDynamics platform captures and provides deeper diagnostic information to help you be more proactive in troubleshooting and reduce your mean time to repair (MTTR).

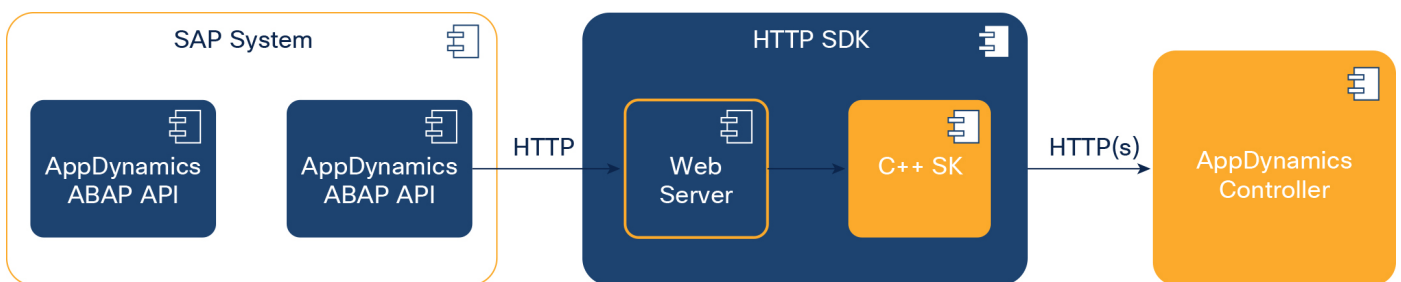
This SAP application server infrastructure can be monitored with the AppDynamics platform.

The core SAP monitoring components are:

- SAP ABAP Agent: Responsible for business transaction monitoring (communication between SAP and external systems, such as the AppDynamics Controller)
- Datavard Insights: Responsible for collecting SAP-specific metrics, logs, and events

### SAP ABAP Agent architecture

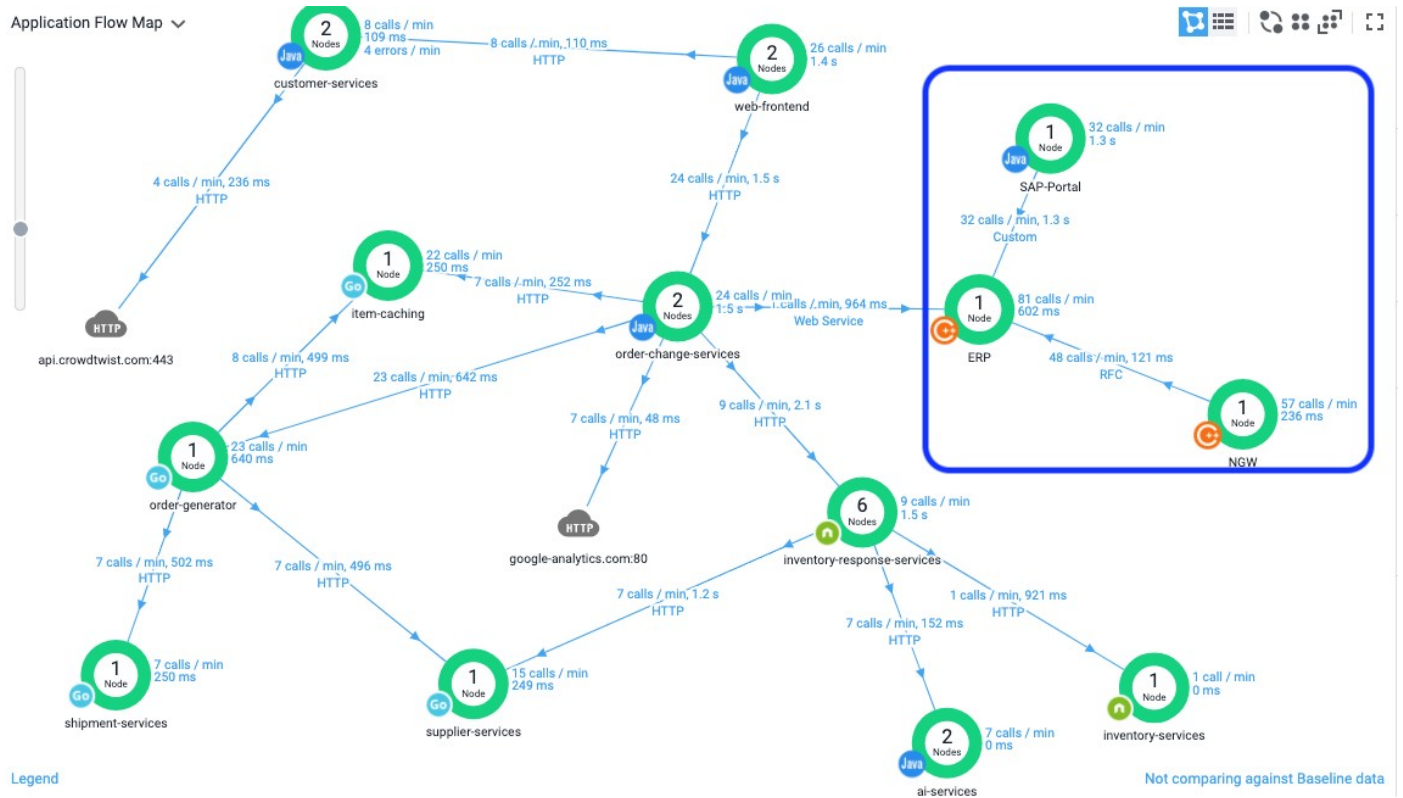
The ABAP Agent uses the AppDynamics C++ Software Development Kit (SDK) wrapped by the AppDynamics HTTP SDK to report business transaction performance metrics and snapshots. Figure 8 shows the communication between the ABAP Agent and the AppDynamics Controller.



