NIST SPECIAL PUBLICATION 1800-34C

Validating the Integrity of Computing Devices

Volume C:
How-To Guides

Tyler Diamond*
Nakia Grayson
William T. Polk
Andrew Regenscheid
Murugiah Souppaya
National Institute of Standards and Technology
Information Technology Laboratory

Christopher Brown
Chelsea Deane
The MITRE Corporation
McLean, Virginia

Karen Scarfone
Scarfone Cybersecurity
Clifton, Virginia

**Former employee; all work for this publication was done while at employer*

June 2022

DRAFT

This publication is available free of charge from
https://www.nccoe.nist.gov/projects/building-blocks/supply-chain-assurance

DISCLAIMER

Certain commercial entities, equipment, products, or materials may be identified by name or company logo or other insignia in order to acknowledge their participation in this collaboration or to describe an experimental procedure or concept adequately. Such identification is not intended to imply special status or relationship with NIST or recommendation or endorsement by NIST or NCCoE; neither is it intended to imply that the entities, equipment, products, or materials are necessarily the best available for the purpose.

While NIST and the NCCoE address goals of improving management of cybersecurity and privacy risk through outreach and application of standards and best practices, it is the stakeholder's responsibility to fully perform a risk assessment to include the current threat, vulnerabilities, likelihood of a compromise, and the impact should the threat be realized before adopting cybersecurity measures such as this recommendation.

National Institute of Standards and Technology Special Publication 1800-34C, Natl. Inst. Stand. Technol. Spec. Publ. 1800-34C, 141 pages, (June 2022), CODEN: NSPUE2

FEEDBACK

You can improve this guide by contributing feedback. As you review and adopt this solution for your own organization, we ask you and your colleagues to share your experience and advice with us.

Comments on this publication may be submitted to: supplychain-nccoe@nist.gov.

Public comment period: June 23, 2022 through July 27, 2022

As a private-public partnership, we are always seeking feedback on our practice guides. We are particularly interested in seeing how businesses apply NCCoE reference designs in the real world. If you have implemented the reference design, or have questions about applying it in your environment, please email us at supplychain-nccoe@nist.gov.

All comments are subject to release under the Freedom of Information Act.

National Cybersecurity Center of Excellence
National Institute of Standards and Technology
100 Bureau Drive
Mailstop 2002
Gaithersburg, MD 20899
Email: nccoe@nist.gov

NATIONAL CYBERSECURITY CENTER OF EXCELLENCE

The National Cybersecurity Center of Excellence (NCCoE), a part of the National Institute of Standards and Technology (NIST), is a collaborative hub where industry organizations, government agencies, and academic institutions work together to address businesses' most pressing cybersecurity issues. This public-private partnership enables the creation of practical cybersecurity solutions for specific industries, as well as for broad, cross-sector technology challenges. Through consortia under Cooperative Research and Development Agreements (CRADAs), including technology partners—from Fortune 50 market leaders to smaller companies specializing in information technology security—the NCCoE applies standards and best practices to develop modular, adaptable example cybersecurity solutions using commercially available technology. The NCCoE documents these example solutions in the NIST Special Publication 1800 series, which maps capabilities to the NIST Cybersecurity Framework and details the steps needed for another entity to re-create the example solution. The NCCoE was established in 2012 by NIST in partnership with the State of Maryland and Montgomery County, Maryland.

To learn more about the NCCoE, visit https://www.nccoe.nist.gov/. To learn more about NIST, visit https://www.nist.gov.

NIST CYBERSECURITY PRACTICE GUIDES

NIST Cybersecurity Practice Guides (Special Publication 1800 series) target specific cybersecurity challenges in the public and private sectors. They are practical, user-friendly guides that facilitate the adoption of standards-based approaches to cybersecurity. They show members of the information security community how to implement example solutions that help them align with relevant standards and best practices, and provide users with the materials lists, configuration files, and other information they need to implement a similar approach.

The documents in this series describe example implementations of cybersecurity practices that businesses and other organizations may voluntarily adopt. These documents do not describe regulations or mandatory practices, nor do they carry statutory authority.

ABSTRACT

Organizations are increasingly at risk of cyber supply chain compromise, whether intentional or unintentional. Cyber supply chain risks include counterfeiting, unauthorized production, tampering, theft, and insertion of unexpected software and hardware. Managing these risks requires ensuring the integrity of the cyber supply chain and its products and services. This project will demonstrate how organizations can verify that the internal components of the computing devices they acquire, whether laptops or servers, are genuine and have not been tampered with. This solution relies on device vendors storing information within each device, and organizations using a combination of commercial off-the-shelf and open-source tools that work together to validate the stored information. This NIST Cybersecurity Practice Guide provides a draft describing the work performed so far to build and test the full solution.

KEYWORDS

computing devices; cyber supply chain; cyber supply chain risk management (C-SCRM); hardware root of trust; integrity; provenance; supply chain; tampering.

ACKNOWLEDGMENTS

We are grateful to the following individuals for their generous contributions of expertise and time.

Name	Organization
Charles Robison	Dell Technologies
Mukund Khatri	Dell Technologies
Rick Martinez	Dell Technologies
Daniel Carroll	Dell Technologies
Jason Young	Dell Technologies
Travis Raines	Eclypsium
John Loucaides	Eclypsium
Jason Cohen	Hewlett Packard Enterprise
CJ Coppersmith	Hewlett Packard Enterprise
Ludovic Jacquin	Hewlett Packard Enterprise
Boris Balacheff	HP Inc.
Jeff Jeansonne	HP Inc.
Joshua Schiffman	HP Inc.
Harmeet Singh	IBM
Tom Dodson	Intel
Jason Ajmo	The MITRE Corporation
Chelsea Deane	The MITRE Corporation

Name	Organization
Spike E. Dog	The MITRE Corporation
Joe Sain	The MITRE Corporation
Thomas Walters	The MITRE Corporation
Andrew Medak	National Security Agency (NSA)
Lawrence Reinert	NSA
Themistocles Chronis	Archer
Dan Carayiannis	Archer
Manuel Offenberg	Seagate
David Kaiser	Seagate
Paul Gatten	Seagate
Simon Phatigaraphong	Seagate
Bill Downer	Seagate Government Solutions
Jack Fabian	Seagate Government Solutions

The Technology Partners/Collaborators who participated in this build submitted their capabilities in response to a notice in the Federal Register. Respondents with relevant capabilities or product components were invited to sign a Cooperative Research and Development Agreement (CRADA) with NIST, allowing them to participate in a consortium to build this example solution. We worked with:

Technology Partner/Collaborator	Build Involvement
Archer	Archer Suite 6.9
Dell Technologies	PowerEdge R650, Secured Component Verification tool; Precision 3530, CSG Secured Component Verification tool
Eclypsium	Eclypsium Analytics Service, Eclypsium Device Scanner

Technology Partner/Collaborator	Build Involvement
HP Inc.	(2) Elitebook 840 G7, HP Sure Start, HP Sure Recover, Sure Admin, HP Client Management Script Library (CMSL), HP Tamperlock
Hewlett Packard Enterprise	Proliant DL360 Gen 10, Platform Certificate Verification Tool (PCVT)
IBM	QRadar SIEM
Intel	HP Inc. Elitebook 360 830 G5, Lenovo ThinkPad T480, Transparent Supply Chain Tools, Key Generation Facility, Cloud Based Storage, TSCVerify and AutoVerify software tools
National Security Agency (NSA)	Host Integrity at Runtime and Start-Up (HIRS), Subject Matter Expertise
Seagate Government Solutions	(3) 18TB Exos X18 hard drives, 2U12 Enclosure, Firmware Attestation API, Secure Device Authentication API

DOCUMENT CONVENTIONS

The terms “shall” and “shall not” indicate requirements to be followed strictly to conform to the publication and from which no deviation is permitted. The terms “should” and “should not” indicate that among several possibilities, one is recommended as particularly suitable without mentioning or excluding others, or that a certain course of action is preferred but not necessarily required, or that (in the negative form) a certain possibility or course of action is discouraged but not prohibited. The terms “may” and “need not” indicate a course of action permissible within the limits of the publication. The terms “can” and “cannot” indicate a possibility and capability, whether material, physical, or causal.

CALL FOR PATENT CLAIMS

This public review includes a call for information on essential patent claims (claims whose use would be required for compliance with the guidance or requirements in this Information Technology Laboratory (ITL) draft publication). Such guidance and/or requirements may be directly stated in this ITL Publication or by reference to another publication. This call also includes disclosure, where known, of the existence of pending U.S. or foreign patent applications relating to this ITL draft publication and of any relevant unexpired U.S. or foreign patents.

ITL may require from the patent holder, or a party authorized to make assurances on its behalf, in written or electronic form, either:

a) assurance in the form of a general disclaimer to the effect that such party does not hold and does not currently intend holding any essential patent claim(s); or

b) assurance that a license to such essential patent claim(s) will be made available to applicants desiring to utilize the license for the purpose of complying with the guidance or requirements in this ITL draft publication either:

1. under reasonable terms and conditions that are demonstrably free of any unfair discrimination; or
2. without compensation and under reasonable terms and conditions that are demonstrably free of any unfair discrimination.

Such assurance shall indicate that the patent holder (or third party authorized to make assurances on its behalf) will include in any documents transferring ownership of patents subject to the assurance, provisions sufficient to ensure that the commitments in the assurance are binding on the transferee, and that the transferee will similarly include appropriate provisions in the event of future transfers with the goal of binding each successor-in-interest.

The assurance shall also indicate that it is intended to be binding on successors-in-interest regardless of whether such provisions are included in the relevant transfer documents.

Such statements should be addressed to: supplychain-nccoe@nist.gov.

Contents

List of Figures

List of Tables

1 Introduction

The following volumes of this guide show information technology (IT) professionals and security engineers how we implemented this example solution. We cover all of the products employed in this reference design. We do not re-create the product manufacturers' documentation, which is presumed to be widely available. Rather, these volumes show how we incorporated the products together in our environment.

Note: These are not comprehensive tutorials. There are many possible service and security configurations for these products that are out of scope for this reference design.

1.1 How to Use This Guide

This National Institute of Standards and Technology (NIST) Cybersecurity Practice Guide demonstrates a standards-based reference design and provides users with the information they need to replicate verifying that the internal components of the computing devices they acquire are genuine and have not been tampered with. This reference design is modular and can be deployed in whole or in part.

This guide contains three volumes:

- NIST Special Publication (SP) 1800-34A: *Executive Summary*
- NIST SP 1800-34B*: Approach, Architecture, and Security Characteristics* – what we built and why
- NIST SP 1800-34C: *How-To Guides* – instructions for building the example solution **(you are here)**

Depending on your role in your organization, you might use this guide in different ways:

Business decision makers, including chief security and technology officers, will be interested in the *Executive Summary, NIST SP 1800-34A*, which describes the following topics:

- challenges that enterprises face in decreasing the risk of a compromise to products in their supply chain
- example solution built at the NCCoE
- benefits of adopting the example solution

Technology or security program managers who are concerned with how to identify, understand, assess, and mitigate risk will be interested in *NIST SP 1800-34B*, which describes what we did and why. The following sections will be of particular interest:

- Section 3.4, Risk, describes the risk analysis we performed.
- Section 3.5, Security Control Map, maps the security characteristics of this example solution to cybersecurity standards and best practices.

You might share the *Executive Summary, NIST SP 1800-34A*, with your leadership team members to help them understand the importance of adopting a standards-based solution for verifying that the internal components of the computing devices they acquire are genuine and have not been tampered with.

IT professionals who want to implement an approach like this will find this whole practice guide useful. You can use this How-To portion of the guide, *NIST SP 1800-34C*, to replicate all or parts of the build created in our lab. This How-To portion of the guide provides specific product installation, configuration, and integration instructions for implementing the example solution.

This guide assumes that IT professionals have experience implementing security products within the enterprise. While we have used a suite of commercial products to address this challenge, this guide does not endorse these particular products. Your organization can adopt this solution or one that adheres to these guidelines in whole, or you can use this guide as a starting point for tailoring and implementing parts of verifying that the internal components of the computing devices they acquire are genuine and have not been tampered with. Your organization's security experts should identify the products that will best integrate with your existing tools and IT system infrastructure. We hope that you will seek products that are congruent with applicable standards and best practices. Section 3.6, Technologies, of *NIST SP 1800-34B* lists the products that we used and maps them to the cybersecurity controls provided by this reference solution.

A NIST Cybersecurity Practice Guide does not describe "the" solution, but a possible solution. This is a draft guide. We seek feedback on its contents and welcome your input. Comments, suggestions, and success stories will improve subsequent versions of this guide. Please contribute your thoughts to supplychain-nccoe@nist.gov.

1.1.1 Supplemental Material

Throughout this draft there are references to code, scripts, and/or configuration files. Due to the size of some of the files, and to provide a more efficient method of access, we have made these assets available via a NIST GitHub repository. This will also enable quicker updates of published code to those interested in replicating parts or all of our demonstration.

1.2 Build Overview

In a previous draft of Volume C, we described the steps necessary to set up an environment that focuses on laptop (sometimes referred to by industry as *client*) computing devices. It also provided guidance on the operational usage of manufacturers' tools that may be useful to your IT personnel who verify that the computing device is acceptable to receive into the acquiring organization. In this draft of Volume C, we incorporate validating the integrity of servers and include additional enterprise services as required to support this capability.

1.3 Typographic Conventions

The following table presents typographic conventions used in this volume.

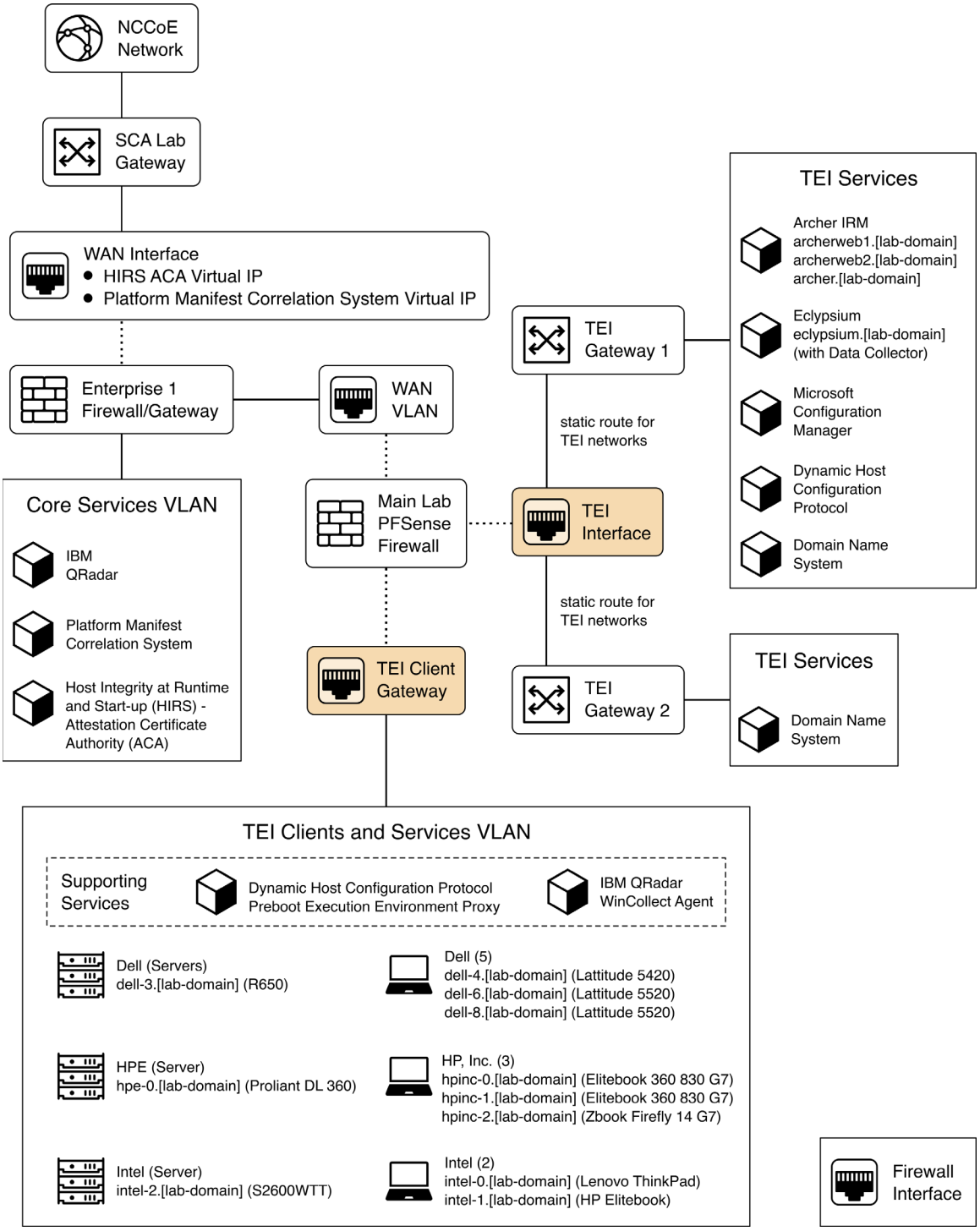
Typeface/Symbol	Meaning	Example
Italics	file names and path names; references to documents that are not hyperlinks; new terms; and placeholders	For language use and style guidance, see the *NCCoE Style Guide*.
Bold	names of menus, options, command buttons, and fields	Choose **File** > **Edit.**
`Monospace`	command-line input, onscreen computer output, sample code examples, and status codes	`mkdir`
`Monospace Bold`	command-line user input contrasted with computer output	**`service sshd start`**
blue text	link to other parts of the document, a web URL, or an email address	All publications from NIST's NCCoE are available at https://www.nccoe.nist.gov.

1.4 Logical Architecture Summary

Figure 1-1 depicts the architecture for the prototype demonstration environment used within the NCCoE network boundaries. The environment uses a combination of physical and virtual systems to emulate an enterprise architecture. We recommend the reader start with Volume B, Section 4 of this publication for a component-level view of the completed architecture before implementing the systems in this section.

Common enterprise services, such as Active Directory (AD) and Domain Name System (DNS), are provided by NCCoE's Trusted Enterprise Infrastructure (TEI). TEI provides common services that labs can use. Previously each lab would spend time and resources to set up common services at the beginning of each project and tear them down after the end of the project. To provide efficiency and consistency across projects, and to represent a true enterprise infrastructure, NCCoE has initiated the TEI effort, which offers common services such as core services and shared security services for those labs who would like to use them.

271 **Figure 1-1 Demonstration Network Architecture**



Services specific to the capabilities of this prototype demonstration are instantiated on the Core Services virtual network. This virtual network represents the integration of supply chain risk management (SCRM) requirements into an enterprise architecture to support the SCRM controls, as described in the Risk Assessment section of Volume B.

2 Product Installation Guides

This section of the practice guide contains detailed instructions for installing and configuring all of the products used to build an instance of the example solution.

2.1 Supporting Systems and Infrastructure

This section describes the supporting infrastructure required to execute the acceptance testing and continuous monitoring capabilities provided by our collaborators.

2.1.1 Network Boot Services

The following procedures will create an environment that will enable the acceptance testing of computing devices into an enterprise. First, we create CentOS 7, CentOS 8, and WinPE images that will be booted on computing devices via a Preboot Execution Environment (PXE). We then configure the PXE environment to boot the images.

2.1.1.1 Linux-Based Acceptance Testing Image Creation

On a development CentOS 7 system, install the latest version of the Host Integrity at Runtime and Start-Up (HIRS) Trusted Platform Module (TPM) Provisioner. We'll use the system as a basis to create the network booted image. Note that there are a number of dependencies that you'll need to satisfy before installing the HIRS TPM Provisioner package. One of those dependencies, PACCOR, is maintained by the HIRS project. In our prototype demonstration, we used version 1.1.4 revision 5 but recommend using the latest version available. Note that any version prior to revision 5 will not successfully complete the provisioning process with the laptop computing devices used in this demonstration.

2.1.1.1.1 HIRS TPM Provisioner Configuration

The HIRS TPM provisioner is the core application in the computing device acceptance testing process. The system running the provisioner must be configured for your local environment before use.

1. Use a text editor to configure the HIRS TPM Provisioner for your local environment.

```
$ [your favorite editor] /etc/hirs/hirs-site.config
```

2. Change the variables noted below and save the file.

```
#########################################
#* HIRS site configuration properties file
#########################################
```

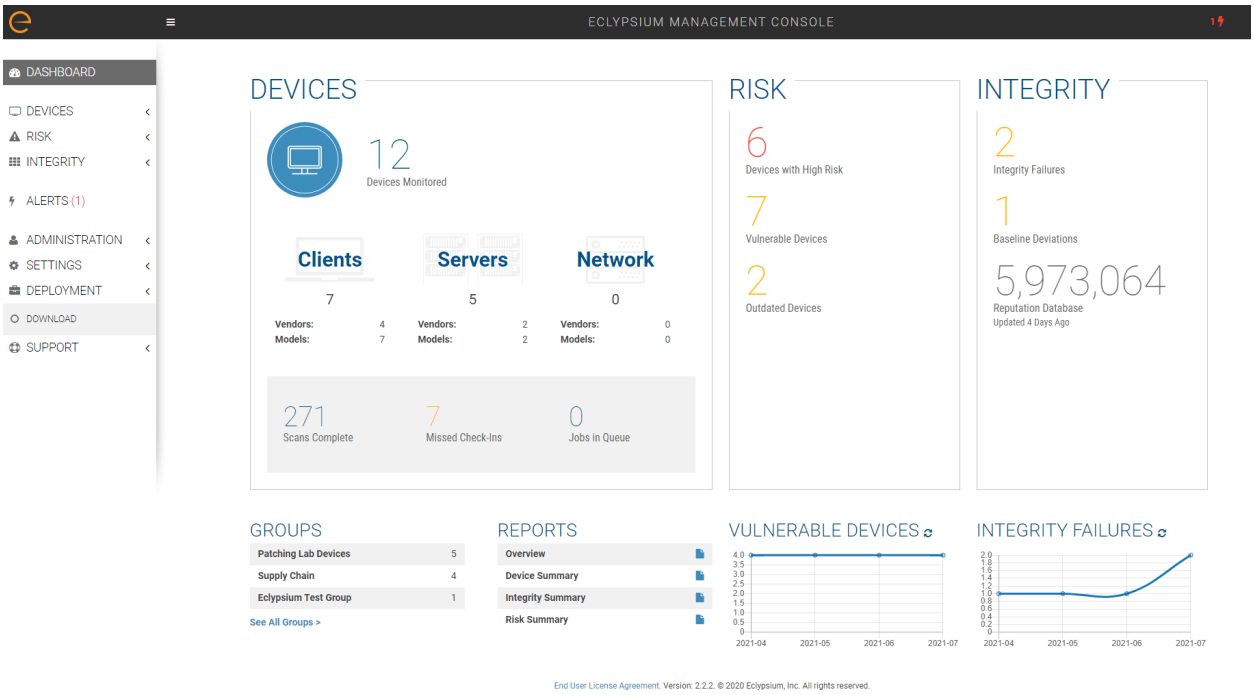
```
# Client configuration
CLIENT_HOSTNAME=localhost
TPM_ENABLED=true
IMA_ENABLED=false

# Site-specific configuration
ATTESTATION_CA_FQDN=hirs-server.yourdomain.test
ATTESTATION_CA_PORT=8443
BROKER_FQDN=hirs-server.yourdomain.test
# Change this port number to your local configuration
BROKER_PORT=61616
PORTAL_FQDN=hirs-server.yourdomain.test
# Change this port number to your local configuration
PORTAL_PORT=8443
```

3. If using a network boot environment, use the configuration file (step 2) in the kickstart file that creates the CentOS 7 provisioner image in the `%post` section.

2.1.1.1.2 Eclypsium Agent Configuration

On the same CentOS 7 system described in Section 2.1.1.1.1, install the Eclypsium Linux agent using the following procedures.

1. Navigate to the **Eclypsium Management Console** in a web browser.



2. Select **Deployment > Download.**

3. Download the Linux (RPM) Portable Scanner. The filename will have the format `eclypsium_agent_builder-x.x.x.run`.
4. Install the prerequisites for the builder script.

```
# yum groupinstall "Development Tools"
# yum install kernel-devel
```

5. Run the builder script downloaded above as a user with root privileges. This will build the Eclypsium Portable Scanner drivers, extract the application binaries, and place them into a directory named `eclypsium_agent`.

```
# ./eclypsium_agent_builder-X.X.X.run –out [PATH]
```

6. Confirm the previous step was successful by listing the `eclypsium_agent` directory and ensuring the portable scanner was created with the name `EclypsiumAppPortable`. This executable is referenced by our customized acceptance testing script.

2.1.1.1.3 CentOS 7 Image Creation

The CentOS 7 image we created enables quick revisions and simultaneous measurements on our devices. The image runs the required kernel, configures the system for reaching our infrastructure, and includes vendor tools to perform platform measurements. In order to generate the CentOS 7 image, the livecd-creator tool is utilized on a separate CentOS 7-based system. This tool uses Anaconda, Kickstart, and Lorax to generate the image. The following steps are performed:

7. Install the latest *livecd-tools* package, preferably built directly from the project GitHub repository.
8. Create your own kickstart file or use the kickstart that will be provided by this project as a basis for your own. In our kickstart, we will insert commands to install required dependencies of our vendor products. Your environment will require further configuration to include networking, host file modification, and user management. You will also need to adjust hostnames and IP addresses to fit your environment.
9. Some tools, such as required drivers, were installed into a local repository (repo) on the image generating system using the `createrepo` command. This repo can be accessed by kickstart during the image generation. Copy *HIRS_Provisioner_TPM_2_0-X.X.X.x86_64.rpm* and *paccor-X.X.X-X.noarch.rpm* into the newly created repository.

```
$ createrepo -u file:///sca-packages sca-packages
```

10. Generate the ISO image from the kickstart file.

```
$ livecd-creator --config=kickstart-filename.ks
```

11. The ISO file will be created in the local directory with a filename indicating the time of generation. Once this is done, the *pxeboot* directory can be generated:

```
$ livecd-iso-to-pxeboot imagename.iso
```

12. The *pxeboot* directory will be created, containing the required *vmlinuz* and *initrd0.img* files. It will also create a directory named *pxelinux.cfg* which contains a file named *default*. *default* contains the kernel flags necessary to boot the image. Use these files in the PXE environment detailed in Section 2.1.1.3.

2.1.1.1.4 CentOS 8 Image Creation

Before continuing with CentOS 8 image creation, create the prerequisite files in Section 2.6. This set of procedures creates an acceptance testing environment similar to what is described in Section 2.1.1.1.3 with the following deviations:

13. In Step 2, retrieve the CentOS 8 kickstart file *(Integration-Scripts\Acceptance Testing Environment Build Scripts\HPE PCVT - Centos8\HPE - Centos8.ks)* from the project repository.

14. In Step 3, retrieve the latest version of the Java 11 Java Development Kit (JDK). This demonstration uses Azul Zulu build, but other builds may also work. Additionally, create a folder named `HPE Tooling` in your working directory. Copy the provisioning scripts *(Integration-Scripts\Manufacturer-specific Scripts and Tools\HPE Tooling)* from our repository into the directory as well as the HPE Platform Certificate Verification Tool (PCVT) binaries built in Section 2.6.

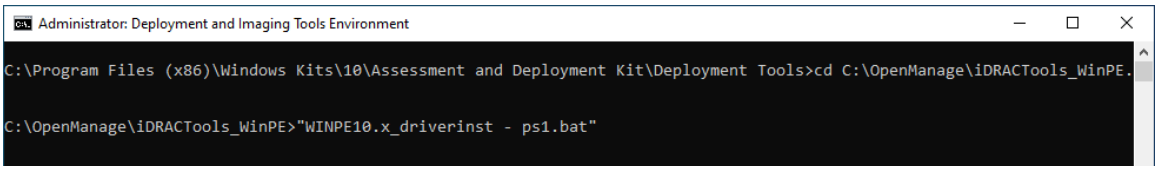
15. Complete the remaining steps as documented.

2.1.1.2 Windows-Based Acceptance Testing Image Creation

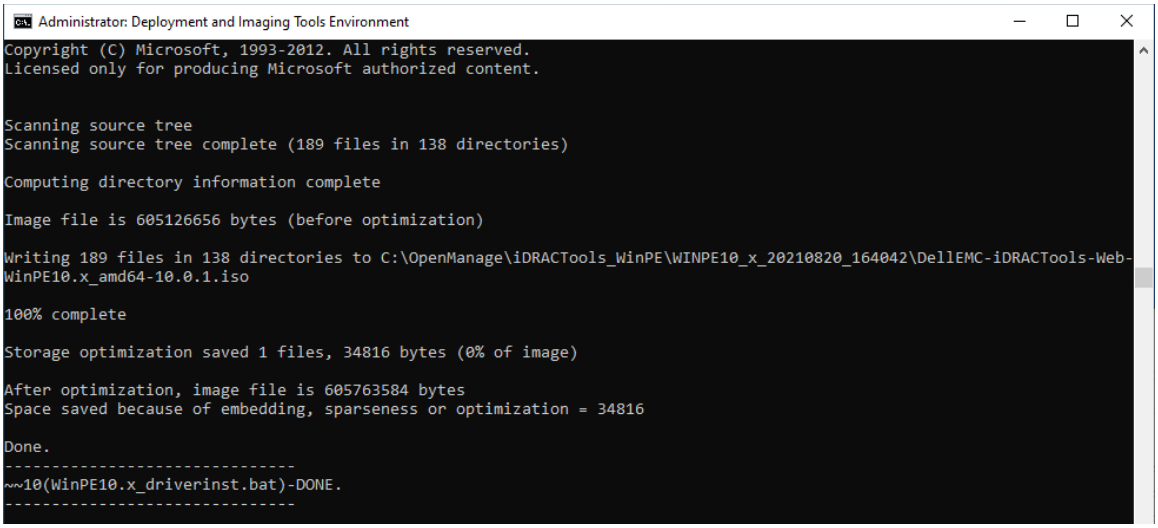
The following procedures will produce a Windows Preinstallation Environment (WinPE) bootable image that can be used in computing device acceptance testing. You will need to have a Windows Server (2016 or above) environment available to complete the following steps.

2.1.1.2.1 Build WinPE

1. Download and install the Windows Assessment and Deployment Kit (ADK) and WinPE add-on.
2. Download the Dell EMC iDRAC Tools for Microsoft WinPE (R), v10.1.0.0 software package.
3. Run the self-extractor and choose all defaults.
4. Launch cmd.exe as an administrator and change directory to the extracted folder, then run our modified batch file (WinPE10.x_driverinst - ps1.bat).



5. If successful, the preceding batch script will create a folder in the same directory with a name similar to *WINPE10.x-%timestamp%* or *WINPE5.x-%timestamp%.*



2.1.1.3 Preboot Execution Environment (PXE)

2.1.1.3.1 Dynamic Host Configuration Protocol (DHCP) Proxy

In this prototype demonstration, we use a combination of DNSMasq and the iPXE project to deliver the acceptance testing capabilities to computing devices. DNSMasq provides network boot services via DHCP on a network that already has other DHCP services present, such as assigning IP addresses to hosts. Since our network used DHCP services that could not easily be modified for network boot, we made the design decision to use DNSMasq as a proxy. However, for your setup you may want to include network boot services directly into the DHCP product that is used in your environment.

The iPXE project provides open-source network boot firmware. Using iPXE enabled a script-based boot process from an HTTP server. We also chainload the iPXE boot process from a Trivial File Transfer Protocol (TFTP) server, avoiding the need to replace the network card firmware with an iPXE client.

The system specification and procedures follow below. Note that this project uses computing devices that support Unified Extensible Firmware Interface (UEFI) booting and does not support legacy personal computer (PC) Basic Input/Output System (BIOS) booting. Table 2-1 shows the system information used in our prototype demonstration.

Table 2-1 DHCP Proxy System Information

Operating System	Version	Platform
Ubuntu Server	Release 20.04	Virtual Machine

6. Install DNSMasq, the TFTP server, and the HTTP server using the software package manager of your chosen operating system (OS). On Ubuntu, use the following command.

```
$ apt install dnsmasq tftpd-hpa apache2
```

7. Create a custom iPXE bootloader that directs iPXE to boot from a fixed URL.
    a. Create a file named *embed.ipxe* with the following contents.

```
#!ipxe
dhcp
chain http://<IP or Hostname>/ipxe/boot.ipxe || shell
```

    b. Download and extract the iPXE source files. Install all software dependencies noted on the download page.
    c. Change directory to *ipxe/src* and run the following command.

```
$ make bin-x86_64-efi/ipxe.efi EMBED=/path/to/embed.ipxe
```

8. Copy the newly built iPXE efi boot file to */var/lib/tftpboot*.
9. Edit the DNSMasq configuration file to suit your environment.
    a. `$ [your favorite editor] /etc/dnsmasq.conf`
    b. Ensure the following configuration variables are set in the configuration file:

```
pxe-service=x86-64_efi,"Network Boot EFI",ipxe.efi
enable-tftp
tftp-root=/var/lib/tftpboot
```

10. Restart DNSMasq.

```
$ systemctl restart dnsmasq
```

11. Copy the WinPE, CentOS 7, and CentOS 8 images to the HTTP server.
    a. In the root of your HTTP server, create two directories to store the images.

```
$ mkdir -p images/winpe images/centos7
```

b. Copy the */media* directory created in Section 2.1.1.2.1 to *images/winpe*.

c. Copy *initrd.img* and *vmlinuz* created in Section 2.1.1.1.2 to *images/centos7*.

d. Copy *initrd.img* and *vmlinuz* created in Section 2.1.1.1.4 to *images/centos8*.

e. Download the latest wimboot binary from the iPXE repository and store it in the *images* directory.

12. Create a directory named *ipxe* in the HTTP server root, and copy the *boot.ipxe* file supplied by this project's repository to this location. Consider our configuration file as a starting point and ensure the contents of this file match your environment. Errors may result in a non-functioning network boot service.

2.1.2 Platform Manifest Correlation System (PMCS)

The PMCS is custom software that allows original equipment manufacturer (OEM) platform manifests (post-acceptance testing) to be translated into a format that is suitable for the Asset Discovery and Repository System (Archer Integrated Risk Management [IRM]). The system provides a web user interface (UI) for the IT administrator, and representational state transfer (REST) application programming interfaces (APIs) are provided for programmatic access. The following steps will set up the environment.

13. The system is based on Node.js, an open-source JavaScript runtime built on Chrome's V8 JavaScript engine designed to build scalable network applications. Download and install Node.js on a system best suited for your environment. This demonstration uses an Ubuntu 20.04.2 LTS virtual machine.

14. Install the node package manager (npm).

15. Install git on the platform chosen in Step 1. Git provides source code management capabilities used in later steps.

16. Install Process Manager 2 (PM2). This package will manage the Node.js processes that run the PMCS codebase.

```
$ npm install pm2 -g
```

17. Start the application using *pm2* from the cloned copy of the project repository:

```
$ cd platform-manifest-collation-system
$ pm2 start index.js
```

The PMCS should now be running as a background process. Consider using a startup script to keep your process list intact across expected or unexpected machine restarts.

2.2 Dell

2.2.1 Laptops

The following section describes how to prepare Dell laptops for acceptance testing and continuous monitoring scenarios. Note that the Dell Trusted Device agent requires access to the Dell cloud. Consult the Dell website to determine the ports and IP addresses. Additionally, download the custom scripts for the scheduled tasks from our repository and store them on each target Dell laptop. In this demonstration, we chose *c:\Dell\HIRS* and *c:\Dell\TrustedDevice*.

2.2.1.1 Extract the Platform Certificate

Perform the following preparatory steps to create an acceptance testing environment suitable for Dell laptops. Contact your Dell representative to ensure the target laptop has been provisioned with a Platform Certificate from the factory.

18. Boot the target Dell laptop to the Windows 10 environment.
19. Start cmd.exe as an Administrator and run the following command:

    ```
    mountvol o: /s
    ```

20. Copy *o:\EFI\tcg\cert\platform\Dell.[Line of Business].[Servicetag].ver2.Base.cer* to a system with a text editor available. Note that *Line of Business* and *Servicetag* will be specific to your laptop.
21. Separate the Platform Certificate from the signing certificate:
    a. Cut the signing certificate out of the file and save the Platform Certificate.

    ```
    -----BEGIN CERTIFICATE-----<cert content>  -----END CERTIFICATE-----
    ```

    ```
    {Ctrl} + X
    ```

    ```
    {Ctrl} + S
    ```

    b. Create a new file and save it as the signing certificate.

    ```
    {Ctrl} + N
    ```

    ```
    {Ctrl} + V
    ```

    ```
    {Ctrl} + S
    ```

    c. Name the signing certificate.

    ```
    <HSM-Signing-Certificate.cer>
    ```

22. Create a dedicated CentOS 7 host for running the HIRS Attestation Certificate Authority (ACA) portal that is accessible to the computing device undergoing acceptance testing. This step is detailed in Section 2.4.

23. Create a network bootable CentOS 7 image. This step is detailed in Section 2.1.1.

Note that to perform acceptance testing with Dell laptops, two settings in the BIOS are modified:

24. Power-on the laptop and boot to the BIOS setup by pressing the Function 2 (F2) key.
25. Clear the TPM to remove Windows ownership of the device. Navigate to *Security > TPM 2.0 Security > Clear* in the main menu. Click the *Clear* radio box and select **Yes** in the dialog box.
26. Turn off *Secure Boot*. Navigate *Secure Boot > Secure Boot Enable* in the main menu. Click the *Clear* radio box and select **Yes** in the dialog box.
27. Reboot the laptop by clicking **Apply** and **Yes** in the dialog box followed by **Exit.**

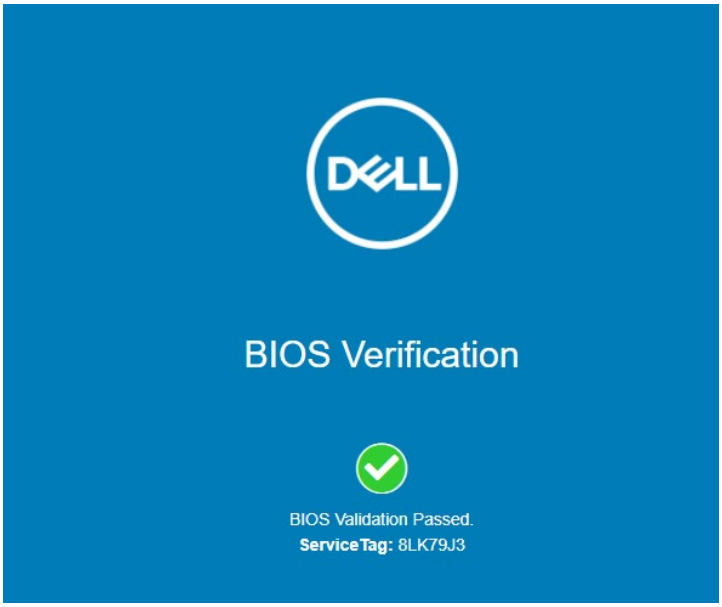
2.2.1.2 Install the Dell Trusted Device Agent

General installation instructions are posted on the Dell website. Below, we use the interactive graphical installation wizard, but other **deployment options** are also available.

28. Download the latest version of the Dell Trusted Agent from the Dell website.
29. Open a command prompt as an Administrator. Install the agent with the following command:

```
msiexec.exe /i Trusted-Device-<version>\Win64R\TrustedDevice-64bit.msi
```

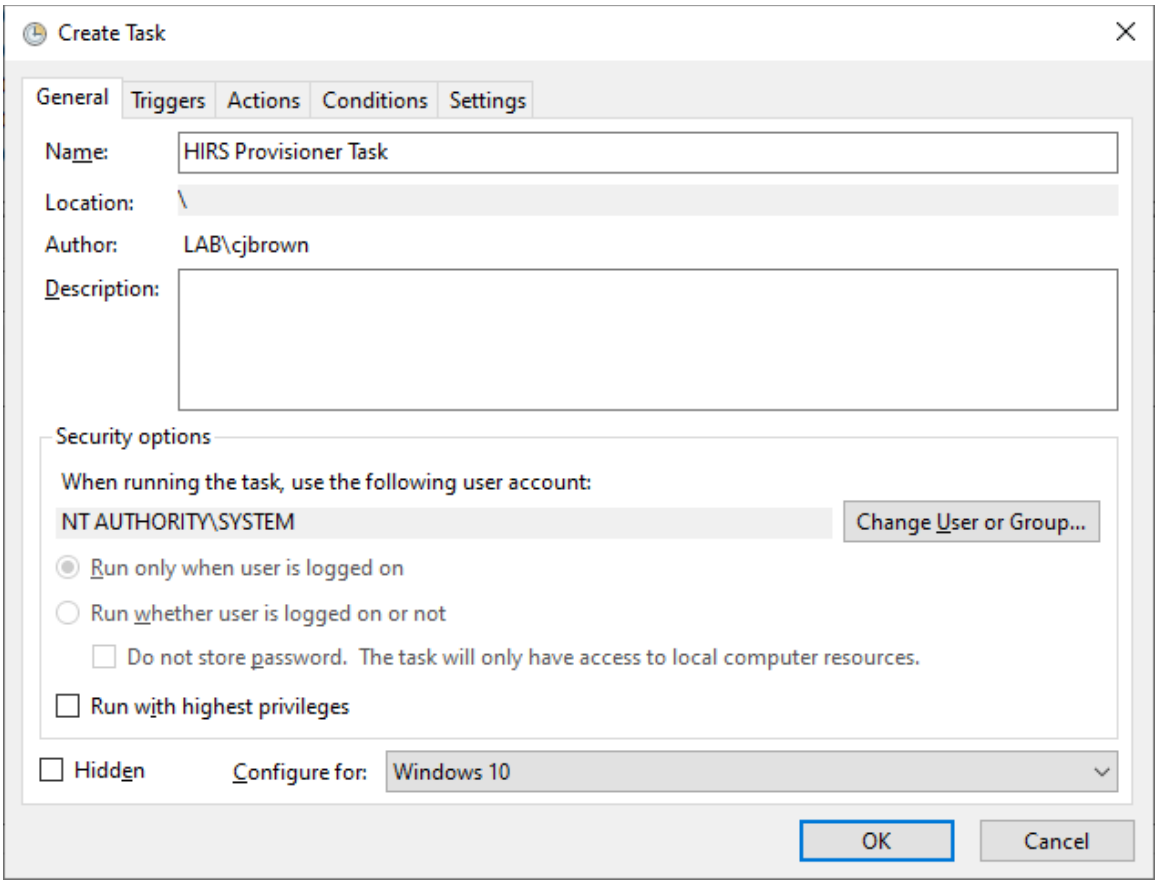
30. An installation wizard will launch. Click **Next** and then the **Install** button. The installation package will warn that the laptop will require a reboot. Accept the warning.
31. Follow the prompt to reboot the laptop. After the reboot, check the installation by manually launching the agent. If successful, a browser window will launch with a message similar to the following.



