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**NIST Special Publication**  
**NIST SP 800-219r1 ipd**

**Automated Secure Configuration**  
**Guidance from the macOS**  
**Security Compliance Project**  
**(mSCP)**

Initial Public Draft

Mark Trapnell  
Eric Trapnell  
Murugiah Souppaya  
Bob Gendler  
Karen Scarfone

This publication is available free of charge from:  
<https://doi.org/10.6028/NIST.SP.800-219r1.ipd>

NIST Special Publication  
NIST SP 800-219r1 ipd

# Automated Secure Configuration Guidance from the macOS Security Compliance Project (mSCP)

Initial Public Draft

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U.S. Department of Commerce  
Gina M. Raimondo, Secretary

National Institute of Standards and Technology  
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87 **All comments are subject to release under the Freedom of Information Act (FOIA).**

## 88 **Abstract**

89 The macOS Security Compliance Project (mSCP) provides resources that system administrators,  
90 security professionals, security policy authors, information security officers, and auditors can  
91 leverage to secure and assess macOS desktop and laptop system security in an automated way.  
92 This publication introduces the mSCP and gives an overview of the resources available from the  
93 project's GitHub site, which is continuously curated and updated to support each new release of  
94 macOS. The GitHub site provides practical, actionable recommendations in the form of secure  
95 baselines and associated rules. This publication also describes use cases for leveraging the mSCP  
96 content. Updates from the previous version of this publication mainly involve the new mSCP  
97 capability to create a custom benchmark by tailoring a baseline.

## 98 **Keywords**

99 Apple; baseline; configuration management; endpoint device security; macOS; macOS Security  
100 Compliance Project (mSCP); operating system security; security compliance.

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111 with industry, government, and academic organizations.

112

113 **Supplemental Content**

114 The mSCP's GitHub site is at [https://github.com/usnistgov/macOS\\_security#readme](https://github.com/usnistgov/macOS_security#readme), and the  
115 project documentation wiki is at [https://github.com/usnistgov/macOS\\_security/wiki](https://github.com/usnistgov/macOS_security/wiki).

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## 1. Introduction

The National Institute of Standards and Technology (NIST) has traditionally published secure configuration guides for Apple desktop/laptop operating system versions as prose-based Special Publications (SPs), such as NIST SP 800-179, Revision 1, *Guide to Securing Apple macOS 10.12 Systems for IT Professionals: A NIST Security Configuration Checklist*. In order to provide security configuration guidance to organizations more quickly and in a machine-consumable format, NIST established the open-source macOS Security Compliance Project (mSCP). NIST no longer produces SP guidance documents for each macOS release; instead, the mSCP continuously curates and updates machine-consumable macOS guidance. The latest macOS security baseline content is maintained and updated on the mSCP GitHub page [1].

*Security baselines* are groups of settings used to configure a system to meet a target level or set of requirements or to verify that a system complies with requirements. The mSCP seeks to simplify the macOS security development cycle by reducing the amount of effort required to implement security baselines. This collaboration between federal agencies minimizes duplicate effort that would otherwise be needed for these agencies to administer individual security baselines. Additionally, the secure baseline content provided is easily extensible by other parties to implement their own security requirements.

Organizations using mSCP content, particularly security baseline examples, should take a risk-based approach for selecting the appropriate settings and defining values that consider the context under which the baseline will be utilized.

### 1.1. Purpose and Scope

The purpose of this document is to introduce the mSCP to broader audiences. This document provides a high-level overview of the mSCP, its components, and some common use cases. It refers readers to the online project documentation for in-depth technical information and use instructions. This document is intended to be independent of macOS version releases; updates will be released as needed when there are substantial changes to the mSCP. Updates from the previous release of this document mainly involve the new mSCP capability to create a custom benchmark by tailoring a baseline.

The information in this document regarding the details of the mSCP GitHub site is accurate as of the time of publication. Readers seeking the latest detailed information on mSCP content or the content itself should visit the [mSCP GitHub page](#) and [wiki](#).

Organizations that need to reference a NIST SP to demonstrate how they are complying with United States Government mandates for adopting secure configurations for their macOS devices may reference this SP instead of its deprecated predecessors, such as SP 800-179 or SP 800-179, Revision 1.

### 1.2. Audience

This document and the mSCP GitHub site are intended for system administrators, security professionals, policy authors, privacy officers, and auditors who have responsibilities involving

macOS security. Additionally, vendors of device management, security, configuration assessment, and compliance tools that support macOS may find this document and the GitHub site to be helpful.

### 1.3. Relevance to NIST SP 800-70 and the National Checklist Program

The security baselines from the mSCP GitHub page are included in the National Checklist Program. NIST SP 800-70, Revision 4 [2], explains that federal agencies are required to use appropriate security configuration checklists from the National Checklist Program when available. Part 39 of the Federal Acquisition Regulations, Section 39.101 paragraph (c) states,

In acquiring information technology, agencies shall include the appropriate information technology security policies and requirements, including use of common security configurations available from the National Institute of Standards and Technology's website at <https://checklists.nist.gov>. Agency contracting officers should consult with the requiring official to ensure the appropriate standards are incorporated.

### 1.4. Document Structure

The remaining sections and appendices of this document are as follows:

- Section 2 provides an overview of the project, including what its goals are and how its content can be used.
- Section 3 explains the major components of the mSCP and provides pointers to additional information on component usage.
- The References section lists the references for the document.
- Appendix A briefly discusses how mSCP can help meet the needs of people in several roles.
- Appendix B provides examples of how a security professional might use mSCP content.
- Appendix C contains an example of how an assessment tool vendor could leverage mSCP content.
- Appendix D lists selected acronyms and abbreviations used in this document.

## 2. Project Description

The mSCP is an open-source project that provides a programmatic approach to generating and using macOS security configuration baselines. The project's content can be used to create customized security baselines of technical security controls by leveraging a library of rules, with each rule mapped to requirements in one or more existing security standards, regulations, or frameworks. This approach provides versioning and consistency of the content. Unifying and standardizing macOS baseline efforts via the mSCP means that updating security guidance is simplified and radically accelerated, even as new versions of macOS are introduced annually.

The mSCP started in August 2019 as a collaboration among operational IT security staff from NIST, the National Aeronautics and Space Administration (NASA), the Defense Information Systems Agency (DISA), and the Department of Energy's (DOE) Los Alamos National Laboratory (LANL).<sup>1</sup> The mSCP sought to map macOS settings to NIST SP 800-53, Revision 4 [3] with an extensible, modern approach to security guidance that could be used by any organization (e.g., government, enterprise, education) that needs to adhere to security compliance frameworks and policy.

As of this writing, the configuration settings represent guidance and best practices from NIST SP 800-53, Revision 5 [4]; NIST SP 800-171, Revision 2 [5]; the macOS DISA Security Technical Implementation Guide (STIG) [6]; the Committee on National Security Systems (CNSS) Instruction (CNSSI) Number 1253 [7]; the Center for Internet Security (CIS) Critical Security Controls Version 8 [8]; and internal organizational security guidance from NIST, NASA, and LANL.

### 2.1. Project Goals

Apple releases a new macOS version every year, and generally, agencies and organizations must wait for guidance or accept risk before deploying the new macOS version. Most agencies or organizations must create their own internal security configuration, which delays the deployment of the new macOS version or new hardware that only supports the new macOS version. The mSCP assists organizations in upgrading sooner. Generally, the technical security settings in macOS do not drastically change from release to release, with only a handful of new settings being introduced. By pursuing a rules-based approach, mSCP rules that remain applicable can be reused and incorporated into guidance for the latest macOS version. This enables quicker adoption of new security features that are not offered in prior versions of macOS.

The goals of the mSCP are to:

- Develop recommended security baselines using a risk-based approach
- Normalize and accelerate annual adoption of the new operating system and hardware by providing guidance to meet the security needs of new operating systems at the earliest availability
- Reduce worldwide efforts in creating annual guidance by unifying and consolidating compliance efforts into a single project

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<sup>1</sup> See [https://github.com/usnistgov/macOS\\_security#authors](https://github.com/usnistgov/macOS_security#authors) for a current list of project contributors.

- Develop a methodology to foster collaboration between baseline authors, reducing overhead and redundancy
- Establish a unified approach for the configuration and assessment of controls across multiple sources and tools
- Enable the customization of existing content and the creation of new content, including creating custom baselines in order to meet organization-specific security requirements
- Provide device management and security tool vendors, auditors, and Apple insight into customer security configuration needs

## 2.2. mSCP Content Use

mSCP content can be used by any organization to assist in setting and assessing the security configuration of macOS systems. Security baselines can map to existing guidance or controls, such as those in NIST SP 800-53, Revision 5 [4], or they can be customized to meet an organization's specific needs. In mSCP terminology, a security baseline is represented as a *baseline file* that designates the rules for meeting a specific set of requirements. The mSCP provides a library of *rules* that are macOS settings. Each rule is mapped to a requirement within a security standard or framework. Baseline files and rules comprise much of the mSCP's content.

