Introducing Security and Compliance

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VMware Validated Design

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About Introducing Security and Compliance

The *Introducing Security and Compliance* document provides general guidance for organizations that are considering VMware solutions to help them address compliance requirements.

Legal Disclaimer This document is intended to provide general guidance for organizations that are considering VMware solutions to help them address compliance requirements. The information contained in this document is for educational and informational purposes only. This document is not intended to provide regulatory advice and is provided “AS IS”. VMware makes no claims, promises or guarantees about the accuracy, completeness, or adequacy of the information contained herein. Organizations should engage appropriate legal, business, technical, and audit expertise within their specific organization for review of regulatory compliance requirements.

Intended Audience

Introducing Security and Compliance is intended for cloud architects, infrastructure administrators, and cloud administrators. Familiarity with VMware software is required. This guide introduces security and compliance as it relates to the VMware Validated Design for Software-Defined Data Center (SDDC).

Required VMware Software

The *Introducing Security and Compliance* document builds on top of VMware Validated Design for Software-Defined Data Center implementations. See *VMware Validated Design Release Notes* for more information about supported product versions.

Security and Compliance in VMware Validated Design

1

Security and compliance guidance outlines the built-in controls in the VMware Validated Design for Software-Defined Data Center and the additional controls that can be added by using enhanced guidance.

Currently, a subset of enhanced guidance controls is part of this document. The document also outlines the overall approach to be used in both the built-in controls and enhanced guidance.

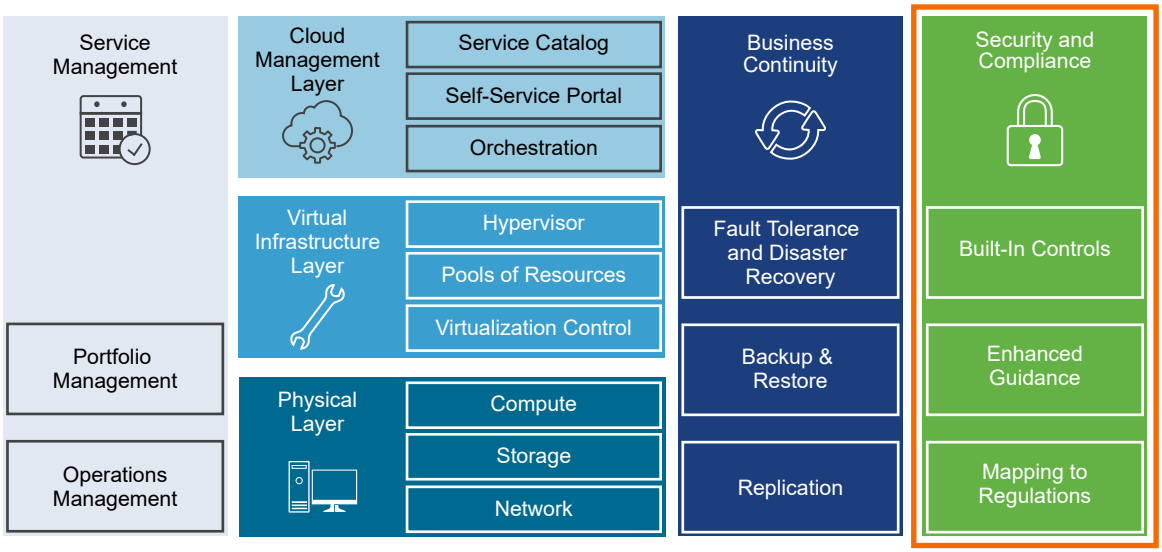
Built-in Controls	Security controls based on compliance requirements that are part of the VMware Validated Design for Software-Defined Data Center. Some controls might require additional configuration, but by design the capabilities are included in the current implementation.
Enhanced Guidance	Additional guidance on a per regulation, or standard basis includes a set of capabilities that can be added to the existing VMware Validated Design for Software-Defined Data Center implementations.

Security Architecture

2

Security in the VMware Validated Design is evaluated with a clear objective to balance best practices with usability and performance.

Figure 2-1. Security and Compliance in the VMware Validated Design for Software-Defined Data Center Layers



For VMware Validated Design for Software-Defined Data Center implementations, security must be handed over to a dedicated team (post-deployment) to augment and monitor the security posture. Attack vectors and compliance guidelines are constantly evolving so the information provided can be used to establish a baseline, not an absolute, or complete picture.