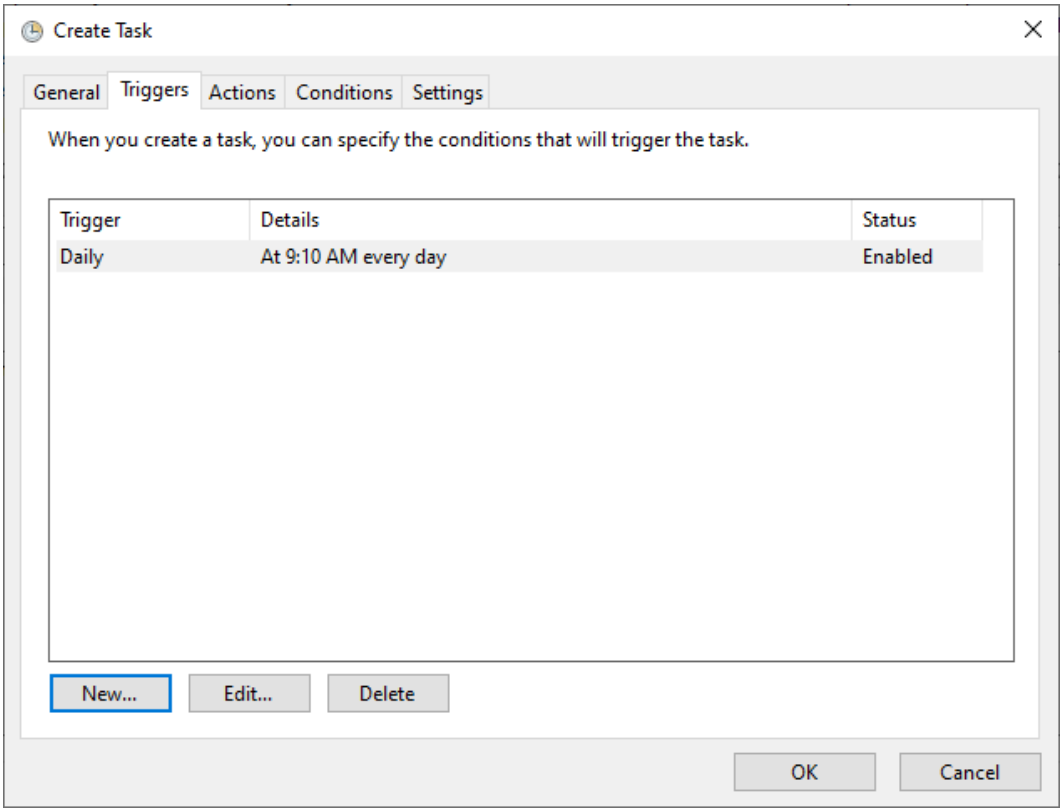
2.2.1.3 Create the Scheduled Tasks

These procedures will create two tasks that periodically execute our custom scripts, which silently launch the Dell Trusted Device (DTD) agent/HIRS Provisioner Agent and detect platform integrity issues.

32. Open the Task Scheduler as an Administrator on the target laptop.
33. Select **Action > Create New Task.**
34. In the **General** tab, enter a name for the task in the **Name** field. Click the **Change User or Group** button and select the *System* account. Select *Windows 10* from the **Configure for** pull-down menu.



35. In the Triggers tab, click the **New**… button. Select a scheduled time appropriate for your environment. Once per day is shown in the example below.



36. In the Action tab, click the **New…** button. Enter *powershell.exe* in the Program/script field. Enter *-file "C:\Dell\HIRS\hirs_script.ps1"* in the **Add arguments (optional)** field. Adjust this value if needed if the custom script is installed in a different location. Click the **OK** button.

37. Click the **OK** button to save the new scheduled task.

Repeat this section to create a scheduled task that will periodically execute the Dell Trusted Device agent using the custom script.

2.2.2 Servers

The Dell R650 used in this demonstration does not require any preparatory activities for acceptance testing. All platform validation tools are included in the network-booted acceptance testing environment. Continue with creating the WinPE acceptance testing environment as described in Section 2.1.1.2.

2.3 Eclypsium

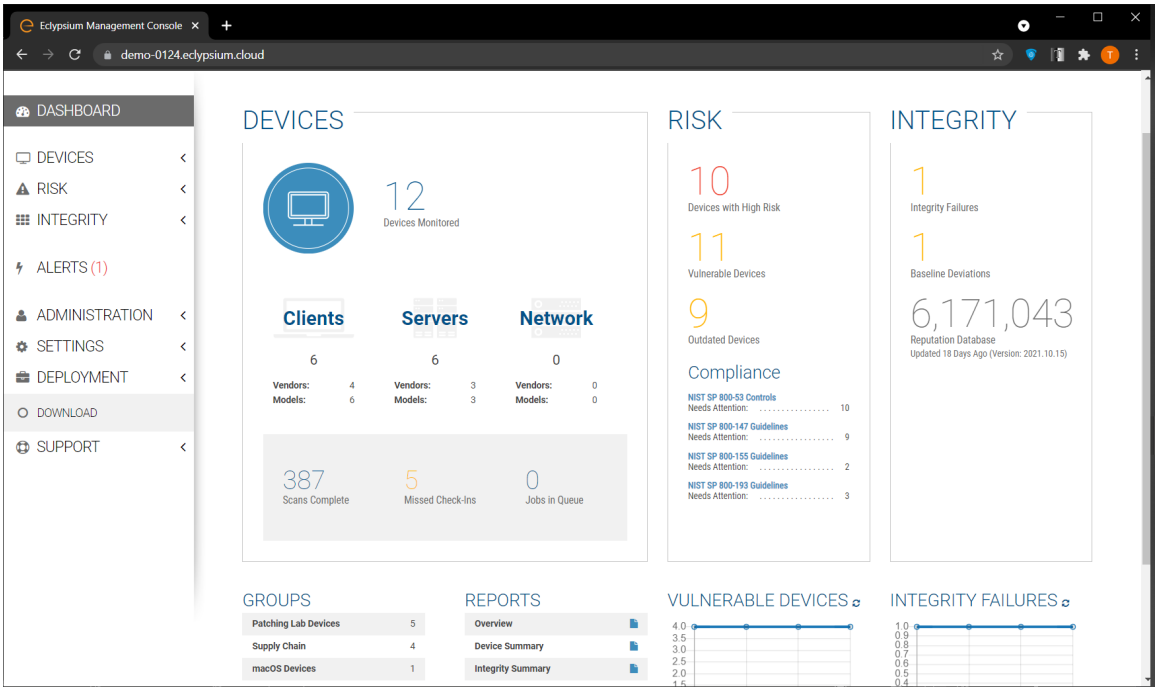
Eclypsium is a firmware security solution with cloud-based and on-premises deployment options. It secures firmware in servers, endpoints, and network devices by:

- identifying devices that contain firmware and creating detailed profiles of each component;
- verifying these profiles are free of vulnerabilities, have maintained their integrity, and are properly configured; and
- fortifying device firmware through a combination of configuration hardening, automated updates, and packaged guidance.

For this demonstration, Eclypsium is leveraged in the acceptance testing and continuous monitoring scenarios. The procedures below will install the Eclypsium agent and continuously monitor Windows-based laptops and Linux-based servers. In the server use case, we configured the agent to communicate with the on-premises deployment of the Eclypsium analytic backend. Refer to Section 3 in NIST SP 1800-31C for installation procedures.

2.3.1 Download Eclypsium Agent

1. Navigate to the **Eclypsium Management Console** in a web browser.



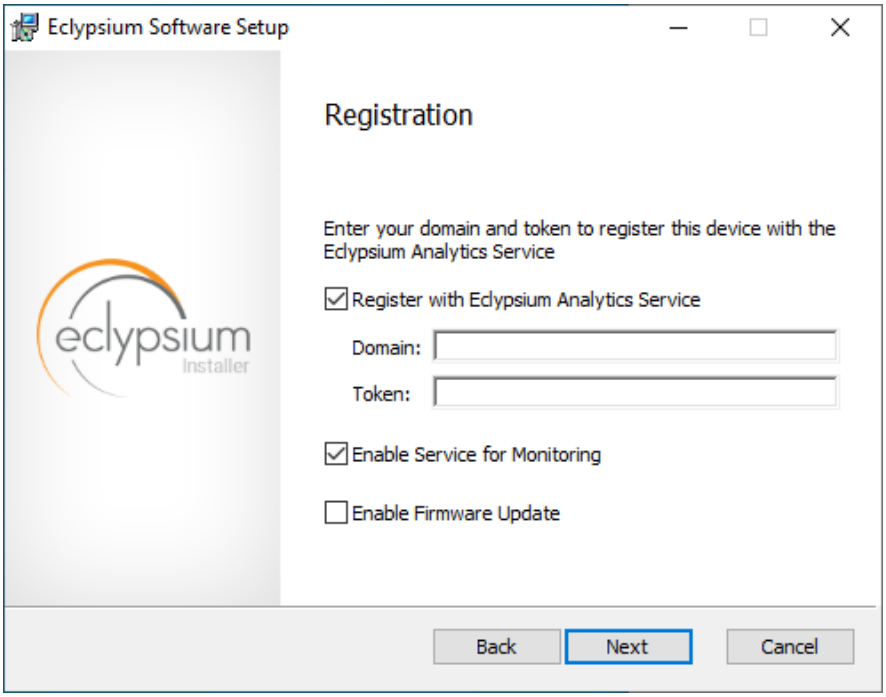
2. Select **Deployment > Download.**
3. Download the installer for the appropriate OS (Windows, macOS, Linux (Deb), or Linux (RPM)).

2.3.2 Install Eclypsium Agent for Windows

4. Start the Eclypsium bundled installer, *Eclypsium-<version>.exe*.

5. Select **Next**.

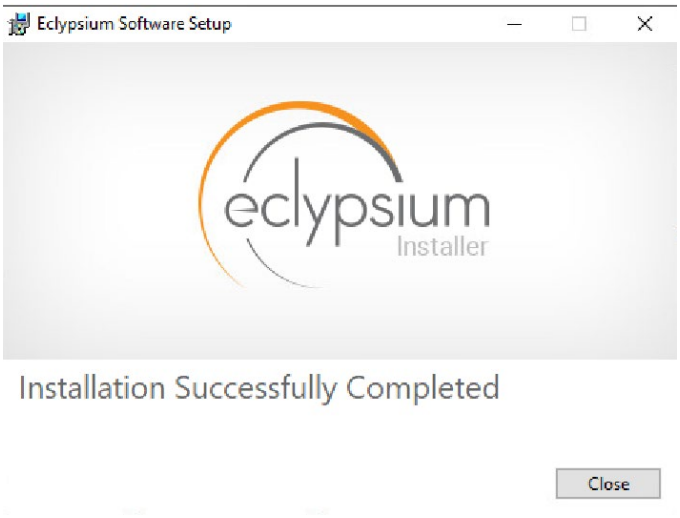
6. Ensure **Register with Eclypsium Analytics Service** and **Enable Service for Monitoring** are selected. Enter the **Domain** and Registration **Token** that can be found on the Download page of the **Eclypsium Management Console**, then select **Next.**



7. Select **Install** to start the Eclypsium installation**.**

8. When prompted, select **Finish.**

9. The Eclypsium agent has successfully installed once the page depicted below is reached. Select **Close.**



When the system scan completes on a newly installed system, the Eclypsium console will identify supply chain integrity concerns and recommend a resolution.

2.3.3 Install Eclypsium Agent for Linux

1. Ensure the *App* and *Driver* installation packages that are appropriate for your distribution are available on the host server system. The example below is an Ubuntu distribution.
2. Install the packages with the following command with root privileges. Note that there may be prerequisite packages that are required before installing the Eclypsium packages.

```
dpkg -i eclypsiumapp-2.8.1.deb eclypsiumdriver-2.8.1.deb
```

3. Register the Eclypsium agent with the on-premises backend with the following command with root privileges.

```
EclypsiumApp -s2 <Eclypsium-backend-hostname> reg_<token>
```

If successful, the server is registered and an initial scan is performed. The output should be similar to the following.

```
Scan data dumped to '/home/<user>/<hostname>-21ee761e90f38bb0-2022-05-
09T12_26_27Z.tar.gz'

Basic info updated successfully. Check the device at https://<backend-
hostname>/resolve-job/6279087374e1ae0726c3d68f

Successful registration.

[Dumping system firmware through SPI] \ 16777KB

[Dumping system firmware through MMIO] / 16777KB
```

```
[Uploaded 100%] [##############################] 12999KB/12999KB

Scan data dumped to '/home/<user>/<hostname>-21ee761e90f38bb0-2022-05-
09T12_26_27Z.tar.gz'

Scan data updated successfully. Check the device at <backend-hostname>/resolve-
job/627908e374e1ae3a06c3d800
```

2.4 Host Integrity at Runtime and Start-Up (HIRS) Attestation Certificate Authority (ACA)

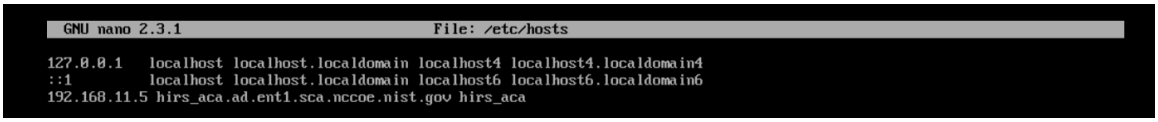
This section describes the installation and configuration of the HIRS-ACA backend components used in the acceptance testing scenario. HIRS-ACA is an open-source tool with three components that are used in this demonstration – the Attestation Certificate Authority, dashboard, and provisioner. The ACA issues identity credentials to devices that have a TPM 2.0 security module; these credentials are requested by the provisioner software. The HIRS-ACA dashboard is available to administrators to view and configure validation reports, credentials, and certificate trust chains. Table 2-2 shows the system information used in our prototype demonstration.

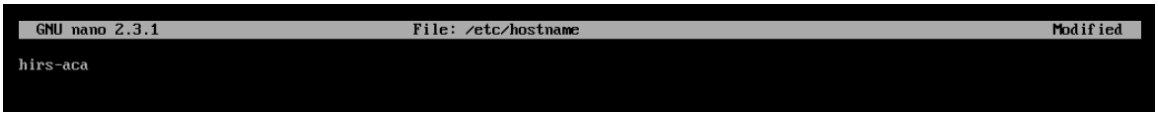
Table 2-2 HIRS-ACA System Information

Operating System	Version	Platform
Centos	7	Virtual Machine

2.4.1 Installing the HIRS-ACA

4. Before installing the required packages, ensure the target system has a fully qualified distinguished hostname. Modify the */etc/hosts, /etc/hostname,* and */etc/resolv.conf* system configuration files as appropriate.





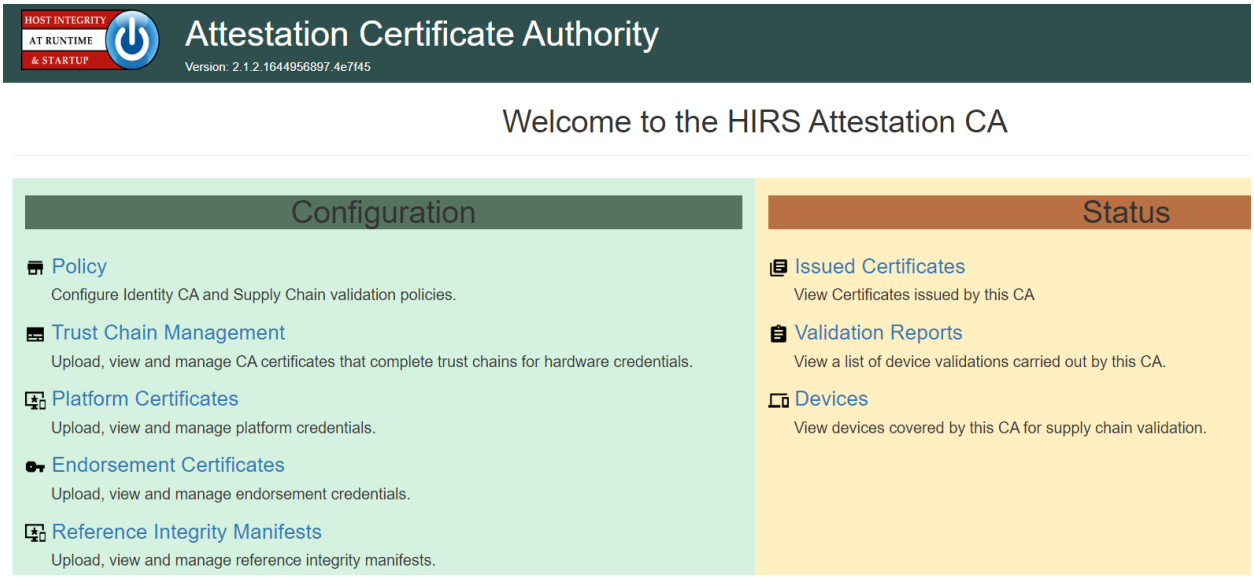
5. Install the HIRS-ACA dependencies using the following command. This will install MySQL/MariaDB, OpenSSL, Tomcat, Java, RPM Dev Tools, GNU Core Utilities, and other Linux commands (initscripts, chkconfig, sed, grep, firewalld, and policycoreutils).

```
# sudo yum install mariadb-server openssl tomcat java-1.8.0 rpmdevtools
coreutils initscripts chkconfig sed grep firewalld policycoreutils
```

6. Download the latest version of HIRS ACA from the Release page on GitHub and execute the following command to install the HIRS ACA.

```
# sudo yum install HIRS_AttestationCA*.rpm
```

Ensure the installation was successful by navigating to the dashboard using the fully qualified domain name (FQDN) configured above. It should look like the screenshot below.



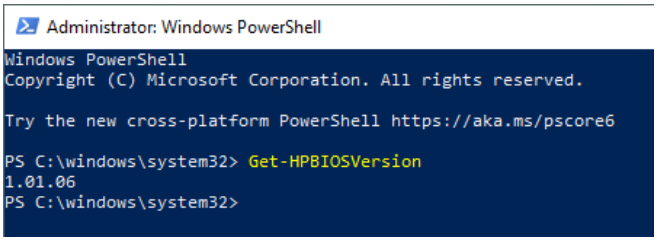
2.5 HP Inc.

The following steps install the HP Client Management Script Library (CMSL) and execute prerequisite provisioning for HP Inc. laptops. The CMSL installs several PowerShell commands on the laptop that will assist in platform validation. Once CMSL is installed, an administrator configures the HP Inc. specific device security feature. In this prototype demonstration, the target computing devices were an HP Inc. Elitebook 840 G7 and Zbook Firefly 14 G7.

2.5.1.1 Install the HP CMSL

7. Download the latest CSML from the HP Developers website onto the target HP Inc. laptop.

8. Launch the executable file and proceed through the wizard. Accept the agreement and click **Next.**
9. Select **Install into PowerShell** path and click **Next.**
10. Click **Install.**
11. Click **Finish.**
12. Test the installation by opening PowerShell as an administrator and executing a CMSL command such as `Get-HPBIOSVersion`.



2.5.1.2 Execute Provisioning Steps

The next steps are used to provision the HP Inc. specific firmware and device security features, HP Sure Start, HP Sure Admin, HP Tamperlock, and HP Sure Recover. Implementers may also want to consult the HP Inc. Developers Blog for more information on how these payloads were created. Using the example provisioning payloads available from our project repository, use the CMSL to apply the six provisioning payloads as shown below:

13. Open PowerShell as an administrative user. Execute the following commands.

```
Set-HPSecurePlatformPayload -PayloadFile EKProvisionPayload.dat
Set-HPSecurePlatformPayload -PayloadFile SKProvisionPayload.dat
```

14. Reboot the laptop. A local administrator must accept the *Physical Presence Prompt* to complete provisioning of the Endorsement and Signing Key.
15. Execute the following commands from PowerShell as an administrator.

```
Set-HPSecurePlatformPayload -PayloadFile EnableEBAMPayload.dat
Set-HPSecurePlatformPayload -PayloadFile LAKProvisionPayload.dat
```

16. Reboot the laptop. This will expose settings that require a BIOS administrator be configured before the next step can be completed.
17. Execute the following commands from PowerShell as an administrator.

```
Set-HPSecurePlatformPayload -PayloadFile BIOSsettingsPayloadFile.dat
```

```
Set-HPSecurePlatformPayload -PayloadFile SureRecoverProvision.dat
```

2.6 Hewlett Packard Enterprise (HPE)

We demonstrate HPE's Platform Certificate Verification Tool (PCVT) in this project by creating a network bootable acceptance testing environment which has PCVT tools and dependencies pre-installed on the image. This image also includes a bash script which executes the PCVT command and, if successful, uploads the hardware manifest to the PMCS.

First, compile the PCVT tools on a separate CentOS 8 system. The general procedures are on the HPE GitHub site and our specific commands follow.

18. Download and extract the source code from the HPE repository.
19. Install the software prerequisites onto the system.

```
yum -y install systemd-devel golang maven java-11-openjdk java-11-openjdk-devel
```

20. Change directory into the PCVT source code. Run the following command:

```
mvn install:install-file -Dfile=/<pcvt_source_directory>/PCVT-
pcvt_v1.0.0/lib/HIRS_Utils-1.1.1.jar -DgroupId=HIRS_Utils -
DartifactId=HIRS_Utils -Dversion=1.1.1 -Dpackaging=jar -
DlocalRepositoryPath=/<pcvt_source_directory>/.m2/repository
mvn install:install-file -Dfile=/<pcvt_source_directory>/PCVT-
pcvt_v1.0.0/lib/HIRS_Structs-1.1.1.jar -DgroupId=HIRS_Structs -
DartifactId=HIRS_Structs -Dversion=1.1.1 -Dpackaging=jar -
DlocalRepositoryPath=/<pcvt_source_directory>/.m2/repository
mvn install:install-file -Dfile=/<pcvt_source_directory>/PCVT-
pcvt_v1.0.0/lib/paccor-1.1.3-2.jar -DgroupId=paccor -DartifactId=paccor -
Dversion=1.1.3-2 -Dpackaging=jar -
DlocalRepositoryPath=/<pcvt_source_directory>/.m2/repository
```

21. Build the PCVT.

```
mvn clean compile assembly:single
```

22. Change to the **diskScan** directory.
23. Set the **GOPATH** to a local directory and set **GO11Module** to **off**.

```
export GOPATH=$HOME/<local_path>/gowork
```

```
go env -w GO111MODULE=off
```

24. Execute the build script in the **build** directory.

```
./build/create_install_bundle.sh
```

Ensure two files named **pcvt-mvn-0.0.1-jar-with-dependencies.jar** and **libdiskscan.so** are generated. Next, the acceptance testing environment is built. Continue with the procedures documented in Section 2.1.1.1.4.

2.7 Intel

The Intel Transparent Supply Chain (TSC) requires two client applications to support acceptance testing and continuous monitoring scenarios: **TSCVerifyUtil** and **AutoVerifyTool**. Contact your Intel representative to download the installation packages for both utilities.

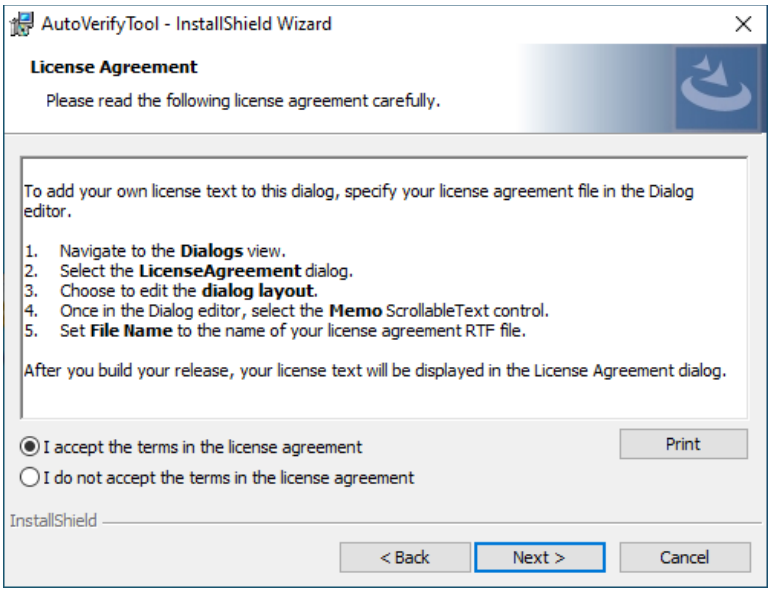
2.7.1 Laptops

Once the binaries have been retrieved, follow these procedures on the target laptop. Table 2-3 lists the laptops used within this demonstration.

Table 2-3 Intel-Contributed Laptops

Machine Name	Operating System	Manufacturer	Model
intel-0	Windows 10	HP Inc.	Elitebook 360 830 G5
intel-1	Windows 10	Lenovo	ThinkPad T480

1. Download and install the latest Microsoft Visual C++ Redistributable for Visual Studio.
2. Launch the AutoVerifyTool installation wizard. Click **Next**.
3. Accept the license and client **Next**.



4. Enter your Name and Organization. Click **Next**.
5. Select the **Typical** installation. Click **Next**.
6. Click **Install**.

2.7.2 Servers

The server contributed by Intel requires the installation of the TSCVerifyUtil application. Contact your Intel representative to determine the best method in your use case. In this prototype implementation, we opted to execute TSCVerifyUtil from a directory created at */opt/intel/tsc*. Table 2-4 lists the server contributed by Intel for this demonstration.

Table 2-4 Intel-Contributed Server

Machine Name	Operating System	Manufacturer	Model
intel-2	CentOS 8	Intel	S2600WTT Server Board

Additionally, to complete the implementation we connected the Seagate enclosure to this server board. Refer to Section 2.9 for a description of this process.

2.8 Archer Integrated Risk Management (IRM)

This section describes the installation of the Archer IRM system for this demonstration. Our instantiation of Archer IRM is viable for a lab environment, but the reader is encouraged to refer to the architecture planning guide on the Archer IRM website for specific guidance for your environment. We elected to install the Archer IRM system across two virtual machines—one hosting a Microsoft SQL database and the other hosting the remainder of the Archer IRM services. Note that the screenshots below are from our original installation of Archer IRM 6.9. During the course of the project, we updated our Archer IRM instance to version 6.10. As a result, some screenshots may differ in your implementation from what is presented in this document.

Table 2-5 shows the system information used in this prototype demonstration for Archer IRM.

Table 2-5 Archer IRM System Information

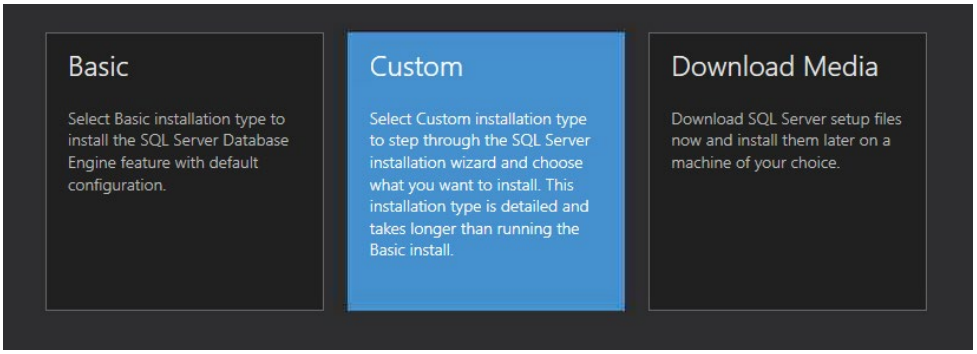
Machine Name	Machine Type	Operating System
Archer Database Server	Virtual	Windows 2019 Server
Archer Services	Virtual	Windows 2019 Server

2.8.1 Prerequisites

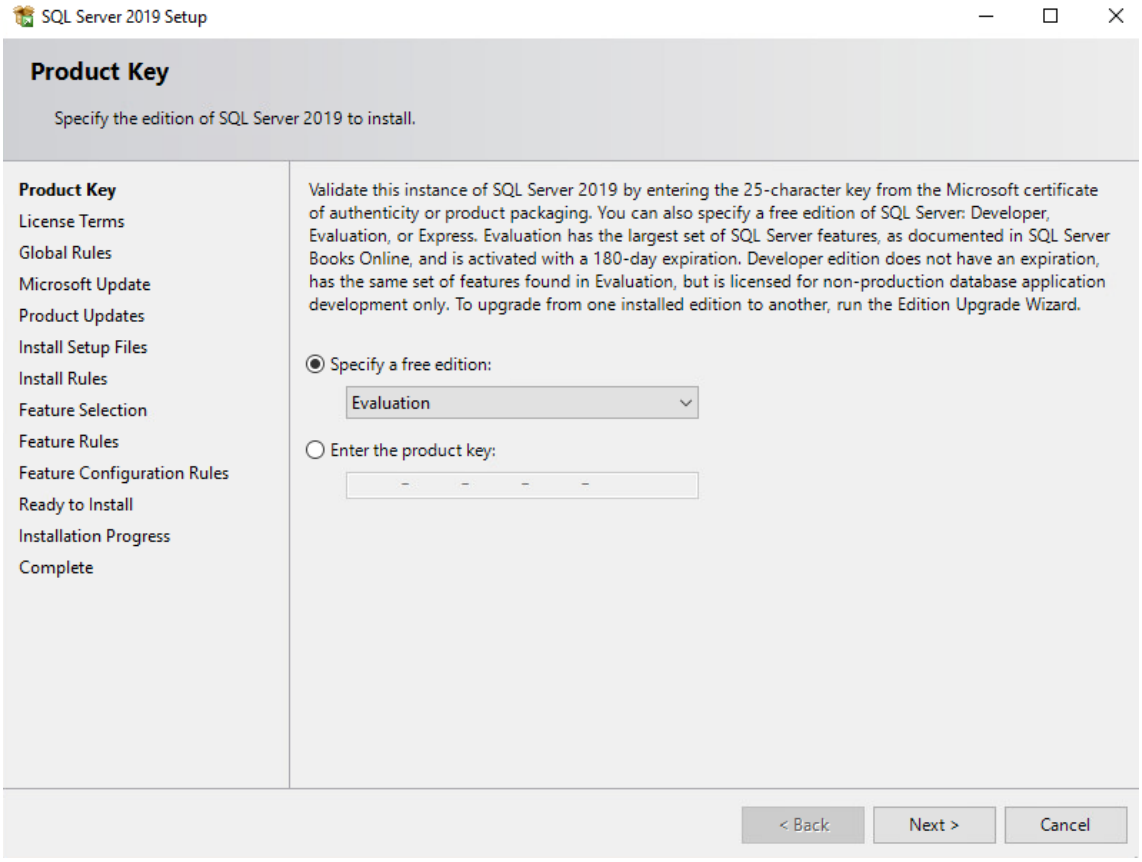
Before installing Archer IRM services, several prerequisites must be fulfilled. In this section, we describe those prerequisites involving the database server and Microsoft's Internet Information Services (IIS) web server.

2.8.1.1 Install SQL Server on Database Server

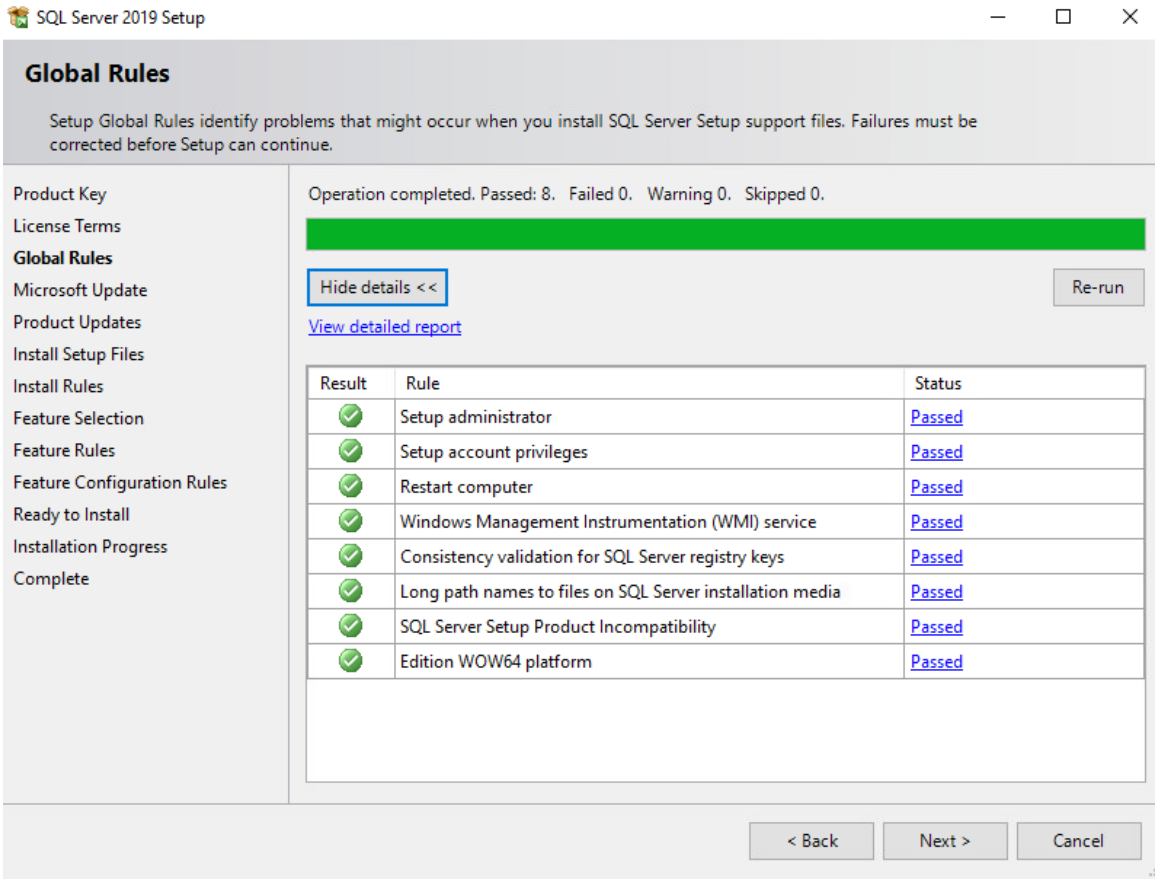
1. Download SQL Server 2019 from https://www.microsoft.com/en-us/sql-server/sql-server-downloads onto the database server.
2. Run the SQL Server 2019 executable.
3. Select the **Custom** installation type.



4. Specify the download location and select **Install.**
5. Allow the installer to download the SQL Server 2019 package.
6. The SQL Server Installation Center should automatically open. From the left menu panel, select **Installation.** Select the option **New SQL Server stand-alone installation or add features to an existing installation**.
7. Enter the product key or select a free edition of the software. Then select **Next.**



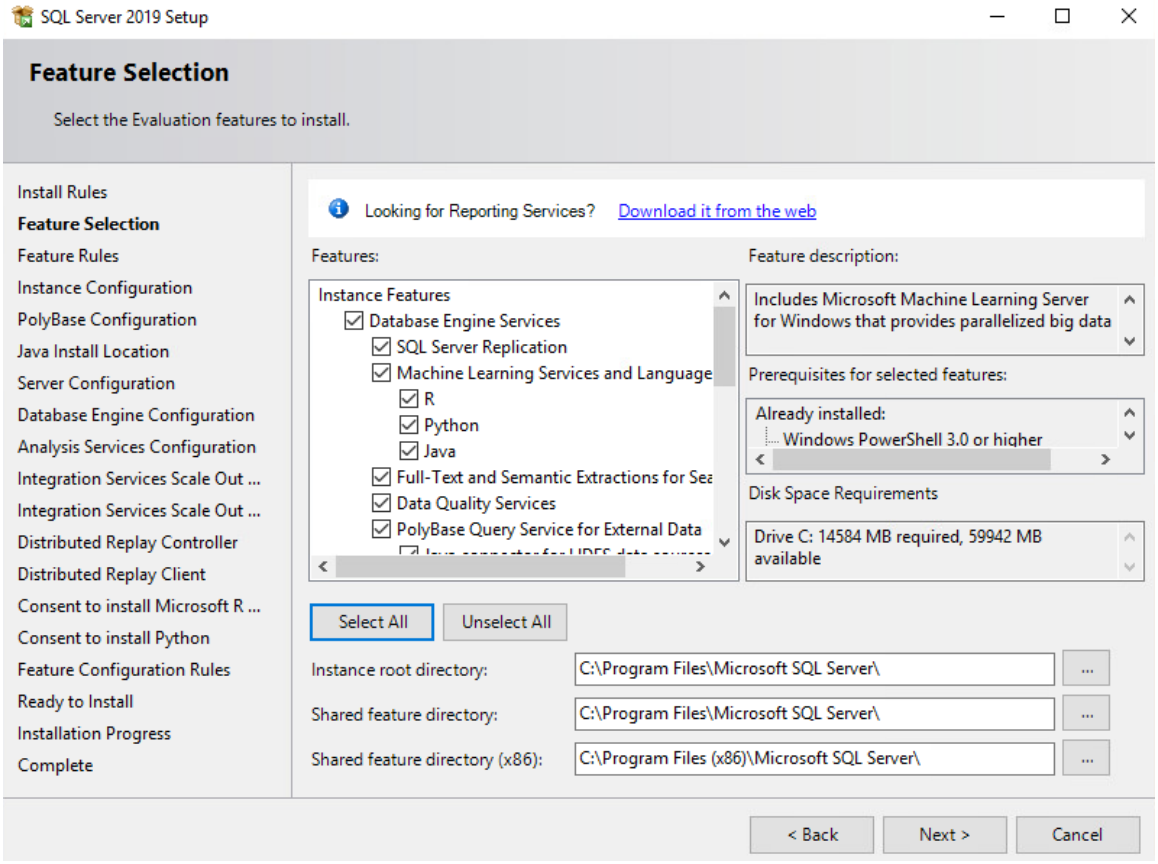
8. Read and accept the License Terms. Then select **Next**.
9. Ensure that all the **Global Rules** have passed. Then select **Next**.



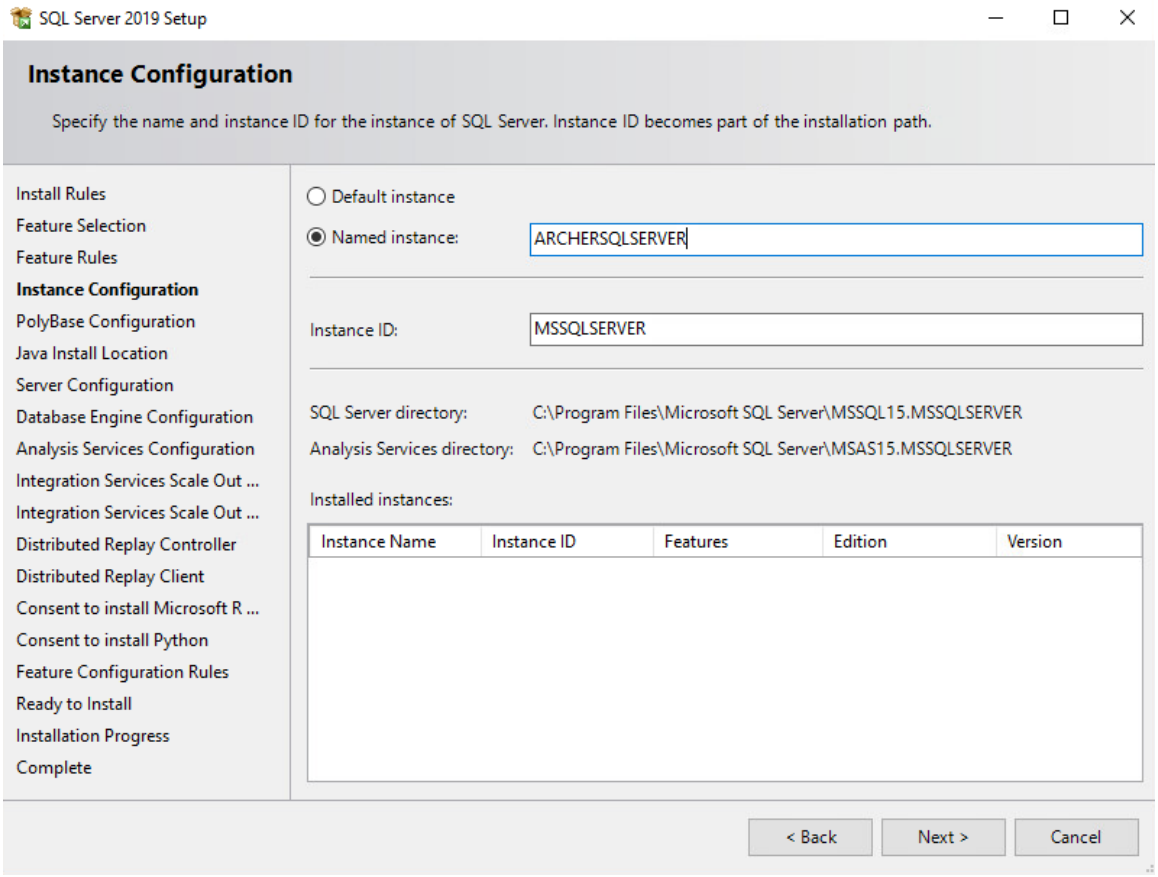
10. To use Microsoft Update to automatically deliver updates, check the box **Use Microsoft Update to check for updates (recommended).** Then select **Next.**

11. Ensure that all the **Install Rules** have passed. Then select **Next.**

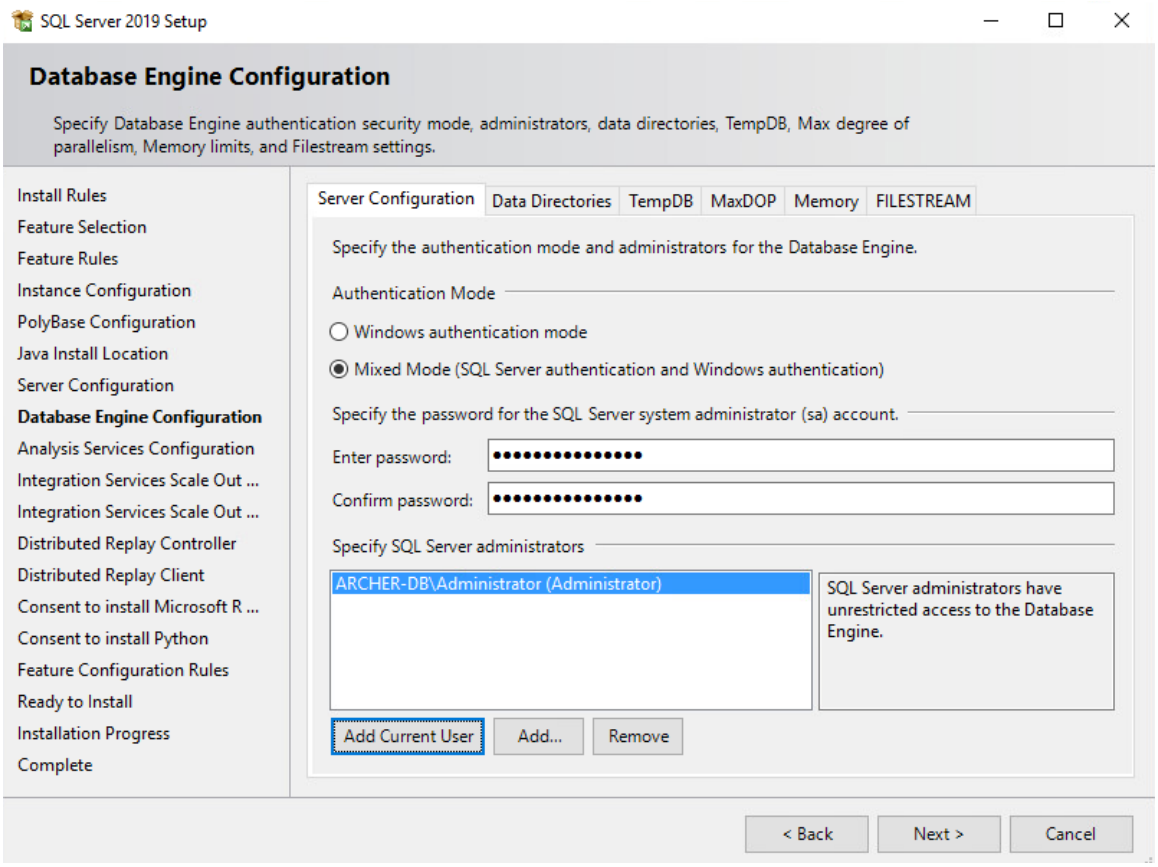
12. Select the desired features to install. Then select **Next.** Complete the sections for the selected features.