The mSCP offers several example baselines with descriptions adapted from Federal Information Processing Standards (FIPS) 199 [9], such as:

- The ***SP 800-53, Revision 5 low baseline*** is a defined map of controls to secure a system defined as a low-impact information system. The loss of confidentiality, integrity, or availability could be expected to have a **limited** adverse effect on organizational operations, organizational assets, or individuals.
- The ***SP 800-53, Revision 5 moderate baseline*** is a defined map of controls to secure a system defined as a moderate-impact information system. The loss of confidentiality, integrity, or availability could be expected to have a **serious** adverse effect on organizational operations, organizational assets, or individuals.
- The ***SP 800-53, Revision 5 high baseline*** is a defined map of controls to secure a system defined as a high-impact information system. The loss of confidentiality, integrity, or availability could be expected to have a **severe or catastrophic** adverse effect on organizational operations, organizational assets, or individuals.

Organizations using any baseline example should take a risk-based approach for selecting the appropriate settings and organizationally defined values depending on the context under which the baseline will be applied. Organizations can tailor any of the baselines to include controls specific to their needs and to produce evidence of control enforcement. Additional information on baseline customization can be found in SP 800-70 [2], which discusses the importance of customizing and testing baselines before applying them to a production system.

The mSCP provides scripts that can be used with baselines for several purposes, including the following:

- Creating scripts and profiles for configuring macOS

- Generating a mapping between security standards, regulations, frameworks, etc.
- Producing human-readable documentation in a variety of formats
- Customizing existing baselines

mSCP content can also be used to generate Security Content Automation Protocol (SCAP) content for automated security compliance scans. The SCAP generated follows the SCAP 1.3 specification [10]. The generation of SCAP content uses an Extensible Stylesheet Language Transformations (XSLT) file to create an Extensible Configuration Checklist Description Format (XCCDF) checklist document with an accompanying Open Vulnerability and Assessment Language (OVAL) document.

The XCCDF and OVAL documents are bundled into an SCAP data stream collection document with accompanying files that include Common Platform Enumeration (CPE) dictionary [11] information and an Open Checklist Interactive Language (OCIL) document. This creates an SCAP 1.3 document that validates using the NIST SCAP Content Validation Tool<sup>2</sup> and can be used by SCAP tools on macOS. More information on SCAP content generation is available at the [project wiki](https://project.wiki).

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<sup>2</sup> See <https://csrc.nist.gov/projects/security-content-automation-protocol/scap-releases/scap-1-3>.

### 3. mSCP Components

This section provides an overview of several components of the mSCP: security baseline files, configuration profiles and scripts, content generation scripts, customization capabilities, and directories. More information about all of these is available at the [GitHub wiki](#).

#### 3.1. Baselines and Benchmarks

The mSCP includes both baselines and benchmarks. A baseline is a catalog of recommended configuration settings, not a checklist or benchmark, and should be customized based on the organization's risk profile. Implementing every item is not likely to be possible or sensible in many operational scenarios. Baselines can be used to assist in the creation of security benchmarks. A *benchmark* differs from a baseline in that it defines values in addition to a set of controls. Benchmarks are published by organizations that have made risk-based decisions, such as DISA and CIS. Organizations can also define their own benchmark. These values are called Organization-Defined Values (ODVs), and they exist throughout the baselines and can be set during customization.

#### 3.2. Security Baseline Files

In the mSCP, a security baseline is defined in a Yet Another Markup Language (YAML) file. A YAML file is a human-readable file format commonly used by configuration files where data are stored and/or transmitted. A baseline YAML file consists of the following required fields:

- **title** – A human-readable name for the baseline
- **description** – A short description of the baseline, including its use case and target operating system (OS) version
- **authors** – Developers of the baseline
- **profile** – The security content portion of the baseline
  - **section** – A keyword for organizing settings
  - **rules** – The names of the rule files that are a part of this baseline

The following code provides a partial example of a YAML file that illustrates the use of these fields (with field names bolded):



```
390 title: "Apple macOS 11 (Big Sur) Test Baseline"
391 description: |
392   This guide describes the prudent actions to take when securing a macOS 11
393   system against the Test Baseline.
394 authors: |
395   ===
396   | Joe Doe | NIST
397   | ===
398 profile:
399   - section: "Authentication"
400     rules:
401       - auth_pam_login_smartcard_enforce
402       - auth_pam_su_smartcard_enforce
403       - auth_pam_sudo_smartcard_enforce
404       - auth_smartcard_allow
405   - section: "Auditing"
406     rules:
407       - audit_acls_files_configure
408       - audit_acls_files_mode_configure
409       - audit_acls_folder_wheel_configure
```

Fig. 1. Security Baseline YAML File.

### 3.2.1. Rule File Composition

A YAML rule file is broken down into the following subsections. This list and the following example are from the Rules section of the [mSCP wiki](#).

- **id** – The **id** should match the file name without the **yaml** file extension.
- **title** – The **title** is a human-readable title of the rule.
- **discussion** – The **discussion** should provide a concise description of the intended use of the rule.
- **check** – Every rule will have a check. A shell-based check should be able to validate and check most rules.
- **result** – Expected results from the check.
- **fix** – The **fix** will appear in a document when generated. If a **fix** includes `[source,bash]`, the **fix** will be used for generating the script to enforce the rule.
- **references** – The **references** include a Common Configuration Enumeration (CCE) identifier and a mapping of the security frameworks, guidance, and individual controls that have been mapped to the rule. See the official repository of NIST CCEs [12] for more information.
- **macOS** – The validated macOS version for this rule.
- **odv** – If a rule supports the ODV functionality, then the **odv** section should be present. At a minimum, this field should contain a **hint** (provides a description when tailoring a baseline) and a default value that replaces the **\$ODV** variable.

- **tags** – Tags are keywords used to categorize and identify related rules, and they can be added to or modified as needed. Tags can also be used to make index-based searching of the rules faster and easier.
- **severity** – The severity level specified in the DISA STIG, if applicable.
- **mobileconfig** – The mobileconfig and mobileconfig\_info subsections are related. If mobileconfig is set to true, the information required for creating the mobileconfig configuration profile is required in the mobileconfig\_info area.

The following code provides a notional example of a YAML rule file (with field names bolded):

```
id: sysprefs_screensaver_timeout_enforce
title: "Enforce Screen Saver Timeout"
discussion: |
  The screen saver timeout _MUST_ be set to $ODV seconds or a shorter length
  of time.

  This rule ensures that a full session lock is triggered within no more than
  $ODV seconds of inactivity.
check: |
  /usr/bin/osascript -l JavaScript << EOS
  function run() {
    let timeout =
objC.unwrap($.NSUserDefaults.alloc.initWithSuiteName('com.apple.screensaver')
\
  .objectForKey('idleTime'))
    if ( timeout <= $ODV ) {
      return("true")
    } else {
      return("false")
    }
  }
  EOS
result:
  string: "true"
fix: |
  This is implemented by a Configuration Profile.
references:
  cce:
    - CCE-91074-5
  cci:
    - CCI-000057
  800-53r5:
    - AC-11
    - IA-11
  800-53r4:
    - AC-11
  srg:
    - SRG-OS-000029-GPOS-00010
  disa_stig:
    - APPL-12-000004
  800-171r2:
    - 3.1.10
  cis:
    benchmark:
      - 2.3.1 (level 1)
    controls v8:
      - 4.3
macos:
  - "12.0"
```

```
488 odv:
489   hint: "Number of seconds."
490   default: 1200
491   stig: 900
492   cis_lvl1: 1200
493   cis_lvl2: 1200
494 tags:
495   - 800-53r5_moderate
496   - 800-53r5_high
497   - 800-53r5_low
498   - 800-53r4_moderate
499   - 800-53r4_high
500   - 800-171
501   - cnssi-1253
502   - cis_lvl1
503   - cis_lvl2
504   - ciscv8
505   - stig
506 severity: "medium"
507 mobileconfig: true
508 mobileconfig_info:
509   com.apple.screensaver:
510     idleTime: $ODV
```

Fig. 2. YAML Rule File

### 3.2.2. Rule File Categories

The mSCP organizes YAML files in the `rules` directory into the following subdirectories, each of which corresponds to a category of settings:

- **audit** – OpenBSM<sup>3</sup>
- **auth** – Smartcard authentication
- **icloud** – Apple’s iCloud/Apple ID service
- **os** – Rules to configure the operating system that do not fit into the other categories
- **pwpolicy** – Password policy
- **system\_settings** or **sysprefs** – Settings controlled within the System Settings or System Preferences application

The `rules` directory also includes a **supplemental** subdirectory, which contains additional information that supports the guidance provided by the baselines. Supplemental content contains information for rules that are not part of an existing baseline but could be beneficial for certain use cases. Supplemental content may not have mappings and may not contain the YAML rule file check and fix sections mentioned in Section 3.2.1. Supplemental content can be added to enhance baselines where organizational requirements are different than the system baseline requirements.