NIST 800-53 Revision 4 forms the security baseline, backdrop, and security foundation used to evaluate the VMware Validated Design. It was selected because of its vast array of controls and because it is often used by other regulations as part of their reference framework.

NIST is a risk-based framework, which requires each organization to assess their own risk posture and identify applicable controls. The VMware Validated Design does not remove this step. The VMware Validated Design security design and compliance mappings are presented to inform the reader of both design decisions, and security controls that can be leveraged.

It is important that the VMware Validated Design security design is not enough on its own. Each organization has a series of supporting security architecture, technology, processes, and people to evaluate.

Super users of the system inherit various technologies and typically work with security specialists to implement controls effectively. The VMware Validated Design has evaluated many design decisions that are incorporated with the overall design. Subsequent deployments benefit from post-implementation security health checks to enhance the organizations security posture as it relates to the VMware Validated Design.

Compliance Regulations and Standards

Organizations expect to keep data safe. They must often comply with one or more regulations from government standards to private standards such as:

- National Institute of Standards and Technology (NIST)
- Defense Information Systems Agency Security Technical Implementation Guides (DISA STIG)
- Federal Risk and Authorization Management Program (FedRAMP)
- Health Insurance Portability and Accountability Act (HIPAA)
- North American Electric Reliability Corporation - Critical Infrastructure Protection Committee (NERC CIP)
- Payment Card Industry (PCI)
- American Institute of Certified Public Accountants - Statement of Compliance (AICPA, SOC 1, or SOC 2)
- International Organization for Standardization number 27001 (ISO27001)

Security Versus Compliance

The VMware Validated Design approaches security and compliance concepts in a practical manner. Security supported by the VMware Validated Design reduces the risk of data theft, cyber-attack, or unauthorized access. While compliance is the proof that a security control is in place, typically within a defined timeline. Security and compliance work with a broader set of considerations including people, processes, and technology. Security is primarily outlined in the design decisions and highlighted within the technology configurations. Compliance is focused on mapping the correlation between security controls and specific requirements. A compliance mapping provides a centralized view to list out many of the required security controls. Those controls are further detailed by including each security control's respective compliance citations as dictated by a domain such as NIST, PCI, FedRAMP, HIPAA, and so forth.

Infrastructure Provider Role and Multi-Tenant Consumer

The VMware Validated Design is deployed using multiple components, for more details see the *VMware Validated Design Architecture and Design* document. In instances of tenancy, either a single tenant or one of multi-tenancy, consumers must be restricted to their respective tenant environments. Access to certain components, or products, might provide visibility into the wider VMware Validated Design functions. These wider VMware Validated Design functions form the backdrop that the infrastructure service provider manages. Access must be assigned only to the levels desired and clearly articulated in group nomenclature to avoid adding consumers into group membership that can extend outside of their approved tenant environment. Components that might be considered for a restriction in layers include:

- Physical
- Virtual infrastructure
- Operations management
- Cloud management
- Business continuity

Typically, access to the virtual infrastructure layer must be further restricted to the tenant environments that the consumer must have access to.

Notice For this guide, the scope is restricted to securing the infrastructure provider, or service provider. Security at the tenant level is not the focus.

NIST as a Security Baseline

The National Institute of Standards and Technology (NIST) works to promote innovation across all industries. In the realm of information security, cybersecurity, and technology, it has created a risk-based framework that provides a catalog of security controls for organizations to secure their systems. This catalog was used as a general guideline to evaluate VMware Validated Design for Software-Defined Data Center. In addition, many regulations cite NIST and build on its baseline. So, the NIST security baseline was deemed as a key building block to design VMware Validated Design security and provide compliance mapping to other regulations/standards.

Classification of Security Controls

3

VMware Validated Design security approach uses three categories to classify security controls.

The following classification identifies security controls, especially within the compliance mapping. This classification also provides a label to underscore each security control's applicability: partial applicability, or no applicability. Security controls were evaluated against each of the following categories to evaluate its scope and relevance to the VMware Validated Design.