13. In the **Instance Configuration** section, select the **Named instance** radio button and choose a name for the database server, or select the **Default instance** radio button to use the default name. Then select **Next.**



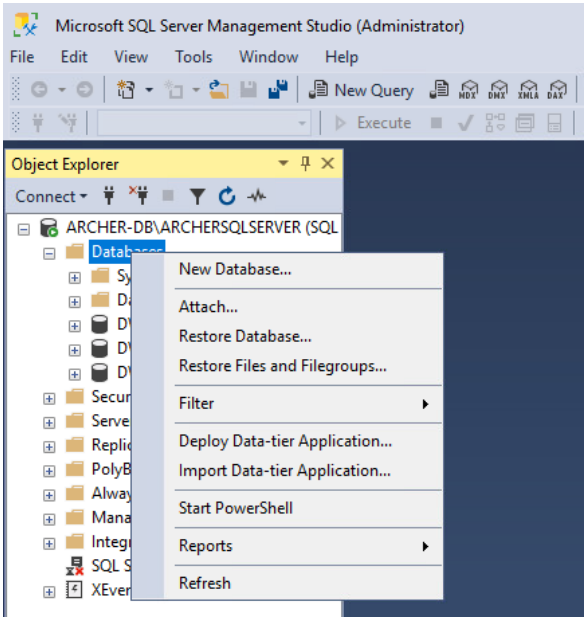
14. In the **Database Engine Configuration** section, select the desired Authentication Mode. Select **Add Current User** to add the current user as a SQL Server administrator and select **Next.**



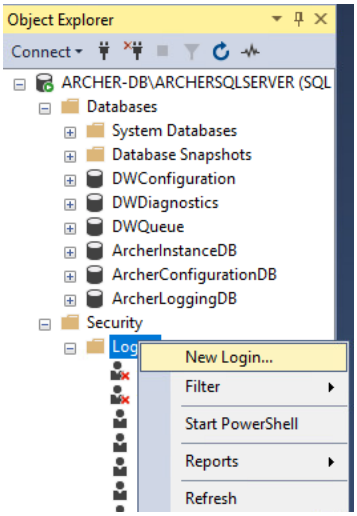
15. Ensure that all the **Feature Configuration Rules** have passed and select **Next.**
16. Confirm the selected settings are desired and select **Install.**
17. Once the installation completes, select **Close.**

2.8.1.2 Create the Archer IRM Databases

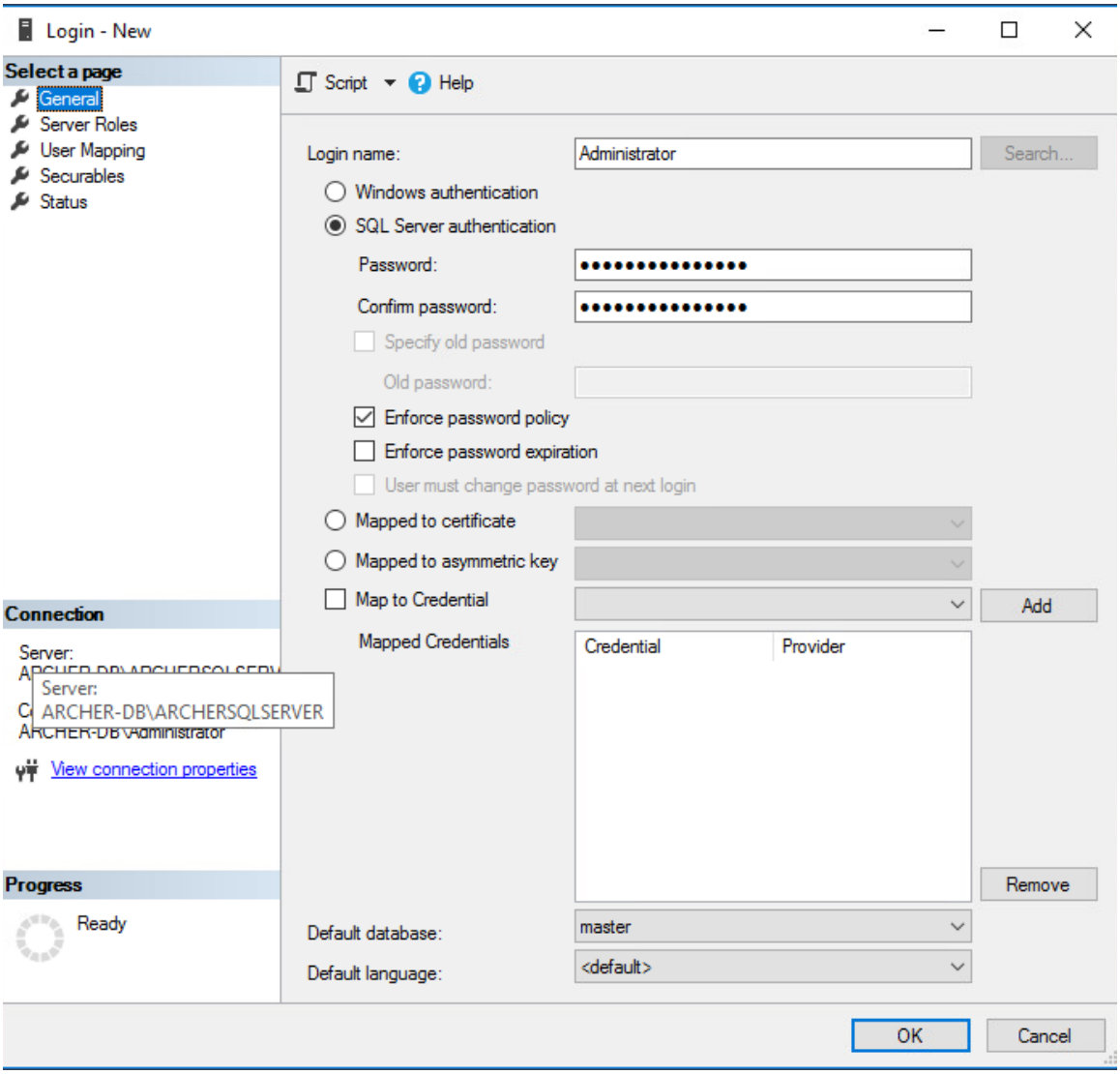
1. Download SQL Server Management Studio (SSMS) from https://aka.ms/ssmsfullsetup. Follow the installation steps.
2. Once installed, open SSMS.
3. Expand the ARCHERSQLSERVER tree. Right-click on **Databases** and select **New Database.** Create three databases: *ArcherInstanceDB, ArcherConfigurationDB,* and *ArcherLoggingDB.*



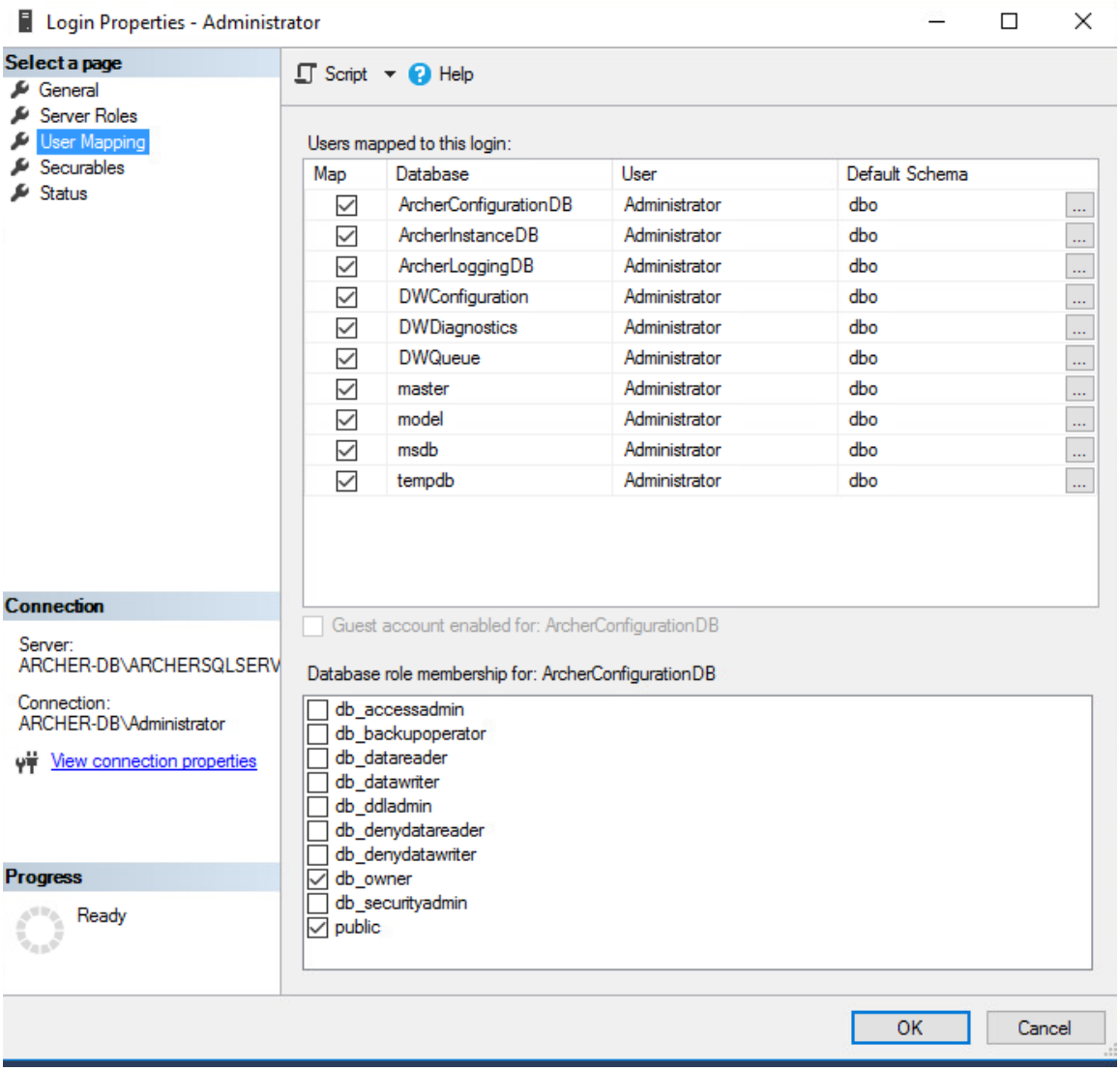
747 4. Next, create a local Administrator user. Right-click **Security** and select **New Login.**



748 5. Under the **General** tab, input the **Login Name** and select the **SQL Server Authentication** radio
749 button. Create a password for this user. These credentials will be used during the Archer IRM
750 installation.

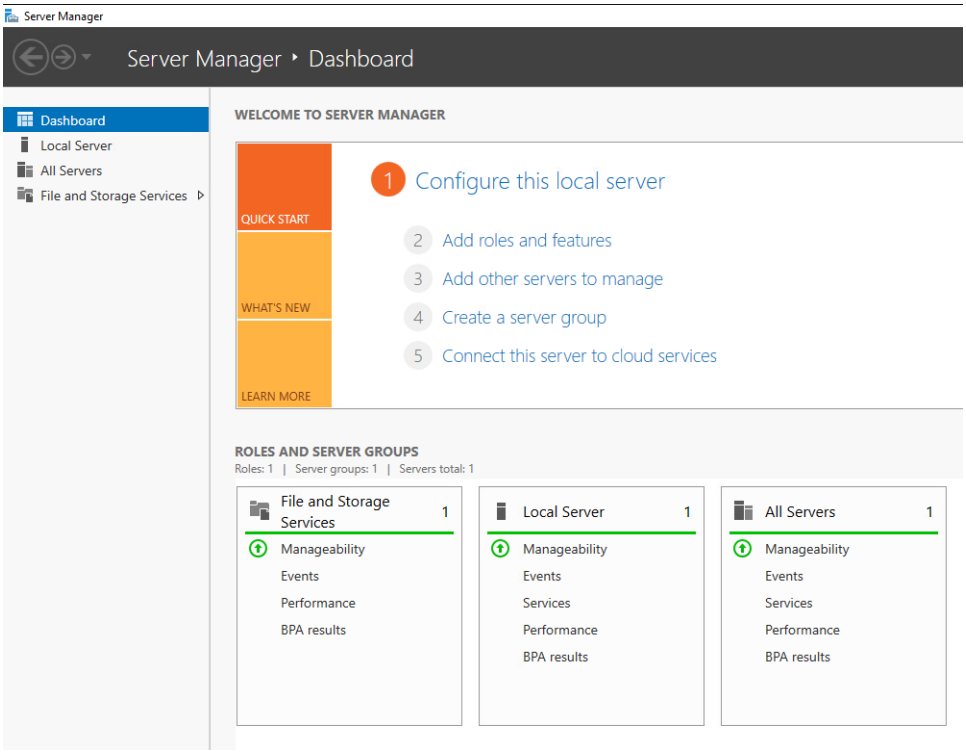


6. Navigate to the **User Mapping** tab. Ensure all the databases have the **Default Schema** set to **dbo.** Also, ensure that **db_owner** is selected for each database under the **Database role membership** section. **Select OK.**

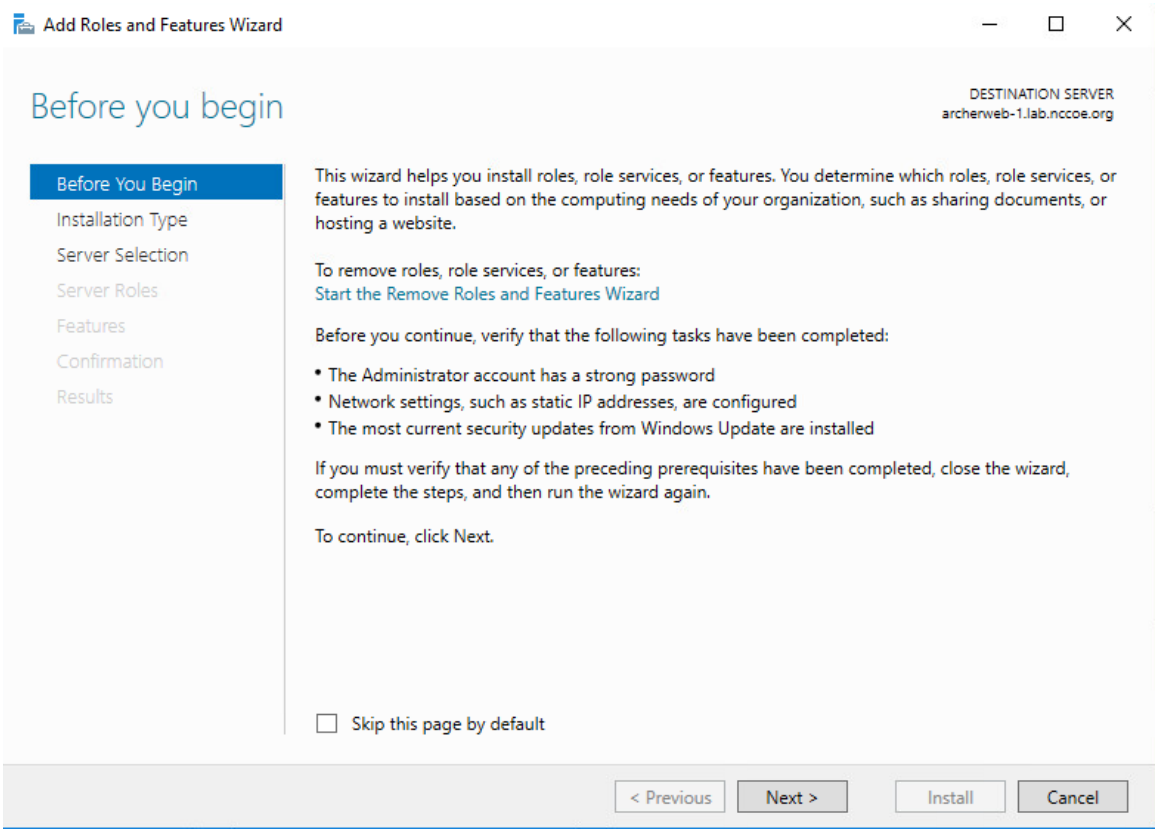


2.8.1.3 *Install Internet Information Services on the Web Server*

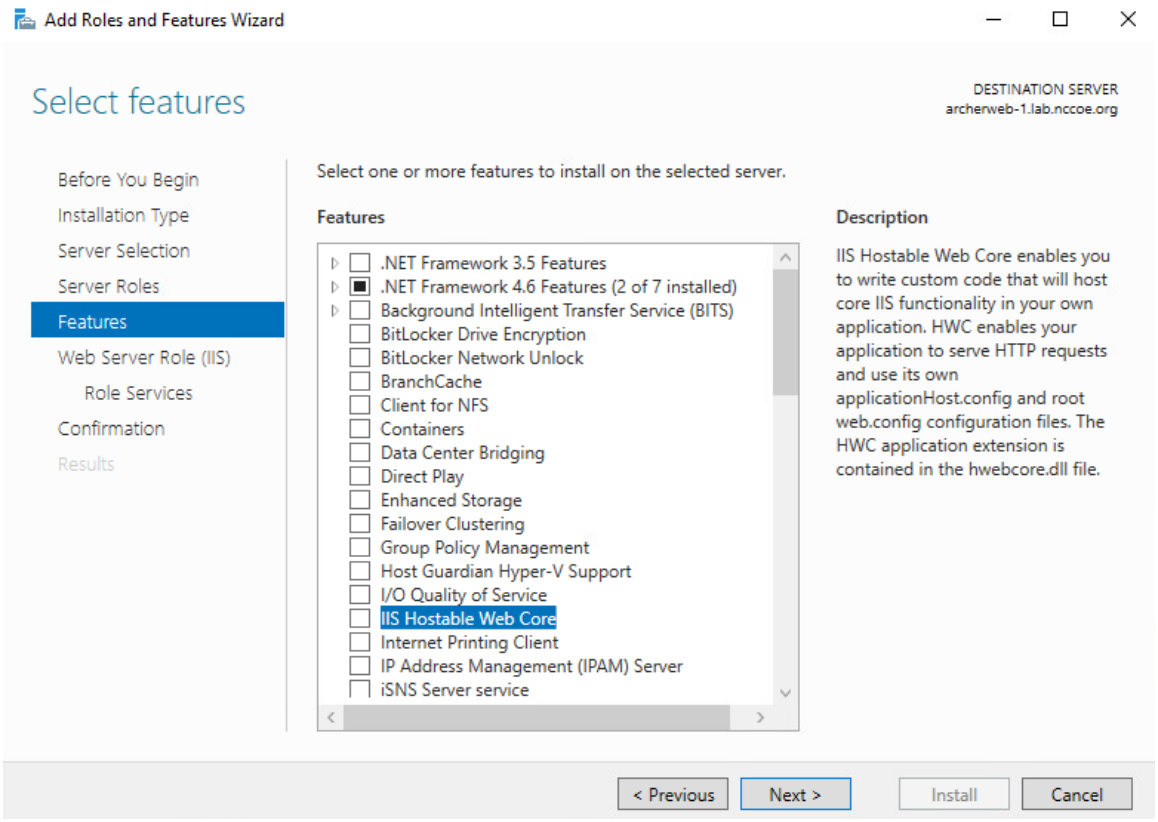
1. On the web server, open **Server Manager.**



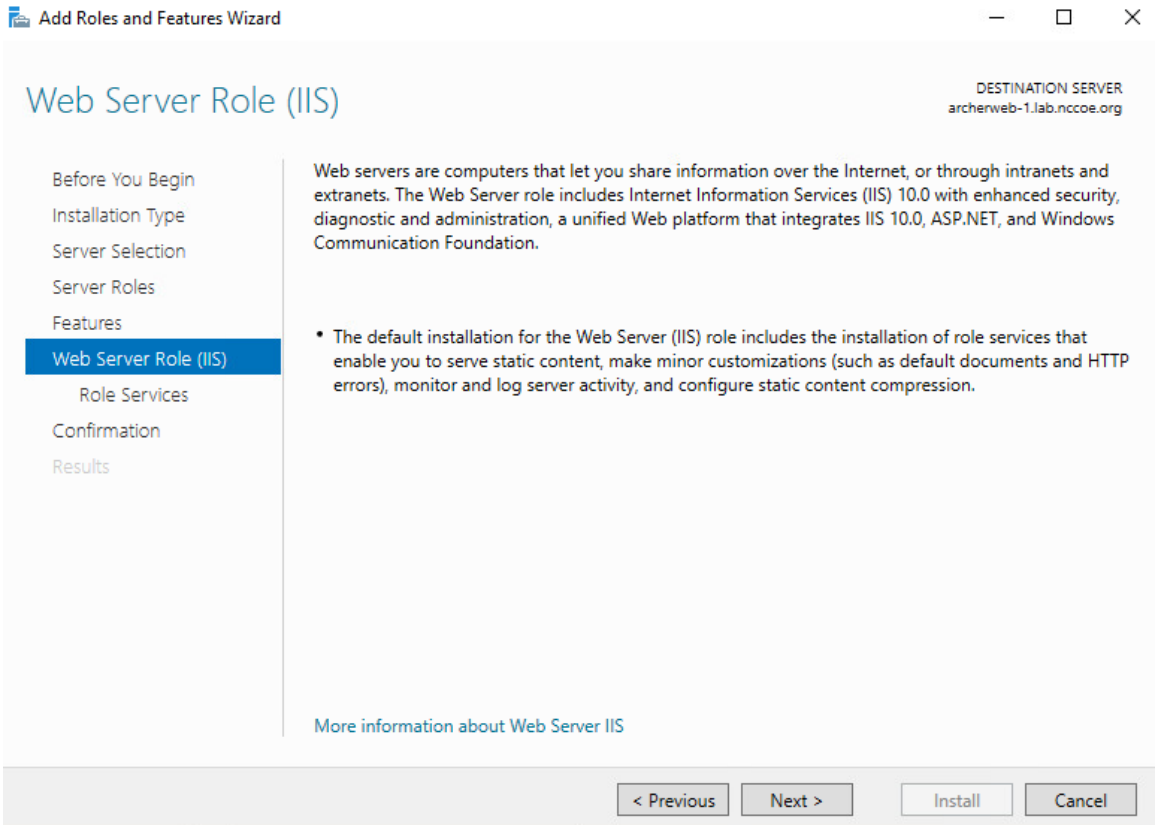
2. Under **Manage**, select **Add Roles and Features.**
3. Select **Next.**



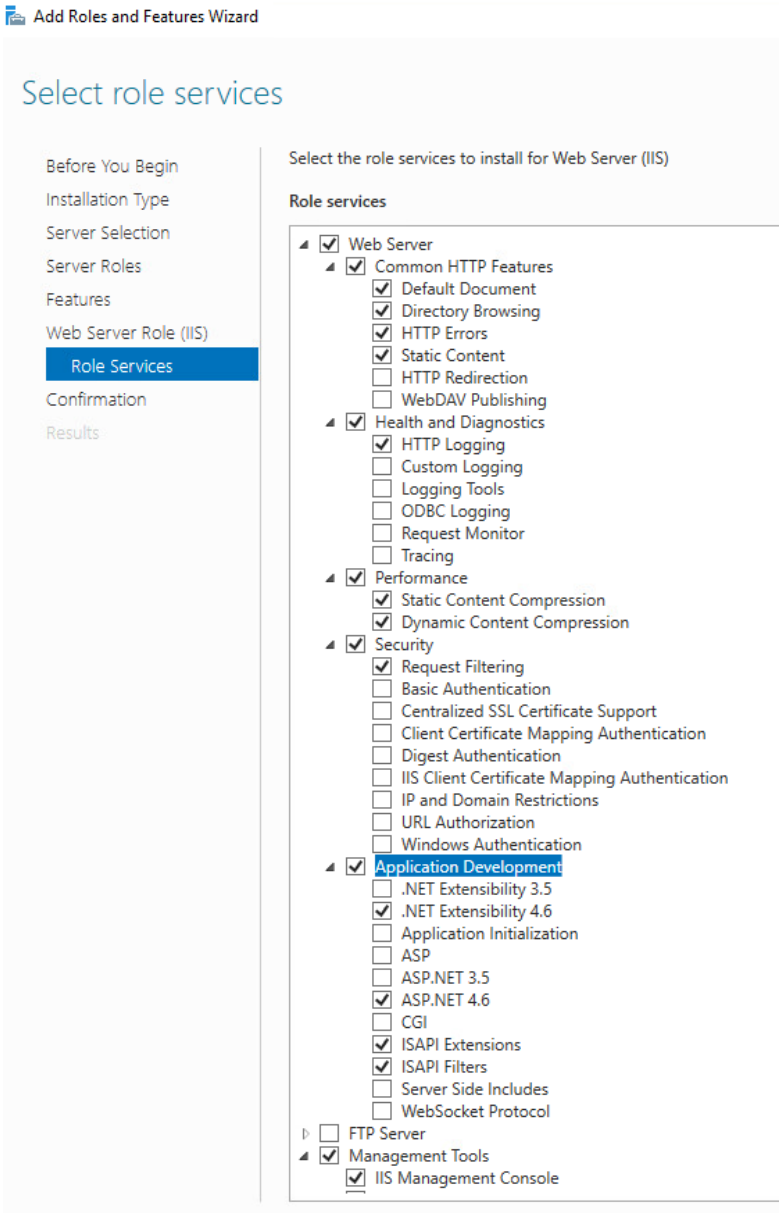
4. Select the **Role-based or feature-based installation** radio button. Select **Next.**
5. Select the **Web Server (IIS)** server role. Then select **Next.**
6. In the pop-up window, select **Add Features.**
7. Select **Next.**



8. Select **Next.**



763 9. Ensure that the **Role Services** shown below are selected. Then select **Next.**



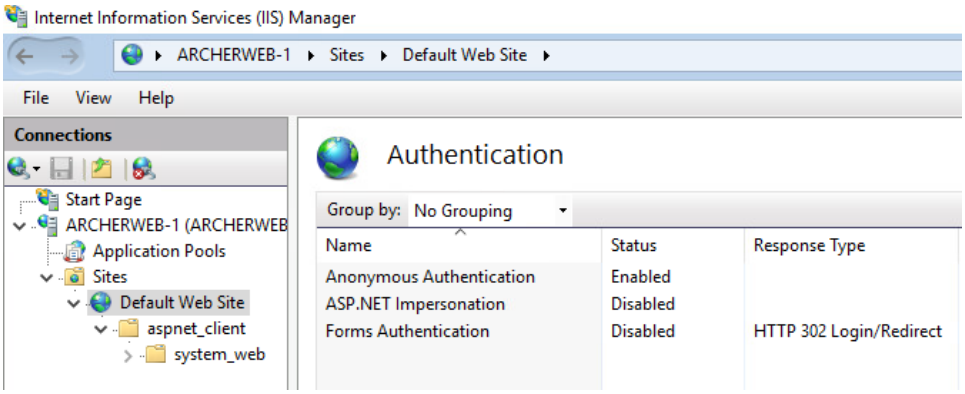
10. Confirm that the selected options are correct and select **Install.**
11. Once the installation completes, select **Close.**
12. Restart the computer.

2.8.1.4 Configure IIS

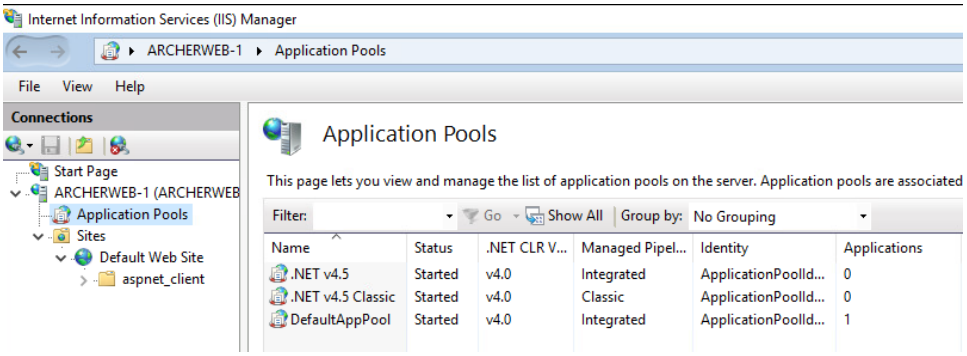
1. Open the IIS application.

2. Click on the web server in the left pane. **Select Authentication.**

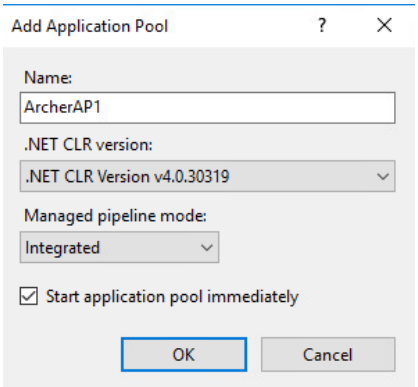
3. Ensure that **Anonymous Authentication** is enabled and **ASP.NET Impersonation** and **Forms Authentication** are disabled for the **Default Web Site.**



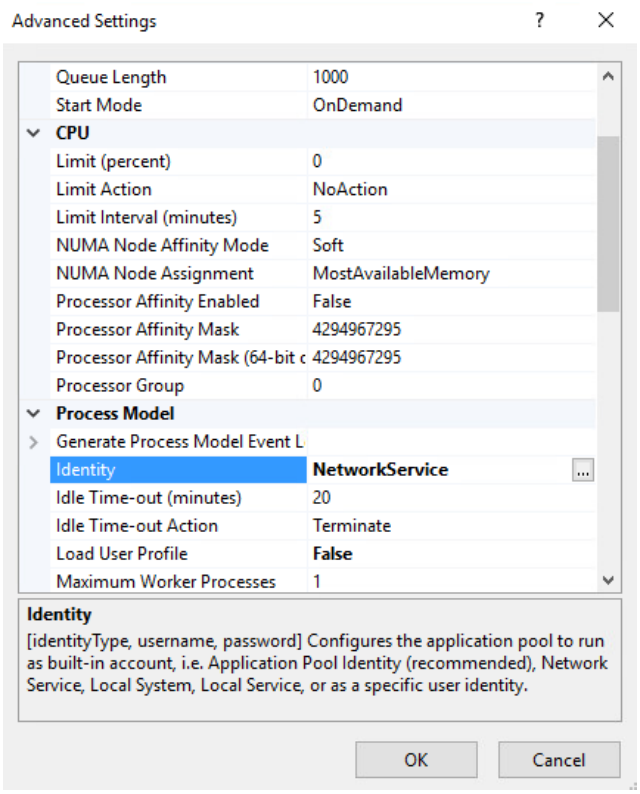
4. Expand the web server tree and select **Application Pools.** In the far-right pane, select **Add Application Pool.**



5. Add a name to the **Name** input field. Ensure that **Managed pipeline mode** is set to **Integrated** and that **Start application pool immediately** is selected. Then, select **OK.**



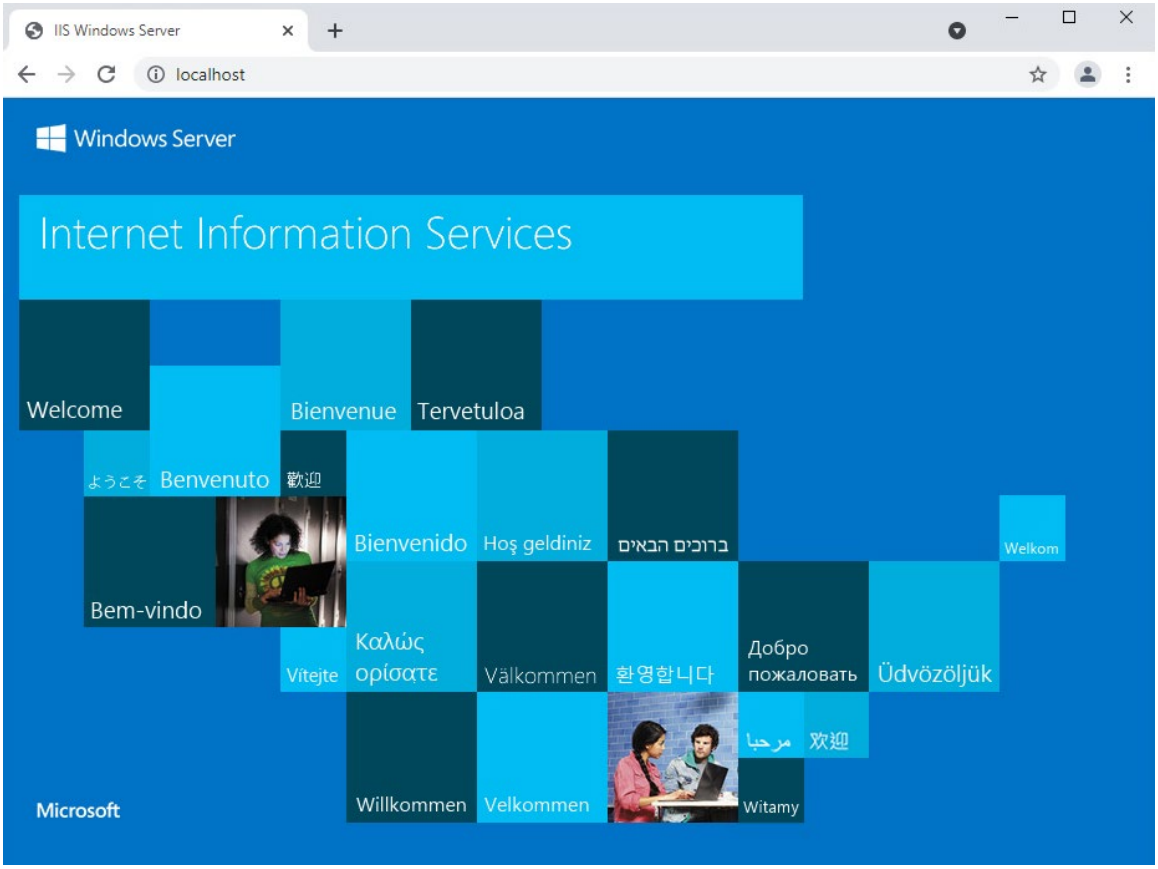
6. Right-click on the newly created application pool and select **Advanced Settings.** Under **Process Model,** select the ellipsis button that is next to the **Identity** field.



7. Select **Custom account,** select **Set,** and enter the appropriate information. Then select **OK.**

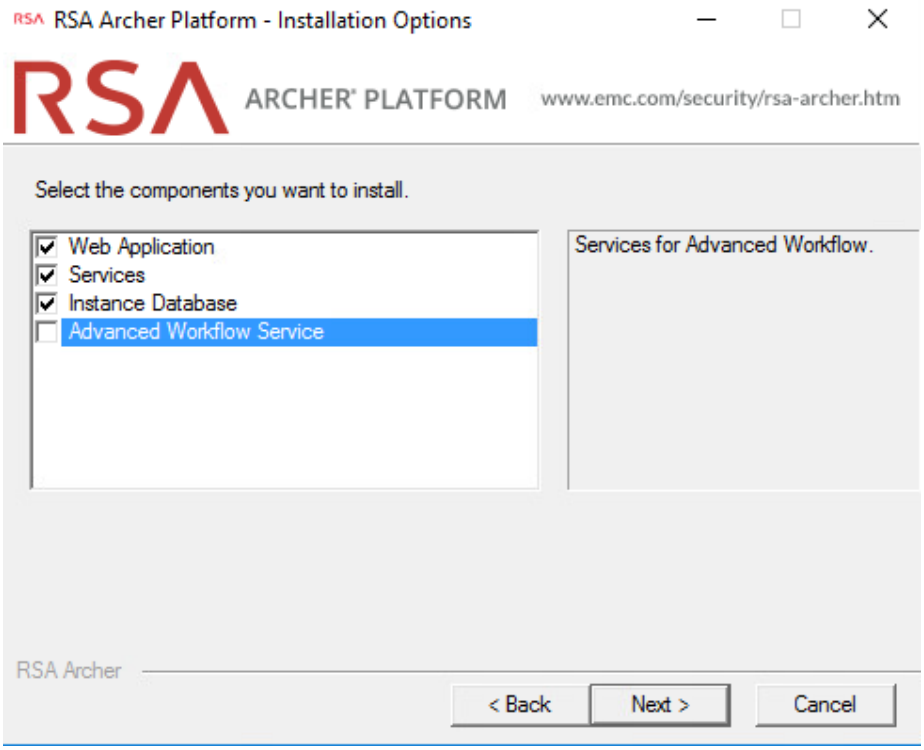
8. Click on the web server. In the far-right pane, select **Restart.**

9. Open a browser and navigate to localhost. If the screen below is shown, then the web server is running properly, and Archer IRM can now be installed.