**Figure 8.**  
Communication between ABAP Agent and AppDynamics Controller

For more information about AppDynamics and SAP monitoring, see <https://docs.appdynamics.com/display/SAP/SAP+Monitoring+Using+AppDynamics>.

Figure 9 presents an AppDynamics map showing the performance of SAP NetWeaver Application Server 7.5 for ABAP, currently running in the organization.



**Figure 9.** AppDynamics map showing the performance of SAP NetWeaver Application Server 7.5 for ABAP

### Microsoft SQL Server database workload monitoring with Cisco Workload Optimization Manager

Cisco Workload Optimization Manager is a real-time decision engine that promotes continuous health in the IT environment. Its intelligent software constantly analyzes workload consumption, costs, and compliance constraints. It assures application performance by giving workloads the resources they need, when they need them. Workload Optimization Manager provides specific real-time actions that help ensure that workloads get the resources they need for:

- Placement
- Scaling
- Capacity

Customers can automate the software’s decisions to match their level of comfort:

- Recommended (view only)
- Manual (select and apply)
- Automated (implemented in real time by software)

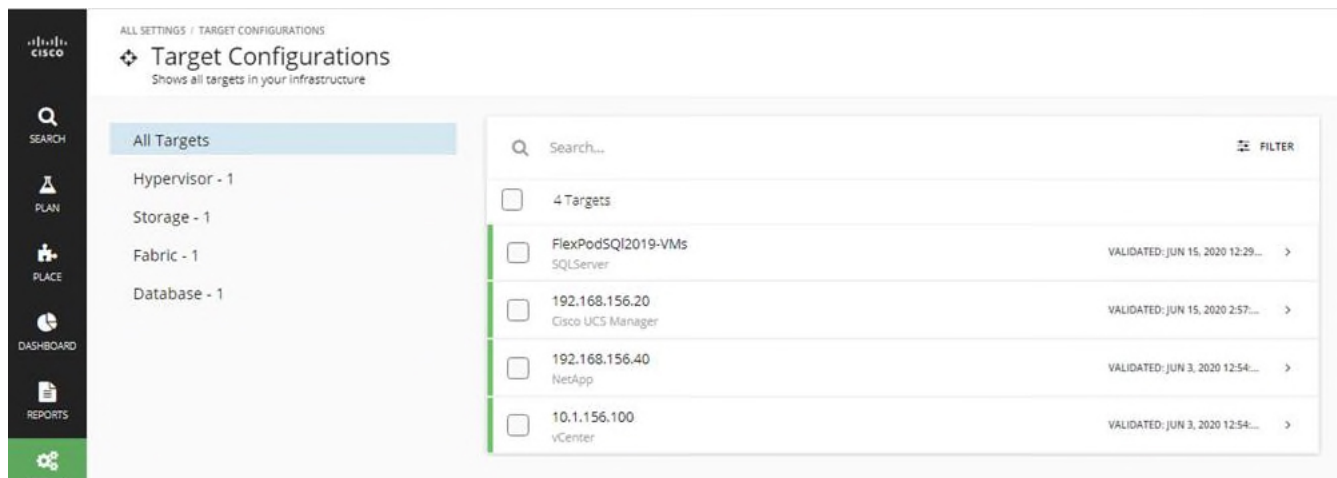
This section discusses the use of on-premises Workload Optimization Manager virtual appliance capabilities to monitor SQL Server databases. The Workload Optimization Manager virtual appliance can be downloaded from the Cisco download center at

<https://software.cisco.com/download/home/286321574/type/286317011/>.