Core technology

Security controls with matching VMware Validated Design capabilities that can be configured with minimal to no dependency on any technology outside of the SDDC. For example, the use of certificates to improve trust within systems falls into this category.

People or process administrative

Security controls that depend on other technology, depend on a wider process, and can be configured in the SDDC. This security control configuration might only be a step within a wider process. For example, assigning users into groups must be part of a wider Access Control process that might depend on other technology such as Active Directory.

Compliance mapping

Customers face varying degrees of compliance domains. For example, PCI for the credit card industry, HIPAA for healthcare, FedRAMP for government regulation in the cloud. We use NIST 800-53 R4 as a mapping baseline to evaluate the population of eligible security controls. The compliance mapping serves to translate the foundation of VMware Validated Design capabilities to the compliance flavor per each enhance guide.

Security Principles

4

Across all regulations or standards, security principles dictate the mind set used when applying security controls within the VMware Validated Design.

Security Principles and Considerations

The following common concepts in separation of duties and privileges are considered:

- Infrastructure provider vs. multi-tenant consumer
- Least privilege
  - Super user
  - Developer
  - Operations team
  - Analyst
  - System account
- Separation of duties
  - Super user compared to non-super user
  - Service accounts compared to user accounts
  - System to system communication
  - Development environment compared to production environment
  - Create, edit, or delete compared to read-only.

User Roles Based on Least Privilege

Access to the VMware Validated Design must be tailored specifically to the type of work that is required. Where possible, access must be restricted to each role based on the user's job function, title, and authorization. The following roles have been established within the VMware Validated Design Security Architecture Design:

Super user	Charged with managing the system and performing elevated privilege actions.
Developer	Primarily creating functionality within the system and especially restricting access to the system of ownership (infrastructure vs. multi-tenant consumer).
Operations team	Design the architecture of the cloud, network, storage, and security, or possibly the maintenance of the system as required.
Analyst	Focused on viewing relevant system data, or auditing settings and restricting access as required, and providing system models and reports to the relevant teams ensuring effectiveness

Notice The concept of an "average user" is not included. The SDDC components outlined in the architecture overview are part of the VMware Validated Design design and management. A typical user might be restricted to the use of an application, or other end-point solution, rather than have access to the SDDC infrastructure.

The following tables are a sample on least privilege in a roles matrix for the infrastructure provider level.

Table 4-1. Physical Layer

	Infrastructure Provider Roles and Responsibilities			
Products	**Super User**	**Developer**	**Operations Team (Day 2)**	**Analyst**
■ VMware ESXi ■ Top of Rack Switches ■ Traditional Storage	ug-Physical-Admin	No access	ug-Physical-OpsTeam (Read Only)	No access

Table 4-2. Virtual Infrastructure Layer

	Infrastructure Provider Roles and Responsibilities			
Products	**Super User**	**Developer**	**Operations Team (Day 2)**	**Analyst**
■ vCenter Server ■ VMware Update Manager ■ VMware NSX for vSphere ■ VMware vSAN ■ Platform Services Controller	ug-VirtualInfra-Admin	No access	ug-VirtualInfra-OpsTeam	No access

Table 4-3. Operations Management Layer

	Infrastructure Provider Roles and Responsibilities			
Products	**Super User**	**Developer**	**Operations Team (Day 2)**	**Analyst**
■ vRealize Log Insight ■ vRealize Operations Manager	ug-OpsMgmt-Admin	ug-OpsMgmt-Developer (Read-Only)	ug-OpsMgmt-Engineer (Read-Only)	ug-OpsMgmt-Analyst

Table 4-4. Cloud Management Layer

	Infrastructure Provider Roles and Responsibilities			
Products	**Super User**	**Developer**	**Operations Team (Day 2)**	**Analyst**
■ vRealize Business Costing ■ vRealize Automation ■ vRealize Orchestrator	ug-CloudMgmt-Admin	ug-CloudMgmt-Developer	ug-CloudMgmt-OpsTeam	ug-CloudMgmt-Analyst

Table 4-5. Business Continuity

	Infrastructure Provider Roles and Responsibilities			
Products	**Super User**	**Developer**	**Operations Team (Day 2)**	**Analyst**
■ Backup software ■ VMware Site Recovery Manager ■ vSphere Replication	ug-BusContinuity-Admin	No Access	ug-BusContinuity-OpsTeam	No Access

Separation of Duties

Establishing trust in the system might require access controls to carve up the flow of work. By establishing a boundary between each key area of a wider process, a review with a focus on governance can be implemented. This approach is used to ensure that changes are not made without prior approval, unauthorized access can be contained, change management processes better monitored, and so on. Because risk tolerance and processes differ so widely, a few key roles are identified and woven into the fabric of the security architecture.