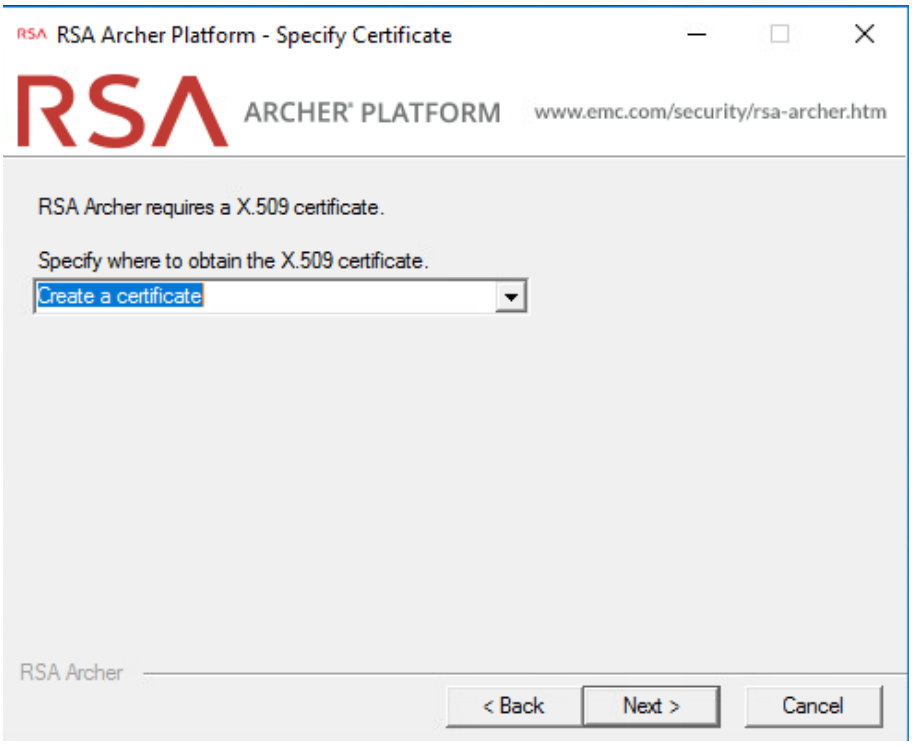


2.8.2 Archer IRM Installation

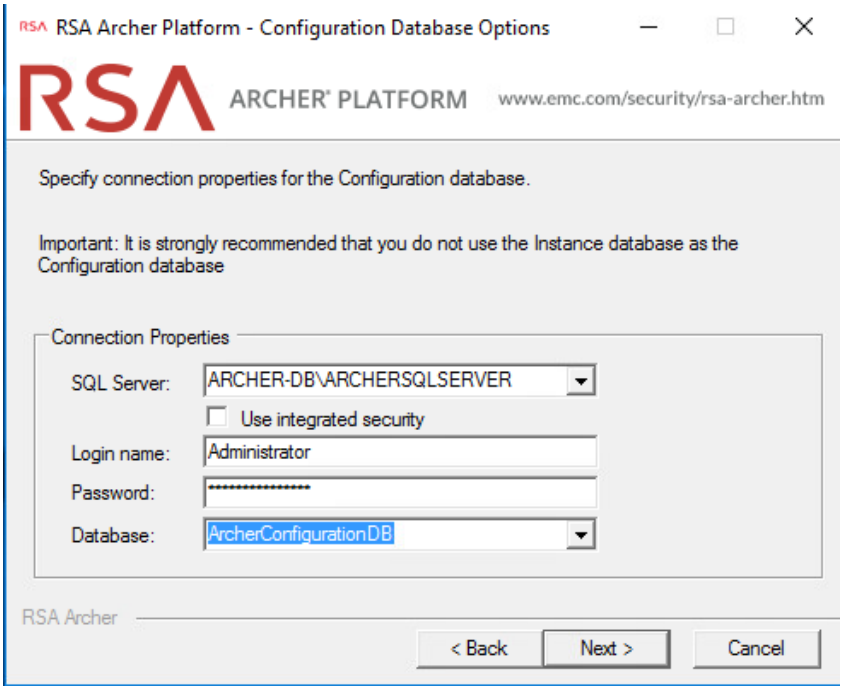
1. Before installing Archer IRM, .NET Framework version 4.7.2 must be installed. It can be downloaded at https://dotnet.microsoft.com/download/dotnet-framework/net472.
2. Extract the zip file that was downloaded from the Archer IRM download page.
3. Open the folder and run the executable **ArcherInstall.**
4. Accept the License Agreement and select **Next.**
5. Select **Next.**
6. For the web server, make sure the components **Web Application, Services,** and **Instance Database** are selected, then select **Next.**



791 7. Select **Create a certificate** from the dropdown menu and select **Next.**

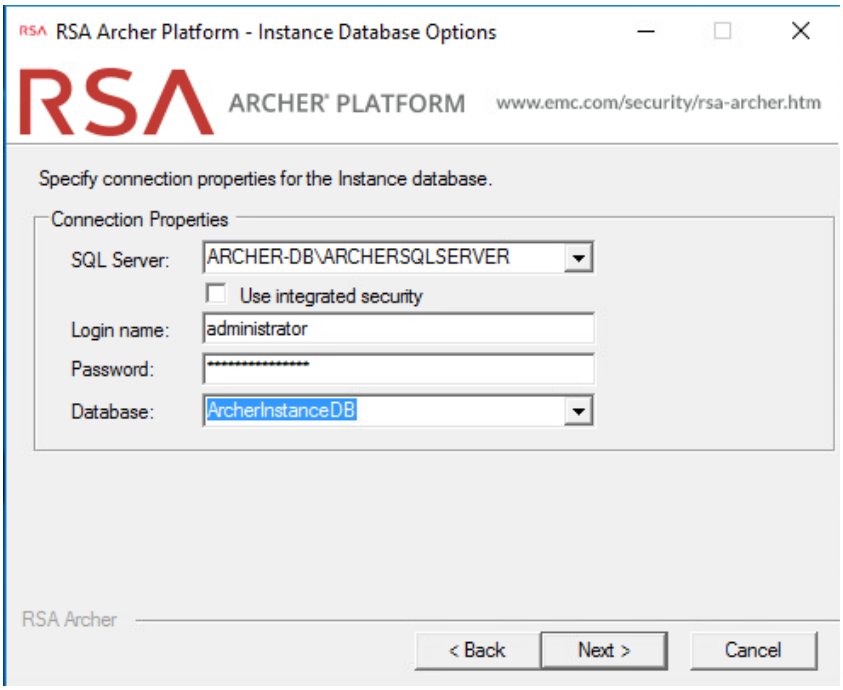


8. Select the database server that was previously created. Enter the credentials that were created in SSMS. Then select the configuration database from the dropdown menu and click **Next.**



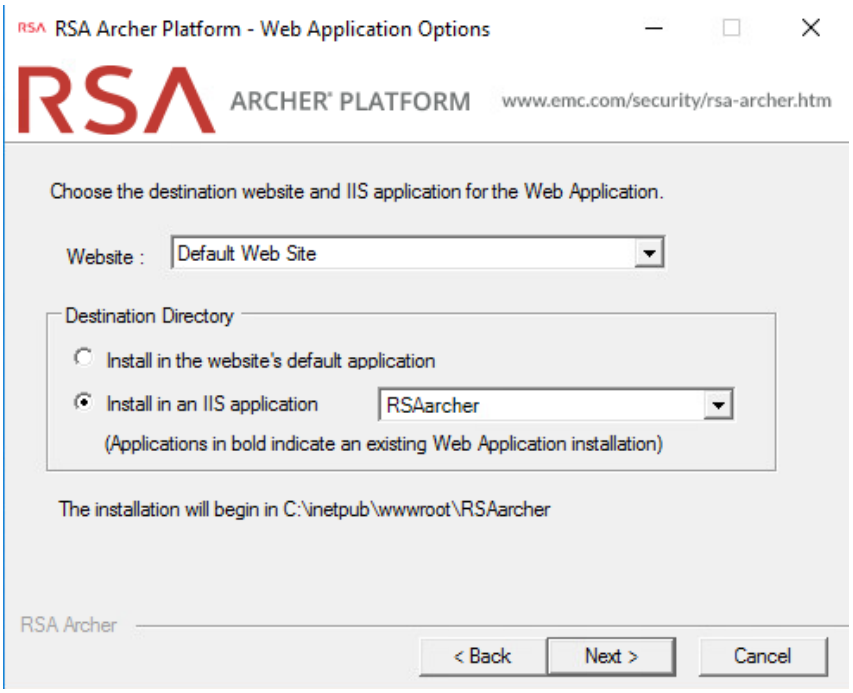
794 9. Select the preferred language from the dropdown menu and select **Next.**

795 10. Repeat step 8 and select the instance database from the dropdown menu. Then select **Next.**



11. Select the time zone and select **Next.**

12. Select **Default Web Site** as the website location and choose the **Install an IIS application** radio button. Select **RSAarcher** from the dropdown menu. Then select **Next.**



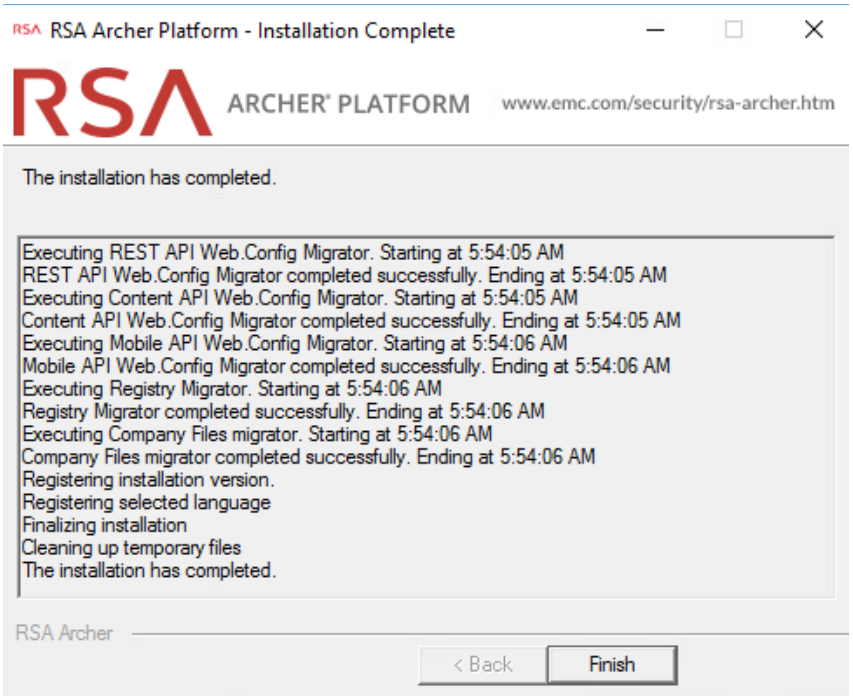
13. To add an Instrumentation Database, repeat step 8 and use the **ArcherLogging** database that was created in SSMS. Otherwise, select **Not using Archer IRM Instrumentation service.** Select **Next.**

14. Specify the account to run the services. Then select **Next.**

15. Confirm or edit the installation paths for the services and application files. Select the **Create Archer IRM program group for all users** radio button. Then select **Next.**

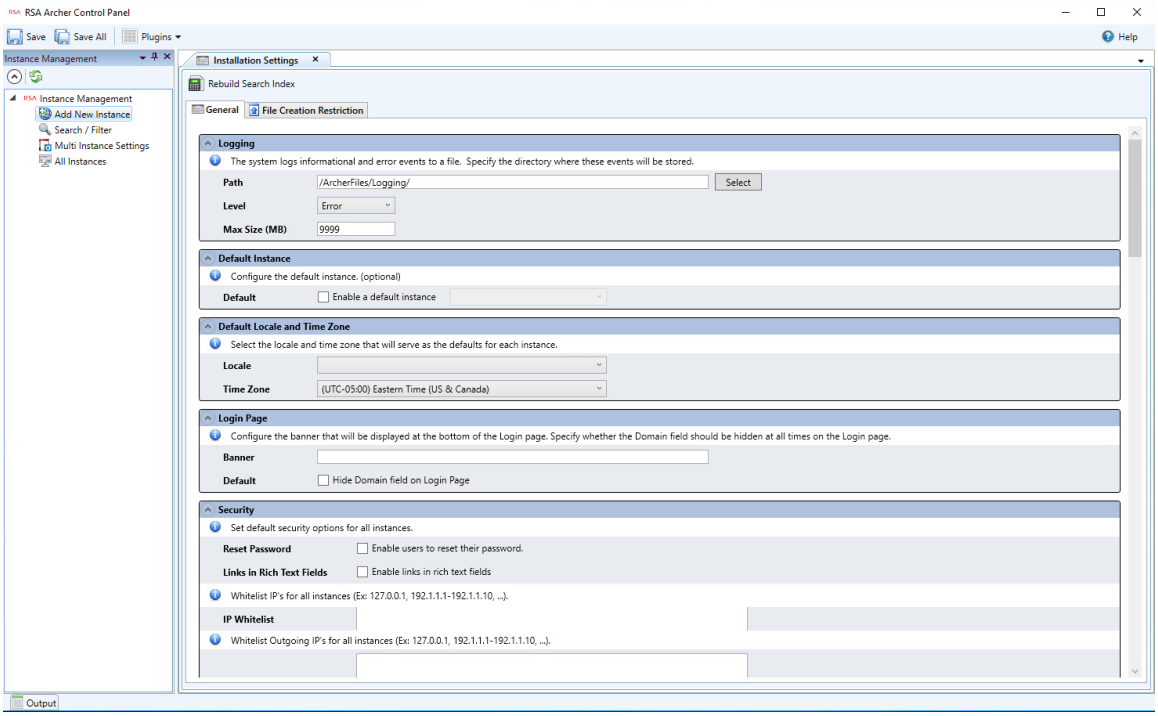
16. Confirm or edit the path for installation logs. Then select **Next.**

17. Select **Install** and wait for the installation to complete. Once completed, select **Finish.**



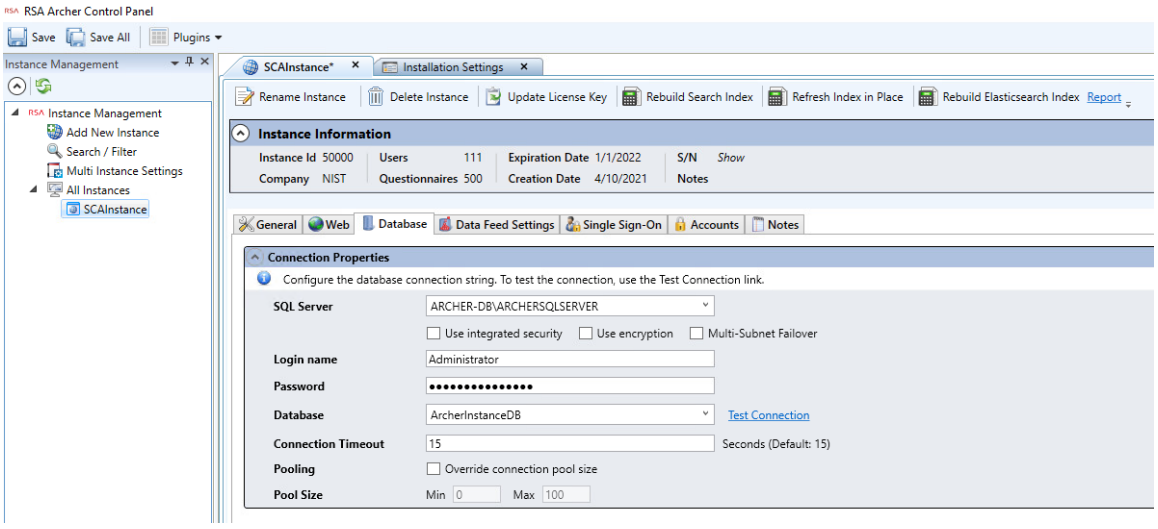
2.8.2.1 Configure Options in the Control Panel

1. Open the RSA Control Panel.
2. In the left pane, select **Add New Instance.**



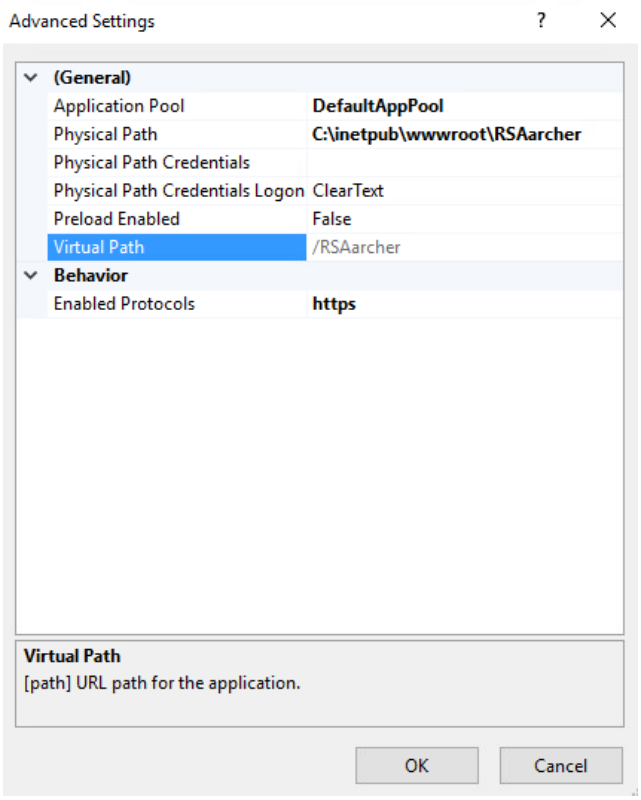
3. Enter a name for the instance in the **Instance Name** field. Select **Go.**

4. Double-click on the new instance. Input the required information in the **General**, **Web**, and **Database** tabs. When completed, click **Save** in the top left corner.

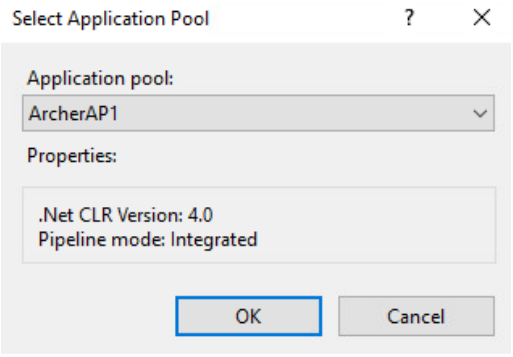


2.8.2.2 Add New Application to Application Pool

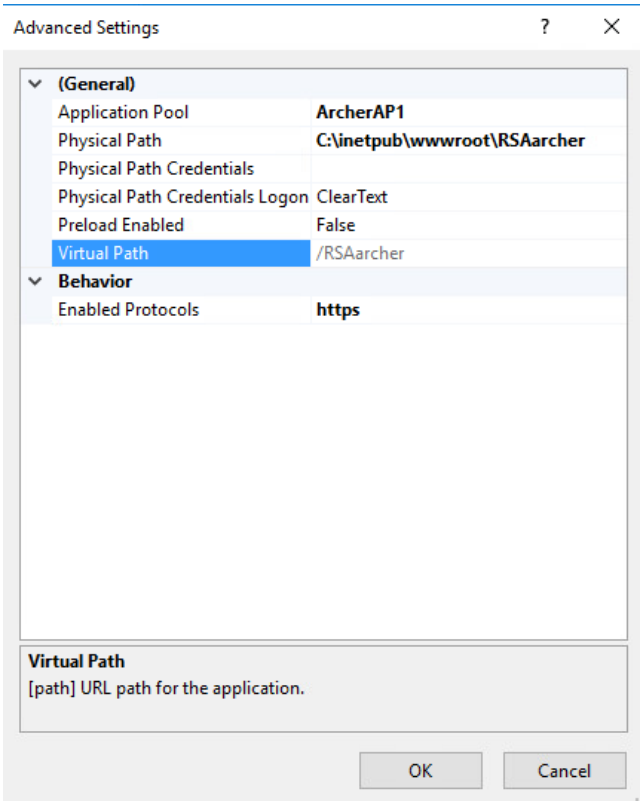
1. Navigate back to IIS. Expand the web server directory, expand the **Sites** directory, and expand the **Default Web Site** directory.
2. Select the RSAarcher site. Click on **Authentication** and ensure that **Anonymous Authentication** is the only thing that is enabled.
3. Right-click on the RSAarcher site and select **Manage Application > Advanced Settings.**
4. Click on **Application Pool** and select the ellipsis button. You will see a screen similar to the following:



5. Select the application pool that was previously created and select **OK.**



822 6. Select **OK.** You should see something similar to the screenshot below:



823 7. Restart the Archer IRM site.

824 8. Open a browser and navigate to the URL that was set in the RSA Control Panel application. If the
825 following page displays, then Archer IRM installed successfully.

2.9 Seagate

Seagate contributed three hard drives (Table 2-6) stored within a 2U12 enclosure. As described in Section 2.7.2, the enclosure is connected to our demonstration Intel server via a Serial Attached SCSI (SAS) interface. The demonstration server did not have the required SAS interface, so we purchased a Broadcom 9500-8e Tri-Mode Storage Adapter to complete the connection.

Table 2-6 Seagate Hardware Contribution

Machine Name	Operating System	Manufacturer	Model
N/A	N/A	Seagate	Exos 18TB Self Encrypting Hard Disk Drive x 3
N/A	N/A	Seagate	Exos E 2U12 Rackmount Enclosure

Once the enclosure is connected to the server, power on the server into the native Linux environment. Execute the **lshw** command which prints detailed hardware information about the server. The output should resemble the following for one of the Seagate drives. Note that because these are SAS drives there are two paths to the drive. As a result, you will notice two */dev/sdx* devices pointing to the same physical drive.

```
       *-disk:0
                    description: SCSI Disk
                    product: ST18000NM005J
                    vendor: SEAGATE
                    physical id: 0.0.0
                    bus info: scsi@0:0.0.0
                    logical name: /dev/sdb
                    version: ET02
```

```
                        serial: ZR5056HD0000C107GP5G
                        size: 16TiB (18TB)
                        capacity: 45TiB (50TB)
                        capabilities: 7200rpm
                        configuration: ansiversion=7 logicalsectorsize=512
        sectorsize=4096
```

Additionally, we recommend using Seagate's command line interface tool that communicates with the drives via the Trusted Computing Group (TCG) Storage API to confirm successful integration. Use the following command to print drive information:

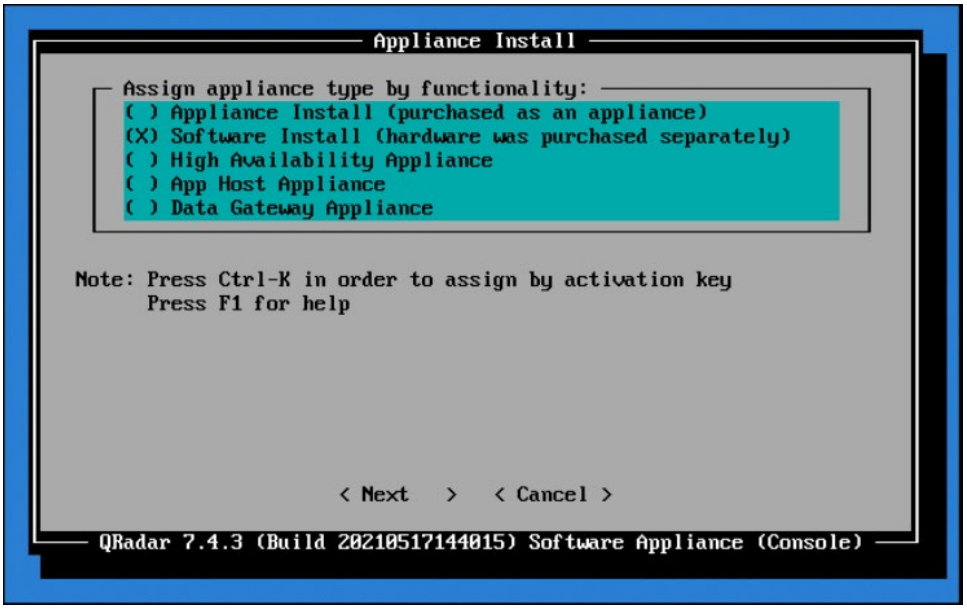
```
python3 sed_cli.py --device=/dev/sdb --operation=printdriveinfo
```

2.10 IBM QRadar

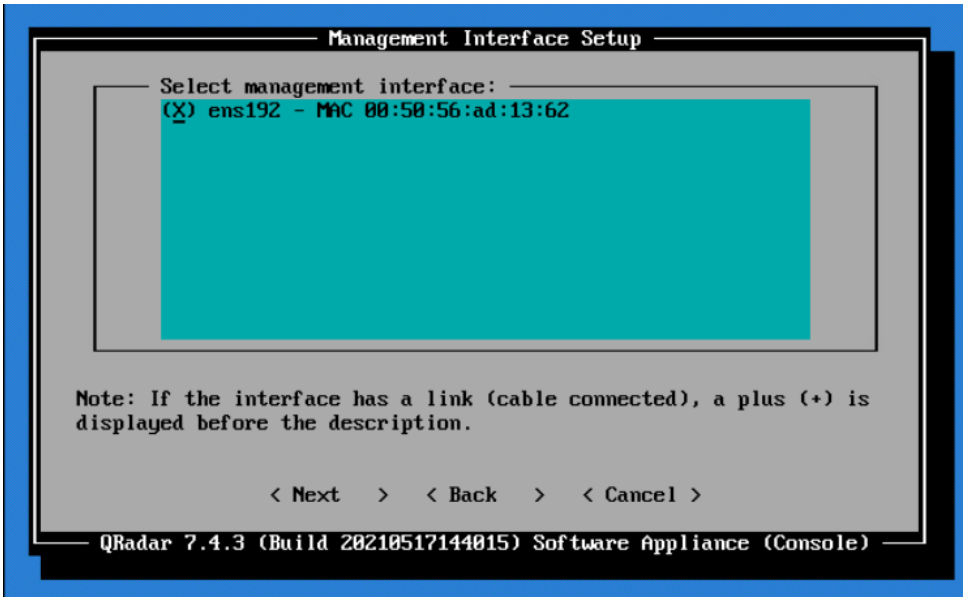
This section describes the installation of the IBM QRadar system for this demonstration. Our instantiation of IBM QRadar is viable for a lab environment, but the reader is encouraged to refer to the architecture planning guide on the IBM website for specific guidance for your environment.

We opted to install the full IBM QRadar suite onto a single virtual machine via an ISO provided by the IBM engineering team. Note that Red Hat Enterprise Linux Server V7.6 (or binary equivalent) must be deployed on the virtual machine before the QRadar installation. Once this prerequisite is met, boot the virtual machine using the ISO provided by IBM. This process will be unique to your environment. Next, follow the instructions provided by the IBM documentation website. The remainder of this section includes example screenshots from the installation wizard we used in our environment.

1. Select the **Software Install** option for the appliance type.



2. For the functionality, select **"All-In-One" Console.**
3. Select **Normal Setup (default)** as the type of setup.
4. Either manually adjust the date and time, or add the name or IP address of a Network Time Protocol (NTP) server to automatically update the date and time.
5. Select the appropriate time zone.
6. Select the appropriate network adapter that will allow communication with the installed system.



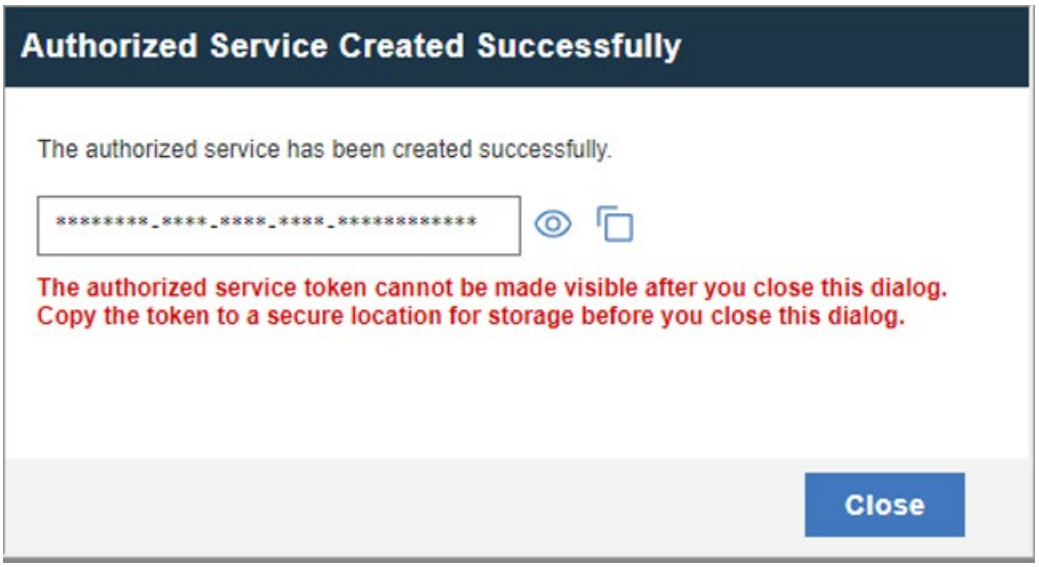
7. Enter the network information for this installation. Note that only static addresses are supported.
8. Set the Admin user password.
9. Set the Root password for console access.

2.10.1 WinCollect Agent

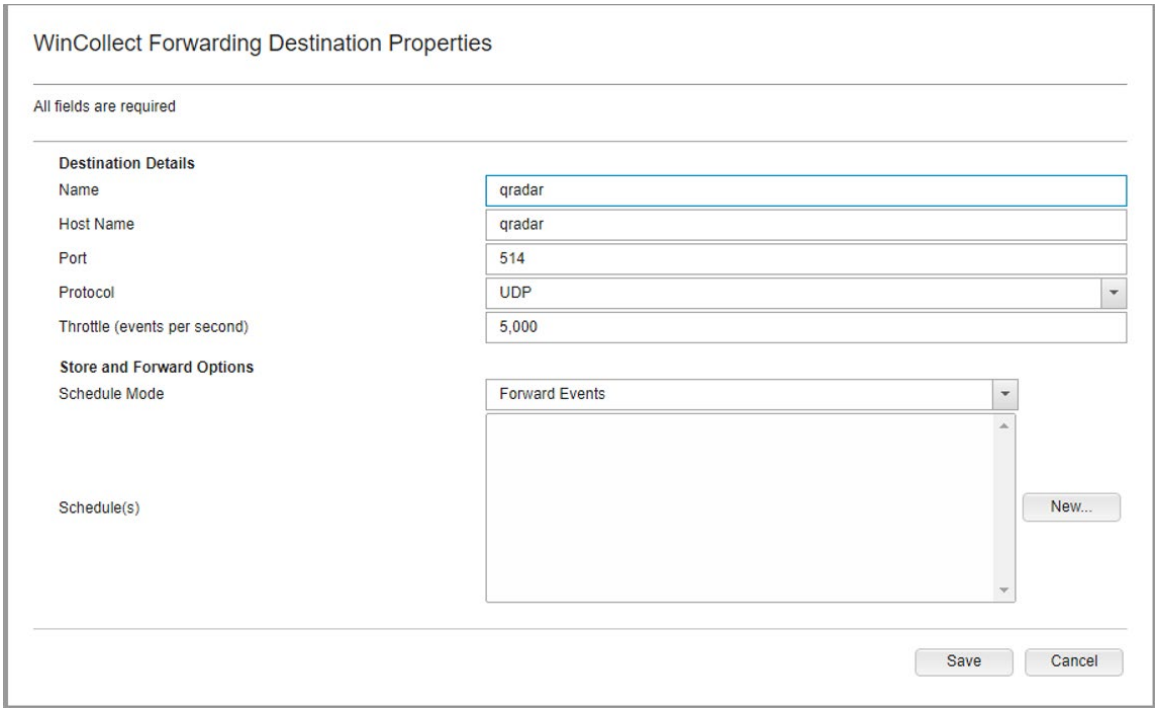
On a separate Windows Server system, configure and install the WinCollect agent. This component polls the remote hosts (laptops), and then sends event information to QRadar.

1. Install the WinCollect application on the QRadar system if not already present or upgrade to the latest version. This process is documented on the IBM website.

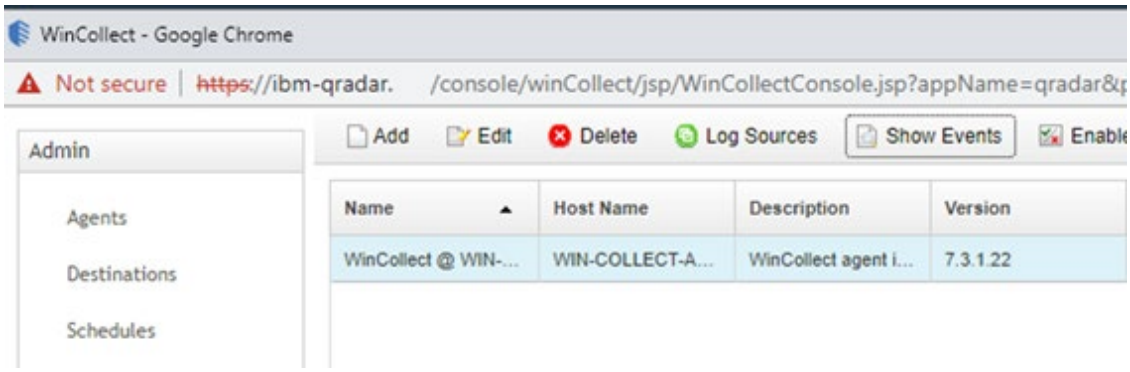
2. Create an authentication token so that the managed WinCollect agents can exchange data with QRadar appliances. This process is documented on the IBM website. Note that you will not be able to retrieve the token from QRadar after it has been created.



3. Configure a forwarding destination host for the log source data. This process is documented on the IBM website. Enter the appropriate values for your environment.



4. Install the managed WinCollect agent on the Windows Server host. This process is documented on the IBM website. If successful, the agent will appear in the QRadar console under **Admin > Data Sources > WinCollect > Agents.**



2.11 Integrations

This section describes the steps we took to configure and integrate the products described earlier in this volume. The integrations are generally network-based and require connectivity both between the systems and to Internet-based cloud services.

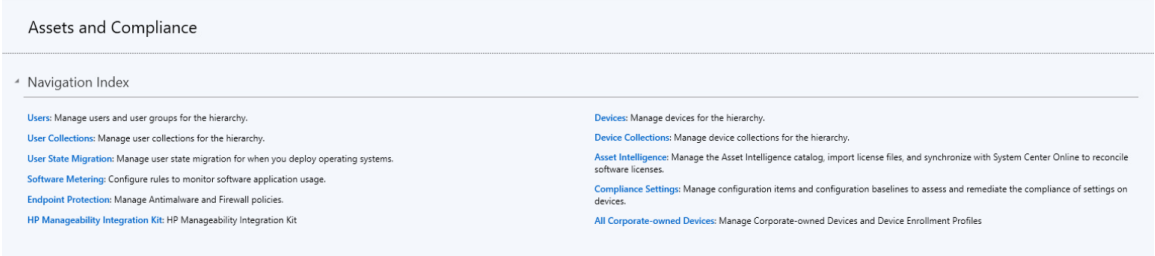
2.11.1 Microsoft Endpoint Configuration Manager and Platform Validation Tools

For the Intel laptops, a command-line version of the AutoVerify tool named TSCVerifyUtil periodically monitors the changes to laptop components. A custom PowerShell script installed on each laptop and run every hour via task scheduler captures the result of TSCVerifyUtil execution and stores it in the Windows registry. This section describes how to configure Microsoft Endpoint Configuration Manager to run a configuration baseline which monitors the results of the customized PowerShell script. This data is reflected in the Archer IRM dashboard.

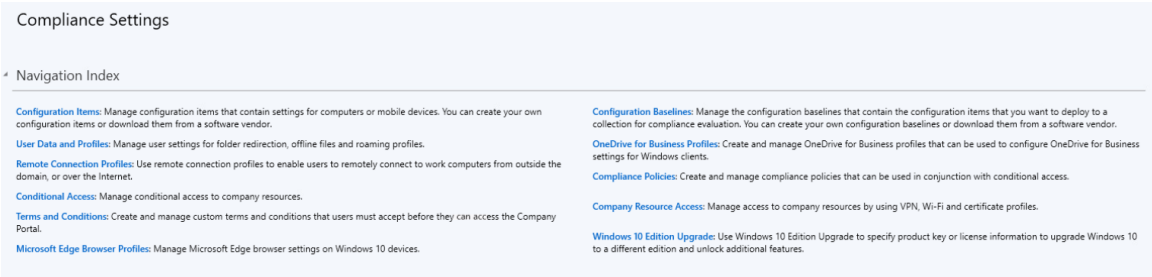
Similarly for HP Inc. and Dell laptops, the HIRS-ACA Windows-based Provisioner periodically monitors the changes to laptop components. We chose to use the same monitoring approach for consistency – the Windows task scheduler captures the result of the Provisioner execution and stores it in the Windows registry. Repeat this section to configure Microsoft Endpoint Configuration Manager with the HIRS Provisioner, changing input where noted.

2.11.1.1 Set Up Configuration Item

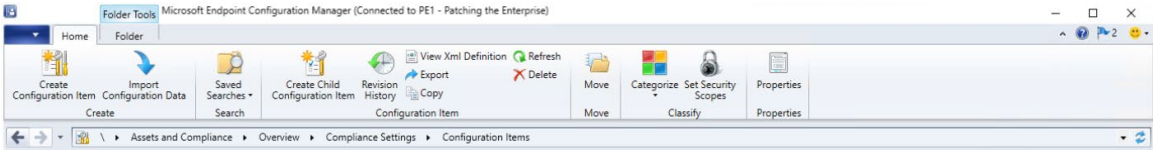
1. In the Microsoft Endpoint Configuration Manager console, under **Assets and Compliance > Overview**, select **Compliance Settings**.



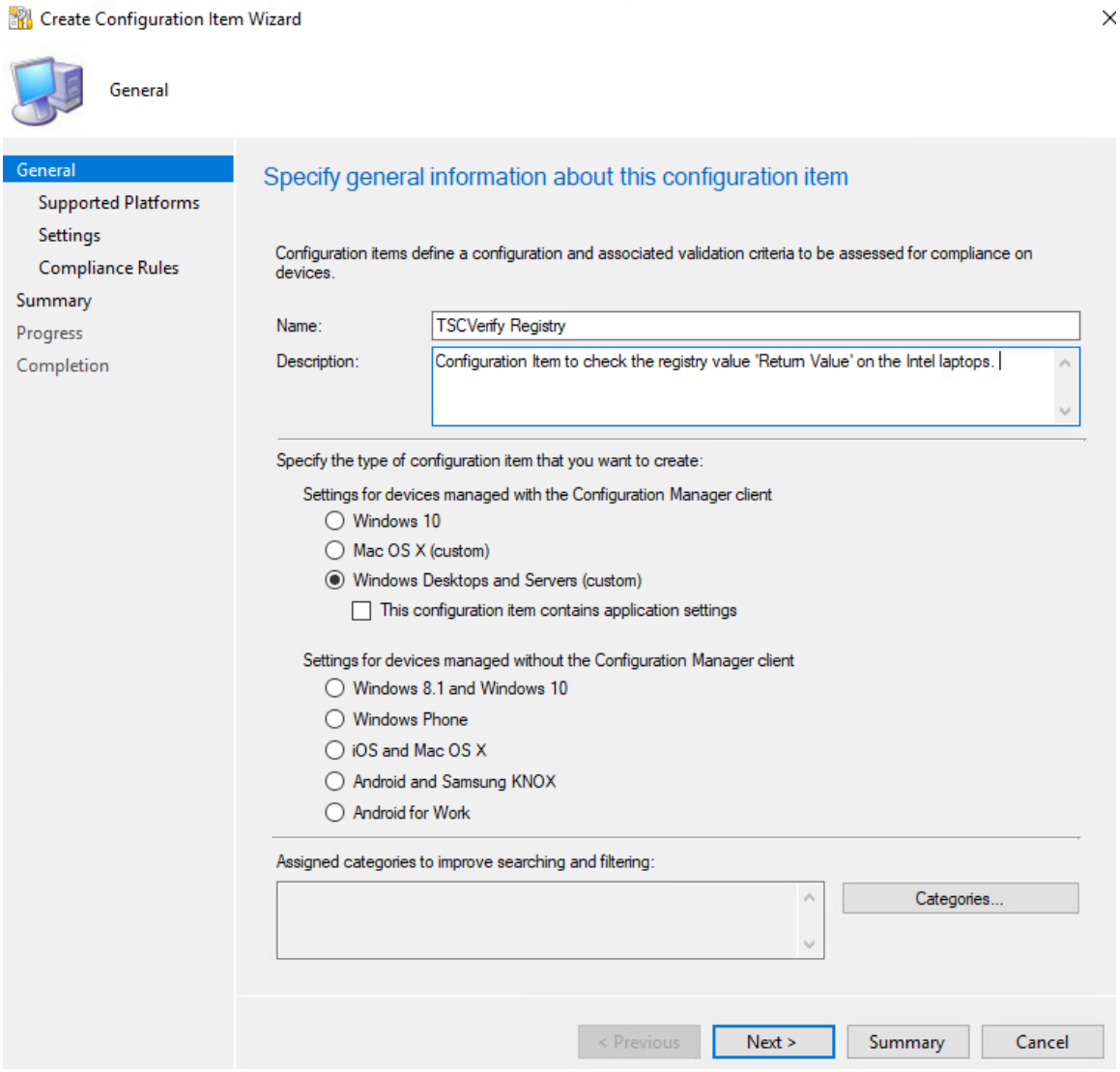
908 2. Next, select **Configuration Items**.



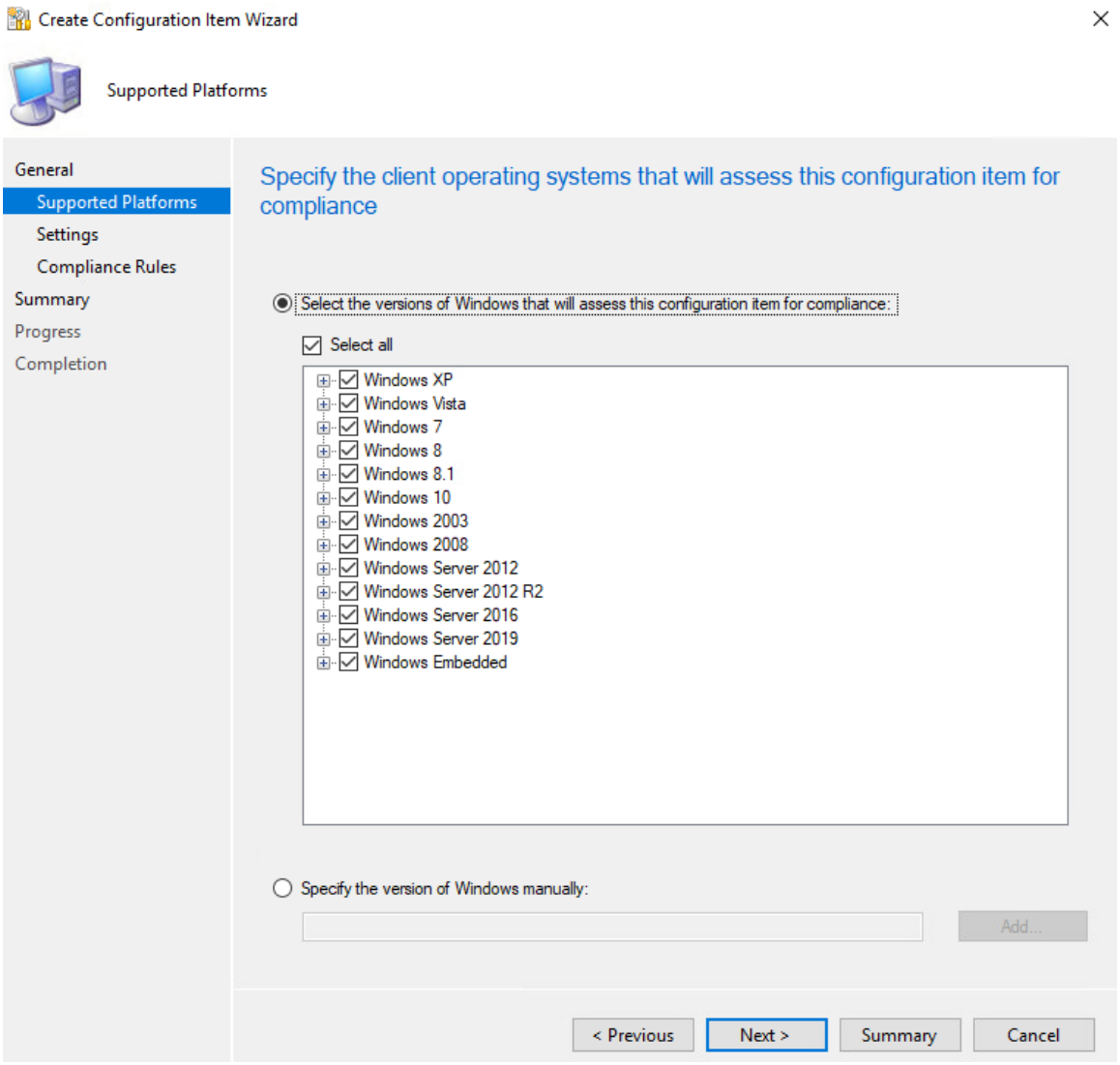
909 3. From the **Home** panel at the top, select **Create Configuration Item**.