<sup>3</sup> See OpenBSM at <https://github.com/openbsm/openbsm>.

### 3.3. Configuration Profiles and Scripts

When an mSCP YAML file is processed, it yields a configuration script and/or configuration profile (`mobileconfig` file) as outputs. Both are used to apply configuration settings to a system.

A *configuration profile* is an Extensible Markup Language (XML) formatted file with a `mobileconfig` extension that contains a configuration payload. macOS can automatically configure itself based on a `mobileconfig` file's contents upon execution. Configuration profiles offer a convenient, Apple-supported mechanism for applying security settings to a macOS environment. Additionally, they can be cryptographically signed to ensure integrity and authenticity. These factors make configuration profiles the preferred vehicle for configuration delivery. However, `mobileconfig` files cannot modify all macOS settings, so a configuration script is needed for those settings that are not supported. See the developer [documentation page](#) for an example configuration profile and brief descriptions of its properties.

A *configuration script* is a shell script that directly manipulates operating system files. The script content is derived from all YAML rule files that have a `mobileconfig` value of `false` and belong to the specified baseline. The YAML rule file must contain the `fix` section in order to generate its corresponding configuration script entry.

### 3.4. Content Generation Scripts

The mSCP provides several types of scripts for generating baselines, human-readable guidance, baseline compliance checkers, and other types of content. Each script is described below.

#### 3.4.1. Generate Baseline Script

The `generate_baseline.py` Python script compiles a list of security rules into a single baseline YAML file. It can be used to modify an existing security baseline or create a new one. See the [wiki](#) for additional information.

#### 3.4.2. Generate Guidance Script

The `generate_guidance.py` script can produce human-readable guidance and generate the macOS Security Compliance Tool, which is a Z shell script.

The `generate_guidance.py` script takes a baseline file and produces a human-readable guide with information from the YAML rules files. The script can create documentation in several formats but always generates an AsciiDoc file. AsciiDoc (`.adoc`) is a plain text format that uses markup conventions for traditional document formatting and organization. AsciiDoc files are easily transformable into many other formats via the `generate_guidance.py` script, including HTML, PDF, and Excel. The Excel format is particularly useful for quickly viewing all of the rules of a baseline, and it contains all of the data in the YAML rules files.

The `generate_guidance.py` script can also create configuration profiles (`mobileconfig` files) and the macOS Security Compliance Tool. Using the `-s` argument, the `generate_guidance.py` script will generate an `org.{baseline}.audit.plist` file and another script, the macOS Security Compliance Tool, that can check and remediate compliance settings. The `audit.plist`

file can be used to set an exemption to organizational rules for approved users so that compliance checks can succeed without findings. To create an exemption for a rule, the `exempt` field should be set to `true` and an `exempt_reason` should be added.

See the [wiki](#) for more information on the `generate_guidance.py` script.

### 3.4.3. macOS Security Compliance Tool

The `{baseline}_compliance.sh` script runs interactively by default. It can evaluate a system's conformance to a baseline or remediate any incorrectly configured settings. Alternatively, the script can autonomously assess a system with the `-check` argument or automatically remediate baseline settings with `-fix`.

The lines below provide an example of the results of running the script:

```
Thu Jan 21 15:09:41 UTC 2021 auth_pam_login_smartcard_enforce passed (Result:
2, Expected: {integer: 2})
Thu Jan 21 15:09:41 UTC 2021 auth_smartcard_allow passed (Result: 1,
Expected: {integer: 1})
Thu Jan 21 15:09:41 UTC 2021 auth_pam_sudo_smartcard_enforce passed (Result:
2, Expected: {integer: 2})
Thu Jan 21 15:09:41 UTC 2021
auth_smartcard_certificate_trust_enforce_moderate passed (Result: 2,
Expected: {integer: 2})
Thu Jan 21 15:09:41 UTC 2021 auth_smartcard_enforce has an exemption (Reason:
Broken Reader)
```

Fig. 3. Compliance Script Sample Output.

For more information on the macOS Security Compliance Tool script, see the [wiki](#).

### 3.4.4. SCAP Generation Script

The SCAP generation script, `generate_scap.py` can generate an SCAP 1.3 document, XCCDF document, or OVAL file. The script builds content from available tags within the YAML files and does not need to be pointed to a baseline file.

For more information, see the [wiki](#).

### 3.4.5. Generate Mapping Script

The `generate_mapping.py` script allows for the quick creation of custom rules and baselines for a compliance framework not published by the mSCP. The script requires a user-created comma-separated values (CSV) file containing control identifiers that maps to a new framework (CSV column 1) from another already defined by the project (CSV column 2). By default, the script is designed to map a framework to the NIST SP 800-53, Revision 5 [4] set of controls. Adding the `-f` argument allows for mapping to another supported framework. See the [wiki](#) for more information on the `generate_mapping.py` script.

### 3.5. Customization

Organizations should make the risk-based decision on what controls and rules to use and how to apply them, as stated by NIST SP 800-53, Revision 5 controls PL-10 and PL-11. Customization allows organizations to generate their own customized content outside of that provided by the project. Additionally, it allows them to add content for internal-only controls, which are not suitable for inclusion in a global baseline. Customization primarily takes place within the custom folder. Here are examples of customizations supported by mSCP:

- **Baselines:** A `baseline` folder can be included within the `custom` folder to create customized baselines that fit an organization's needs. These baseline files may include rule, section, and template customization (discussed below). An existing baseline can be configured to create a custom benchmark. Additionally, it is possible to customize an included benchmark, but in doing so, it may no longer be compliant with the original requirements of that benchmark.
- **Rules:** Existing rules can have their setting values overridden via the `custom` folder instead of modifying the mSCP-supplied rule file. New rules can be created and added to existing baselines or to user-defined baselines. Organizations can create their own discussions, checks, results, fixes, and mappings of rules to security frameworks not included in the project. In order to override an existing rule, the custom rule file name must match an existing rule so that the `generate_guidance.py` script will pick up the new values. New rules not included in mSCP must be listed in the baseline YAML file specified when running `generate_guidance.py`. Additional information on custom rules can be found in an article written by mSCP contributor Allen Golbig [13].
- **Sections:** Custom sections can be used to organize existing or custom YAML rule files. Sections defined in the `custom` folder must be included in a baseline YAML file in order to be used by `generate_guidance.py`.
- **Templates:** Custom templates can be used to define new template structures for the project and affect the organization and appearance of generated documentation. The template files must match the name of an existing template and will override that template when running `generate_guidance.py`.
- **Logos:** An organization can include a custom logo when running the `generate_guidance.py` script by using the `-l` argument to point to an image file.
- **Tailoring:** The `generate_baseline.py` script allows for a baseline to be tailored using the `-t` argument. During the tailoring process, the script will prompt for each control containing an ODV to have its values customized. If a value is not supplied to a control with an ODV, it will use the default value in the rule file. Refer to Appendix C for an example of tailoring with ODVs.