- Super user vs. non-super user
- Service accounts vs. user accounts
- System to system communication
- Development environment vs. production environment
- Create/edit/delete vs. read-only

Compliance Mapping

5

The VMware Validated Design establishes many security capabilities. Some capabilities can be traced to a compliance requirement, while others are best practice.

Where possible, examples of the audit artifacts as evidence can be included in a separate audit guide, focused on compliance and producing evidence to meet controls. Mapping is derived using the Unified Compliance Framework (UCF), a third-party lexicography tool that specializes in the realm of compliance mapping and compliance interpretation.

Notice The compliance mapping is a subject of expansion, as more security controls are evaluated, including additional compliance domains/regulations.

VMware Validated Design Compliance Kits

6

Compliance kits are solutions that build on top of VMware Validated Design to provide guidance for enhanced configurations and audit review. Each compliance kit is specific to a compliance standard, regulation, or framework.

Every compliance kit is designed and validated to tailor security configurations without impacting the ability of VMware Validated Design to meet its design objectives. The kit can assist organizations to secure information systems in a compliance context.

This guidance has been validated and tested. Changes between subsequent releases of VMware Validated Design are designed for stability and optimal upgrade experience. Guidance provided by the VMware Validated Design Compliance Kit is for a specific VMware Validated Design release, but can still be used until a subsequent release is available.

Kit Structure

The kit consists of documents specific to the Standard SDDC implementation of VMware Validated Design.

Document Name	Document Description	Intended Audience
Product Applicability Guide	Attested by an independent, third-party auditor, which describes security capabilities and their corresponding security control mapping.	■ Procurement ■ Cloud Architects ■ Security Professionals
Configuration Guide	Enhanced configurations that can be performed after deployment of the VMware Validated Design for Standard Architecture. This guide mirrors the format and structure of the VMware Validated Design with a layered approach to securing the Software-Defined Data Center standard implementation.	■ System Integrators ■ Cloud Administrators ■ Infrastructure Administrators
Audit Guide	Procedures to validate both built-in and enhanced configurations with a preface composed by an independent, third-party auditor introducing the audit content and its applicability to control testing of a Software-Defined Data Center.	■ Security Professionals ■ Auditors

The compliance kit is designed to work holistically. Each document supports the overall blueprint and builds trust across multiple personas that may interact with the life cycle of a system operating within a compliance context: architects, system administrators, system integrators, security professionals, and auditors.

Introducing Security and Compliance outlines security and compliance concepts used in the development of the VMware Validated Design Compliance Kit. For example, considerations such as governance, risk, and compliance, separation of duties, and security architecture to name a few.