910 4. Enter a name and description for the configuration item in the **Name** and **Description** fields.
911 Ensure that **Windows Desktops and Servers (custom)** is selected. Then select **Next.**

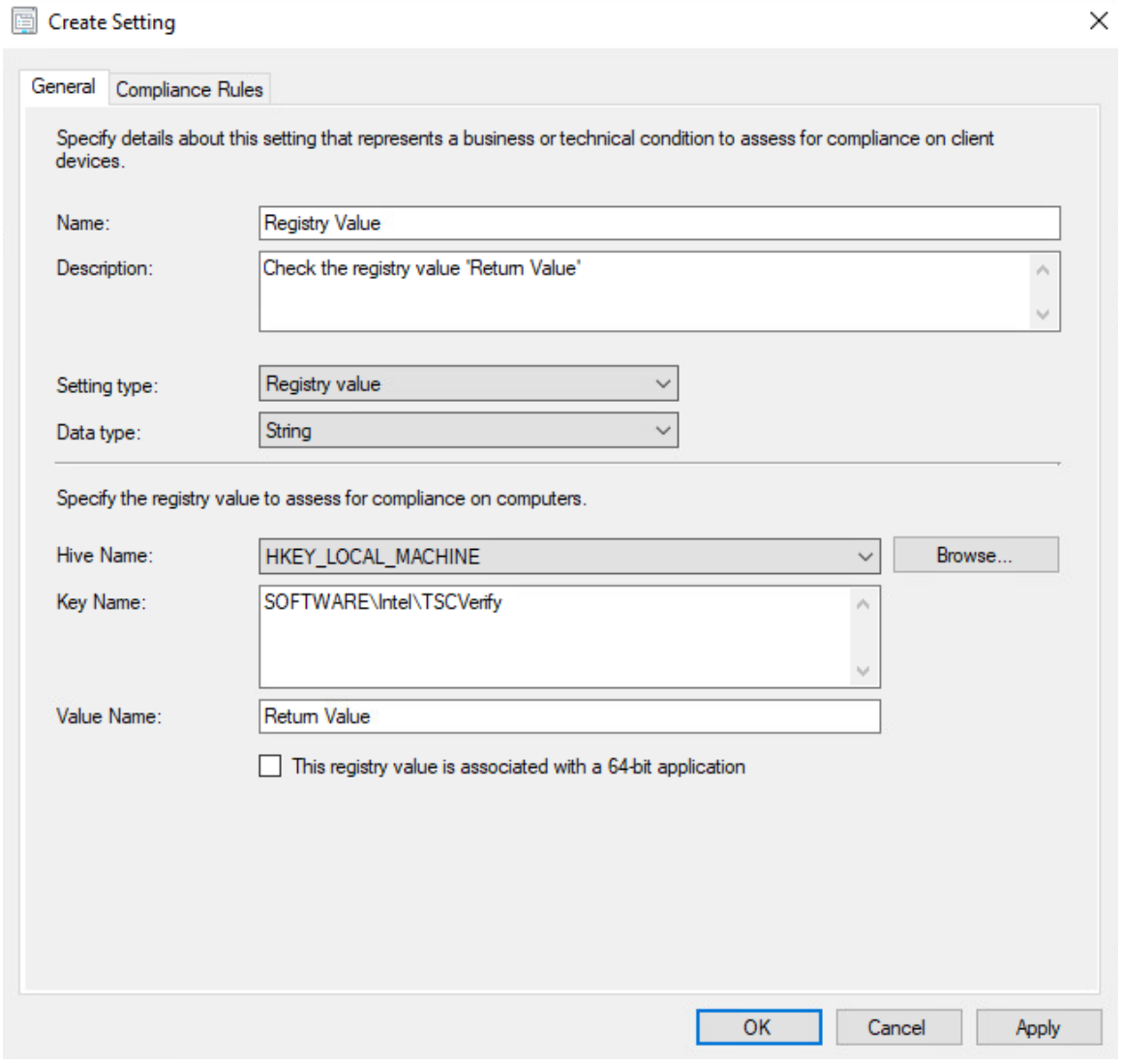


912 5. Ensure that all versions are selected and click **Next.**



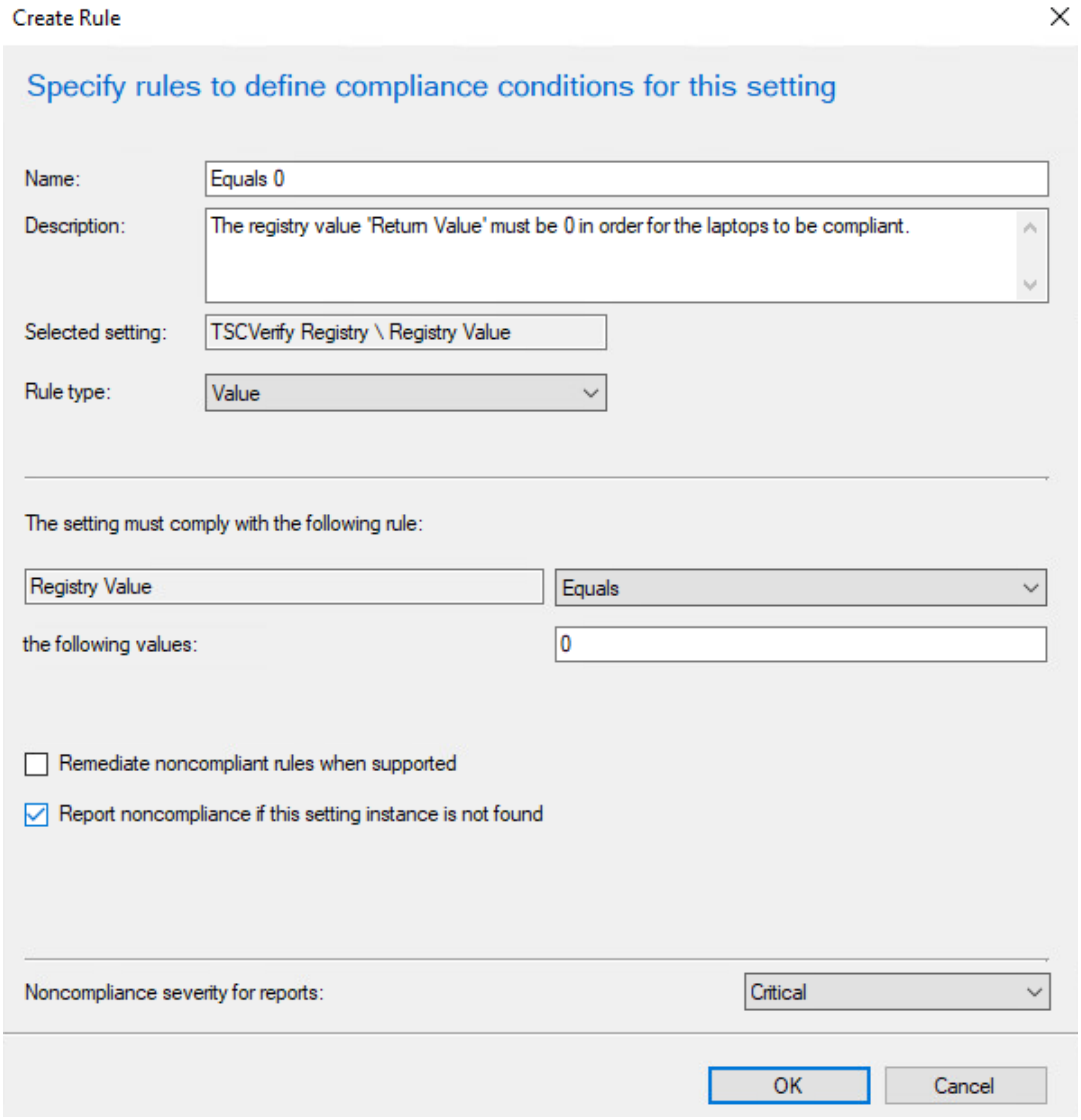
913 6. On the **Settings** tab, select **New**.

914 7. On the **General** tab, enter a name and description in the **Name** and **Description** fields. For
915 **Setting type**, select **Registry value** from the dropdown. For **Data type**, selection **String** from the
916 dropdown. To specify the registry value, select the appropriate **Hive Name** and enter the **Key**
917 **Name** and **Value Name** in their respective fields (Note: When configuring the HIRS Provisioner,
918 use `SOFTWARE\HIRS\provisioner` as the **Key Name**). Next, switch to the **Compliance Rules** tab.

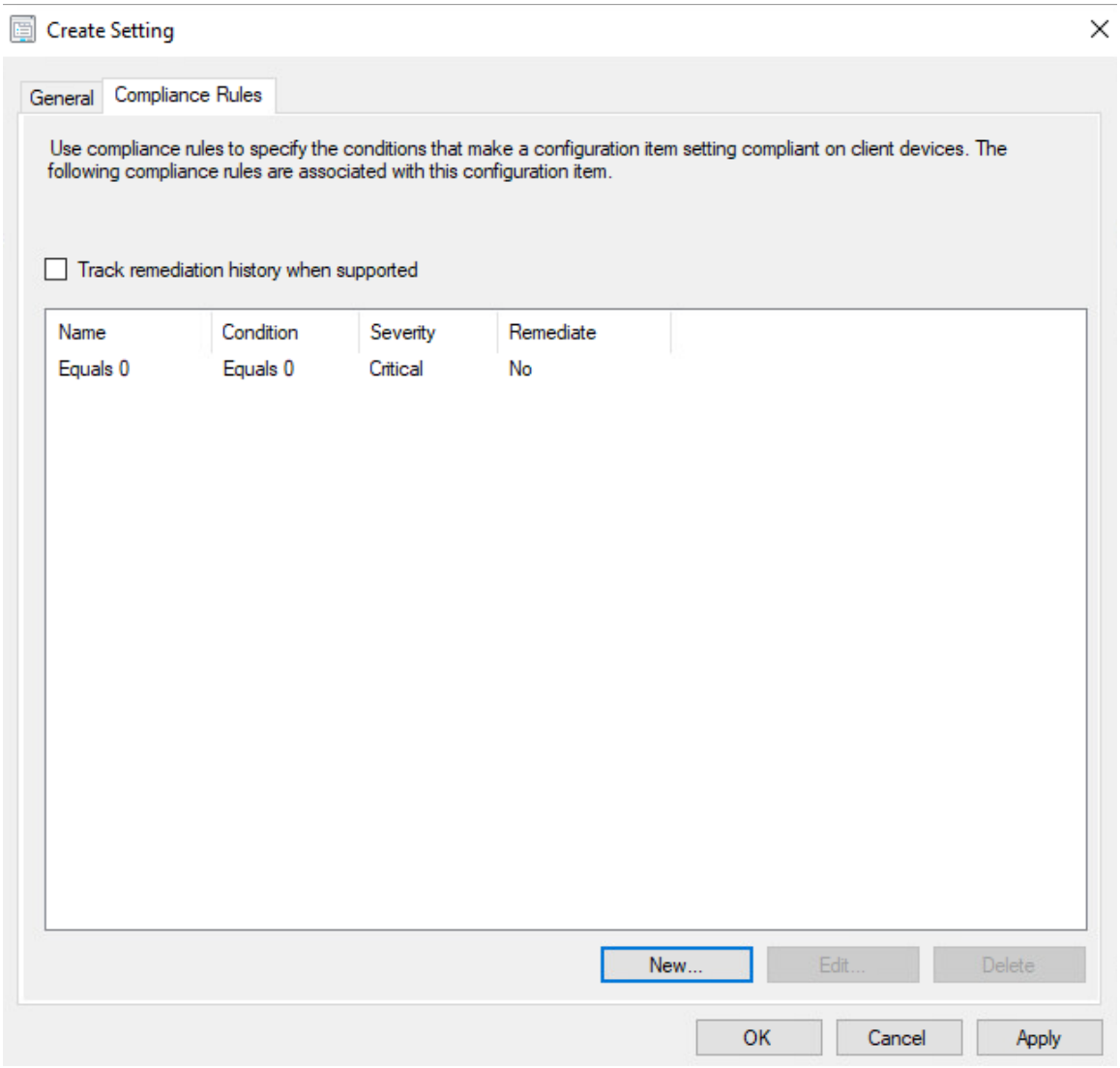


8. Select **New.**

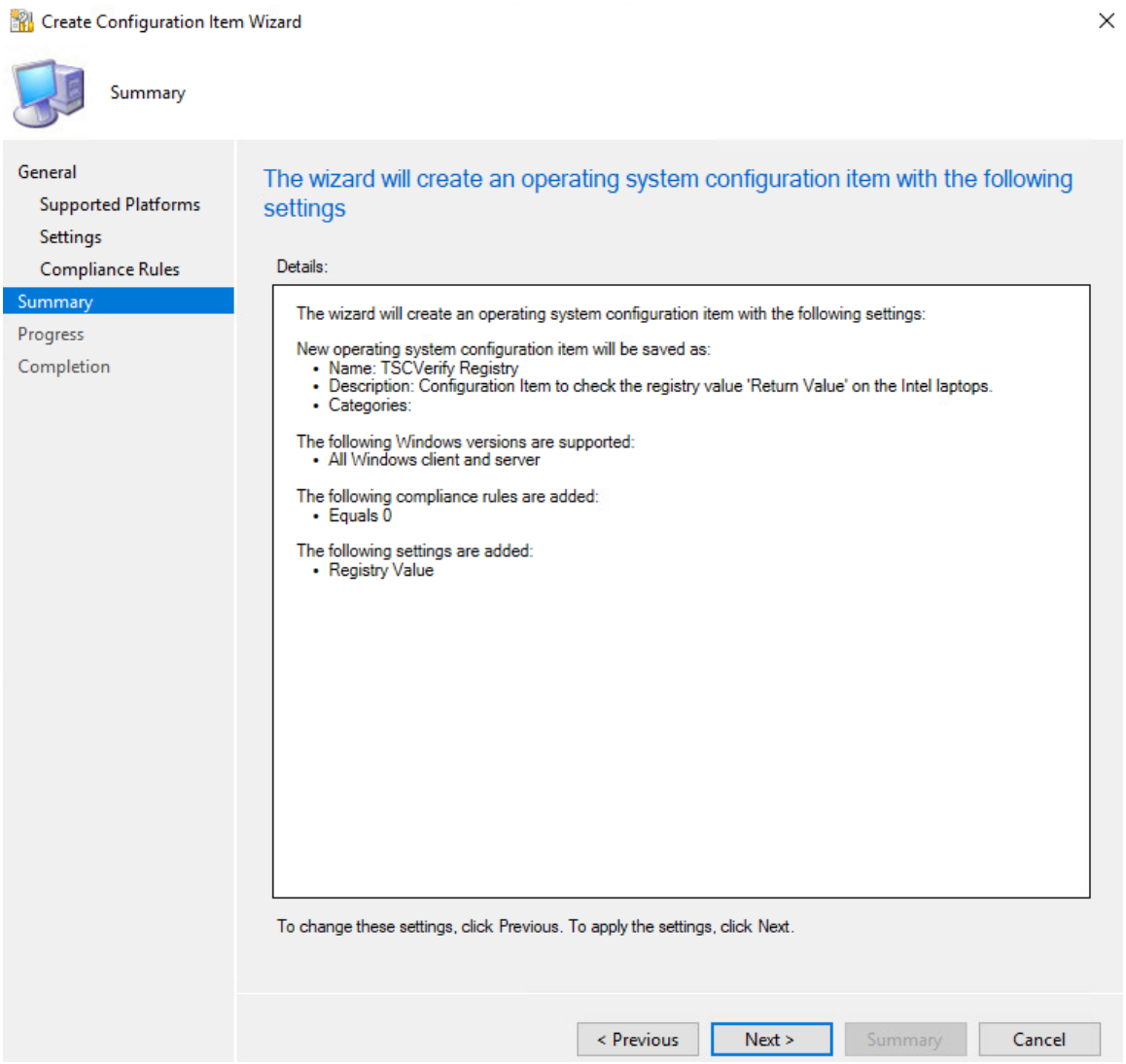
9. Specify the name and description for the rule in the **Name** and **Description** fields. For **Rule type**, select **Value** from the dropdown. Under **The setting must comply with the following rule**, select **Registry Value** and **Equals**, and enter 0 (zero) in **the following values:** field. Ensure that **Report noncompliance if this setting instance is not found** is selected. Choose the **Noncompliance severity for reports** appropriate for your environment. Then select **OK**.



925 10. Select **Apply**. Then select **OK**.



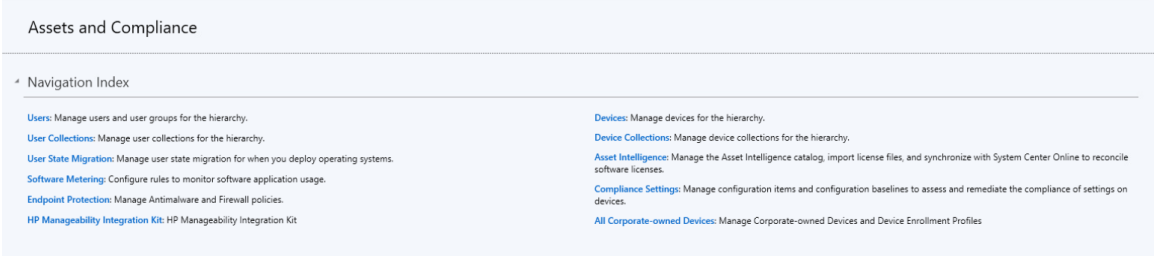
926 11. Review the configurations on the Summary page. After confirming that the configurations are
927 correct, select **Next**.



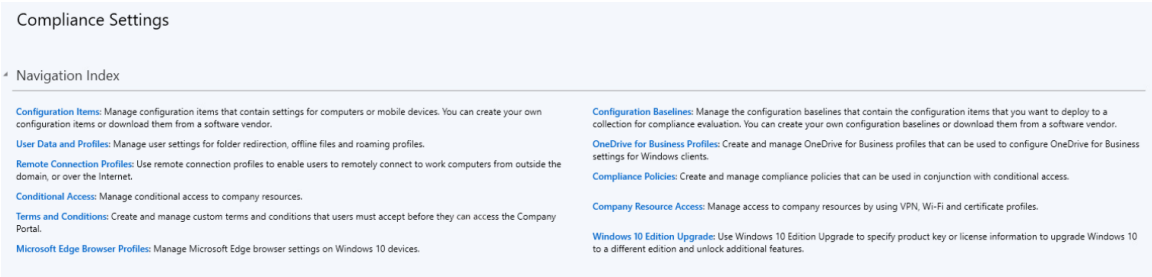
928 12. After the wizard completes, select **Close.**

929 ### *2.11.1.2 Set Up Configuration Baseline*

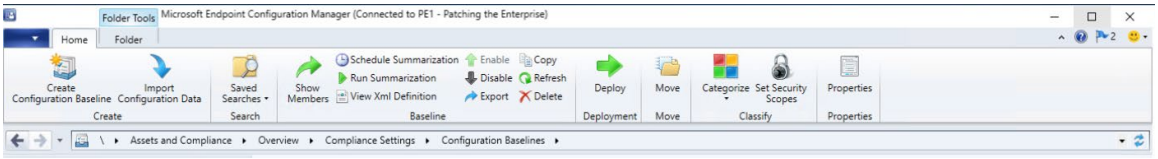
930 1. In the Microsoft Endpoint Configuration Manager console, under **Assets and Compliance >**
931 **Overview**, select **Compliance Settings**.



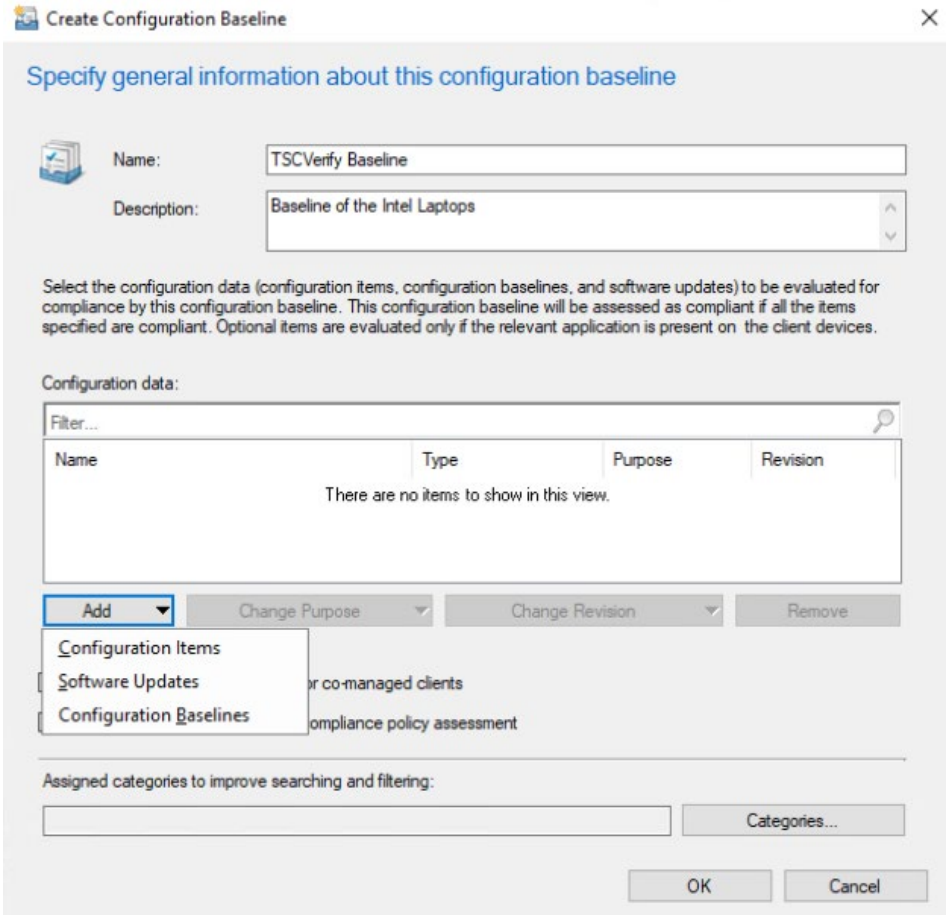
932 2. Next, select **Configuration Baselines**.



933 3. From the **Home** panel at the top, select **Create Configuration Baseline**.

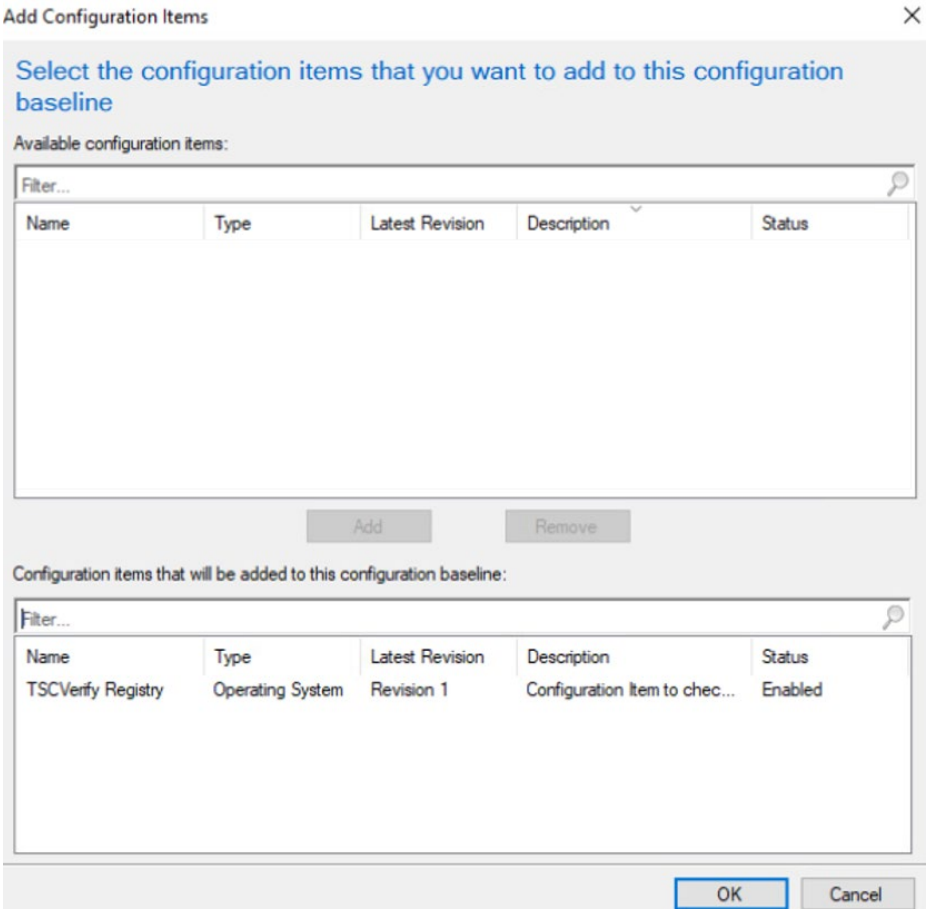


934 4. Provide a name and description for the configuration baseline in the **Name** and **Description**
935 fields. Next, select **Add** and choose **Configuration Items**.

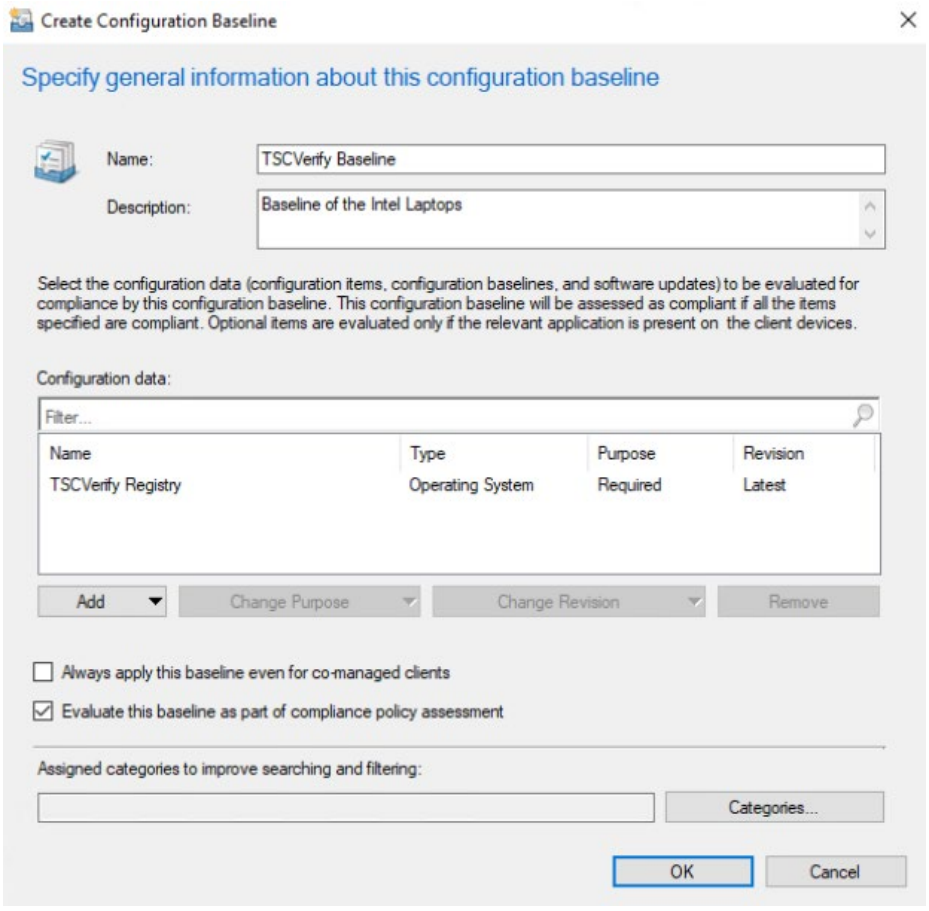


936 5. Select the previously created configuration item from the list and select **Add**.

937 6. Select **OK**.

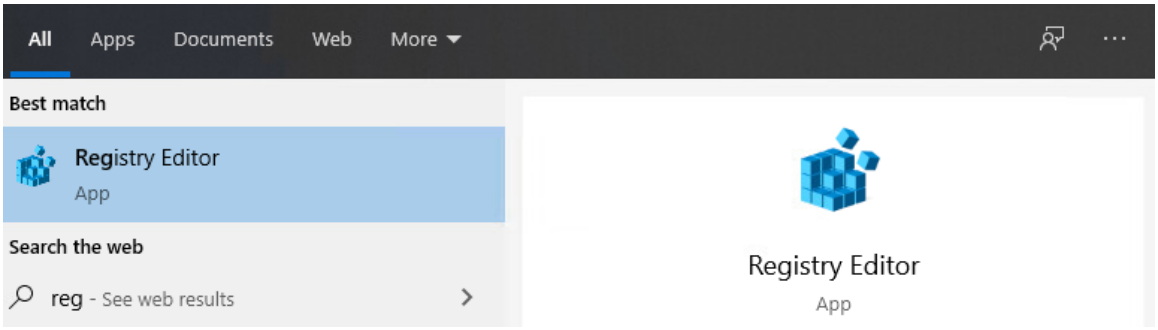


938 7. Select **OK**.

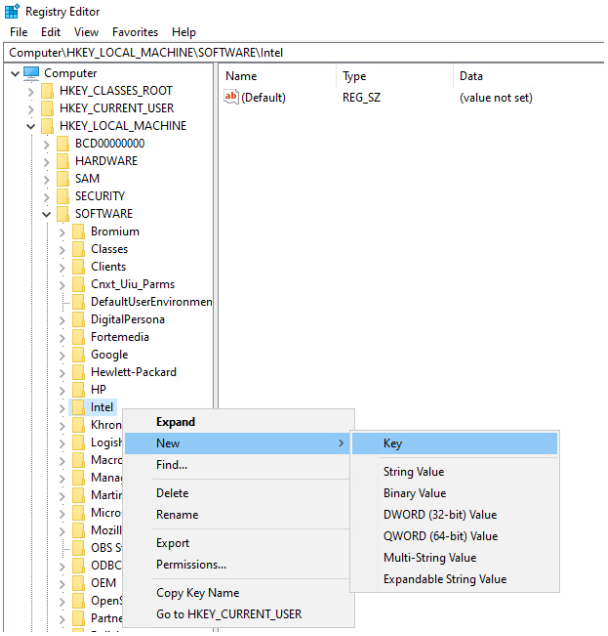


2.11.1.3 Set Up Registry Entry on Intel Devices

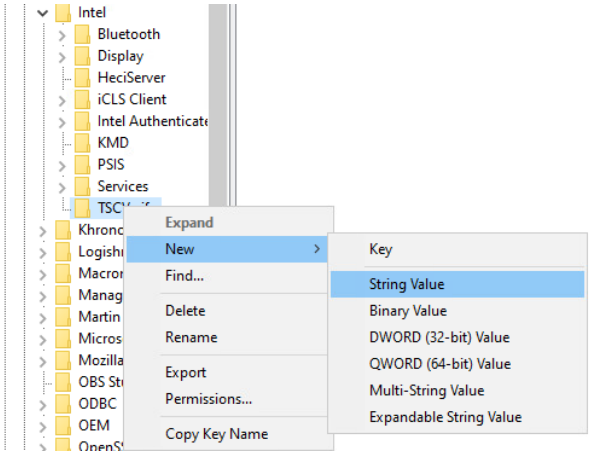
1. On the Windows 10 laptop, go to **Start**, search for the **Registry Editor,** and open that program.



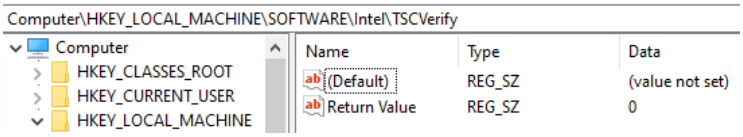
2. Find the Intel folder located in **HKEY_LOCAL_MACHINE\SOFTWARE**. Right click and select **New > Key**. Name the key **TSCVerify**.



943 3. Select the **TSCVerify** key, right-click and select **New > String Value**.



944 4. Enter *Return Value* in the **Name** field.



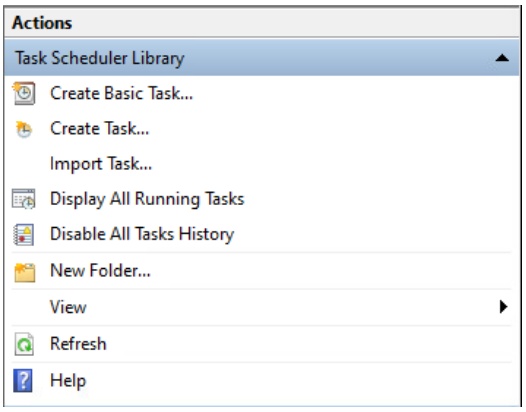
2.11.1.4 Run Script Via Task Manager

1. Place the script onto the local machine (snippet shown below). A copy of this script can be obtained from our repository.

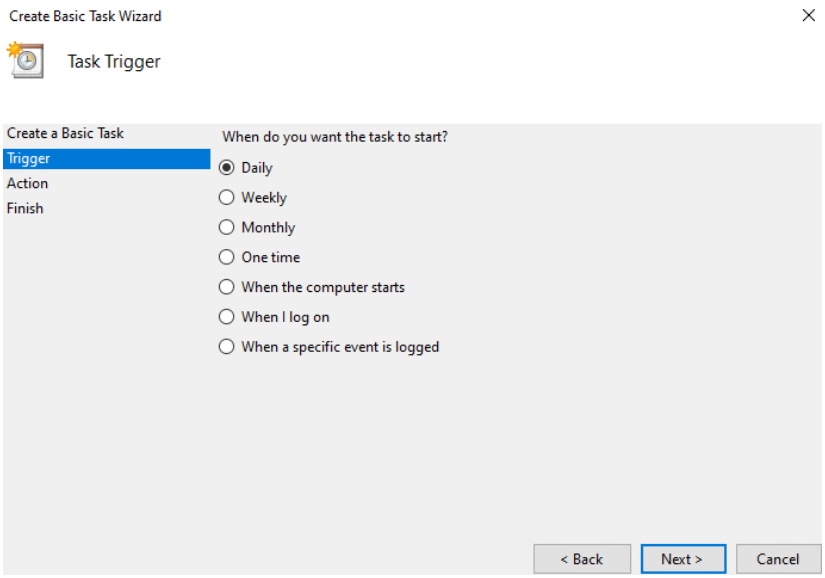
```
# Run Scan and capture exit code.
# 0=No components have changed and platform certificate validation passed
# 1=At least one component has changed OR platform certificate validation
failed
# 2=At least one component has changed AND Platform Certificate validation
failed


# Write-Output "Starting DPD file scan and compare..."
$tscpinfo = New-Object System.Diagnostics.ProcessStartInfo
$tscpinfo.FileName = "TSCVerifyTool_3.40.exe"
$tscpinfo.WorkingDirectory = $artifactdirectory
$tscpinfo.RedirectStandardError = $true
$tscpinfo.RedirectStandardOutput = $true
$tscpinfo.UseShellExecute = $false
$tscpinfo.Arguments = "SCANREADCOMP -in $dpdfile"
$dpdprocess = New-Object System.Diagnostics.Process
$dpdprocess.StartInfo = $tscpinfo
$dpdprocess.Start() | Out-Null
$stdout = $dpdprocess.StandardOutput.ReadToEnd()
$dpdprocess.WaitForExit()


# Write-Output "Starting Platform Certificate validation ..."
$tscpinfo.Arguments = "PFORMCRTCOMP -in $platformcertificatefile"
$platformcertprocess = New-Object System.Diagnostics.Process
$platformcertprocess.StartInfo = $tscpinfo
$platformcertprocess.Start() | Out-Null
$stdout = $platformcertprocess.StandardOutput.ReadToEnd()
$platformcertprocess.WaitForExit()


# If the return value is nonzero, then the computer is not compliant
$retValue = $dpdprocess.ExitCode + $platformcertprocess.ExitCode
Write-Output $retValue


# Add retValue to registry location
$regPath = "HKLM:\SOFTWARE\Intel\TSCVerify"
Set-ItemProperty -Path $regPath -Name "Return Value" -Value $retValue
```

2. From the **Start Menu**, search for **Task Scheduler** and open the program.

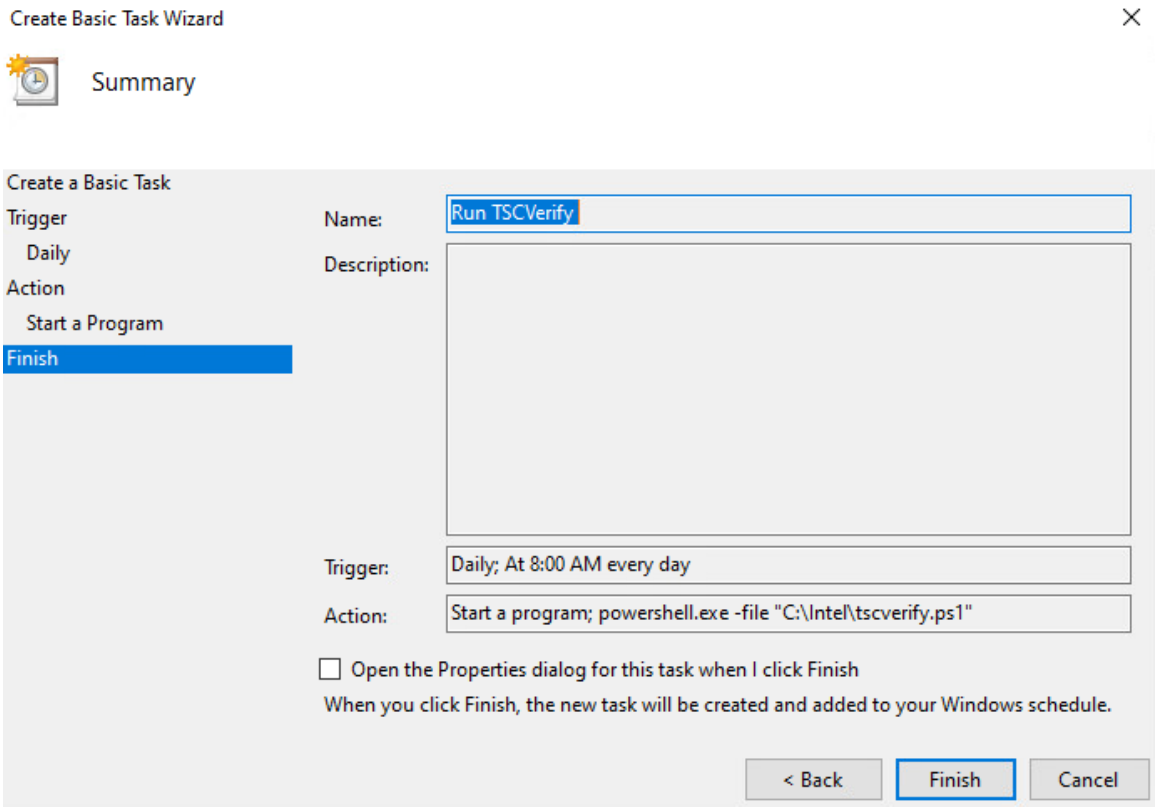
3. Under the **Actions** panel, select **Create Basic Task**.



4. Fill in the **Name** and **Description** fields. Then select **Next**.
5. Select the frequency for this task to run. Then select **Next**.

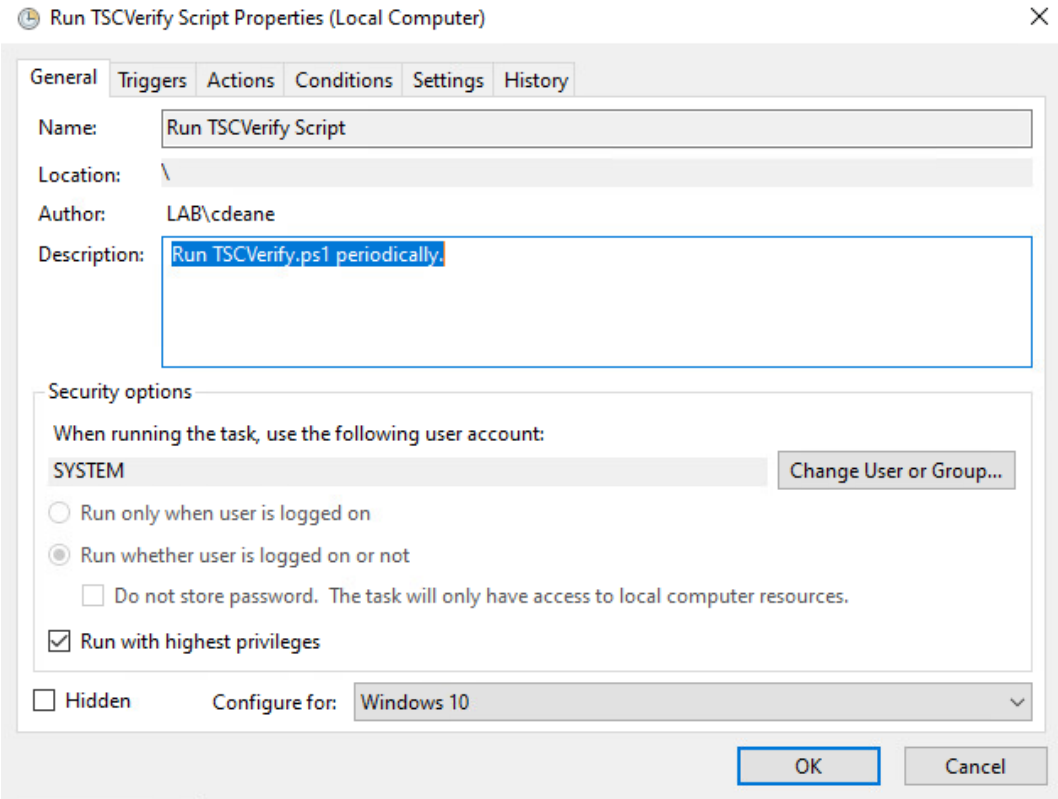


6. Select the start date and time for the task. Then select **Next**.
7. Select the action **Start a program**. Then select **Next**.
8. In the **Start a program** section, type the following in the **Program/script** field: *powershell.exe*. Next, add the following to the add arguments (optional) field: *-file "<Location of script>"*. Then select **Next**.
9. Confirm the settings are correct and select **Finish**.