### 3.6. Directories

mSCP source code releases available on the [mSCP GitHub](#) include the following directories:

- **baselines** – Contains the defined YAML baseline files

- 641 • **build** – Holds scripts, documents, and configuration profiles generated by running  
642 scripts
- 643 • **custom** – Used for creating customized baselines, rules, sections, or templates to meet an  
644 organization’s requirements
- 645 • **includes** – Contains the YAML-based libraries required for running the scripts
- 646 • **rules** – Contains YAML rule files with one rule per file
- 647 • **scripts** – Contains the content generation scripts and their required files
- 648 • **sections** – Defines the sections that correlate to the directories in the `rules` folder; each  
649 section has its own YAML file that contains the section name and description as it will  
650 appear in the generated guide, which is human-readable documentation
- 651 • **templates** – Includes AsciiDoc templates for generating an AsciiDoc guide

## References

- [1] macOS Security Compliance Project (2023) *macOS Security Compliance Project*. Available at [https://github.com/usnistgov/macOS\\_security](https://github.com/usnistgov/macOS_security)
- [2] Quinn SD, Souppaya MP, Cook MR, Scarfone KA (2018) National Checklist Program for IT Products: Guidelines for Checklist Users and Developers. (National Institute of Standards and Technology, Gaithersburg, MD), NIST Special Publication (SP) 800-70, Rev. 4. <https://doi.org/10.6028/NIST.SP.800-70r4>
- [3] Joint Task Force Transformation Initiative (2013) Security and Privacy Controls for Federal Information Systems and Organizations. (National Institute of Standards and Technology, Gaithersburg, MD), NIST Special Publication (SP) 800-53, Rev. 4, Includes updates as of January 22, 2015. <https://doi.org/10.6028/NIST.SP.800-53r4>
- [4] Joint Task Force (2020) Security and Privacy Controls for Information Systems and Organizations. (National Institute of Standards and Technology, Gaithersburg, MD), NIST Special Publication (SP) 800-53, Rev. 5. Includes updates as of December 10, 2020. <https://doi.org/10.6028/NIST.SP.800-53r5>
- [5] Ross R, Pillitteri V, Dempsey K, Riddle M, Guissanie G (2020) Protecting Controlled Unclassified Information in Nonfederal Systems and Organizations. (National Institute of Standards and Technology, Gaithersburg, MD), NIST Special Publication (SP) 800-171, Rev. 2, Includes updates as of January 28, 2021. <https://doi.org/10.6028/NIST.SP.800-171r2>
- [6] Department of Defense (2023) *DISA STIG for macOS*. Available at [https://public.cyber.mil/stigs/downloads/?\\_dl\\_facet\\_stigs=mac-os](https://public.cyber.mil/stigs/downloads/?_dl_facet_stigs=mac-os)
- [7] Committee on National Security Systems (2014) Security Categorization and Control Selection for National Security Systems. (National Security Agency, Ft. Meade, MD), Committee on National Security Systems Instruction (CNSSI) No. 1253. Available at <https://www.cnss.gov/CNSS/issuances/Instructions.cfm>
- [8] Center for Internet Security (2023) *CIS Critical Security Controls Version 8*. Available at <https://www.cisecurity.org/controls/v8/>
- [9] National Institute of Standards and Technology (2004) Standards for Security Categorization of Federal Information and Information Systems. (U.S. Department of Commerce, Washington, DC), Federal Information Processing Standards Publication (FIPS) 199. <https://doi.org/10.6028/NIST.FIPS.199>
- [10] Waltermire DA, Quinn SD, Booth H, III, Scarfone KA, Prisaca D (2018) The Technical Specification for the Security Content Automation Protocol (SCAP): SCAP Version 1.3. (National Institute of Standards and Technology, Gaithersburg, MD), NIST Special Publication (SP) 800-126, Rev. 3. <https://doi.org/10.6028/NIST.SP.800-126r3>
- [11] National Institute of Standards and Technology (2023). *Official Common Platform Enumeration (CPE) dictionary*. Available at <https://nvd.nist.gov/products/cpe>
- [12] National Institute of Standards and Technology (2022) *CCE Platform Listing*. Available at <https://ncp.nist.gov/cce>
- [13] Golbig A (2021) *Getting to Know: macOS Security Compliance Project – Part 2*. Available at <https://golbiga.medium.com/getting-to-know-macos-security-compliance-project-part-2-24131b60cdfb>



## Appendix A. mSCP User Roles

The mSCP was designed to meet the needs of different security roles. These perspectives are briefly examined below.

**Security policy authors** define the policies for their organizations. The customization and ease of extensibility offered by the mSCP facilitate new content creation. Policy authors will need to familiarize themselves with the YAML rule file format described in Section 3.2.1. Of particular interest is the ability to map rules directly to references. Additionally, the generate mapping script (Section 3.4.5) enhances portability between compliance frameworks.

**System administrators and security professionals** are responsible for configuring the systems under their purview. They implement the guidance issued by security policy authors. Security professionals may wish to generate baselines (Section 3.4.1), guidance (Section 3.4.2), and configuration using the macOS Security Compliance Tool (Section 3.4.3).

**Auditors** approach macOS security compliance from a validator perspective, seeking proof that a system is configured in the required way. They are more interested in system setting documentation and compliance evidence than technical tools, such as configuration scripts. Both of these needs can be met by mSCP tools. The generate guidance script (Section 3.4.2) provides the necessary documentation in a variety of formats, including HTML, PDF, and Excel. The macOS Security Compliance Tool (Section 3.4.3) assesses a system and produces a log of the results. Additionally, some auditors may be interested in examining YAML rule content directly (Section 3.2.1).

**Information security officers** have a variety of goals but are ultimately responsible for ensuring that systems are configured according to their organizational requirements. To accomplish this, they need policy documentation (Section 3.4.2) and the results of compliance scans (Section 3.4.3). Information security officers may also be responsible for reviewing the security rules proposed by the policy authors. If this is the case, they may be interested in YAML rule file components (Section 3.2.1).

**Vendors of device management, security, configuration assessment, and compliance tools** can produce a series of audit files based on mSCP content to support different macOS versions and associated security baselines. These audit files are maintained, tested, published, and supported by the tool vendors. Tool customers can download and import the content into the tool to assess the state of their system against a particular baseline in an automated way.

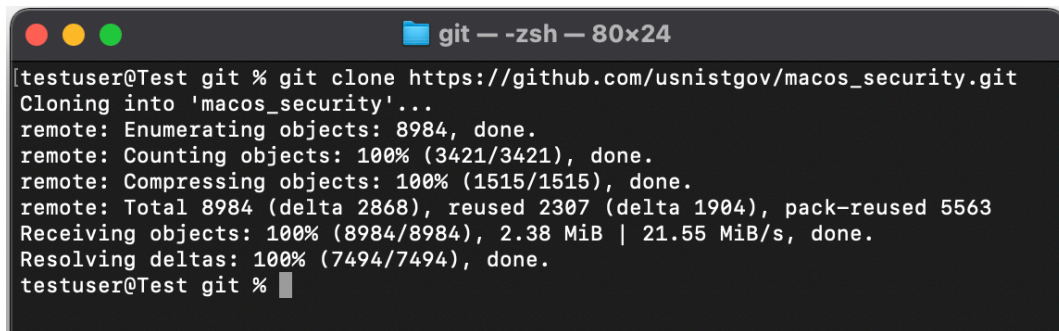
Specific audit files of the mSCP by tool vendors are described on the project wiki page. This content will be updated as contributing tool vendors develop new audit content.

## Appendix B. Example of mSCP Usage by a Security Professional

This appendix provides examples of how a security professional might use mSCP content. People in other roles might perform some of the same actions. The examples illustrated below were accurate at the time of publication, but see the [mSCP wiki](#) for up-to-date usage guidance. Note that the mSCP scripts are not meant to replace enterprise-class configuration and management tools. Configurations should be tested on development systems before being deployed on end users' systems.

### Preparing to use mSCP

All project components are available from the mSCP GitHub page [1] by navigating to Releases and downloading the latest source code revision for the desired macOS version. Alternatively, the project source code can be downloaded via git, as the example below illustrates.



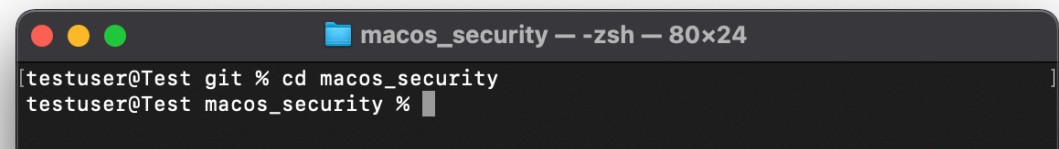
```
git — zsh — 80x24
[testuser@Test git % git clone https://github.com/usnistgov/macOS_security.git ]
Cloning into 'macOS_security'...
remote: Enumerating objects: 8984, done.
remote: Counting objects: 100% (3421/3421), done.
remote: Compressing objects: 100% (1515/1515), done.
remote: Total 8984 (delta 2868), reused 2307 (delta 1904), pack-reused 5563
Receiving objects: 100% (8984/8984), 2.38 MiB | 21.55 MiB/s, done.
Resolving deltas: 100% (7494/7494), done.
[testuser@Test git % ]
```

Fig. 4. Downloading the mSCP code.

mSCP components rely on prerequisite software listed on the [Getting Started page](#), and any missing software must be installed.

### Changing code branches and generating a baseline

After obtaining a copy of the source code, change the directory to the mSCP git folder, macOS\_security.