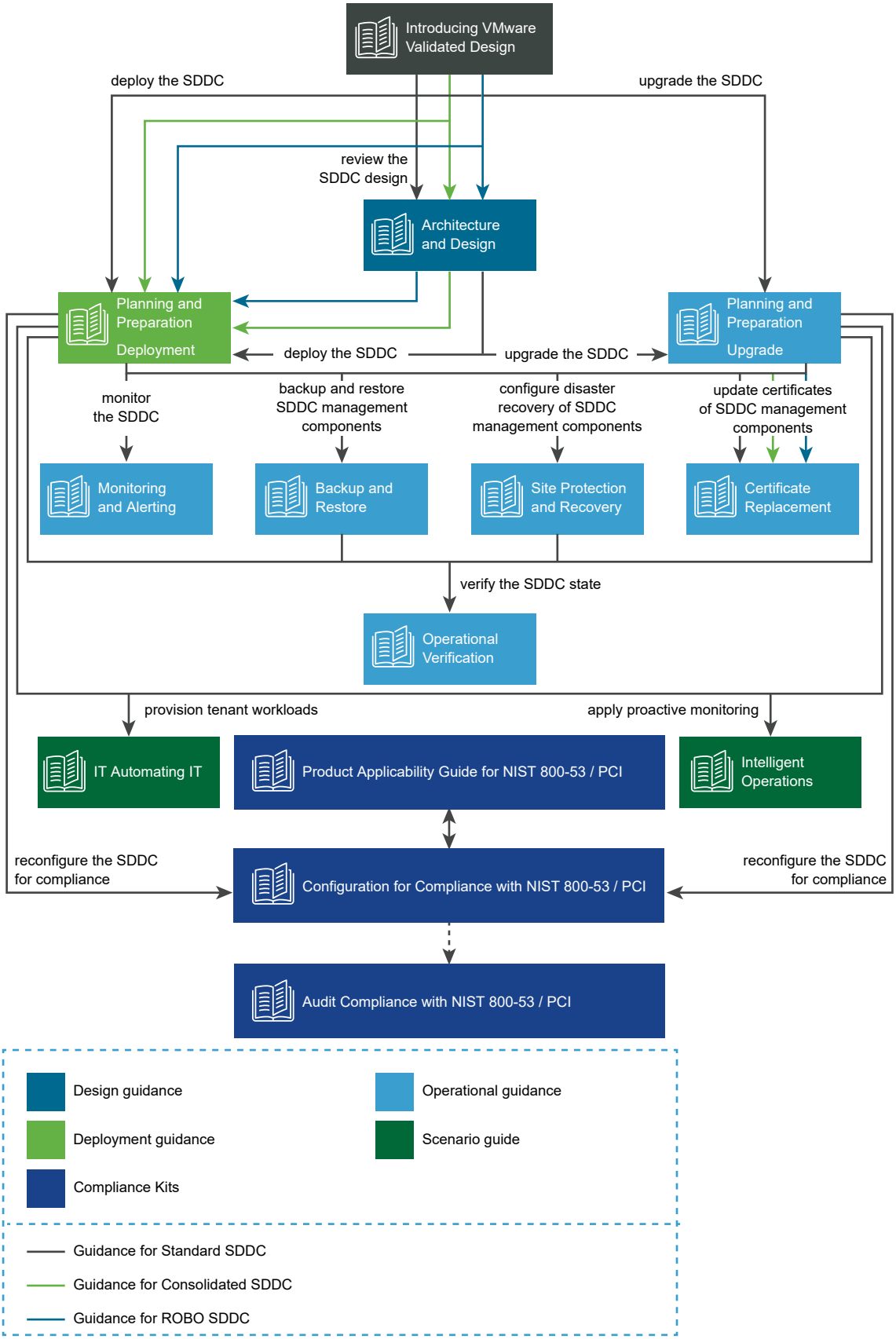
The *Product Applicability Guide* provides an overview of compliance requirements. Each product capability that has compliance applications is documented. Independent, third-party auditor attested the product capabilities and control mappings, to provide the proof of concept specific to the potential applicability of the products to meet compliance requirements. The product capabilities are also mapped to specific security configurations in the Audit Guide.

The *VMware Validated Design Configuration Guide* evaluates the product capabilities identified in the *Product Applicability Guide* and distills the information into the security configuration building blocks. All configurations are evaluated against the VMware Validated Design. Built-in configurations are confirmed and excluded from the configuration guide as part of the VMware Validated Design deployment. You must perform the procedures from the guide to ensure that the SDDC performance is not compromised.

The Audit Guide supports the post-implementation process and audit process. It includes procedures to validate both Built-in and Enhanced configurations. The preface to the Audit Guide is composed by an independent third-party auditor evaluating the VMware Validated Design Compliance Kit and attests to its ability to address compliance requirements. It includes concepts required to audit a virtualized environment and tips on how to audit a Software-Defined Data Center. Appendices in the Audit Guide include mapping product capabilities to controls, product capabilities to configurations, configuration items to audit items, audit items to controls, and a comprehensive inventory of configurations designated as Built-in or Enhanced.

Compliance Kit Guidance Documentation Map

The VMware Validated Design Compliance Kit enhances the documentation of the VMware Validated Design for Software-Defined Data Center and must be applied after the SDDC is deployed.