For more information about deploying Workload Optimization Manager as a virtual appliance, see [https://www.cisco.com/c/dam/en/us/td/docs/unified\\_computing/ucs/ucs-workload-optimization-mgr/installation-guide/2-3/cisco-ucs-wom-install-2-3.pdf](https://www.cisco.com/c/dam/en/us/td/docs/unified_computing/ucs/ucs-workload-optimization-mgr/installation-guide/2-3/cisco-ucs-wom-install-2-3.pdf).

A target is a service in a data center that can be monitored with Workload Optimization Manager. Currently, a wide variety of targets and services can be monitored using Workload Optimization Manager. For information about supported targets, including about SQL Server database targets, and how to configure them, see [https://www.cisco.com/c/dam/en/us/td/docs/unified\\_computing/ucs/ucs-workload-optimization-mgr/target-configuration/2-3/cisco-ucs-wom-target-config-2-3-13.pdf](https://www.cisco.com/c/dam/en/us/td/docs/unified_computing/ucs/ucs-workload-optimization-mgr/target-configuration/2-3/cisco-ucs-wom-target-config-2-3-13.pdf).

Workload Optimization Manager is used to monitor SQL Server virtual machines running on the FlexPod system. For end-to-end visibility of all the layers of the application stack, required targets such as vCenter, Cisco UCS fabric interconnects, the NetApp storage array, and SQL Server targets must be added to Workload Optimization Manager. Figure 10 shows all the required targets added for complete visibility of the FlexPod system.



**Figure 10.**  
Adding FlexPod targets to Cisco Workload Optimization Manager

Figure 11 shows the addition of a SQL Server target to Workload Optimization Manager. You need a SQL Server login account for Workload Optimization Manager to get inventory and use data for threw SQL Server database. In the example here, the SQL Server login **cwom** is used. Be sure that the SQL Server login account that Workload Optimization Manager uses has the appropriate rights to the SQL Server databases. “Scope” here indicates the vCenter cluster name of a group of virtual machines running SQL Server databases.



EDIT SQLServer Target

TARGET NAME \*  
FlexPodSQL2019-VMs

USERNAME \*  
CWOM

PASSWORD \*  
\*\*\*\*\*

SCOPE \*  
VMs\_FlexPod-DC\SQL

Select Scope

BROWSING SERVICE PORT  
0

SQLSERVER PORT  
1433

AD DOMAIN

FULL VALIDATION

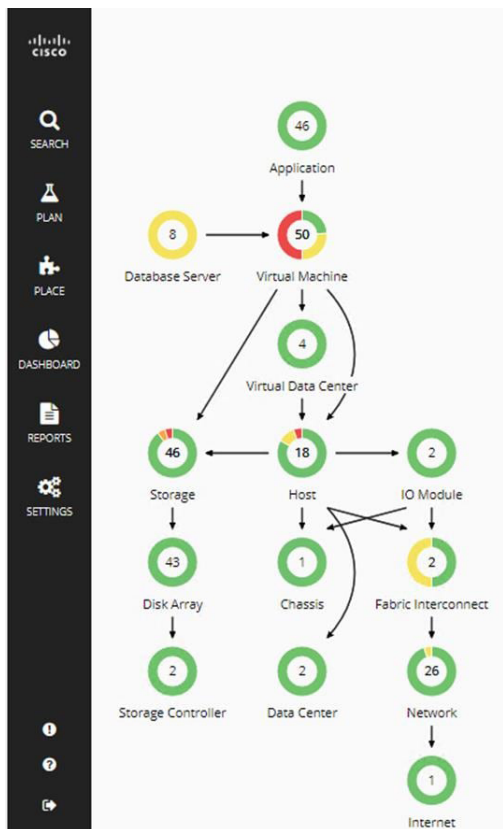
SAVE

**Figure 11.**  
Adding other Cisco Workload Optimization Manager targets

After the required targets have been added to Workload Optimization Manager, the manager will contact each target; develop a dependency graph; get complete inventory, configuration, and resource utilization data; and provide suggestions using its intelligent recommendation engine.