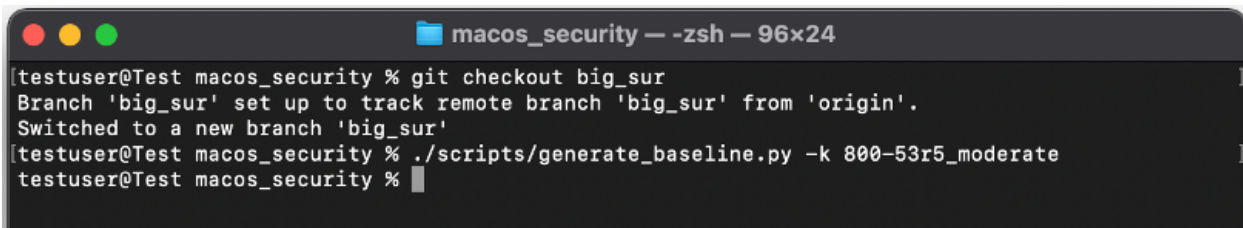


```
macOS_security — zsh — 80x24
[testuser@Test git % cd macOS_security ]
[testuser@Test macOS_security % ]
```

Fig. 5. Changing the directory to the mSCP git folder.

Next, select the appropriate code branch that corresponds to the target OS version. Then choose a baseline and use the generate\_baseline.py script to create a baseline YAML file. The

example below illustrates these steps for the NIST SP 800-53, Revision 5 moderate baseline for macOS Big Sur.

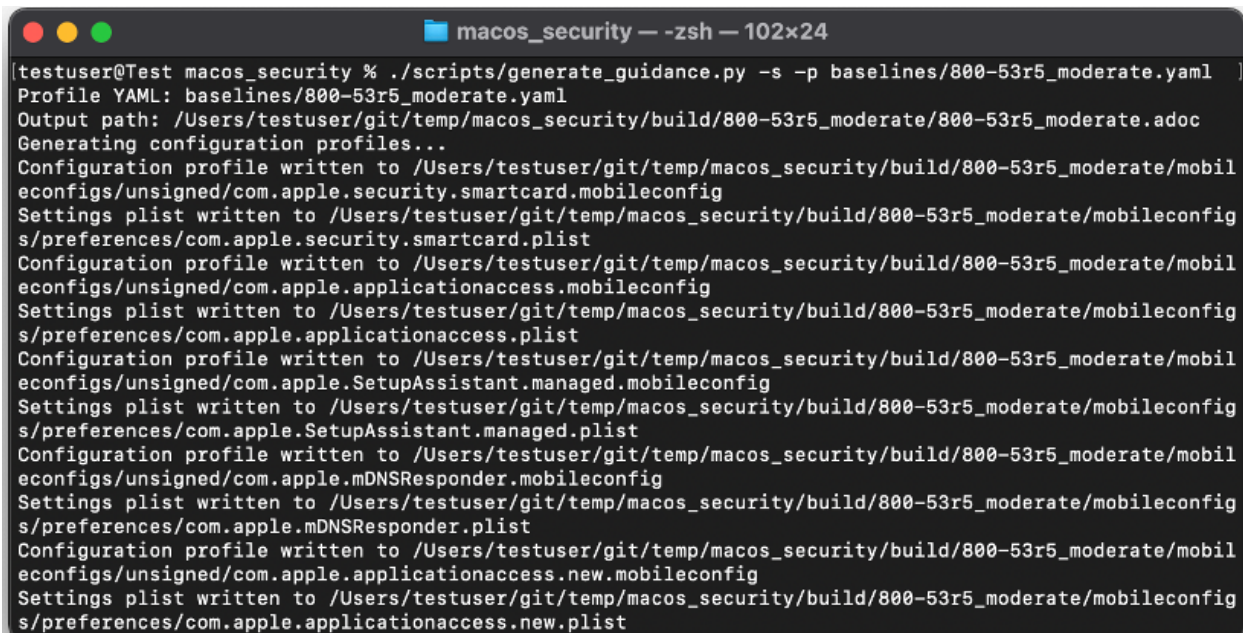


```
macos_security --zsh-- 96x24
[testuser@Test macos_security % git checkout big_sur
Branch 'big_sur' set up to track remote branch 'big_sur' from 'origin'.
Switched to a new branch 'big_sur'
[testuser@Test macos_security % ./scripts/generate_baseline.py -k 800-53r5_moderate
testuser@Test macos_security %
```

Fig. 6. Changing code branches and generating a baseline.

## Creating the macOS Security Compliance Tool and configuration profiles

Using the generate\_guidance.py script, create the macOS Security Compliance Tool and configuration profiles. The example below illustrates this, continuing from the previous example.

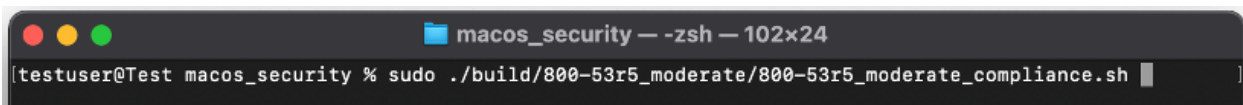


```
macos_security --zsh-- 102x24
[testuser@Test macos_security % ./scripts/generate_guidance.py -s -p baselines/800-53r5_moderate.yaml
Profile YAML: baselines/800-53r5_moderate.yaml
Output path: /Users/testuser/git/temp/macos_security/build/800-53r5_moderate/800-53r5_moderate.adoc
Generating configuration profiles...
Configuration profile written to /Users/testuser/git/temp/macos_security/build/800-53r5_moderate/mobileconfigs/unsigned/com.apple.security.smartcard.mobileconfig
Settings plist written to /Users/testuser/git/temp/macos_security/build/800-53r5_moderate/mobileconfigs/preferences/com.apple.security.smartcard.plist
Configuration profile written to /Users/testuser/git/temp/macos_security/build/800-53r5_moderate/mobileconfigs/unsigned/com.apple.applicationaccess.mobileconfig
Settings plist written to /Users/testuser/git/temp/macos_security/build/800-53r5_moderate/mobileconfigs/preferences/com.apple.applicationaccess.plist
Configuration profile written to /Users/testuser/git/temp/macos_security/build/800-53r5_moderate/mobileconfigs/unsigned/com.apple.SetupAssistant.managed.mobileconfig
Settings plist written to /Users/testuser/git/temp/macos_security/build/800-53r5_moderate/mobileconfigs/preferences/com.apple.SetupAssistant.managed.plist
Configuration profile written to /Users/testuser/git/temp/macos_security/build/800-53r5_moderate/mobileconfigs/unsigned/com.apple.mDNSResponder.mobileconfig
Settings plist written to /Users/testuser/git/temp/macos_security/build/800-53r5_moderate/mobileconfigs/preferences/com.apple.mDNSResponder.plist
Configuration profile written to /Users/testuser/git/temp/macos_security/build/800-53r5_moderate/mobileconfigs/unsigned/com.apple.applicationaccess.new.mobileconfig
Settings plist written to /Users/testuser/git/temp/macos_security/build/800-53r5_moderate/mobileconfigs/preferences/com.apple.applicationaccess.new.plist
```

Fig. 7. Generating the compliance checker script and configuration profiles.

## Running a compliance scan

As the example below shows, the macOS Security Compliance Tool is typically run with administrator privileges so that it can access all of the settings.



```
macos_security --zsh-- 102x24
[testuser@Test macos_security % sudo ./build/800-53r5_moderate/800-53r5_moderate_compliance.sh
```

Fig. 8. Running the compliance checker script.

The example below shows the main menu presented by the macOS Security Compliance Tool.

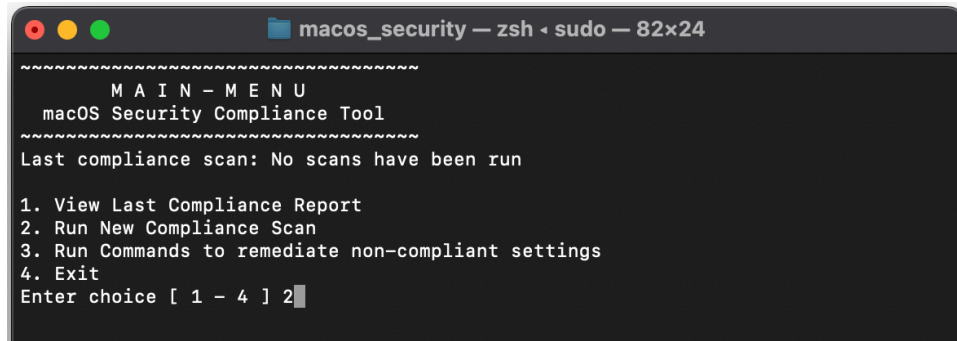
A terminal window titled 'macos\_security — zsh — sudo — 82x24' displays the main menu of the macOS Security Compliance Tool. The menu is titled 'MAIN - MENU' and 'macOS Security Compliance Tool'. It shows the last compliance scan status as 'No scans have been run'. The menu lists four options: 1. View Last Compliance Report, 2. Run New Compliance Scan, 3. Run Commands to remediate non-compliant settings, and 4. Exit. The prompt 'Enter choice [ 1 - 4 ]' is followed by the number '2'.