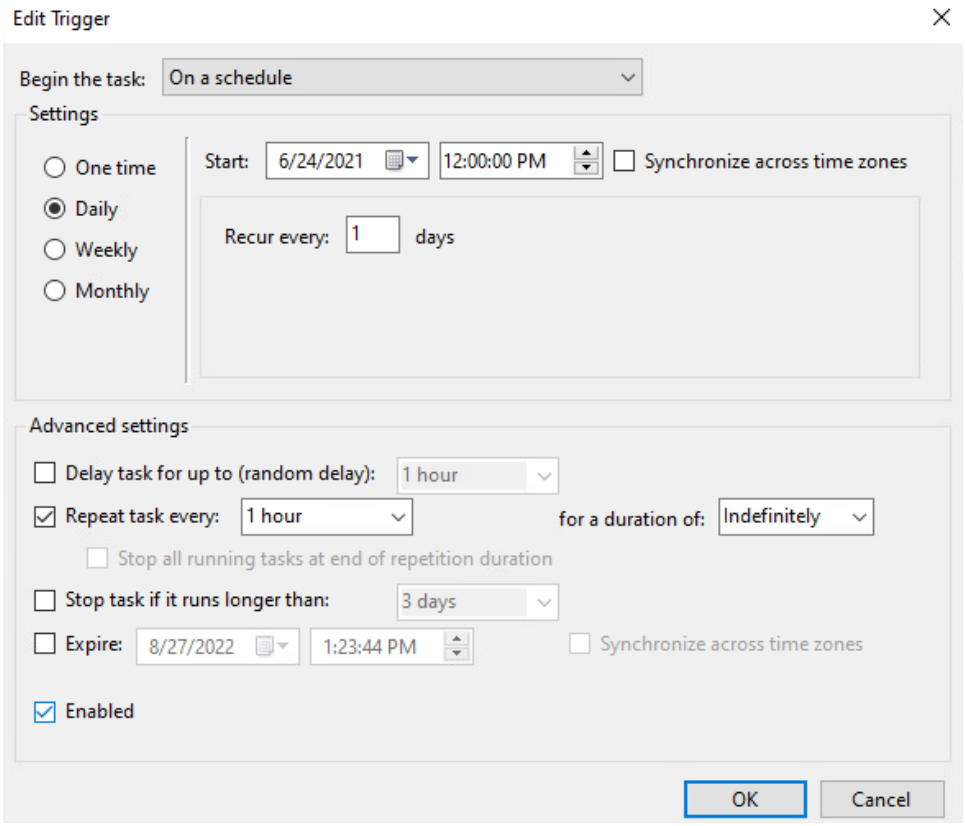
10. On the main page of Task Scheduler, select the newly created task, right-click it, and select **Properties**.

11. On the **General** tab, under **Security Options**, change the user to **SYSTEM**. Next, ensure that the option **Run with highest privileges** is checked.

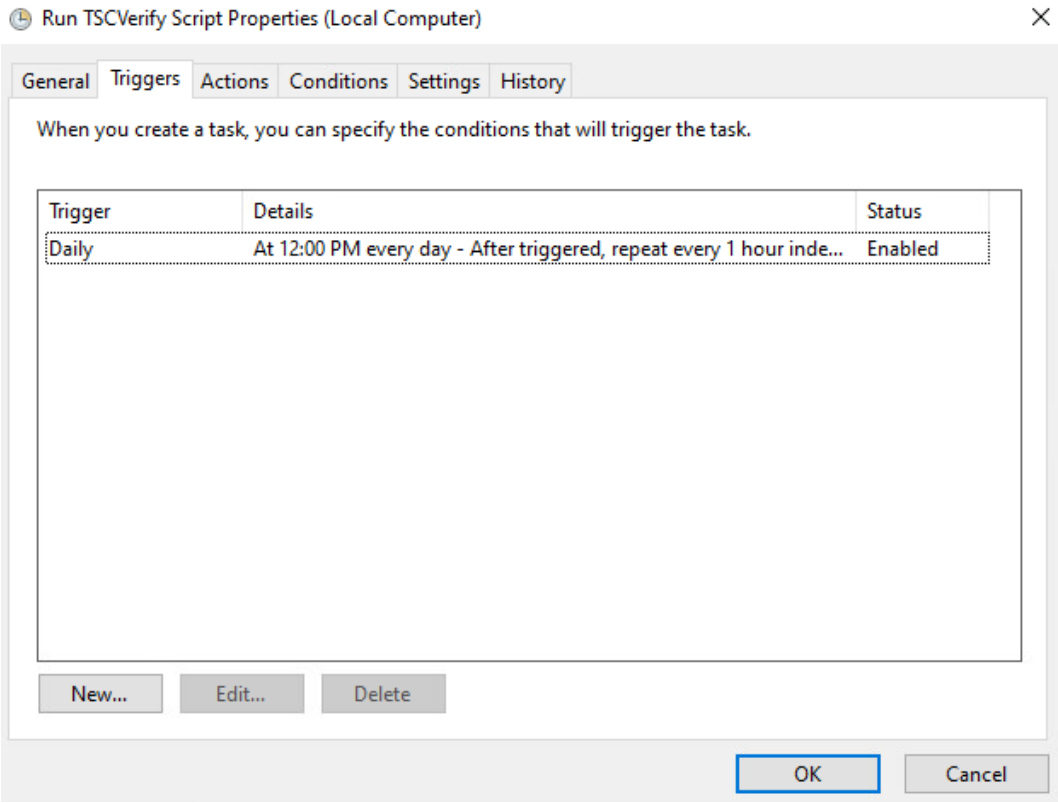


998 12. Navigate to the **Triggers** tab. Select the existing trigger and select **Edit**.

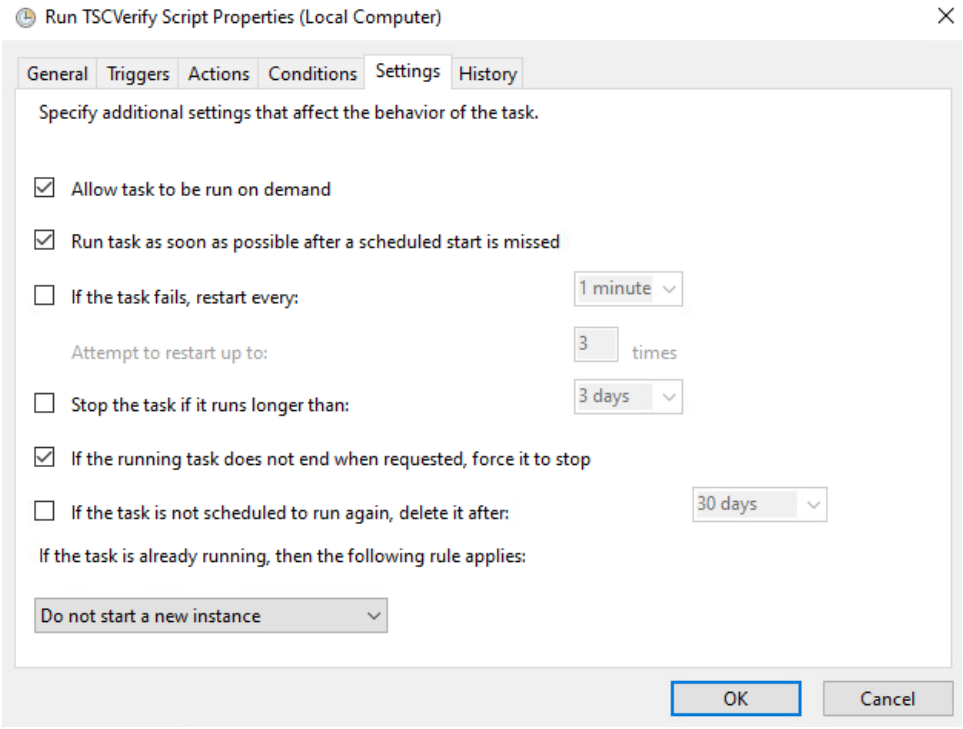
999 13. Under the **Advanced Settings** section, ensure that **Repeat task every 1 hour for a duration of**
1000 **Indefinitely** is checked, as well as **Enabled**. Select **OK**.



1001 14. Select **OK**.



15. Navigate to the **Settings** Tab and ensure the following are checked, then select **OK**.
    a. Allow task to be run on demand
    b. Run task as soon as possible after a scheduled start is missed
    c. If the running task does not end when requested, force it to stop
    d. Select other options to suit your environment.



2.11.2 Archer IRM DataFeed Integrations

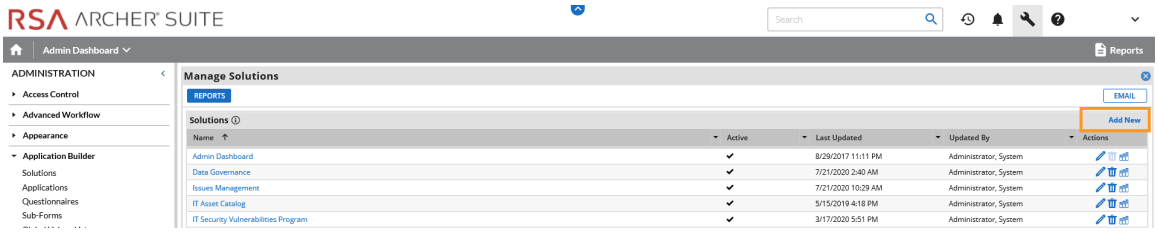
Archer IRM serves a dual role in the prototype demonstration - the Asset Management and Discovery System and the IT Administrator Dashboard. This section will detail the steps necessary to integrate Archer IRM with the PMCS, the Eclypsium Firmware Analytics Platform, and Microsoft Configuration Manager, which will form the basis of the Asset Management and Discovery System. From there, we will describe how to create a dashboard using the data gathered from the preceding integrations.

2.11.2.1 Create the Devices Application

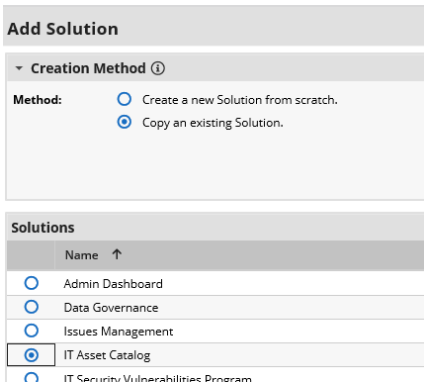
Before platform and firmware data can be stored in the in the Asset Management and Discovery System, the Archer IRM application must be created. For this task, we leverage the default *Devices* application described as *the central repository of knowledge about your business-critical devices.*

We use the Devices application as a starting point for our customizations that are described in the section. Your organization may have additional requirements that can also be integrated into this solution. As a user with administrative privileges, ensure your installation has the *IT Asset Catalog* solution included before starting the following procedures.

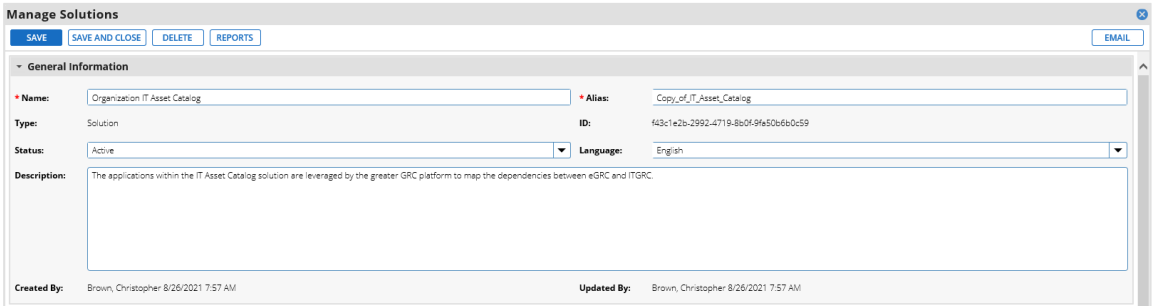
1. In the administration menu, navigate to **Application Builder** > **Solutions**. Select **Add New**.



1022 2. Select **Copy an existing Solution** and the **IT Asset Catalog**. Click **OK**.



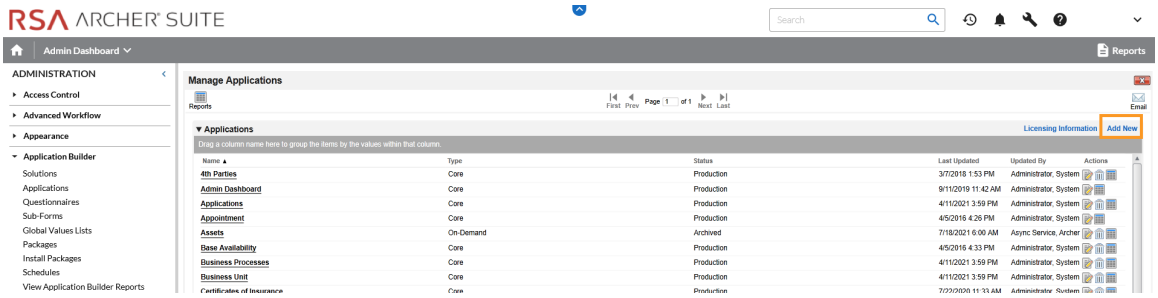
1023 3. Enter an identifier for the catalog in the **Name** field. Click **SAVE AND CLOSE**.



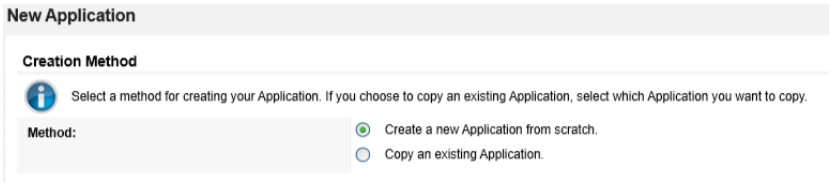
1024 #### 2.11.2.1.1 Create Supporting Applications

1025 Next, create custom applications that will augment the default *Devices* application. Refer to Appendix B
1026 as you work through creating the supporting application. The application in the following steps, named
1027 *Components*, will store the components associated with each computing device that satisfies acceptance
1028 testing.

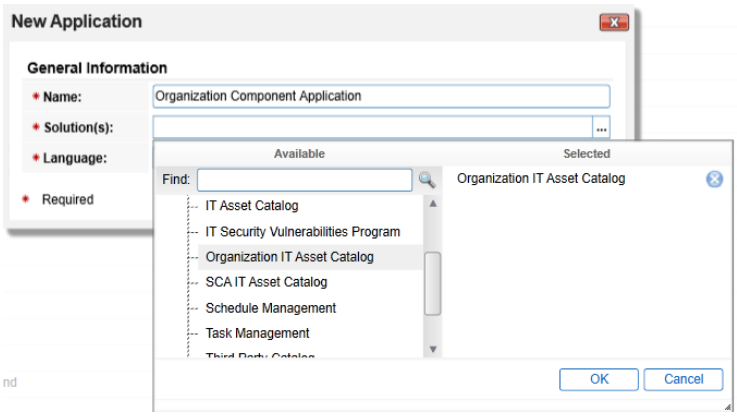
1029 1. In the administration menu, navigate to **Application Builder > Applications.** Select **Add New.**



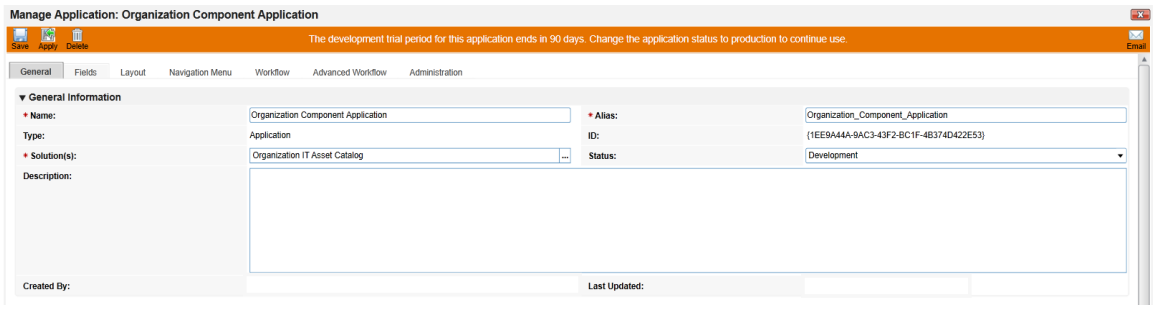
1030 2. Select Create a new **Application from scratch** and click **OK.**



1031 3. Create an identifier in the **Name** field and select the solution created earlier. Click **OK.**



1032 4. Click **Save.**

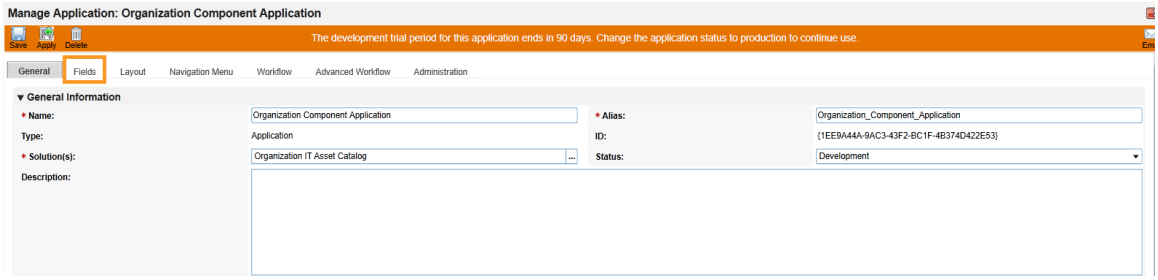


1033 In the next series of steps, we will add several Data Fields to the newly created application. These are
1034 like table columns you might define in a relational database. Note that we will only walk through one

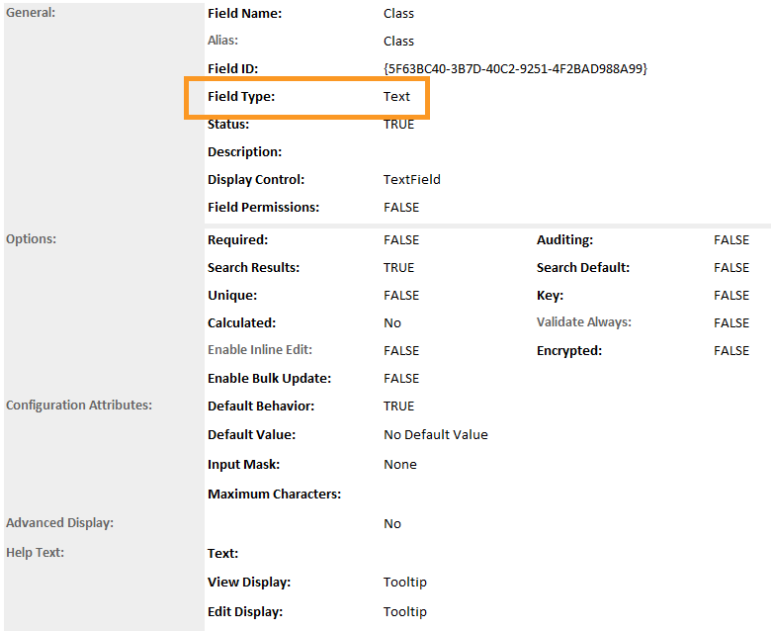
example, but the steps can be repeated for the remaining data fields. Before starting these steps, download and open the Components application schema from our repository. Some data fields, such as **Tracking ID**, **First Published**, and **Last Updated** are automatically created with each new application and do not need to be repeated.

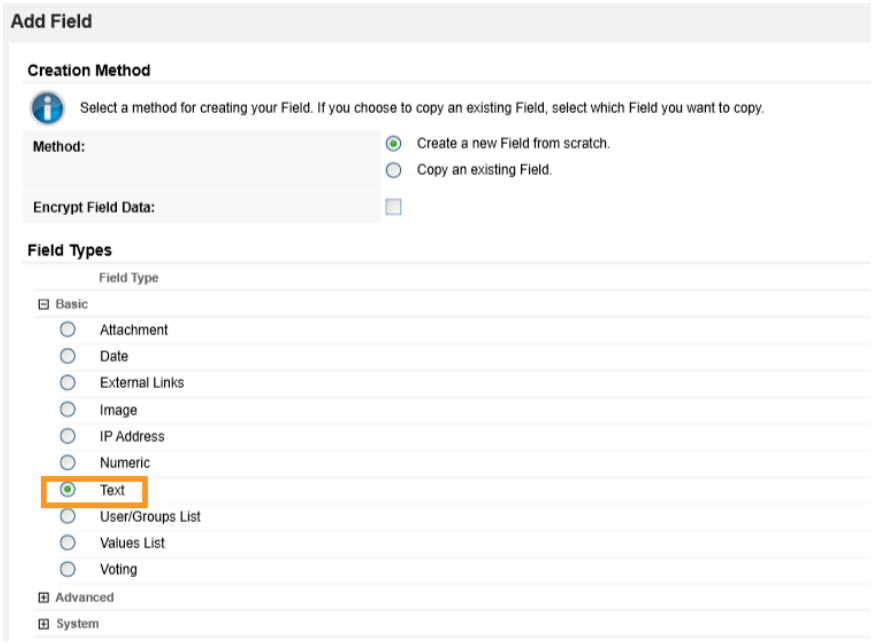
5. Open the target Components application from the Administration menu under **Application Builder > Applications.**

6. Click the **Fields** tab.

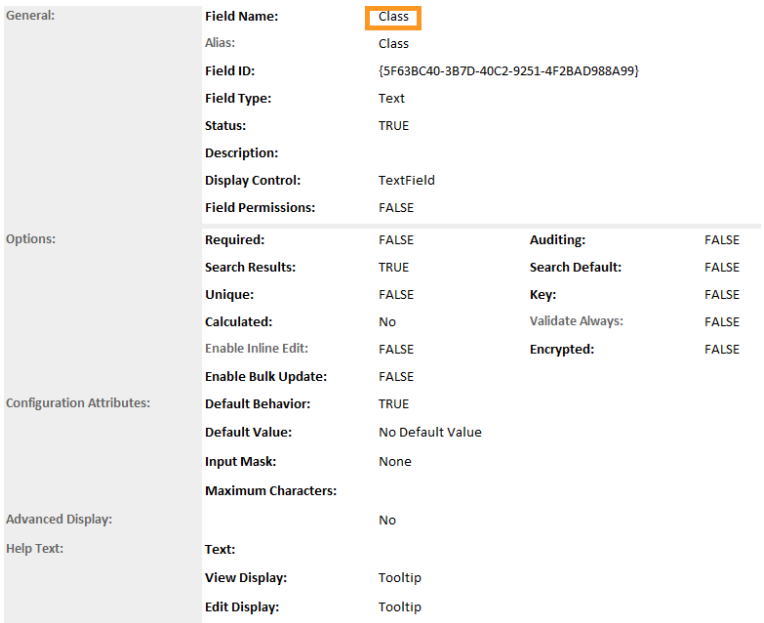


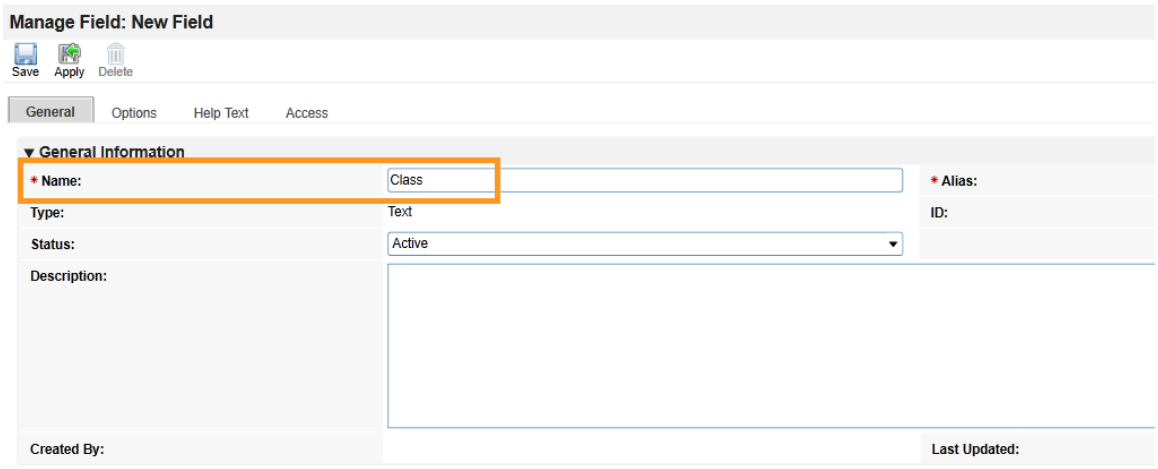
7. Click **Add New.** Match the Field Type from Appendix B to the **Field Type** field in Archer IRM. Click **OK.**





1044 8. Match the **Field Name** from Appendix B to the **Field Name** field in Archer IRM. Click **Save.**





9. Repeat this process for all remaining data fields in Appendix B. Refer to the online documentation for other data types that might require additional configuration.

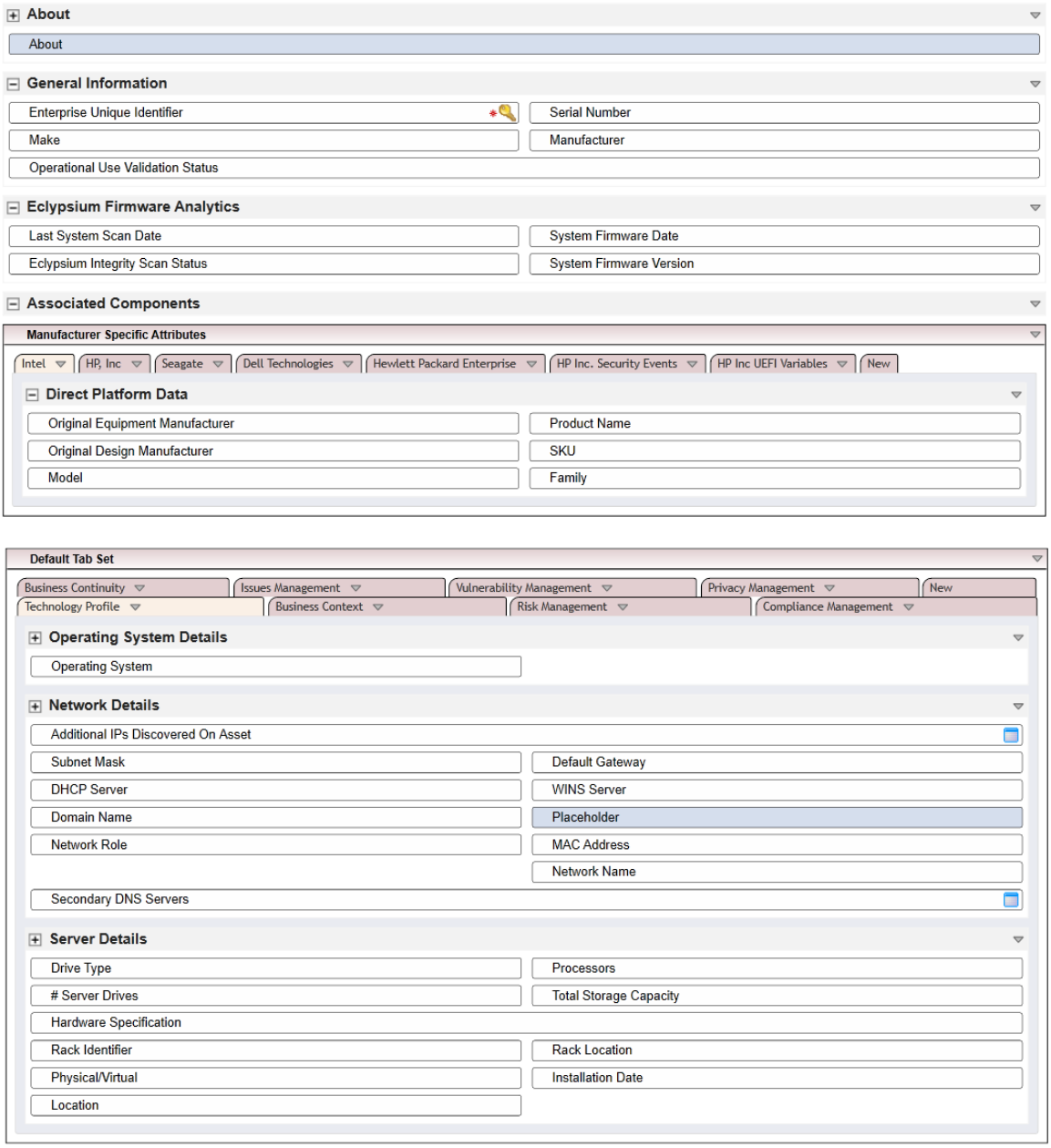
At this point, you have created the first supporting application for the Asset Discovery and Inventory system. Repeat these procedures to create the *HP UEFI Configuration Variables, Seagate Firmware Attestation, and Seagate Firmware Hash* applications. These applications support the demonstration's dashboard capability that continuously monitors HP Inc.'s laptop platform security configurations and Seagate measurement values respectively. Make note of these applications as they are also referenced in the integration procedures (Section 2.11.2.2).

2.11.2.1.2 Modify Default *Devices* Application

In the next series of steps, modify the *Devices* with custom data fields that support the capabilities of this demonstration. You will also link this application to the supporting applications created in Section 2.11.2.1.1.

1. Using the Devices table in Appendix B, add the custom data fields using the same method as described in Section 2.11.2.1.1. Note that cross-referenced data fields are links that will automatically create a new data field in the associated application.

2. Modify the layout of the Devices application to include data field customizations created in this section. The layout will be used to display detailed information about a computing device that has completed the acceptance testing process. Of note, we have added three sections—*General Information, Eclypsium Firmware Analytics,* and *Associated Components*. Use the screenshots below as a starting point for customizations that fit into your organization's workflow. More information regarding layouts can be found on RSA's website.



2.11.2.1.3 Modify Default Security Incidents Application

Modify the *Security Incidents* application with custom data fields that support the capabilities of this demonstration. Using Table 2-7, add the custom data fields using the same method as described in Section 2.11.2.1.1. Note that cross-referenced data fields are links that will automatically create a new data field in the associated application.

1071 **Table 2-7 Security Incidents Application Custom Data Fields**

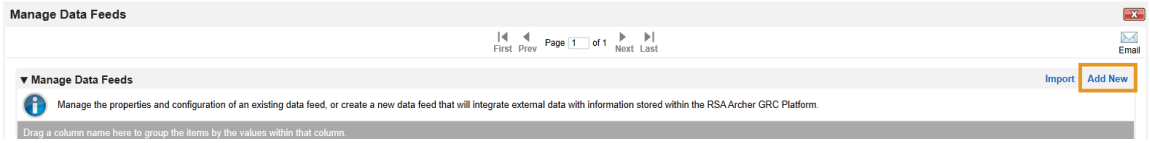
Data Field Name	Data Field Type	Notes
Date/Time QRadar LastUpdate	Date	Stores the date from each *QRadar Offense*
Incident ID (QRadar)	Text	Stores the *QRadar Offense* unique identifier
SCA Computing Device	Cross-Reference	Links to the *Devices* application computing device unique identifier

1072 ### *2.11.2.2 Create Data Feed Integrations*

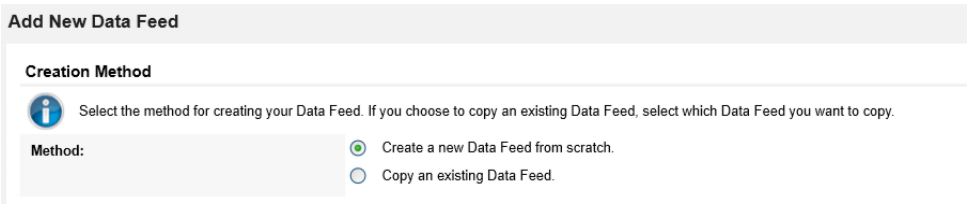
1073 In this section, the implementer will create *data feeds* in Archer IRM that will complete the integration
1074 with the PMCS, Microsoft Configuration Manager, IBM QRadar, and Eclypsium. The data feeds will
1075 periodically pull data from the three data sources and map it to the *Devices* application created in the
1076 preceding section.

1077 #### 2.11.2.2.1 Create Eclypsium Data Feeds

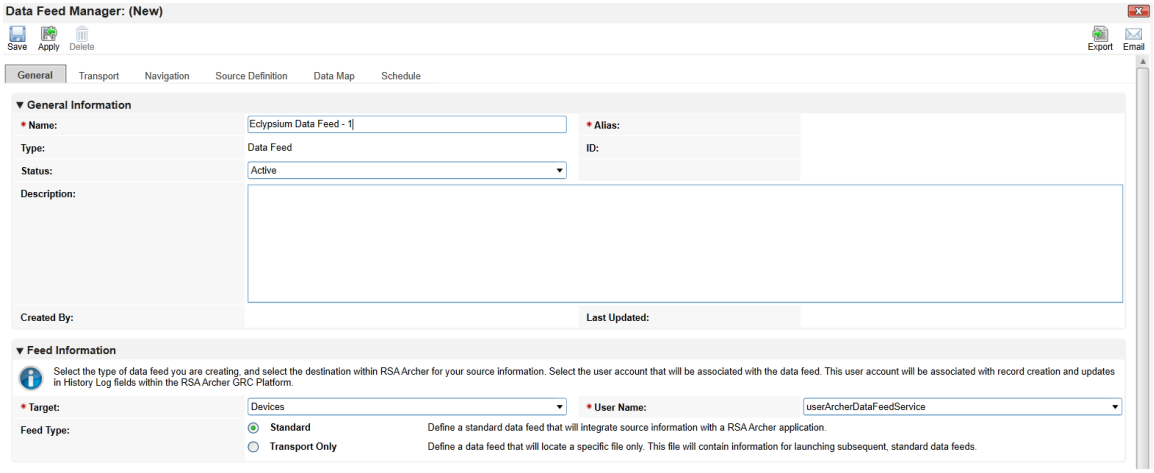
1078 1. In the Administration menu, navigate to **Integration > Data Feeds**. Click **Add New**.



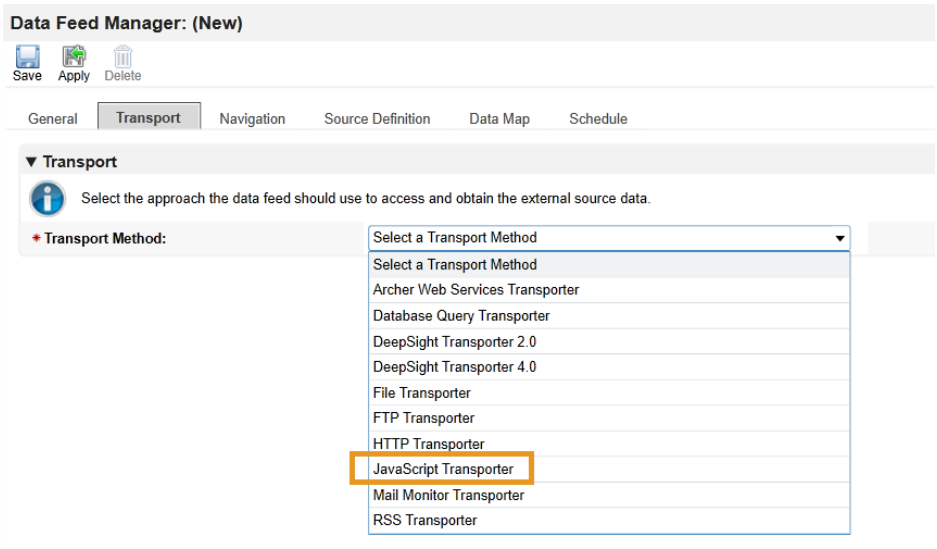
1079 2. Select **Create a new Data Feed from scratch**. Click **OK**.



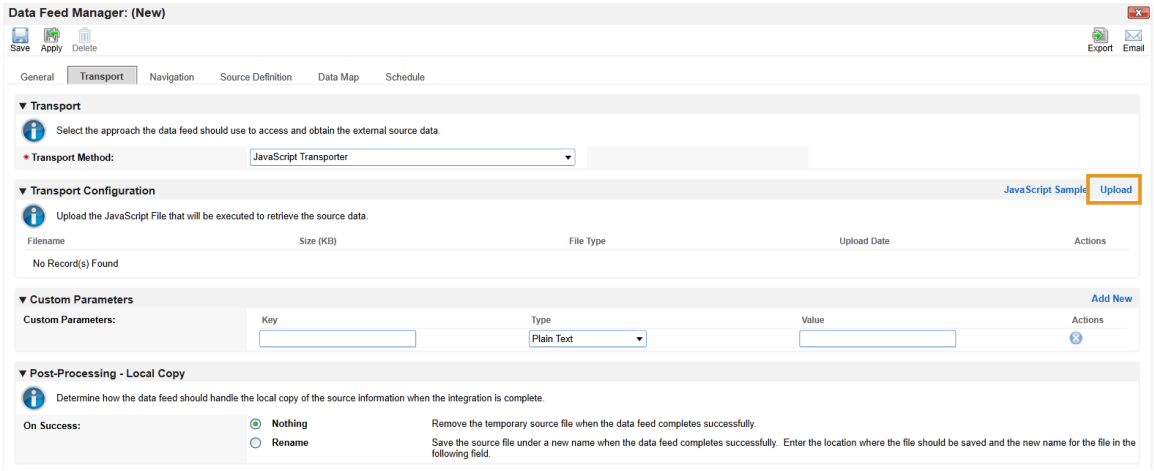
1080 3. Create an identifier in the **Name** field. Select the **Devices** application created in Section 2.11.2.1
1081 in the **Target** field.



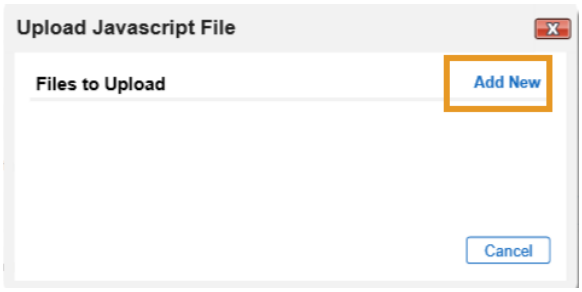
1082 4. Click the **Transport** tab. Select **JavaScript Transporter**.



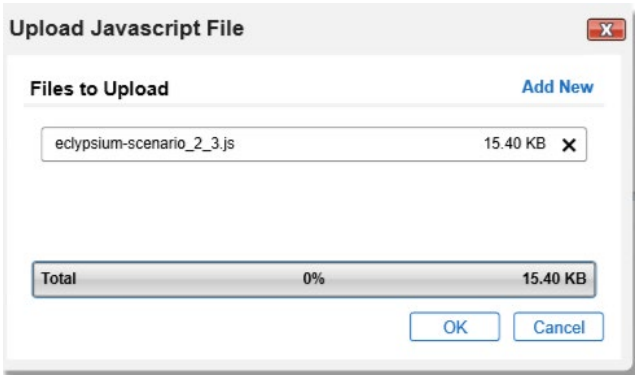
1083 5. Click **Upload** in the **Transport Configuration** section.



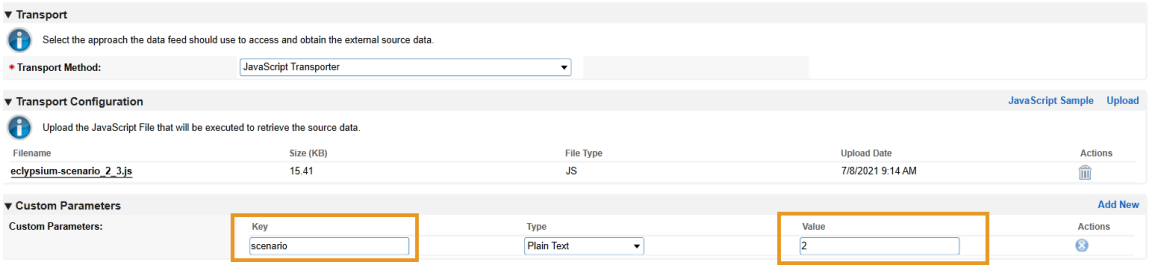
1084 6. Click **Add New**.



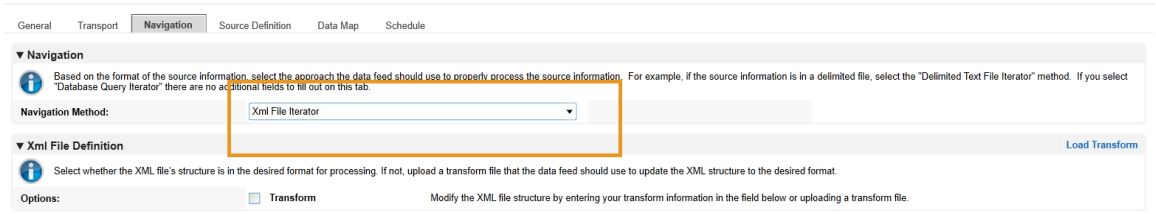
1085 7. In the file selection modal, select the Eclypsium JavaScript data feed file from the repository.
1086 Click **OK**.