Figure 12 shows the complete inventory details for the FlexPod system. You can click each item and get complete visibility of all the dependent layers.





**Figure 12.**  
Cisco Workload Optimization Manager dashboard

Workload Optimization Manager provides a wide variety of recommendations for workload placement and sizing for optimal SQL Server database performance and efficient infrastructure utilization for on-premises, hybrid, and cloud-based SQL Server instances.

### Cisco Intersight systems management

The Cisco Intersight™ solution is Cisco’s new systems management platform that delivers intuitive computing through cloud-powered intelligence. This platform offers more intelligent management and enables IT organizations to analyze, simplify, and automate their IT environments in ways that were not possible with prior generations of tools. This capability empowers organizations to achieve significant TCO savings and deliver applications faster to support new business initiatives.

The Cisco UCS platform uses model-based management to provision servers and fabrics automatically, regardless of form factor. The Cisco Intersight platform works in conjunction with Cisco UCS Manager and the Cisco Integrated Management Controller (IMC). By simply associating a model-based configuration with a resource through service profiles, your IT staff can consistently align policy, server personality, and workloads. These policies can be created once and then used repeatedly by IT staff with little effort to deploy servers. The result is improved productivity and compliance and lower risk of failures due to inconsistent configuration.

The Cisco Intersight platform can be integrated with data center and hybrid cloud platforms and services to securely deploy and manage infrastructure resources across data center and edge environments. In addition, Cisco will provide future integrations with third-party operations tools to allow customers to use their existing solutions more effectively.

The Cisco Intersight platform monitors all Cisco UCS servers and switches in the solution and offers cloud-based, centralized management of Cisco UCS servers across all enterprise locations. The unique capabilities it delivers include the following:

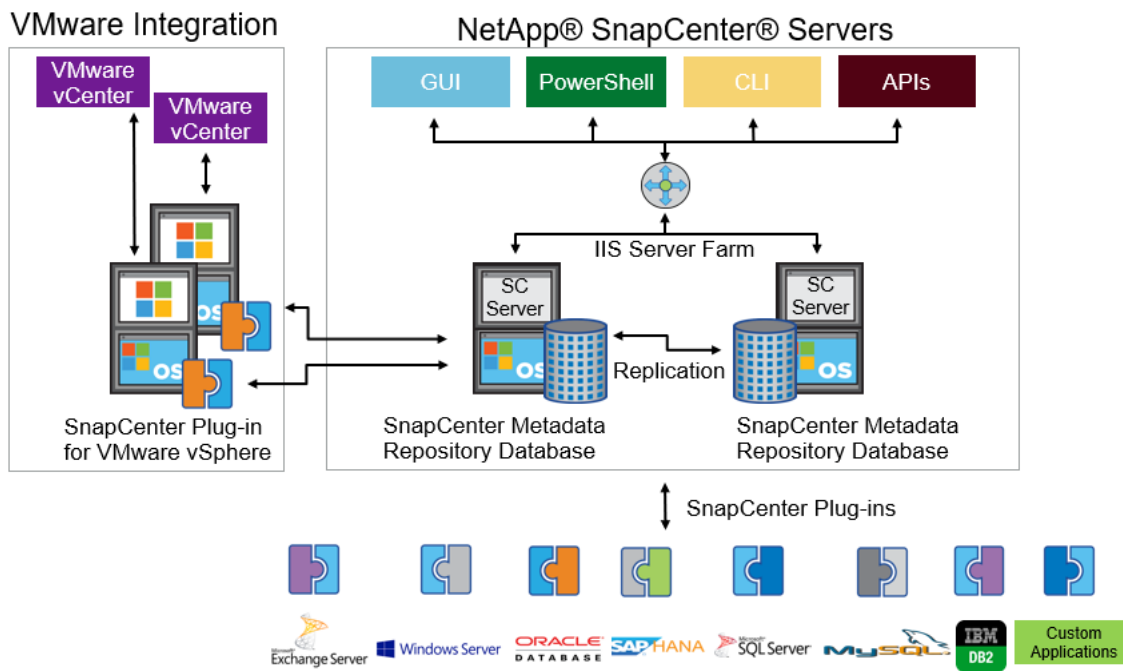
- Integration with Cisco Technical Assistance Center (TAC) for support and case management
- Proactive, actionable intelligence for issues and support based on telemetry data
- Compliance checks through integration with the Cisco Hardware Compatibility List (HCL)
- Centralized service profiles for policy-based configuration

For more information about the Cisco Intersight platform and its various editions, see [Cisco Intersight: SaaS Systems Management Platform](#).