Fig. 9. Selecting “Run New Compliance Scan” from the main menu.

Selecting option 2, “Run New Compliance Scan,” from the main menu launches the scan. The example below shows output from the scan, which in this case reflects numerous rule failures, each indicating a deviation from the expected configuration.

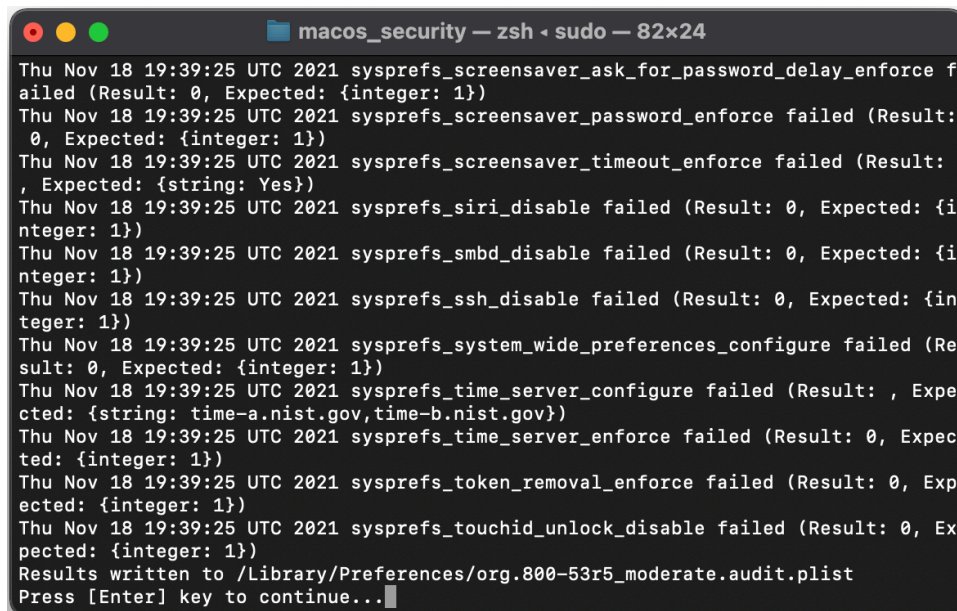
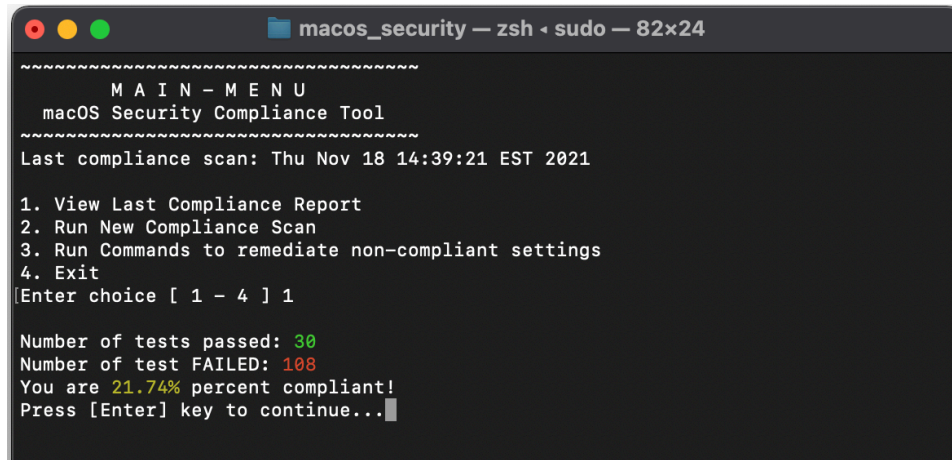
A terminal window titled 'macos\_security — zsh — sudo — 82x24' displays the output of a compliance scan. The output shows a list of failed rules with their results and expected values. The rules listed are: sysprefs\_screensaver\_ask\_for\_password\_delay\_enforce, sysprefs\_screensaver\_password\_enforce, sysprefs\_screensaver\_timeout\_enforce, sysprefs\_siri\_disable, sysprefs\_smbd\_disable, sysprefs\_ssh\_disable, sysprefs\_system\_wide\_preferences\_configure, sysprefs\_time\_server\_configure, sysprefs\_time\_server\_enforce, sysprefs\_token\_removal\_enforce, and sysprefs\_touchid\_unlock\_disable. The output concludes with 'Results written to /Library/Preferences/org.800-53r5\_moderate.audit.plist' and a prompt to press the Enter key to continue.

Fig. 10. Compliance scan output.



Selecting option 1, “View Last Compliance Report,” from the main menu displays a summary of the compliance report results. The example below depicts results indicating that 30 tests passed and 108 tests failed for an overall score of 21.74 % compliant.



```
macos_security — zsh — sudo — 82x24

MAIN - MENU
macOS Security Compliance Tool

Last compliance scan: Thu Nov 18 14:39:21 EST 2021

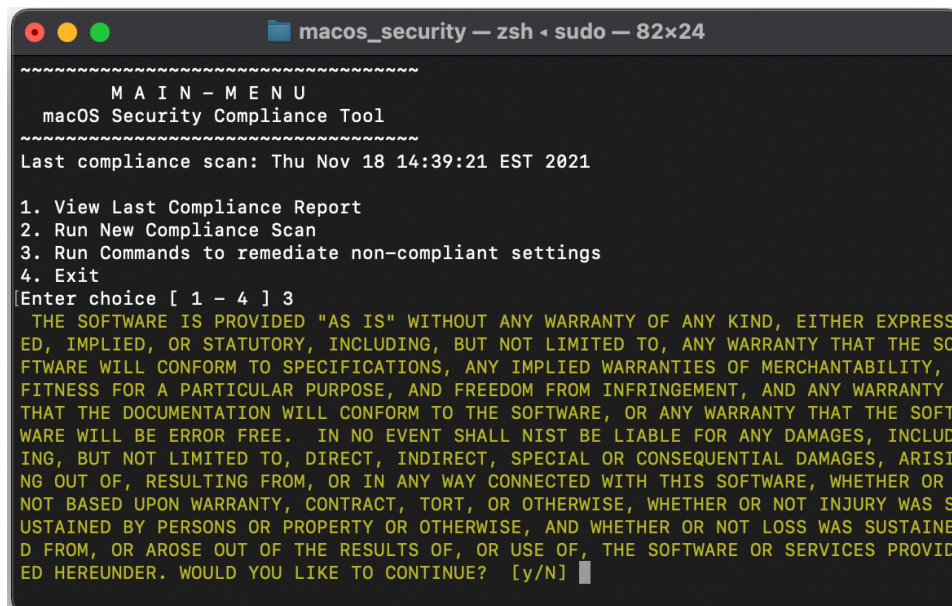
1. View Last Compliance Report
2. Run New Compliance Scan
3. Run Commands to remediate non-compliant settings
4. Exit
[Enter choice [ 1 - 4 ] 1

Number of tests passed: 30
Number of test FAILED: 108
You are 21.74% percent compliant!
Press [Enter] key to continue...
```

Fig. 11. Viewing a compliance report.