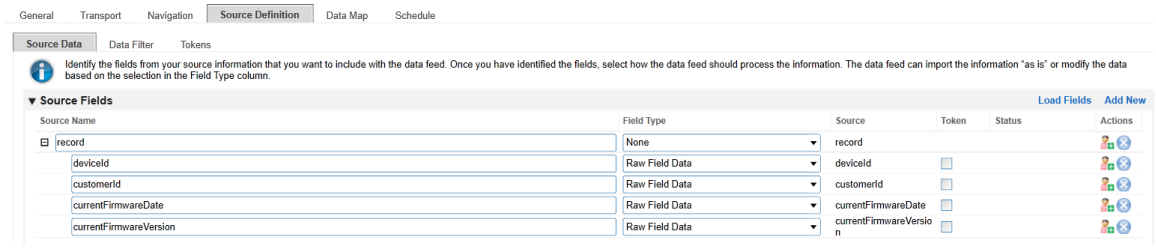
1087 8. Enter “scenario” in the **Key** field and “2” in the **Value** field.



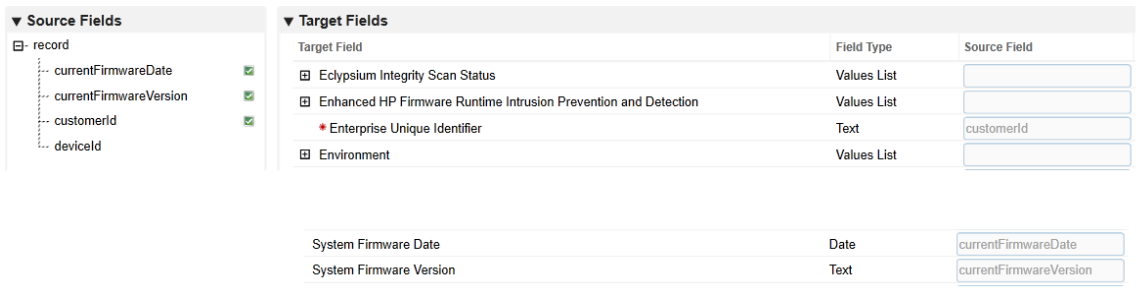
9. Click the **Navigation** tab. Ensure **XML File Iterator** is selected in the **Navigation Method** dropdown menu.



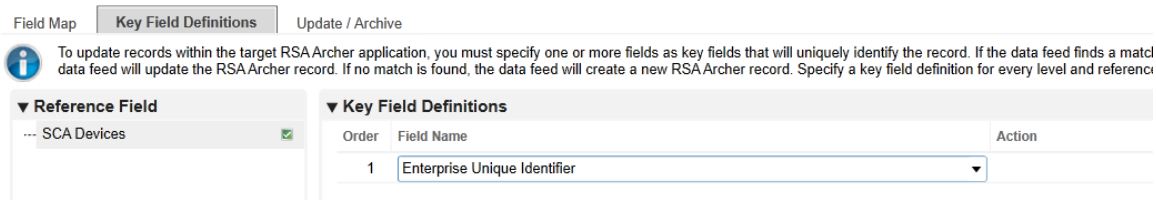
10. Click the **Source Definition** tab. In the **Source Data** sub-tab, select **Load Fields**. Select the Eclypsium example XML file. The configuration in Archer should populate the **Source Fields** as follows.



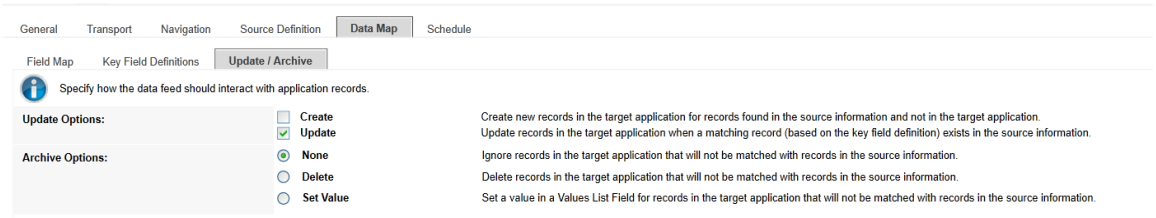
11. Click the **Data Map** and tab which will default to the **Field Map** sub-tab. Drag and drop the source fields onto the application data fields. Due to the large amount of data fields in the Devices application, below we present a truncated view of the mapping.



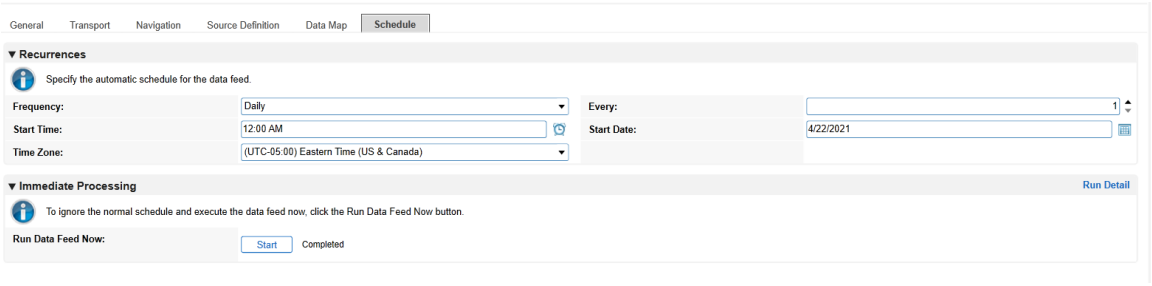
12. Click the **Key Field Definitions** tab. Select **Enterprise Unique Identifier** in the Field Name column.



13. Click the **Update / Archive** tab. Ensure only the **Update** option is selected. Choose **None** for the **Archive Options**.



14. Click the **Schedule** tab. Select a cadence appropriate for your organization. In this example, we've chosen to run the data feed on a daily frequency at 12:00AM.



At this point, the data feed for Eclypsium (Scenario 2) is configured. Scenario 3 is configured with the same process, except a "3" is used in the Value field in Step 8. Click the **Start** button to confirm that the data feed has been properly configured. Archer IRM will report any errors that are useful for debugging.

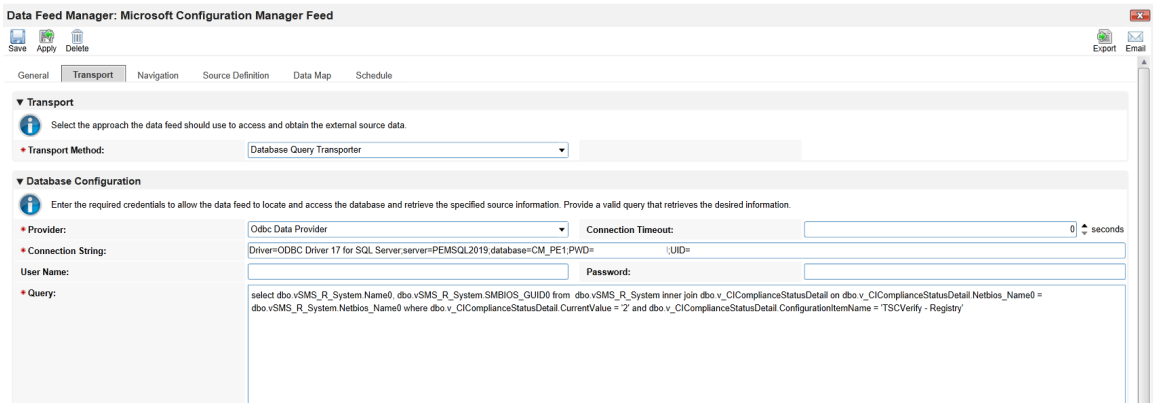
2.11.2.2.2 Create Microsoft Configuration Manager Data Feed

Repeat the preceding steps to add the Microsoft Configuration Manager Data Feed with the following modifications:

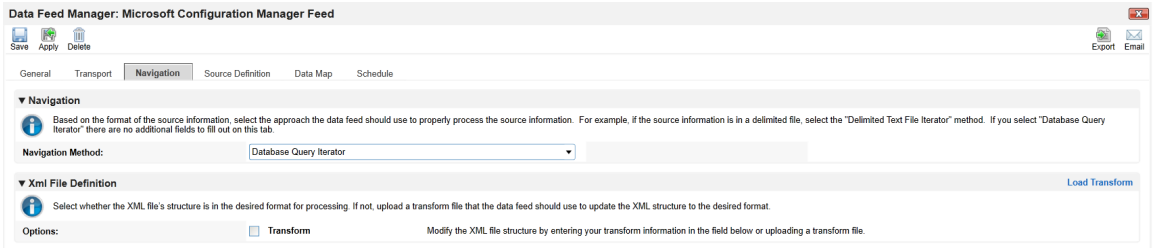
15. In the **Transport** tab, select **Database Query Transporter**. Insert the following values in the form:

Provider	`Odbc Data Provider`

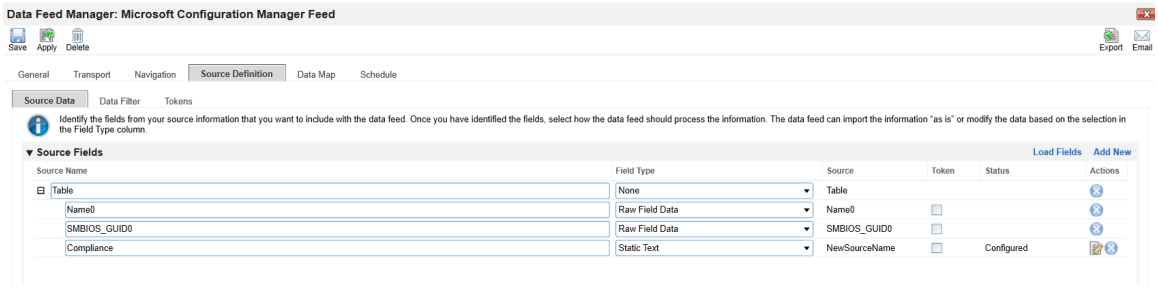
Connection String	`Driver=ODBC Driver 17 for SQL Server;server=PEMSQL2019;database=CM_PE1;PWD=[SQL USER PASSWORD];UID=[SQL USER]`
Query	`select dbo.vSMS_R_System.Name0, dbo.vSMS_R_System.SMBIOS_GUID0 from dbo.vSMS_R_System inner join dbo.v_CIComplianceStatusDetail on dbo.v_CIComplianceStatusDetail.Netbios_Name0 = dbo.vSMS_R_System.Netbios_Name0 where dbo.v_CIComplianceStatusDetail.CurrentValue = '2' and dbo.v_CIComplianceStatusDetail.ConfigurationItemName = 'TSCVerify - Registry'`



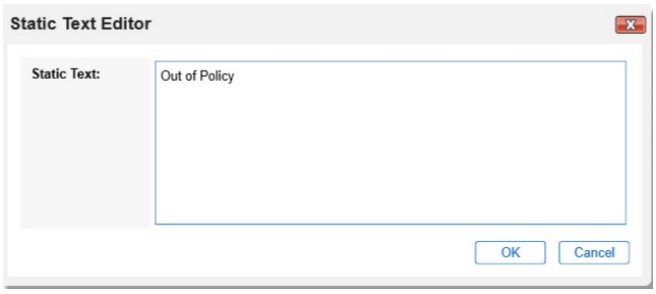
1110 16. In the **Navigation** tab, select **Database Query Iterator**.



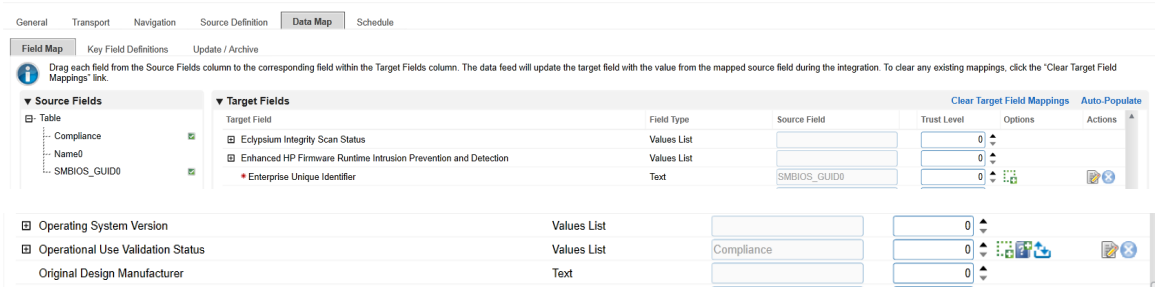
1111 17. In the **Source Definition** tab, add a new **Source Field** named Compliance.



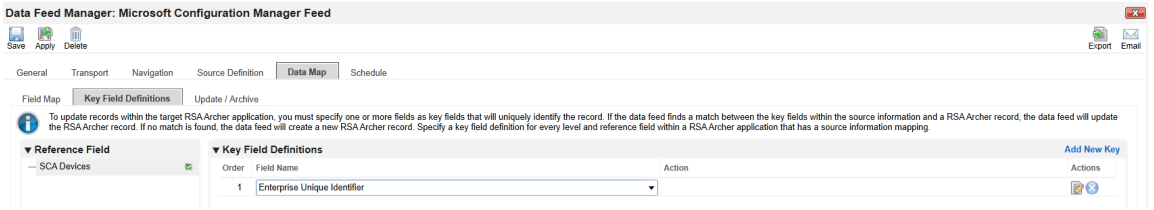
18. Edit the new **Source Field** with the static text “Out of Policy”.



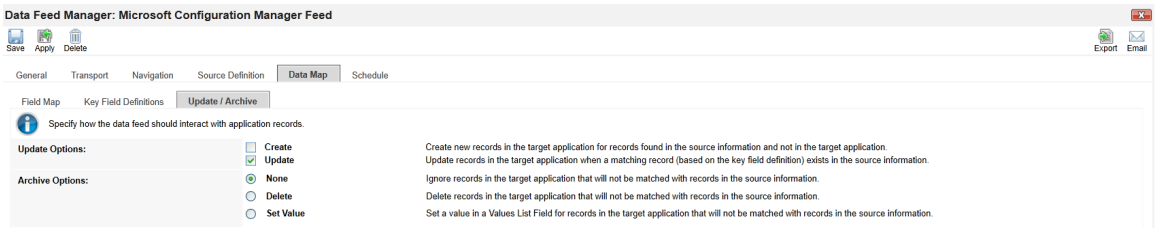
19. In the **Field Map** sub-tab in the **Data Map** tab, drag and drop the **Source Fields** onto the **Target Fields** as shown in the images below.



20. In the **Key Field Definitions** sub-tab in the **Data Map** tab, select **Enterprise Unique Identifier**.



21. In the **Update / Archive** sub-tab in the **Data Map** tab, ensure only **Update** is selected.

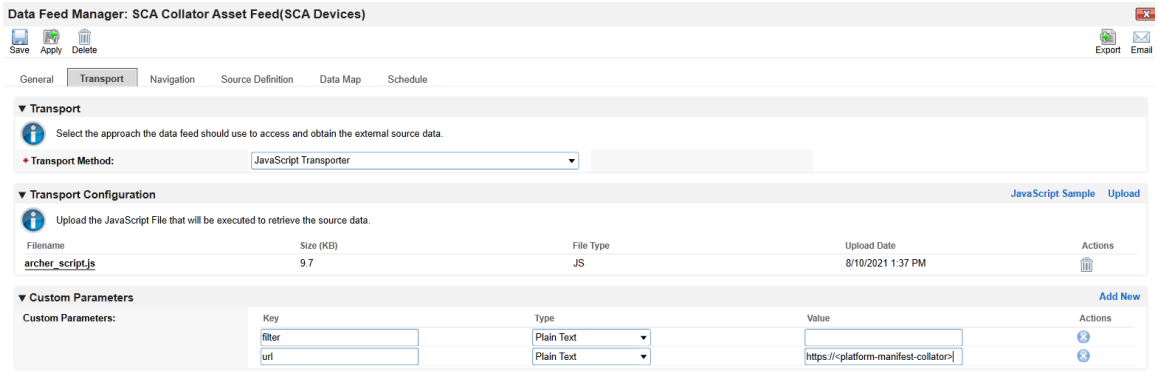


At this point, the Data Feed for the Microsoft Configuration Manager is configured. Click the **Start** button to confirm that the Data Feed has been properly configured. Archer will report any errors that are useful for debugging.

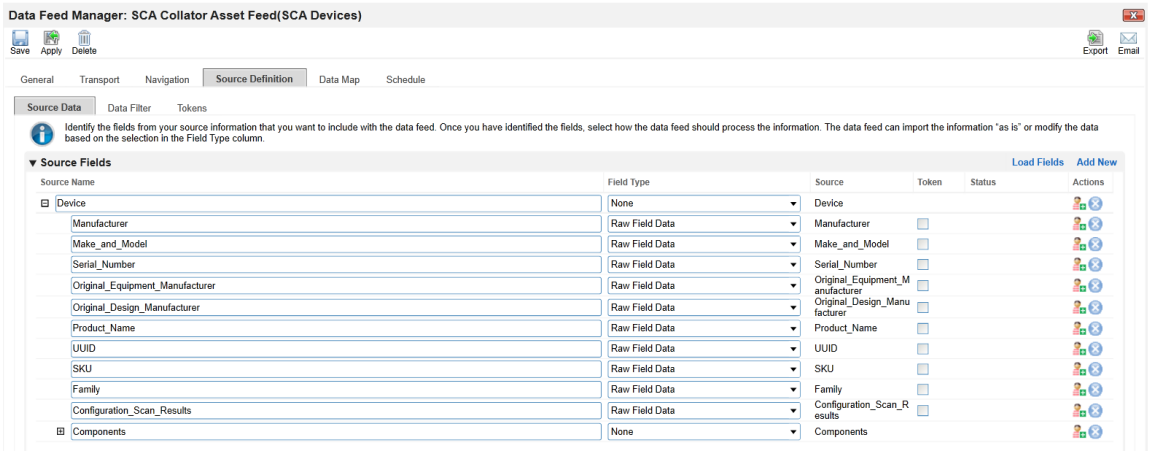
2.11.2.2.3 Create the PMCS Data Feed

Repeat the initial steps to add the Data Feed for the PMCS with the following modifications:

22. In the **Transport** tab, upload the custom JavaScript from the project repository. In the Custom Parameters fields, add **filter** and **url** keys as shown below. The value for **filter** may be blank or set to a specific manufacturer (refer to comments in the script for the specific values we used). Set **url** to the location of the PMCS in your environment.



23. In the **Source Definition** tab, upload the example XML file from the project repository. The **Source Fields** should resemble the following screenshot.



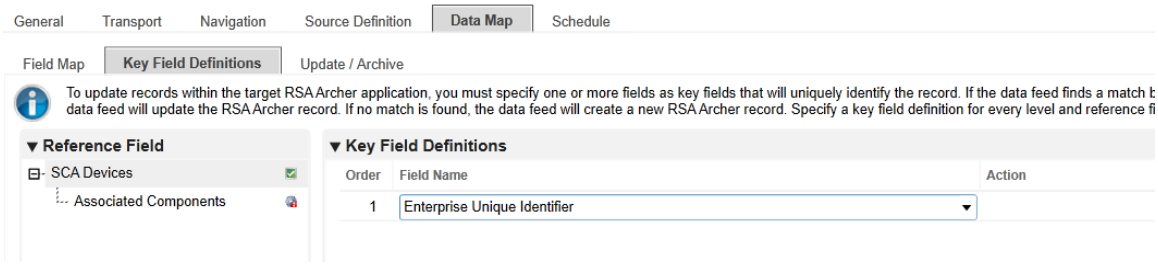
24. Map the **Source Fields** to the **Target Fields** and the **Field Map** sub-tab in the **Data Map** tab. Use Table 2-8 for reference.

Table 2-8 PMCS Data Feed Source Field to Destination Field Mapping

Source Field	Destination Field
/Component/Addresses/Address	Associated Components/Addresses/Address

Source Field	Destination Field
/Component/Class	Associated Components/Class
/Component/Field_Replaceable	Associated Components/Field Replaceable
/Component/Manufacturer	Associated Components/Manufacturer
/Component/Model	Associated Components/Model
/Component/Platform_Certificate	Associated Components/Platform Certificate
/Component/Platform_Certificate_URI	Associated Components/Platform Certificate URI
/Component/Revision	Associated Components/Revision
/Component/Serial	Associated Components/Serial
/Component/Version	Associated Components/Version
UUID	Enterprise Unique Identifier
Family	Family
Make_and_Model	Make
Manufacturer	Manufacturer/Value
Original_Design_Manufacturer	Original Design Manufacturer
Original_Equipment_Manufacturer	Original Equipment Manufacturer
Product_Name	Product Name
Serial_Number	Serial Number
SKU	SKU

25. In the **Key Field Definitions** sub-tab in the **Data Map** tab, choose Enterprise Unique Identifier as the **Key Field** definition.

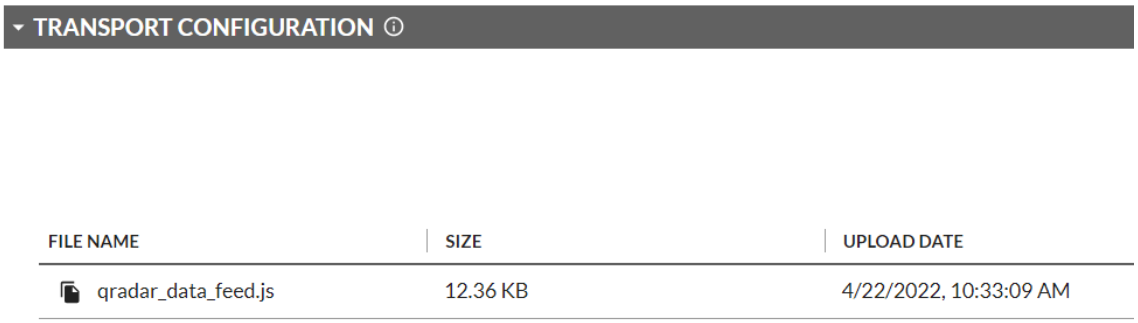


The Data Feed for the PMCS is configured. Click the **Start** button to confirm that the Data Feed has been properly configured. Archer will report any errors that are useful for debugging.

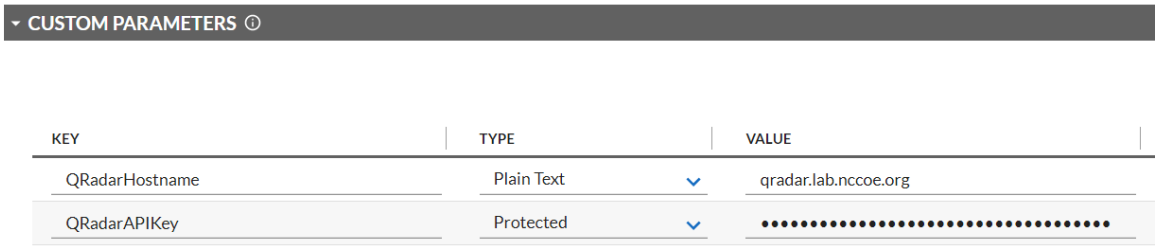
2.11.2.2.4 Create IBM QRadar Offenses Data Feed

Repeat the steps from Section 2.11.2.2.1 to add the Data Feed for IBM QRadar with the following modifications:

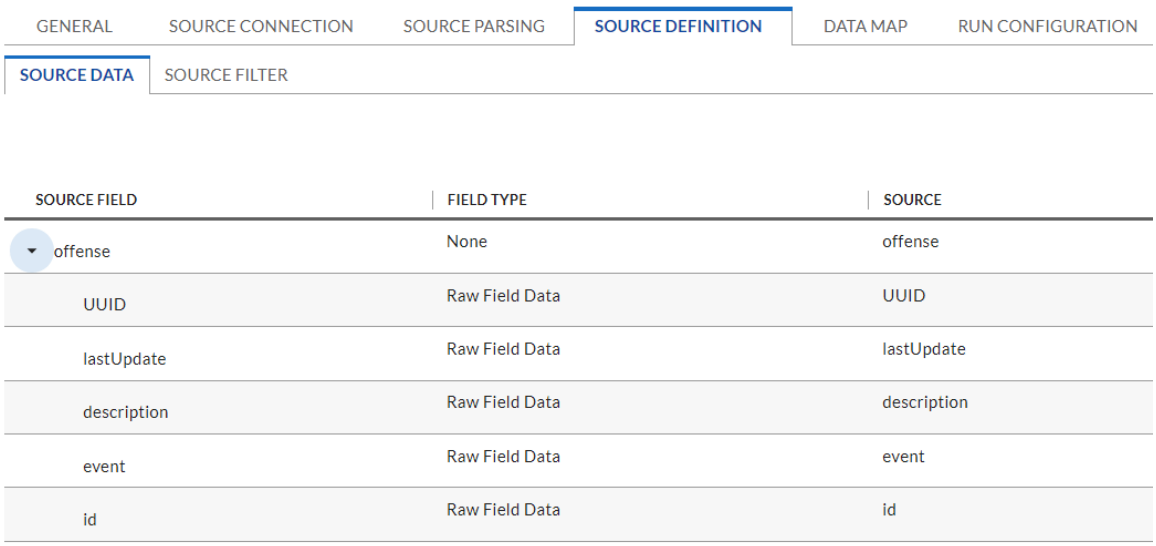
26. In the **Transport Settings** section of **Source Settings,** choose the IBM QRadar script *(Integration-Scripts\Archer Integrated Risk Management Data Feed Integrations\IBM QRadar\app.js)* from the project repository.



27. In the Custom Parameters section of the Source Connection tab, enter the hostname of the QRadar system and the API key created in Section 2.11.3.2.4. Ensure that the QRadarAPIKey is of type Protected.



28. In the **Source Data** section of the **Source Definition** tab, upload the example XML QRadar response file.

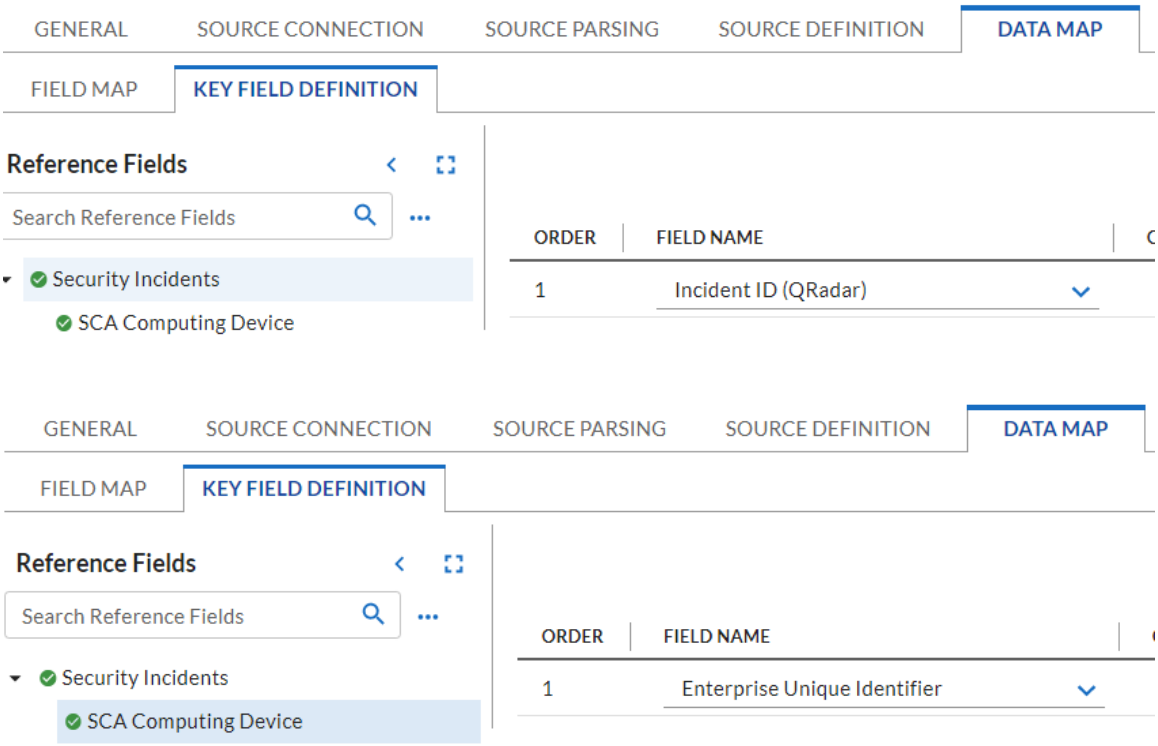


29. Map the **Source Fields** to the **Target Fields** in the **Field Map** sub-tab in the **Data Map** tab. Use Table 2-10 for reference.

Table 2-9 QRadar Data Feed Source Field to Destination Field Mapping

Source Field	Destination Field
UUID	/SCA Computing Device/Enterprise Unique Identifier
lastUpdate	Date/Time QRadar LastUpdate
description	Incident Summary
event	Title
id	Incident ID (QRadar)

30. In the **Key Field Definition** sub-tab in the **Data Map** tab, choose **Incident ID (QRadar)** as the Key Field Definition. Additionally, choose **Enterprise Unique Identifier** as the **Key Field** definition for the **SCA Computing Device** reference field.

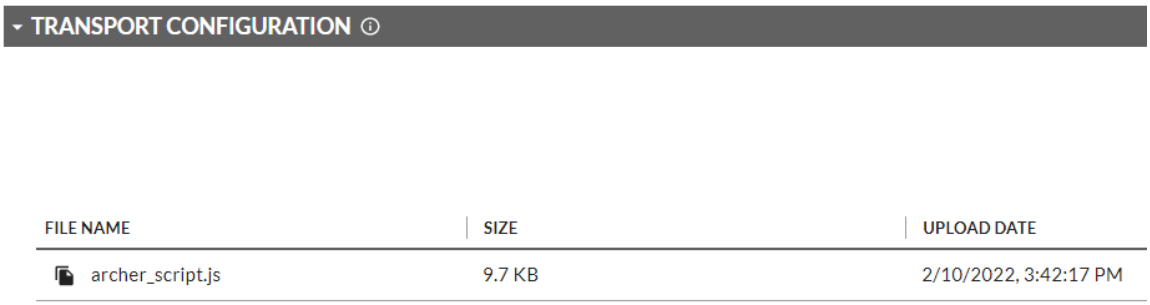


2.11.2.2.5 Create Seagate API Data Feeds

Repeat steps from Section 2.11.2.2.1 to add the Data Feed for Seagate drive firmware attestation and firmware hash data with the following modifications:

31. Enter *Seagate Attestation Feed* in the **Name** field section of the **General** tab. In the **Feed Information** section of the same tab, select *Seagate Firmware Attestation* from the **Target Application** pull-down menu.

32. In the **Transport Configuration** section of **Source Settings,** choose the Seagate script from the project repository.



33. In the **Custom Parameters** section of **Source Connection** tab, enter the PMCS URL and the **filter** value of *seagate.fw.attestation*.

34. In the **Source Data** section of the **Source Definition** tab, upload the example Seagate Firmware Attestation XML response file.

SOURCE FIELD	FIELD TYPE	SOURCE
SeagateDriveFirmwareAttestation	None	SeagateDriveFirmwareAttestation
device_uuid	Raw Field Data	device_uuid
drive_serial	Raw Field Data	drive_serial
assessor_id	Raw Field Data	assessor_id
root_of_trust_id	Raw Field Data	root_of_trust_id
root_of_trust_nonce	Raw Field Data	root_of_trust_nonce
device_nonce	Raw Field Data	device_nonce
fw_version	Raw Field Data	fw_version
secure_boot_device_state	Raw Field Data	secure_boot_device_state
signing_auth_database	Raw Field Data	signing_auth_database

35. Map the **Source Fields** to the **Target Fields** and the **Field Map** sub-tab in the **Data Map** tab. Use Table 2-10 for reference.

1166 **Table 2-10 Seagate Drive Data Feed Field Mapping**

Source Field	Destination Field
drive_serial	/Seagate Drive Serial/Serial
assessor_id	Assessor Identifier
root_of_trust_id	Root of Trust Identifier
root_of_trust_nonce	Root of Trust Nonce
device_nonce	Device Nonce
fw_version	Firmware Version
secure_boot_device_state	Secure Boot Device State
signing_auth_database	Signing Auth Database

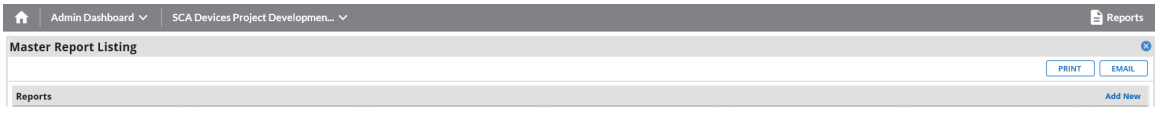
1167 36. In the **Key Field Definition** tab within the **Data Map** tab, select *Serial* in the pull-down **Field**
1168 **Name** column.

1169 37. Save the new Data Feed.

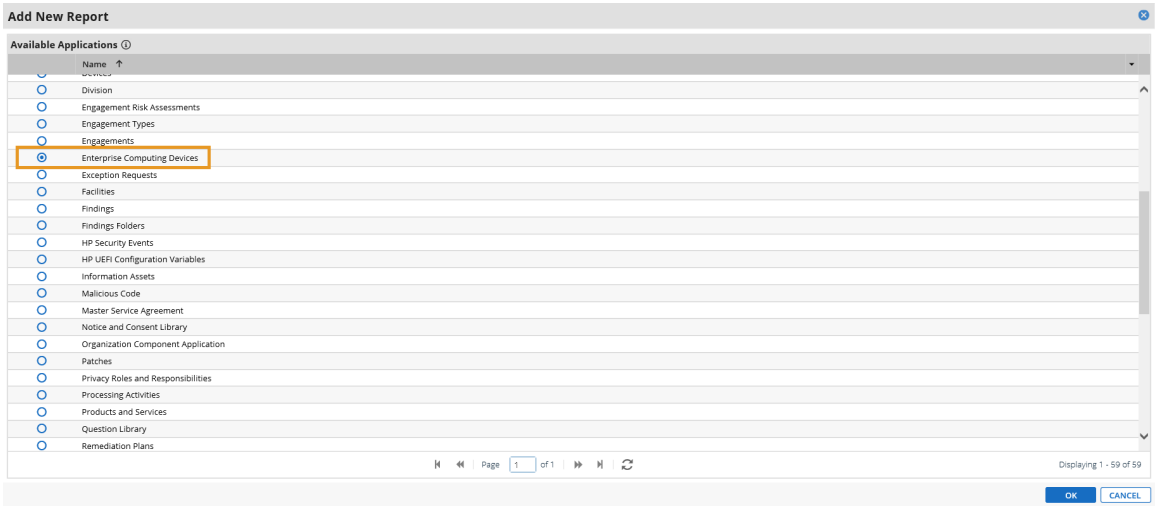
1170 Repeat the procedures in this section to create a Data Feed that will collect the Seagate drive firmware
1171 hash values. Note that this Data Feed will target the *Seagate Firmware Hash* application.

1172 *2.11.2.3 Create the Dashboard*

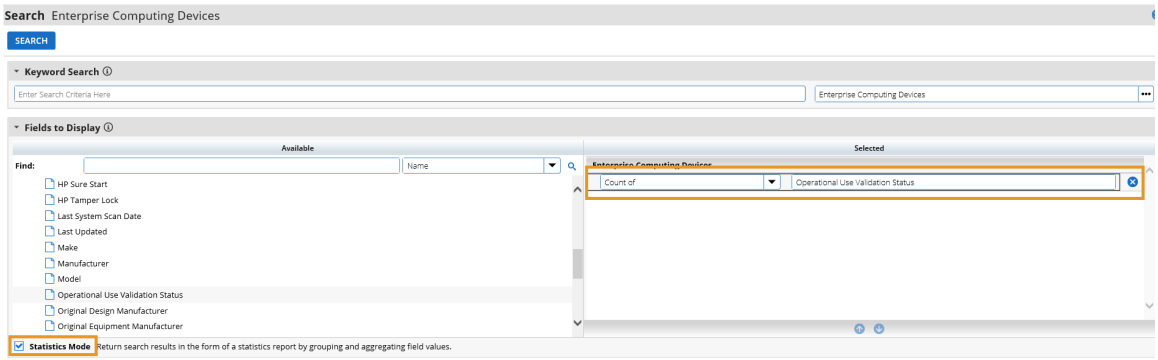
1173 1. Create a new report by clicking **Reports** in the administrative console and **Add New.**



1174 2. Select the Devices application that was created in the preceding steps—in this case, **Enterprise**
1175 **Computing Devices.**

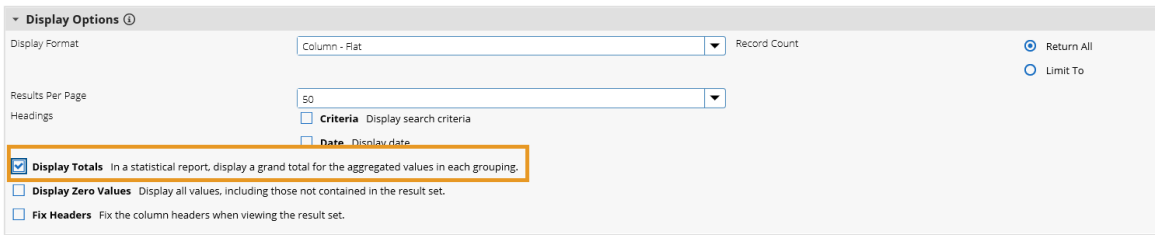


1176 3. Click the **Statistics Mode** option. In the **Fields to Display** section, select **Operational Use**
1177 **Validation Status** and remove the default selections.

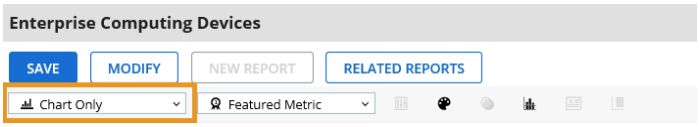


1178 4. In the **Filters** section, select *Operational Use Validation Status* for **Field to Evaluate**, *Equals* for
1179 **Operator,** and *Policy violation* for **Value(s).**

1180 5. Select **Display Totals** in the **Display Options** section.

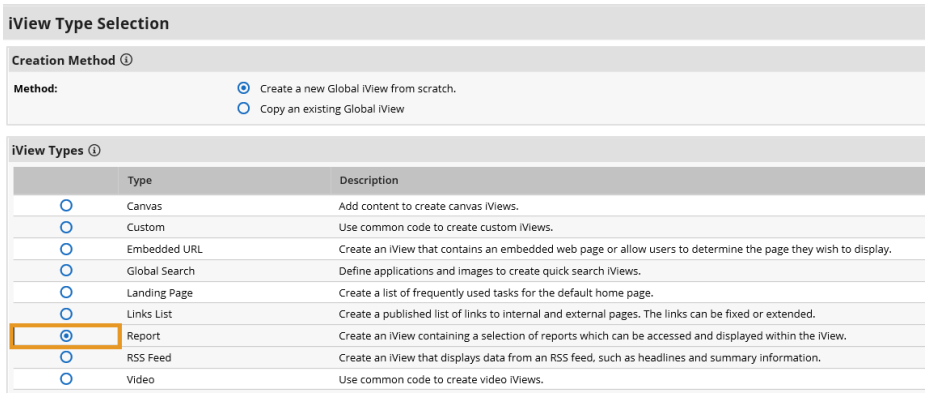


6. Select **Chart Only** and click **Save** and supply a unique name for the report.

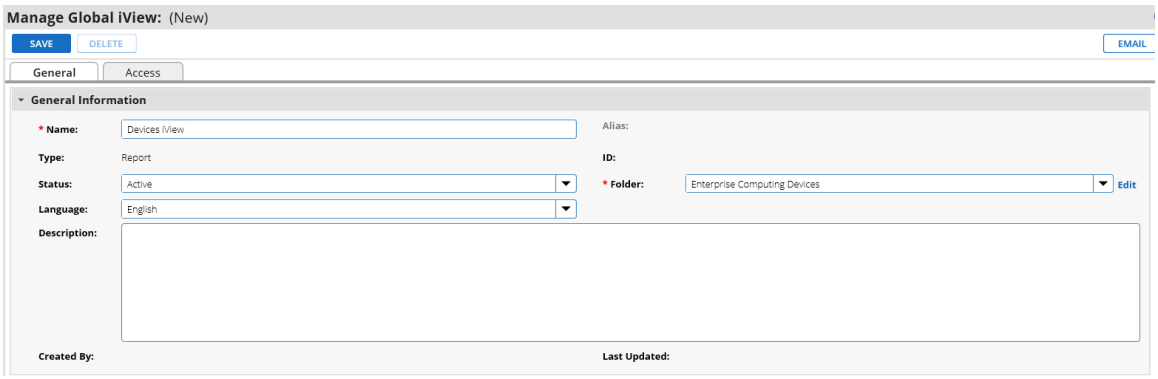


7. Create a new iView by navigating to **Workspaces and Dashboards > Global iViews** in the administrative menu. Click **Add New.**

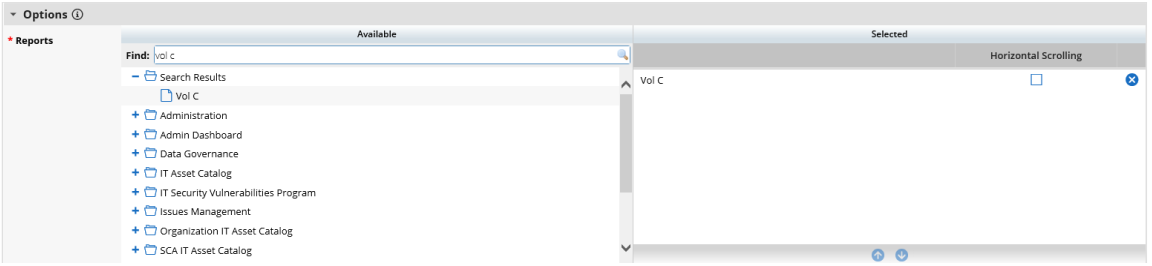
8. In the **iView Types** section, select **Report** and click **OK.**



9. In the **General Information** section, supply a name and a folder to store the new iView.

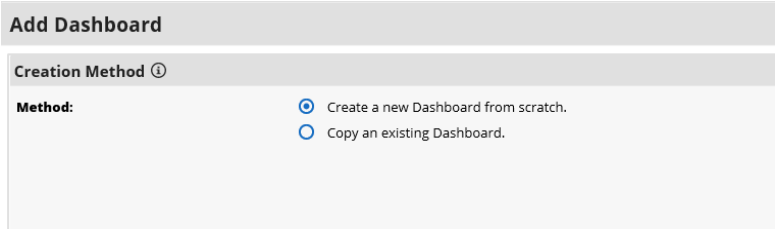


10. In the **Options** section, choose the report that was created in the preceding steps and save the iView.



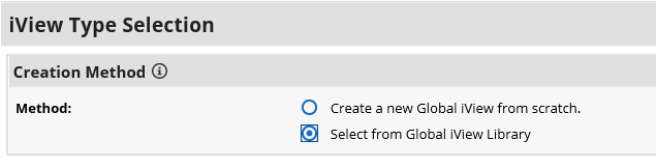
11. Create a new Dashboard by navigating to **Workspaces and Dashboards > Dashboards** in the administration menu. Click **Add New.**

12. Select **Create a new Dashboard from scratch** and click **OK.**



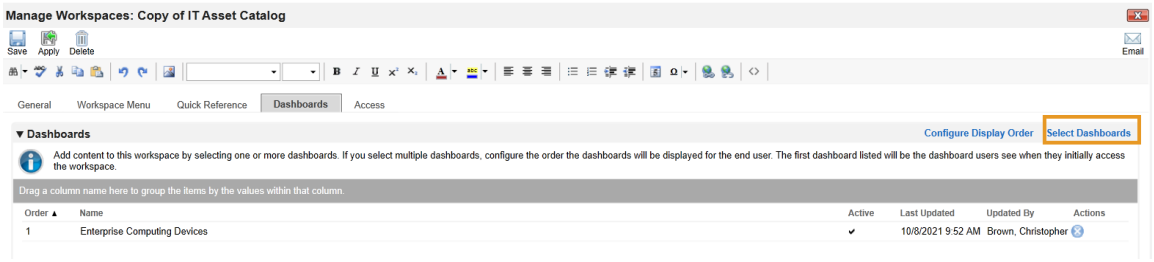
13. In the **General** tab, supply a name for the Dashboard.