## NetApp SnapCenter data protection

NetApp SnapCenter is a centrally managed, web-based application that runs on Microsoft Windows and manages and protects multiple servers remotely.

Figure 13 shows the high-level architecture of a NetApp SnapCenter Server deployment.



**Figure 13.**  
NetApp SnapCenter architecture

The SnapCenter Server has an HTML5-based GUI and Microsoft Windows PowerShell cmdlets and APIs. The SnapCenter Server is capable of high availability without additional configuration. If one SnapCenter host becomes unavailable for any reason, the second SnapCenter Server can take over seamlessly, and no operations are affected.

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The SnapCenter Server can push out plug-ins to remote hosts. These plug-ins are used to interact with applications, databases, and file systems. Usually, the plug-ins must be present on the remote host so that application-level or database-level commands can be issued from the same host on which the application or database is running.

SnapCenter uses SM Service to manage plug-ins and interactions between the SnapCenter Server and the plug-in host. SM Service is a NetApp SnapManager web service running on top of Microsoft Windows Internet Information Services (IIS) on the SnapCenter Server. SM Service handles all client requests, including backup, restore, and clone requests.

The SnapCenter Server communicates those requests to SMCORE, a service that runs within the SnapCenter Server and remote servers. SMCORE plays a significant role in coordinating with the SnapCenter plug-ins package for Microsoft Windows.

SnapCenter Virtualization (SCV) is a plug-in that manages virtual servers running on VMware and helps discover the host file system, databases on virtual machine disks (VMDKs), and raw device mapping (RDM).

## NetApp SnapCenter features

SnapCenter enables you to create application-consistent snapshot copies and to complete data-protection operations, including snapshot copy-based backup, clone, restore, and backup-verification operations. SnapCenter provides a centralized management environment, and it uses role-based access control (RBAC) to delegate data-protection and management functions to individual application users across the SnapCenter Server and Microsoft Windows hosts.

SnapCenter offers the following main features:

- A unified and scalable platform across applications and database environments, with virtual and nonvirtual storage powered by the SnapCenter Server
- Consistency of features and procedures across plug-ins and environments supported by the SnapCenter user interface
- RBAC for security and centralized role delegation
- Application-consistent snapshot copy management, restore, clone, and backup verification support from both primary and secondary destinations (using NetApp SnapMirror and NetApp SnapVault technology)
- Remote package installation from the SnapCenter GUI
- Nondisruptive, remote upgrades
- A dedicated SnapCenter repository for faster data retrieval
- Load balancing that is implemented by using Microsoft Windows network load balancing (NLB) and application request routing (ARR), with support for horizontal scaling
- Centralized scheduling and policy management to support backup and clone operations
- Centralized reporting, monitoring, and dashboard views
- SnapCenter 4.3 support for data protection for VMware virtual machines, Microsoft SQL Server databases, Oracle databases, MySQL, SAP HANA, MongoDB, and Microsoft Exchange

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## Microsoft SQL Server database storage layout with SnapCenter

SnapCenter best-practices considerations for the SQL Server database layout align with the suggested SQL Server deployment. SnapCenter supports backup only of user databases that reside on a NetApp storage system. Along with the performance benefit of segregating the user database layout into different volumes, SnapCenter significantly influences the time required for backup and restore operations. The use of separate volumes for data and log files significantly improves the restore time compared to the time needed for a single volume hosting multiple user data files. Similarly, user databases with I/O-intensive applications may experience increased backup time.