### Fixing non-compliant settings

Selecting option 3, “Run Commands to remediate non-compliant settings,” begins the process of fixing non-compliant settings discovered during a previous compliance scan. The example below illustrates the disclaimer to be reviewed and accepted before fixes are initiated. This disclaimer indicates the potential risk in applying fixes.



```
macos_security — zsh — sudo — 82x24

MAIN - MENU
macOS Security Compliance Tool

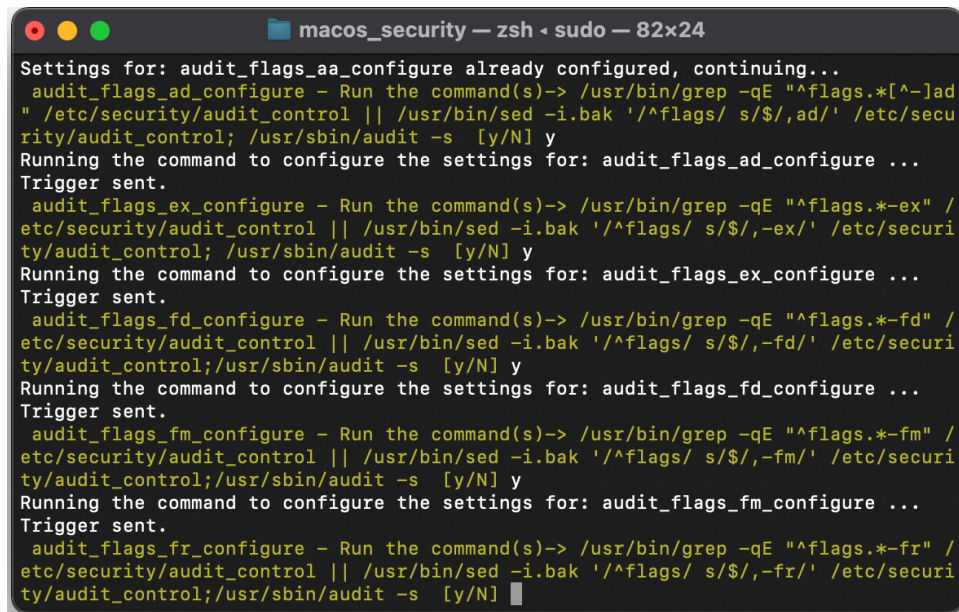
Last compliance scan: Thu Nov 18 14:39:21 EST 2021

1. View Last Compliance Report
2. Run New Compliance Scan
3. Run Commands to remediate non-compliant settings
4. Exit
[Enter choice [ 1 - 4 ] 3

THE SOFTWARE IS PROVIDED "AS IS" WITHOUT ANY WARRANTY OF ANY KIND, EITHER EXPRESS
ED, IMPLIED, OR STATUTORY, INCLUDING, BUT NOT LIMITED TO, ANY WARRANTY THAT THE SO
FTWARE WILL CONFORM TO SPECIFICATIONS, ANY IMPLIED WARRANTIES OF MERCHANTABILITY,
FITNESS FOR A PARTICULAR PURPOSE, AND FREEDOM FROM INFRINGEMENT, AND ANY WARRANTY
THAT THE DOCUMENTATION WILL CONFORM TO THE SOFTWARE, OR ANY WARRANTY THAT THE SOFT
WARE WILL BE ERROR FREE. IN NO EVENT SHALL NIST BE LIABLE FOR ANY DAMAGES, INCLUD
ING, BUT NOT LIMITED TO, DIRECT, INDIRECT, SPECIAL OR CONSEQUENTIAL DAMAGES, ARISI
NG OUT OF, RESULTING FROM, OR IN ANY WAY CONNECTED WITH THIS SOFTWARE, WHETHER OR
NOT BASED UPON WARRANTY, CONTRACT, TORT, OR OTHERWISE, WHETHER OR NOT INJURY WAS S
USTAINED BY PERSONS OR PROPERTY OR OTHERWISE, AND WHETHER OR NOT LOSS WAS SUSTAIN
ED FROM, OR AROSE OUT OF THE RESULTS OF, OR USE OF, THE SOFTWARE OR SERVICES PROVID
ED HEREUNDER. WOULD YOU LIKE TO CONTINUE? [y/N]
```

Fig. 12. Disclaimer for non-compliant settings remediation.

After the disclaimer statement is accepted, the fixes are applied to the system, as the example below illustrates.

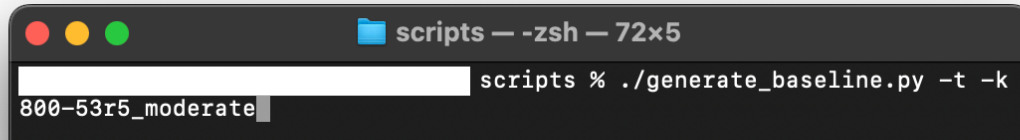


```
macos_security - zsh - sudo - 82x24
Settings for: audit_flags_aa_configure already configured, continuing...
audit_flags_ad_configure - Run the command(s)-> /usr/bin/grep -qE "^flags.*[-]ad" /etc/security/audit_control || /usr/bin/sed -i.bak '/^flags/ s$/,-ad/' /etc/security/audit_control; /usr/sbin/audit -s [y/N] y
Running the command to configure the settings for: audit_flags_ad_configure ...
Trigger sent.
audit_flags_ex_configure - Run the command(s)-> /usr/bin/grep -qE "^flags.*-ex" /etc/security/audit_control || /usr/bin/sed -i.bak '/^flags/ s$/,-ex/' /etc/security/audit_control; /usr/sbin/audit -s [y/N] y
Running the command to configure the settings for: audit_flags_ex_configure ...
Trigger sent.
audit_flags_fd_configure - Run the command(s)-> /usr/bin/grep -qE "^flags.*-fd" /etc/security/audit_control || /usr/bin/sed -i.bak '/^flags/ s$/,-fd/' /etc/security/audit_control; /usr/sbin/audit -s [y/N] y
Running the command to configure the settings for: audit_flags_fd_configure ...
Trigger sent.
audit_flags_fm_configure - Run the command(s)-> /usr/bin/grep -qE "^flags.*-fm" /etc/security/audit_control || /usr/bin/sed -i.bak '/^flags/ s$/,-fm/' /etc/security/audit_control; /usr/sbin/audit -s [y/N] y
Running the command to configure the settings for: audit_flags_fm_configure ...
Trigger sent.
audit_flags_fr_configure - Run the command(s)-> /usr/bin/grep -qE "^flags.*-fr" /etc/security/audit_control || /usr/bin/sed -i.bak '/^flags/ s$/,-fr/' /etc/security/audit_control; /usr/sbin/audit -s [y/N] y
```

Fig. 13. Interactively configuring settings.

## Appendix C. Example of Creating a Benchmark Using ODVs

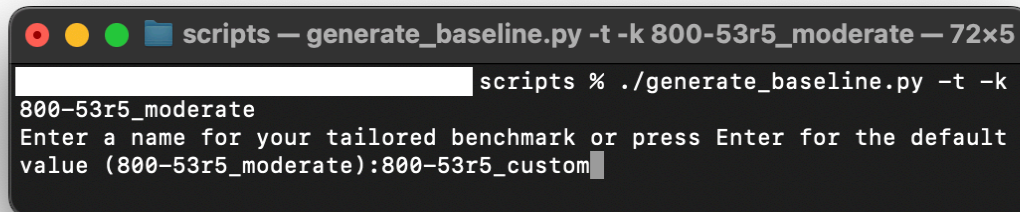
This appendix provides an example of tailoring a baseline to create a custom benchmark using the `generate_baseline.py` script. The screenshot below illustrates the first step to creating a benchmark.



```
scripts — -zsh — 72x5
scripts % ./generate_baseline.py -t -k 800-53r5_moderate
```

Fig. 14. Generate baseline command.

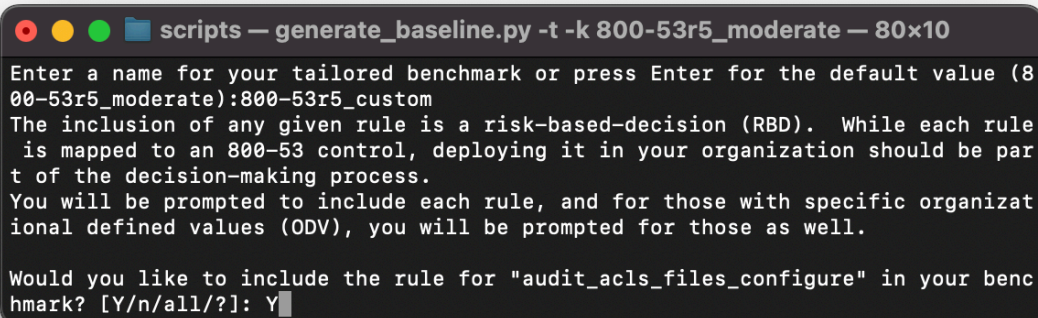
The `-t` option for `generate_baseline.py` is used to customize the specified baseline. The script prompts for a name for the benchmark being created, as the example below shows.



```
scripts — generate_baseline.py -t -k 800-53r5_moderate — 72x5
scripts % ./generate_baseline.py -t -k 800-53r5_moderate
Enter a name for your tailored benchmark or press Enter for the default value (800-53r5_moderate):800-53r5_custom
```

Fig. 15. Prompt for benchmark name.