Introducing VMware Validated Design
deploy the SDDC
upgrade the SDDC
review the SDDC design
Architecture and Design
Planning and Preparation
Deployment
deploy the SDDC
upgrade the SDDC
Planning and Preparation
Upgrade
monitor the SDDC
backup and restore SDDC management components
configure disaster recovery of SDDC management components
update certificates of SDDC management components
Monitoring and Alerting
Backup and Restore
Site Protection and Recovery
Certificate Replacement
verify the SDDC state
Operational Verification
provision tenant workloads
apply proactive monitoring
IT Automating IT
Product Applicability Guide for NIST 800-53 / PCI
Intelligent Operations
reconfigure the SDDC for compliance
Configuration for Compliance with NIST 800-53 / PCI
reconfigure the SDDC for compliance
Audit Compliance with NIST 800-53 / PCI
Design guidance
Deployment guidance
Compliance Kits
Operational guidance
Scenario guide
Guidance for Standard SDDC
Guidance for Consolidated SDDC
Guidance for ROBO SDDC

VMware Validated Design Compliance Kit for NIST 800-53 R4

Designed as the baseline for all compliance kits. This kit addresses compliance requirements outlined by NIST 800-53 Release 4. Currently, this kit applies to a subset of products within the VMware Validated Design limited to the following:

- VMware vSphere (VMware ESXi and VMware vCenter)
- VMware vSAN
- VMware NSX for vSphere (NSX-v)

This chapter includes the following topics:

- Governance, Risk, and Compliance
- NIST 1800 Series Special Publication with the NIST Cybersecurity Center of Excellence

Governance, Risk, and Compliance

To address compliance requirements, an organization must evaluate VMware solutions against existing business processes and overlapping technology in support of audit and risk management.

Often called Governance, Risk, and Compliance, these audit and risk management processes look across the organization to consider, evaluate, and mitigate risk. Systems that are used in support of the business model of an organization are evaluated as part of an organization-wide process.

Control Definition

Controls are designed to mitigate risk. These are derived using a Risk Framework, such as the Guide for Applying the Risk Management Framework to Federal Information Systems published by NIST, publication number 800-37. *VMware Validated Design Compliance Kit for NIST 800-53* used the catalog of controls outlined in NIST 800-53 R4 and compared them to the security capabilities available within the Software-Defined Data Center using the blueprint architecture of the VMware Validated Design. These security configurations must be evaluated and considered against an organization's risk management framework.

Configuration or Security Configuration

Configurations make up the building blocks that are used to identify product capabilities and their mapping to controls. In some cases, a configuration may mirror a control as with encryption. In other cases, multiple configurations may come together to form a control as with logical access. Although configuration and system configuration can be used interchangeably, a configuration may cover an area beyond simply security as with backups.

Type of Controls

Control classifications and frameworks vary. VMware Validated Design Compliance Kit uses the Classification of Controls with an emphasis on Core and Technology controls. Controls are mapped to one or more configurations to provide visibility.

Cybersecurity Considerations

It is the responsibility of each organization's security, compliance, and audit teams to verify that configurations meet their compliance requirements. The attack vectors and compliance guidelines are constantly evolving, which requires constant monitoring and risk management processes.

NIST 1800 Series Special Publication with the NIST Cybersecurity Center of Excellence

Development of the VMware Validated Design Compliance Kit for NIST 800-53 R4 included research and development in partnership with the NIST Cybersecurity Center of Excellence. The output is a NIST special publication 1800 series described as the Trusted Cloud Project. That publication showcases a Software-Defined Data Center designed to address NIST 800-53 R4 and the NIST Cybersecurity frameworks.

Trusted Cloud Project

Showcasing the VMware Validated Design with security configurations aligned to NIST 800-53 R4 and the NIST Cybersecurity Framework, the Trusted Cloud Project is published as an 1800 series with three volumes. This Security Practice Guide for VMware Hybrid Cloud Infrastructure as a Service (IaaS) Environments includes:

- Volume A – Executive Summary
- Volume B – Approach, Architecture, and Security Characteristics
- Volume C - How to Guide (in-progress)

The NIST Cybersecurity Center of Excellence describes the importance of the project and its purpose: *"[to] demonstrate how the implementation and use of trusted compute pools not only will provide assurance that workloads in the cloud are running on trusted hardware and are in a trusted geolocation, but also will improve the protections for the data within workloads and flowing between workloads."*