When backing up databases with SnapCenter, take the following considerations into account:

- Databases with I/O-intensive queries throughout the day should be isolated in different volumes and eventually have separate jobs to back them up.
- Large databases and databases that have a low recovery time objective (RTO) should be placed in separate volumes for faster recovery.
- Consolidate small to medium-size databases that are less critical or that have fewer I/O requirements into a single volume. If you back up many databases residing in the same volume, the system needs to maintain fewer snapshot copies. NetApp also recommends consolidating SQL Server instances to use the same volumes to control the number of backup snapshot copies created.
- Create separate logical unit numbers (LUNs) to store full text-related files and file-streaming-related files.
- Assign a separate LUN for each instance to store SQL Server log backup files. The LUNs can be part of the same volume.
- System databases store database server metadata, configurations, and job details; they are not updated frequently. System databases and tempdb should be placed in separate drives or LUNs. Do not place system databases in the same volume as user databases. User databases have different backup policies, and the frequency of user database backups is not the same as for system databases.
- With a SQL Server availability group setup, the data and log files for replicas should be placed in an identical folder structure on all nodes.

## Best practices

The following are the NetApp recommendations for volume design for optimal performance:

- Allocate at least 10 percent of available free space in an aggregate.
- Use flexible volumes to store SQL Server database files and do not share volumes between hosts.
- Use NTFS mount points instead of drive letters to avoid the 26-drive letter limitation in Microsoft Windows Server.
- Configure a volume autosize policy, when appropriate, to help prevent out-of-space conditions.
- If the SQL Server database I/O profile consists mostly of large sequential read operations, such as with decision support system workloads, enable read reallocation on the volume. Read reallocation optimizes the blocks for better performance.

- 
- Set the snapshot copy reserve value in the volume to zero for ease of monitoring from an operational perspective.
  - Disable storage snapshot copy schedules and retention policies. Instead, use the SnapCenter for SQL Server plug-in to coordinate snapshot copies of the SQL Server data volumes.
  - SQL Server uses the system database tempdb as a temporary workspace, especially for I/O-intensive database consistency checker (DBCC) CHECKDB operations. Therefore, place this database on a dedicated volume with a separate set of spindles. In large environments where volume count is a challenge, you can consolidate tempdb into fewer volumes and store it in the same volume as other system databases. This procedure requires careful planning. Data protection for tempdb is not a high priority because this database is re-created every time the SQL Server is restarted.
  - Place user data files (.mdf) on separate volumes because they are random read-write workloads. It is common to perform transaction log backups more frequently than database backups. For this reason, place transaction log files (.ldf) on a separate volume or VMDK from the data files so that independent backup schedules can be created for each. This separation also isolates the sequential write I/O of the log files from the random read-write I/O of data files and significantly improves SQL Server performance.