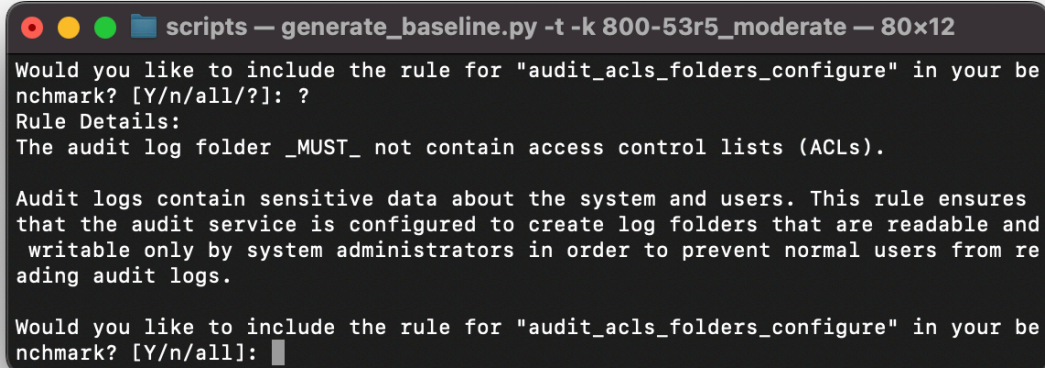
Next, for each rule that exists in the specified starting baseline, the script asks if it should be included in the custom benchmark. An example is shown below.



```
scripts — generate_baseline.py -t -k 800-53r5_moderate — 80x10
Enter a name for your tailored benchmark or press Enter for the default value (800-53r5_moderate):800-53r5_custom
The inclusion of any given rule is a risk-based-decision (RBD). While each rule is mapped to an 800-53 control, deploying it in your organization should be part of the decision-making process.
You will be prompted to include each rule, and for those with specific organizational defined values (ODV), you will be prompted for those as well.
Would you like to include the rule for "audit_acls_files_configure" in your benchmark? [Y/n/all/?]: Y
```

Fig. 16. Prompt for rule file inclusion.

816 Entering a “?” in response to a rule being included will display a description of that rule, as  
817 illustrated below.



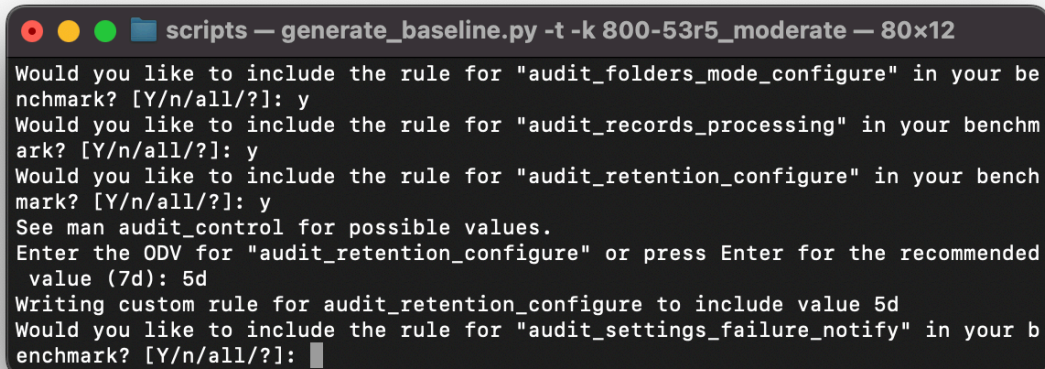
```
scripts — generate_baseline.py -t -k 800-53r5_moderate — 80x12
Would you like to include the rule for "audit_acls_folders_configure" in your benchmark? [Y/n/all/?]: ?
Rule Details:
The audit log folder _MUST_ not contain access control lists (ACLs).

Audit logs contain sensitive data about the system and users. This rule ensures that the audit service is configured to create log folders that are readable and writable only by system administrators in order to prevent normal users from reading audit logs.

Would you like to include the rule for "audit_acls_folders_configure" in your benchmark? [Y/n/all]:
```

818  
819 Fig. 17. Display rule description.

820  
821 If a rule accepts an ODV, the script asks the user to enter their own value or use the default value  
822 displayed. The example below illustrates this.



```
scripts — generate_baseline.py -t -k 800-53r5_moderate — 80x12
Would you like to include the rule for "audit_folders_mode_configure" in your benchmark? [Y/n/all/?]: y
Would you like to include the rule for "audit_records_processing" in your benchmark? [Y/n/all/?]: y
Would you like to include the rule for "audit_retention_configure" in your benchmark? [Y/n/all/?]: y
See man audit_control for possible values.
Enter the ODV for "audit_retention_configure" or press Enter for the recommended value (7d): 5d
Writing custom rule for audit_retention_configure to include value 5d
Would you like to include the rule for "audit_settings_failure_notify" in your benchmark? [Y/n/all/?]:
```

823  
824 Fig. 18. Rule prompting for an ODV.

825



## Appendix D. Example of mSCP Usage by an Assessment Tool Vendor

This appendix provides an example of how an assessment tool vendor converted mSCP content to their tool's proprietary format so that their tool could perform compliance checks against mSCP baselines and rules. Refer to the mSCP [GitHub wiki](#) page for the most current list of tool vendors and associated content that will support the mSCP baselines.

This example is for Tenable, Inc. They automated the conversion of mSCP YAML rules into their .audit format using Python and YAML libraries. Programmatically approaching this conversion allows for faster future releases and greater consistency, and it also maintains the integrity of the source content. Because the YAML content is all command-driven, it is converted to Tenable's CMD\_EXEC check type for use with the Unix plugin. The YAML rules have a "tags" section that was used to create unique audit profiles related to common frameworks. An example of these profiles can be seen in the audit file naming convention:

- NIST\_macOS\_Big\_Sur\_800-171\_v1.4.0.audit
- NIST\_macOS\_Catalina\_800-53r5\_high\_v1.5.0.audit

See [Tenable's research highlight](#) for more details.

The following example shows a YAML-to-audit-check conversion. The content has been condensed and abbreviated for the purposes of comparison:

### mSCP YAML

```
title: "Limit SSHD to FIPS 140 Validated Ciphers"
discussion: |
  If SSHD is enabled, then it _MUST_ be configured to limit the ciphers to
  algorithms that are FIPS 140-validated.
  FIPS 140-2 is the current standard for validating that mechanisms used to
  access cryptographic modules utilize authentication that meets federal
  requirements.
  Operating systems utilizing encryption _MUST_ use FIPS-validated mechanisms
  for authenticating to cryptographic modules.
  NOTE: /etc/ssh/sshd_config will be automatically modified to its original
  state following any update or major upgrade to the operating system.
check: |
  /usr/bin/grep -c "^Ciphers aes256-ctr,aes192-ctr,aes128-ctr"
  /etc/ssh/sshd_config
result:
  integer: 1
```

### Tenable Audit Check

```
<custom_item>
  system      : "Darwin"
  type        : CMD_EXEC
  description : "Big Sur - Limit SSHD to FIPS 140 Validated Ciphers"
  info        : "If SSHD is enabled, then it _MUST_ be configured to limit
the ciphers to algorithms that are FIPS 140-validated.
FIPS 140-2 is the current standard for validating that mechanisms used to
access cryptographic modules utilize authentication that meets federal
requirements."
```

```
874 operating systems utilizing encryption _MUST_ use FIPS-validated mechanisms
875 for authenticating to cryptographic modules.
876 NOTE: /etc/ssh/sshd_config will be automatically modified to its original
877 state following any update or major upgrade to the operating system."
878 cmd      : "/usr/bin/grep -c \"^Ciphers aes256-ctr,aes192-ctr,aes128-
879 ctr\" /etc/ssh/sshd_config"
880 expect   : "1"
881 </custom_item>
```

## **Appendix E. List of Symbols, Abbreviations, and Acronyms**

Selected acronyms and abbreviations used in this paper are defined below.

**CCE**

Common Configuration Enumeration

**CIS**

Center for Internet Security

**CNSS**

Committee on National Security Systems

**CNSSI**

Committee on National Security Systems Instruction

**DISA**

Defense Information Systems Agency

**FIPS**

Federal Information Processing Standards

**LANL**

Los Alamos National Laboratory

**mSCP**

macOS Security Compliance Project

**NASA**

National Aeronautics and Space Administration

**NIST**

National Institute of Standards and Technology

**ODV**

Organization-Defined Value

**OVAL**

Open Vulnerability and Assessment Language

**SCAP**

Security Content Automation Protocol

**SP**

Special Publication

**STIG**

Security Technical Implementation Guide

**XCCDF**

Extensible Configuration Checklist Description Format

**YAML**

Yet Another Markup Language

## Appendix F. Change Log

In March 2023, the following changes were made to this report:

- Made minor editorial changes throughout the report to improve clarity and usability
- Reformatted all content and revised front matter to follow the latest NIST technical report template
- Merged the content of the Executive Summary into Section 1 and deleted the Executive Summary section
- Section 1.1 – Summarized updates from the previous release
- Section 3.1 – Added a new subsection to define and discuss baselines and benchmarks
- Section 3.2.1 – Updated descriptions to match the project wiki and changed the example rule file to one with an ODV
- Section 3.4.4 – Changed from OVAL generation script to SCAP generation script
- Section 3.5 – Added discussion on tailoring baselines and benchmarks using the generate\_baseline.py script and ODVs
- Appendix C – Created a new appendix showing an example of how to tailor a baseline to create a custom benchmark