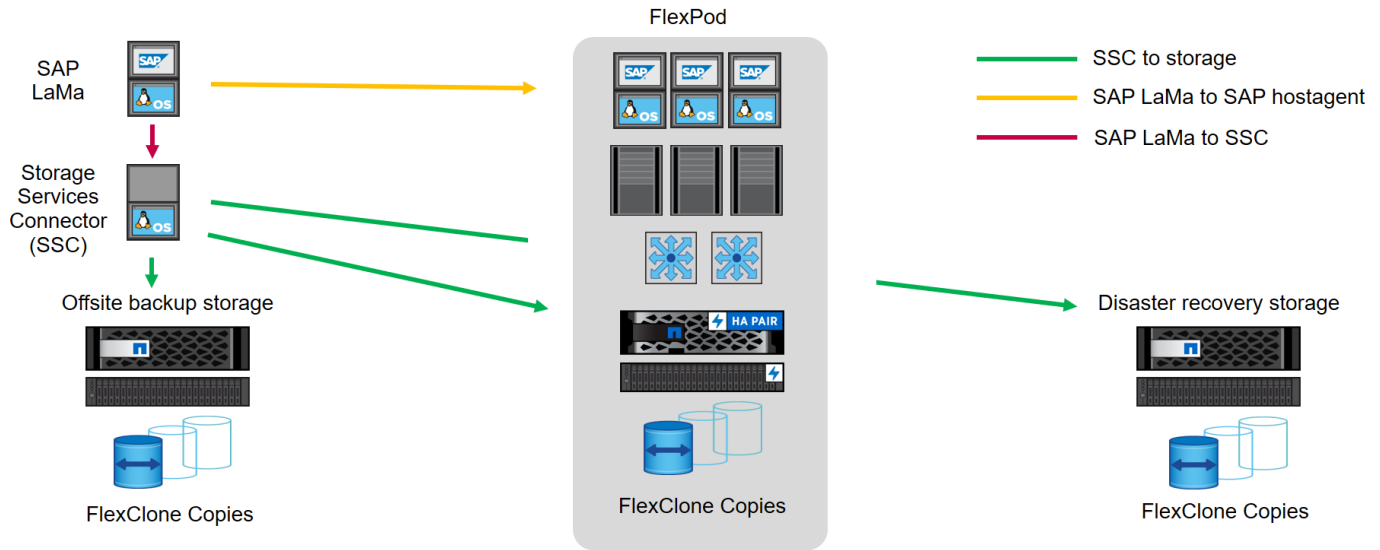
## SAP Landscape Management software

SAP Landscape Management (LaMa) enables SAP system administrators to automate SAP system operations, including end-to-end SAP system copy and refresh operations. SAP LaMa is one of the few SAP software products with which infrastructure providers such as NetApp and Cisco can integrate their products. With such integration, customers can employ NetApp functions directly from the SAP LaMa GUI.

NetApp offers NetApp Storage Services Connector (SSC), which allows SAP LaMa to directly access technologies and features such as NetApp FlexClone instant cloning and NetApp SnapMirror data replication. These technologies help reduce storage use and shorten the time required to create SAP system clones and copies.

With the help of the built-in functions and a robust set of extensibility features within SAP LaMa, FlexPod customers can directly integrate storage-based backups or instantaneously create space-efficient FlexClone system copies in the primary data center. They can even use storage at either the offsite backup site or the disaster-recovery site.

Figure 14 shows how SAP LaMa and NetApp SSC can be integrated into the overall FlexPod architecture.



**Figure 14.**  
SAP LaMa and NetApp SSC integration

- From an administrator's perspective, SAP LaMa is the central tool for operating and monitoring SAP systems, computing instances, and required storage resources. Figure 14 illustrates the required network communications between the various components:
- SAP LaMa must be able to communicate with the SAP Host Agent instance running on the physical or virtual host. Although SAP Host Agent is automatically installed during an SAP system installation, it can be manually configured to include hosts in SAP LaMa management that do not run SAP software, such as web servers.
- To communicate with NetApp storage systems, SAP LaMa must be able to communicate with NetApp SSC. For more information about NetApp SSC, see the NetApp SSC for SAP LaMa website.
- NetApp SSC 4.0 is an executable file that must be installed on a Linux host that is accessible by SAP LaMa and is also able to connect to all NetApp storage systems integrated into SAP LaMa.

For a detailed description of SAP LaMa and NetApp SSC, see the technical report [Integrating NetApp ONTAP Systems with SAP Landscape Management](#).

Note that SAP LaMa does not include regular backup and recovery or disaster-recovery functions. These functions are provided by NetApp SnapCenter.

## Conclusion

FlexPod is the optimal shared infrastructure foundation for deploying a variety of IT workloads. It is built on leading computing, networking, storage, and infrastructure software components. This Cisco Validated Design is a detailed guide for Microsoft SQL Server 2019 deployment on Microsoft Windows Server 2019 virtual machines that are deployed in VMware virtual environments.

FlexPod provides highly efficient data lifecycle management and exceptional storage efficiency for SQL Server databases and logs.

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FlexPod is a flexible infrastructure platform composed of presized storage, networking, and server components. It is designed to ease your IT transformation and operational challenges with high efficiency and little risk.

## For more information

For additional information, see the following resources:

- SAP-related documentation
  - [SAP Product Availability Matrix \(PAM\)](#)
  - [SAP Download Manager](#)
  - [SAP Software Download Center \(SWDC\)](#)
  - [SAP Guide Finder](#)
- Important SAP Notes
  - [1680045 Release Note for Software Provisioning Manager 1.0](#)
  - [555223 Microsoft SQL Server in NetWeaver-Based Systems](#)
  - [2779625 Setting Up Microsoft SQL Server 2019](#)
- Cisco product information
  - [Cisco Unified Computing System](#)
  - [Cisco UCS B-Series Blade Servers](#)
  - [Cisco UCS C-Series Rack Servers](#)
  - [Cisco UCS Manager](#)
  - [Cisco Nexus 9000 Series Switches](#)
- NetApp documentation
  - [NetApp ONTAP 9](#)
  - [NetApp Data Management Software](#)
  - [NetApp SnapCenter](#)
  - [Integrating NetApp ONTAP Systems with SAP Landscape Management](#)
- Interoperability matrixes
  - [Cisco UCS Hardware Compatibility Matrix](#)
  - [NetApp Interoperability Matrix Tool](#)

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