14. In the **Layout** tab, click **Select iViews.** Choose *Select* from **Global iView Library** for the **Creation Method.** Choose the iView created in the preceding steps and click **OK.**



15. The selected iView will appear in the layout. Save the Dashboard.

16. Open the solution workspace by navigating to **Workspaces and Dashboards > Workspaces** in the administration menu. In the **Dashboards** tab, choose the Dashboard created in the preceding steps by clicking **Select Dashboards.**



17. Save the workspace. At this point, the new Dashboard will appear as part of the workspace. For further customization options, refer to the RSA website.

18. Repeat the steps in this section to create a report that tracks platform integrity issues that are detected from the following sources:

Platform	Archer Application	Archer Data Field
Eclypsium Analytic Platform	Enterprise Computing Devices	Eclypsium Integrity Scan Status
HP Inc	HP UEFI Configuration Variables	HP Inc BIOS Configuration Status
Seagate	Seagate Firmware Hash	Firmware Hash Status

2.11.3 IBM QRadar Integrations

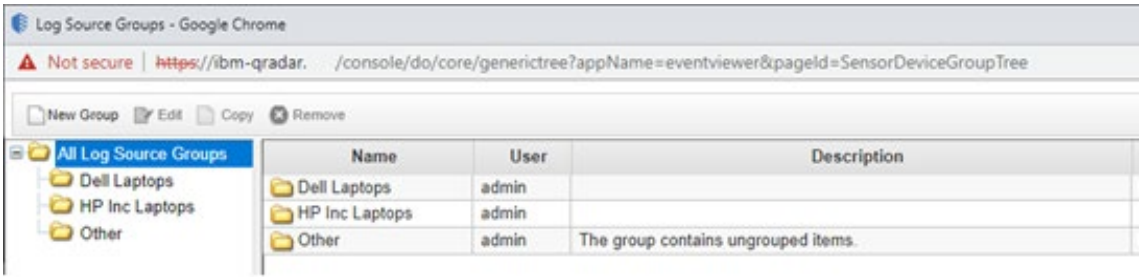
The following sections describe how to integrate Dell and HP Inc. laptops with QRadar so that the laptops transmit continuous monitoring event logs to the QRadar console.

2.11.3.1 Dell and HP Inc. Laptops

Perform the prerequisite steps in Section 2.2.1.3, then on each target laptop:

1. Ensure Remote Event Log Management is enabled for each laptop.

2. (Optional) In the QRadar console, create a new log source group which may be desirable to help organize target laptops. In our demonstration, we created a group for each manufacturer.



3. Create a new log source for the WinCollect Agent (see Section 2.10.1). Note that when configuring the Log Source parameters, a Windows account is required to retrieve the relevant

security event. This demonstration created a domain account with privileges limited to the scope of this capability (Manage auditing and security log permission enabled).

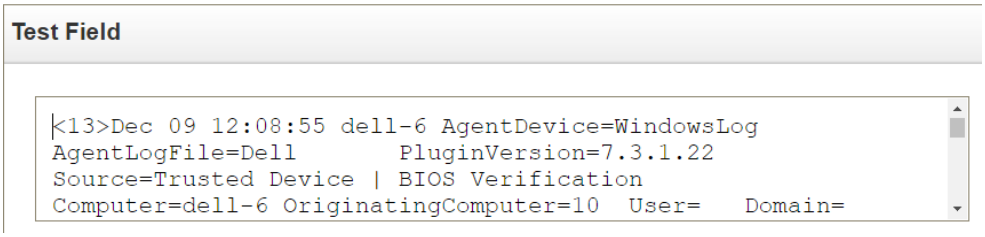
2.11.3.2 IBM QRadar

The section describes the procedures that will create *Offenses* generated from detected laptop platform integrity security events. Additionally, it also describes an API key that is used to access the QRadar REST API. The key is used as input to Section 2.11.2.2.4.

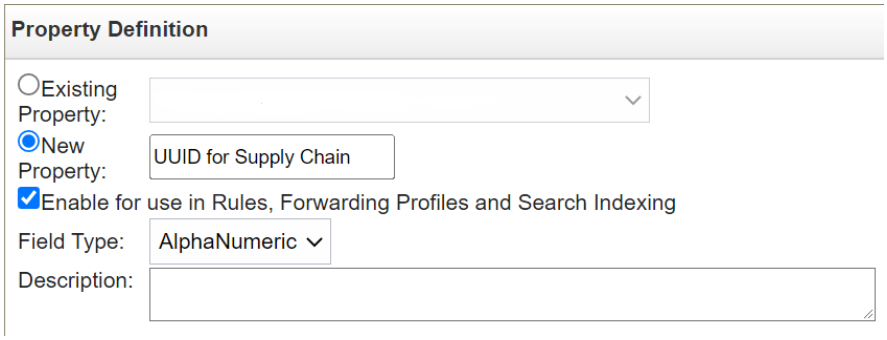
2.11.3.2.1 Create Custom Event Property (UUID)

This property uses a regular expression (regex) to identify universally unique identifiers (UUIDs) that are embedded in Windows 10 Event Logs that are sent from laptops when a platform integrity issue is detected.

4. In the QRadar console, navigate to **Admin** > **Custom Event Properties**. Click **Add** and a new window pops up. In the **Test Field,** paste in the example event log.

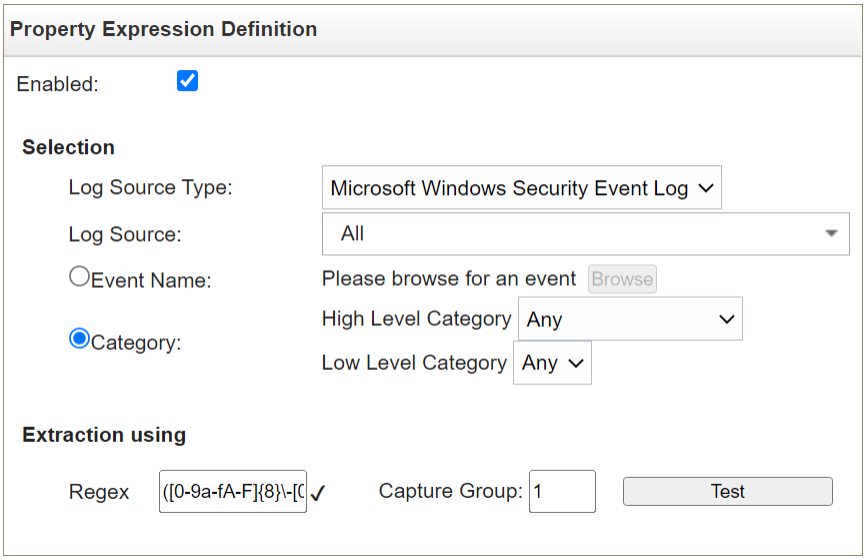


5. In the **Property Definition** section, select **New Property** and enter *UUID for Supply Chain.* Check *Enable for use in Rules, Forwarding Profiles and Search Indexing*.



6. In the **Property Expression Definition** section, ensure *Enabled* is checked. In **the Log Source Type** pull-down, select *Microsoft Windows Security Event Log* and select *All* in the **Log Source** pull-down. Select the *Category* radio button. Choose *Any* in both the **High Level Category** and **Low Level Category** pull-downs. In the **Regex** field, insert the value below.

```
([0-9a-fA-F]{8}\-[0-9a-fA-F]{4}\-[0-9a-fA-F]{4}\-[0-9a-fA-F]{4}\-[0-9a-fA-F]{12})
```



7. Click the **Test** button. If successful, a message will appear that the expression has been highlighted in the payload. Click the **Save** button.

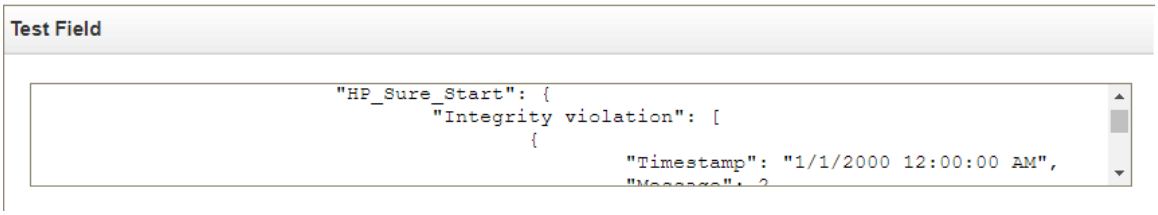
2.11.3.2.2 Create Custom Event Properties (Security Events)

This section describes how to create filters that will identify the individual HP Inc. and Dell platform integrity events that have been detected and reported to QRadar. Use Table 2-11 as a guide. We used existing QRadar Categories which group manufacturer security events. These procedures also require an example of the security event payload that is created on the manufacturer's laptop when a platform integrity issue is detected. For HP Inc laptops, the payloads are generated by custom PowerShell scripts which consume the output from the CMSL Get-HPFirmwareAuditLog command. Dell security event payloads are generated directly by the Dell Trusted Devices platform.

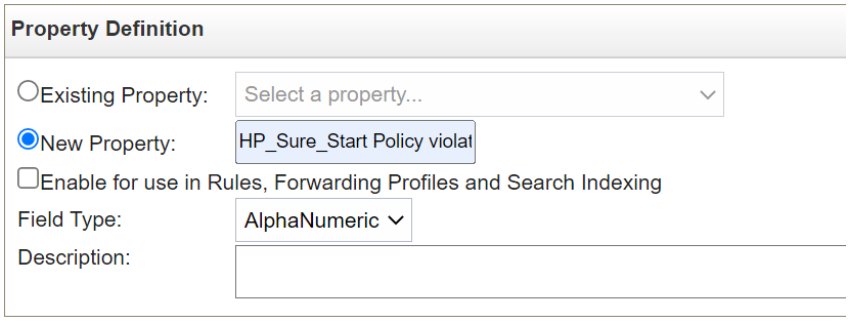
1242 **Table 2-11 QRadar Security Event Mapping**

QRadar Category	Manufacturer Event Category	Manufacturer Event Value
Custom Policy 1	HP_Sure_Start	Integrity violation
Custom Policy 2	HP_Sure_Start	Policy violation
Custom Policy 3	HP_Sure_Start	Recovery
Custom Policy 4	HP_Sure_Start	Revert to default
Custom Policy 5	Sys_Config	Policy violation
Custom Policy 6	HP_Sure_Start	Attack mitigation
Custom Policy 7	HP_Sure_Start	SMM execution halted
Custom Policy 8	Secure_Platform	Management Attack mitigation
Custom Policy 9	HP_Sure_Recover	Recovery initiated
Custom User 1	HP_Sure_Recover	Recovery success
Custom User 2	HP_Sure_Recover	Recovery failure
Custom User 3	HP_Sure_Start	Illegal DMA Blocked
Custom User 4	HP_Sure_Admin	Power off due to failure authentication
Custom User 5	HP_Sure_Admin	WMI blocked due to failed authentication
Custom User 6	HP_Sure_Start	EpSC execution halted
Custom User 7	HP_TamperLock	Cover removed
Custom User 8	HP_TamperLock	TPM cleared based on Policy
Custom User Medium	Dell Laptop DTD BIOS Violation	N/A

1243 1. In the QRadar console, navigate to **Admin** > **Custom Event Properties**. Click **Add** and a new
1244 window pops up. In the **Test Field,** paste in the example event payload. In the screenshots
1245 below, we are using a payload which includes a *HP_Sure_Start Policy violation*.



2. In the **Property Definition**, select *New Property*. Name the new property "[Event Category] [Event Value]". Check *Enable for use in Rules, Forwarding Profiles and Search Indexing*.

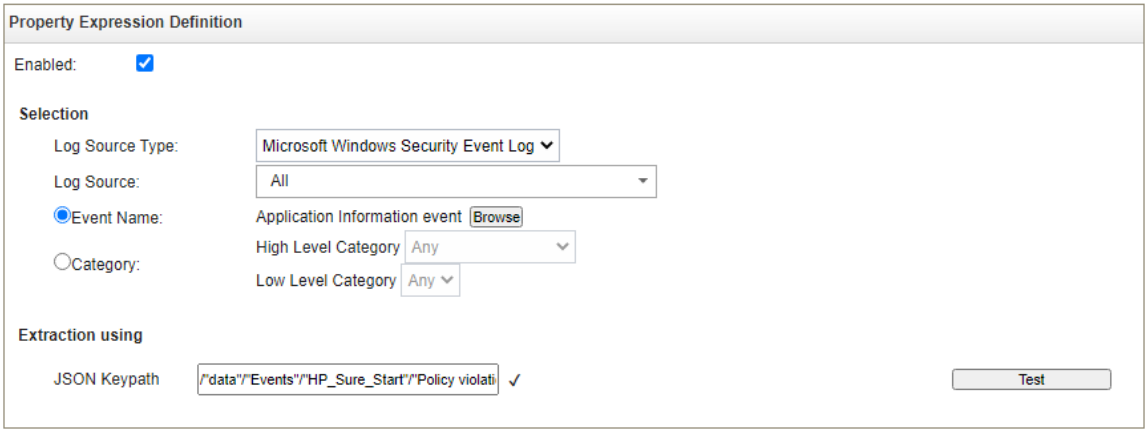


3. In the **Property Expression Definition** section, make sure **Enabled** is checked. In **Log Source Type**, select *Microsoft Windows Security Event Log*. In **Log Source** select **All**. Select the *Event Name* radio button.

    a. Click **Browse** and search for *"Application Information Event"* (with quotes) in the **QID/Name** field. Select it and click **OK**.

    b. Select **Extraction using JSON Keypath**. *"HP_Sure_Start Policy violation"* will look like the following as an example:

```
/"data"/"Events"/"HP_Sure_Start"/"Policy violation"[]
```



4. Click the **Test** button. If successful, the security event is found in the **Test Field**. Click **Save**.

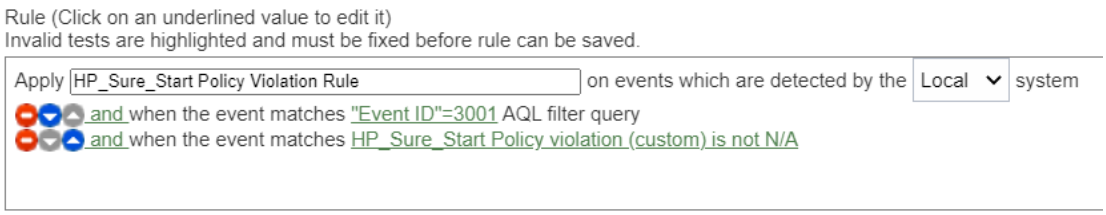
Continue the process for all events listed in Table 2-11.

2.11.3.2.3 Create QRadar Rules

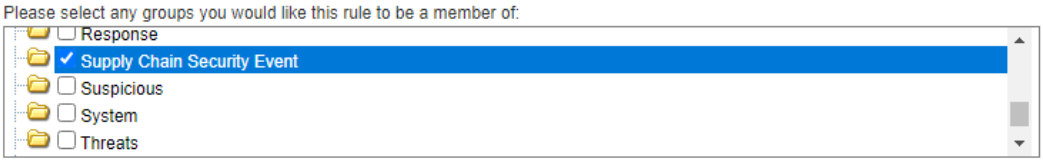
5. In the QRadar console, click **Log Activity**. Select **Rules** > **Rules** then **Actions** > **New Rule**.
6. Ensure **Events** is selected, then click **Next.**
7. Enter a name for the rule. We used the following pattern: *"[Event Category] [Event Value] rule".*
8. In the rules editor, search for *"event matches this AQL filter query"*. Click the *"this"* hyperlink to launch the Ariel Query Language (AQL) filter query. Enter the query below and click **Submit**.

```
"Event ID"=3001
```

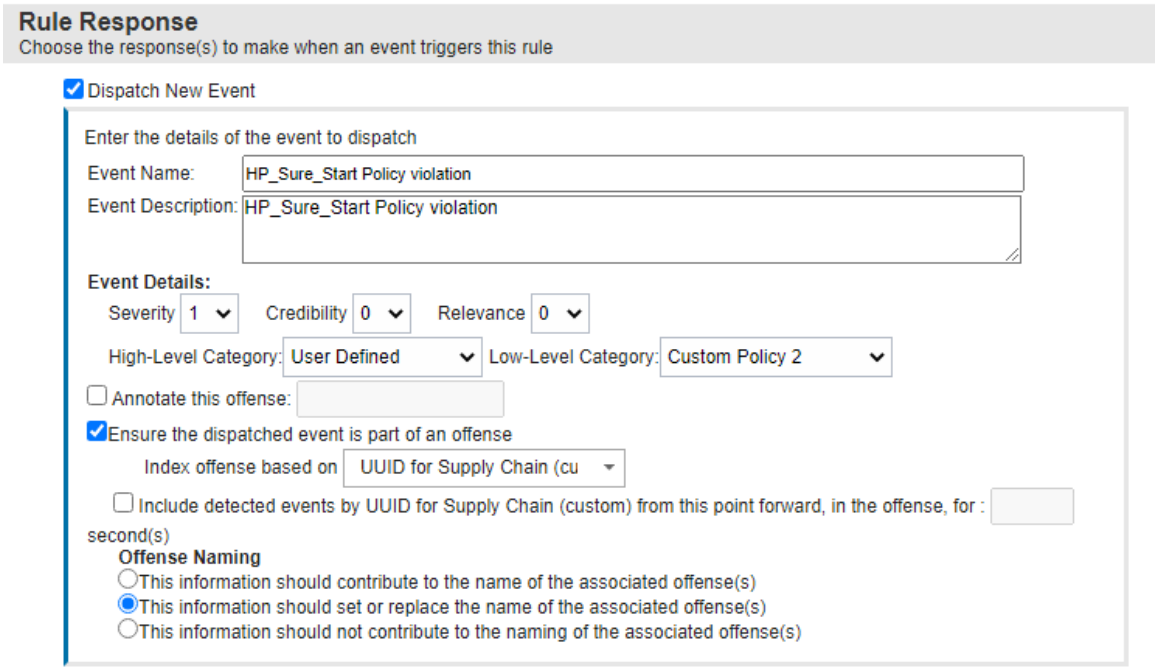
9. Create another criteria by using *"when the event matches this search filter"*. Click *"this search filter"* and locate the matching **Custom Property**. Select *"is not N/A"* and click **Add**. Click **Submit**.



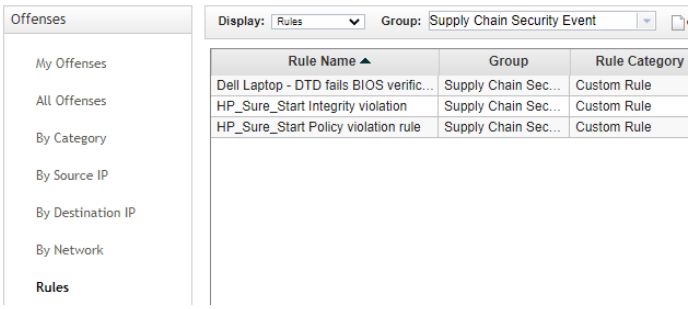
10. (Optional) Make the rule part of a group to organize platform integrity offenses. We created a custom group named *"Supply Chain Security Event"*.



11. Click **Next**. In the **Rule Response** section, select **Dispatch New Event**. Create an **Event Name** and **Event Description** following the same pattern as above.
12. In the **Event Details** section, select the **High-Level Category** of *"User Defined"* and choose the **Low-Level Category** noted in Table 2-11.
13. Check *"Ensure the dispatched event is part of an offense"*. Index offense based on *"UUID for Supply Chain"* in the pull-down menu.
14. In the **Offense Naming** section, select the second option (replace).



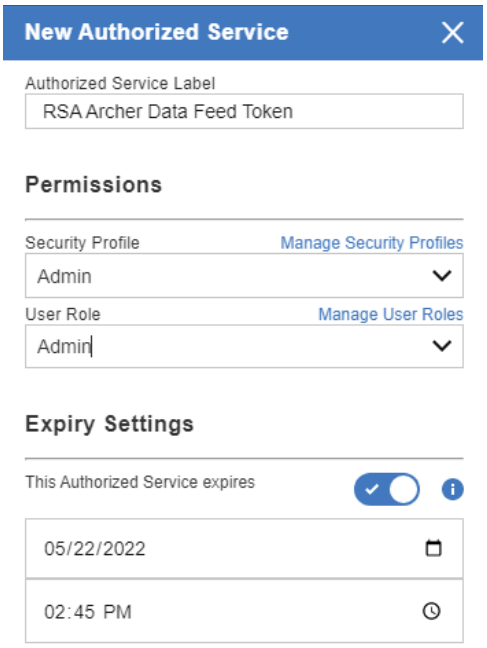
15. Click **Finish.** The new rule will appear in the **Offenses** > **Rules** tab.



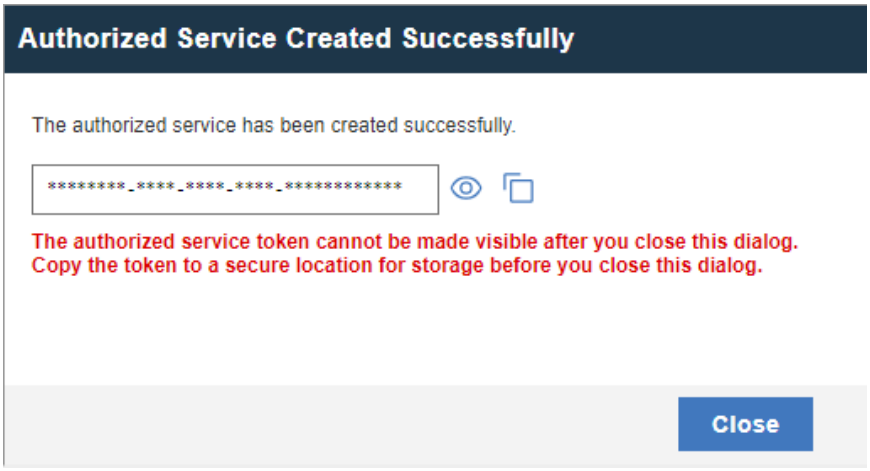
Repeat this section for every security event listed in Table 2-11.

2.11.3.2.4 Create an Authorized Service Token

1. In the administration console, click **Authorized Services**, then **Add New**. Enter an **Authorized Service Label** and appropriate **Security Profile** and **User Role** for your environment. Click **Save**.



2. The QRadar console will display the following dialog. Click the "eye" to reveal the secret token. Store the token securely.



3 Operational Considerations

This section describes the execution steps of an IT administrator assigned to the acceptance testing or monitoring of computing devices during their operational lifecycle. Each subsection restates the scenarios from the project description, but this prototype demonstration does not address each

scenario in totality. This preliminary draft will be updated later with additional guidance for laptops and servers.

Create an environment as described in Section 2 before attempting to use the proof-of-concept tools below.

3.1 Scenario 2: Verification of Components During Acceptance Testing

In this scenario, an IT administrator receives a computing device through nonverifiable channels (e.g., off the shelf at a retailer) and wishes to confirm its provenance and authenticity to establish an authoritative asset inventory as part of an asset management program.

The general execution steps are as follows:

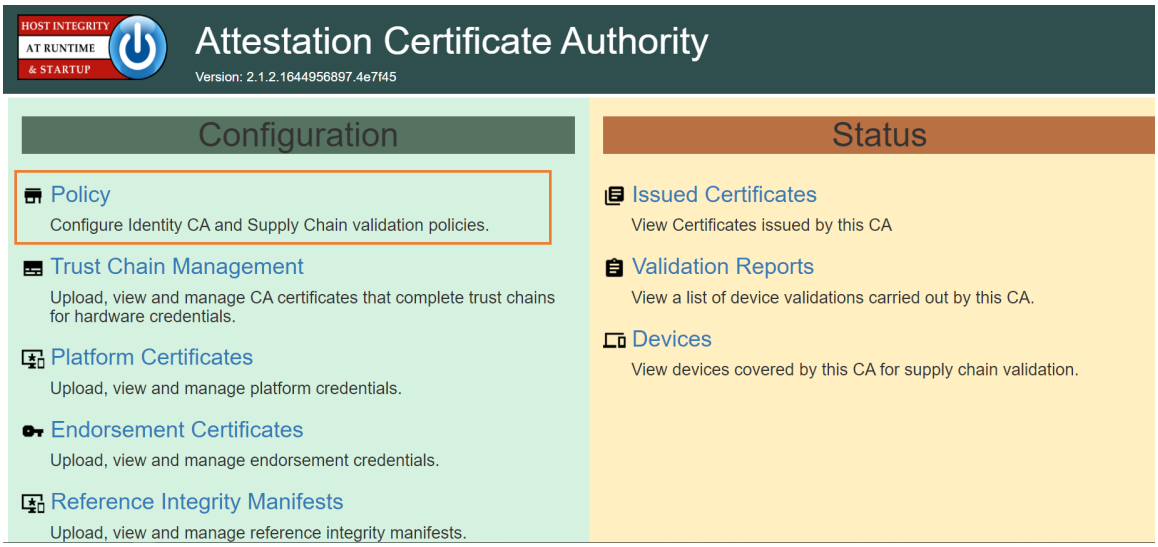
1. As part of the acceptance testing process, the IT administrator uses tools to extract or obtain the verifiable platform artifact associated with the computing device.
2. The IT administrator verifies the provenance of the device's hardware components by validating the source and authenticity of the artifact.
3. The IT administrator validates the verifiable artifact by interrogating the device to obtain platform attributes that can be compared against those listed in the artifact.
4. The computing device is provisioned into the physical asset management system and is associated with a unique enterprise identifier. If the administrator updates the configuration of the platform (e.g., adding hardware components, updating firmware), then the administrator might create new platform artifacts to establish a new baseline.

3.1.1 Technology Configurations

3.1.1.1 Configure the HIRS ACA

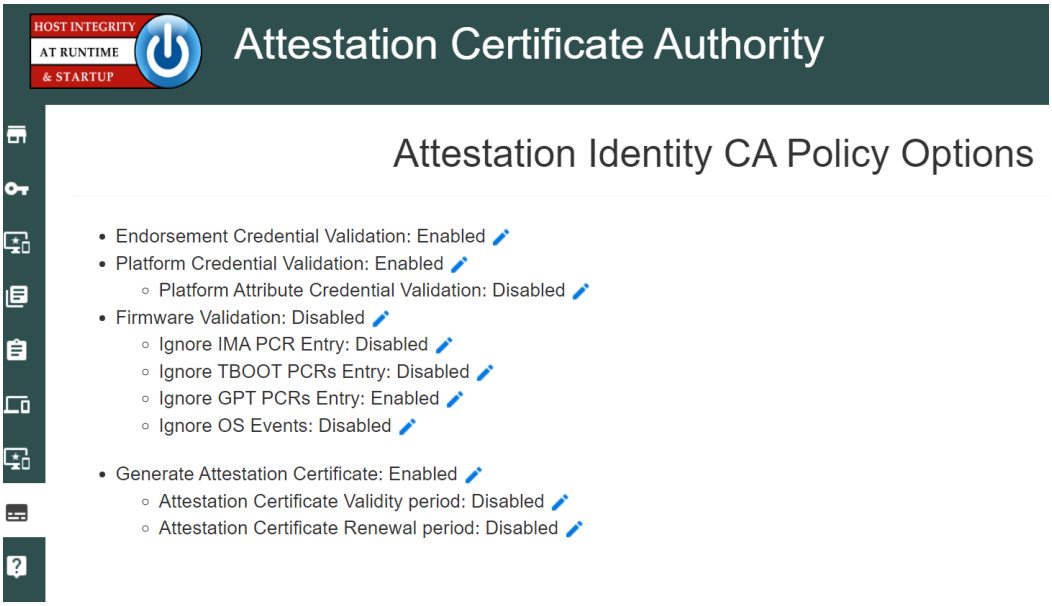
Before running the acceptance test on Dell and HP Inc. laptops, the HIRS ACA must be configured with the target laptop's platform attribute certificate and any trust chains associated with the platform attribute certificate and endorsement credential.

1. On the HIRS ACA web portal, under the **Configuration** panel, select **Policy.**

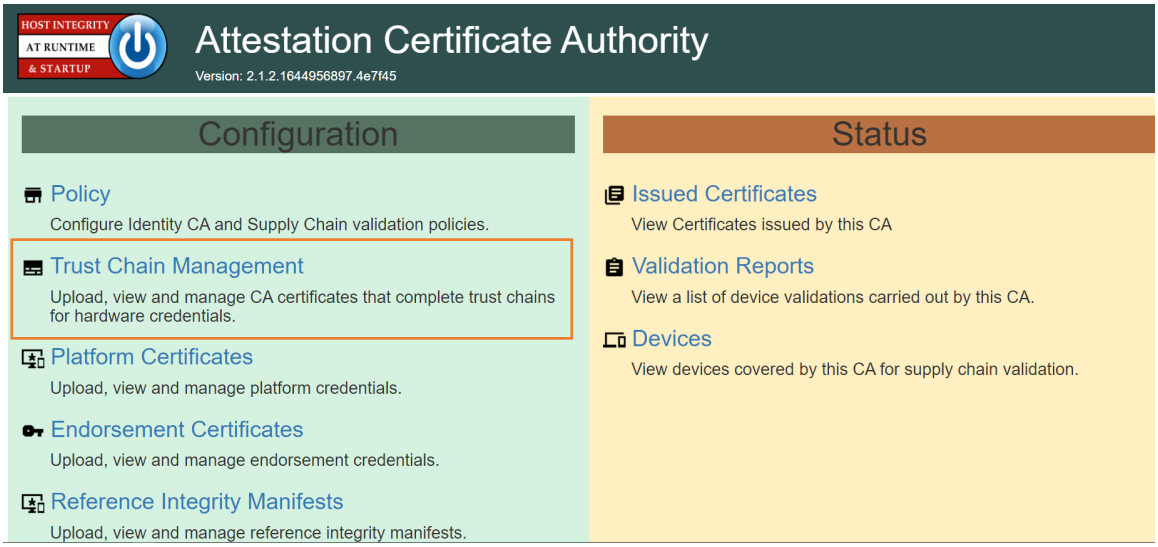


2. For this prototype demonstration, make sure the following policy options are set as listed in the table below.

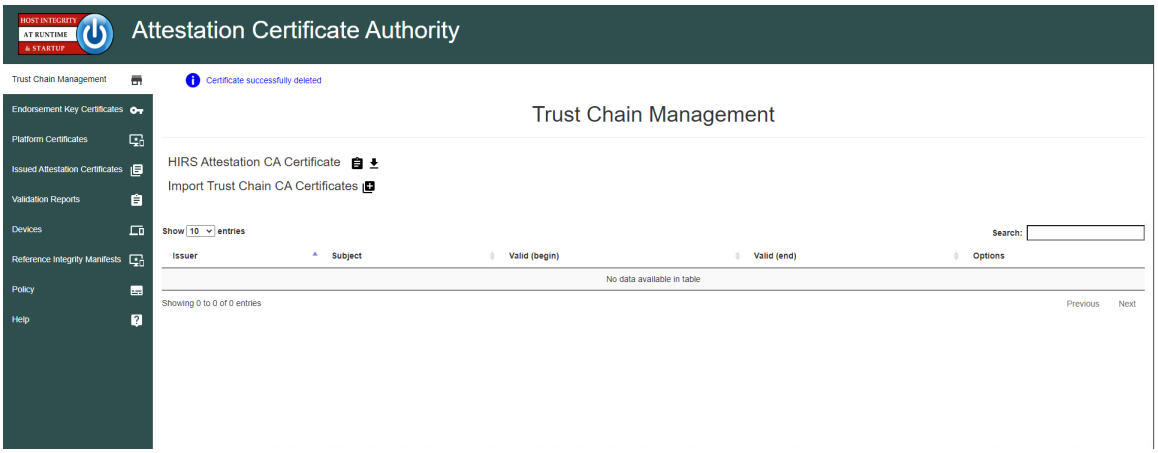
Policy Option	Setting
Endorsement Credential Validation	Enabled
Platform Credential Validation	Enabled
Platform Attribute Credential Validation	Enabled
Firmware Validation	Disabled
Ignore IMA PCR Entry	Disabled
Ignore TBOOT PCRs Entry	Disabled
Ignore GPT PCRs Entry	Disabled
Ignore OS Events	Disabled
Generate Attestation Certificate	Enabled
Attestation Certificate Validity period	Disabled
Attestation Certificate Renewal period	Disabled



3. Upload the trust chain certificates by navigating to the **Configuration** panel, then selecting **Trust Chain Management**.

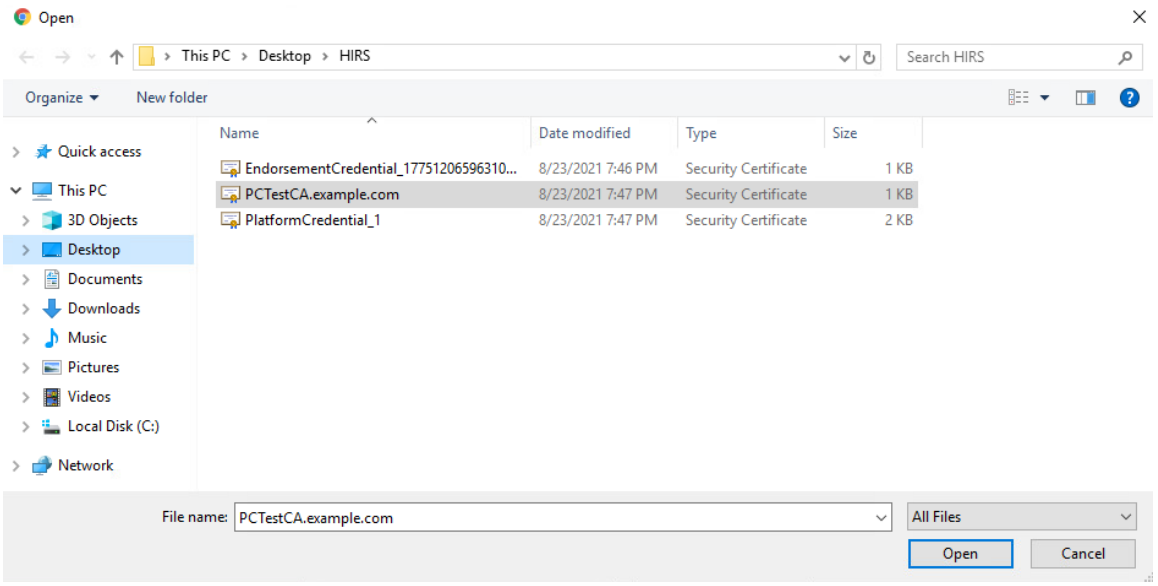


4. Select the icon beside **Import Trust Chain CA Certificates**.



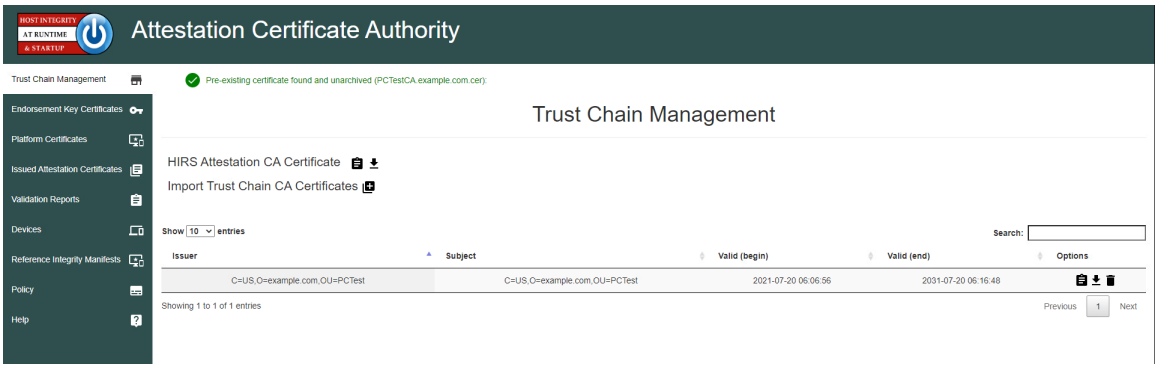
1317 5. Select **Choose Files**.

1318 6. Select the Trust Chain Certificate from the local computer. In the example below, the .crt file is
1319 named *PCTestCA.example.com*. Optionally, select multiple certificates if your implementation
1320 includes computing devices from distinct manufacturers. Click **Open**.

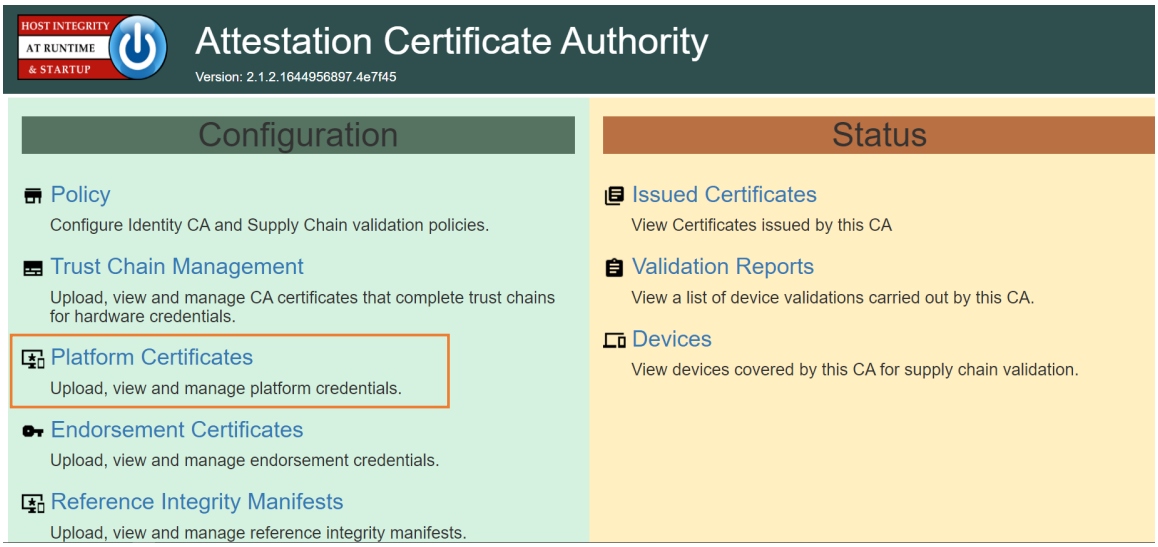


1321 7. Select **Save.**

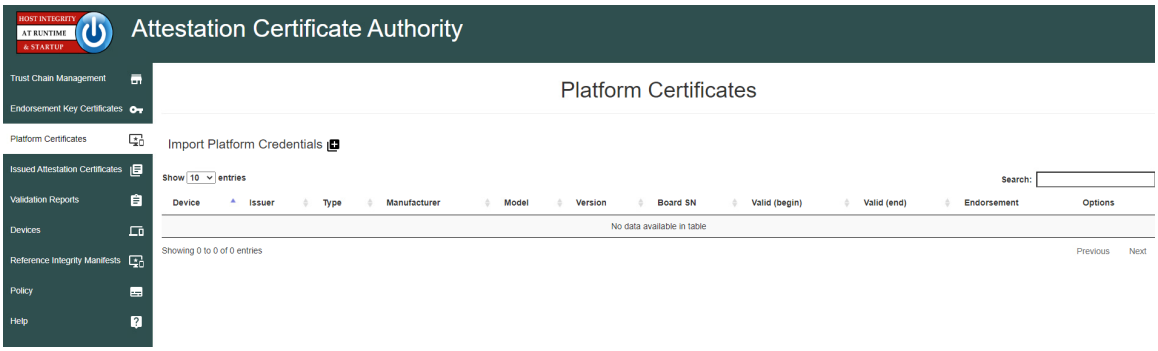
1322 8. The Trust Chain certificate should appear under the **Trust Chain Management** tab. Repeat this
1323 process for all root and intermediate certificates.



1324 9. Update the Platform Attribute certificates by navigating to the **Configurations** panel, then
1325 selecting **Platform Certificates**.

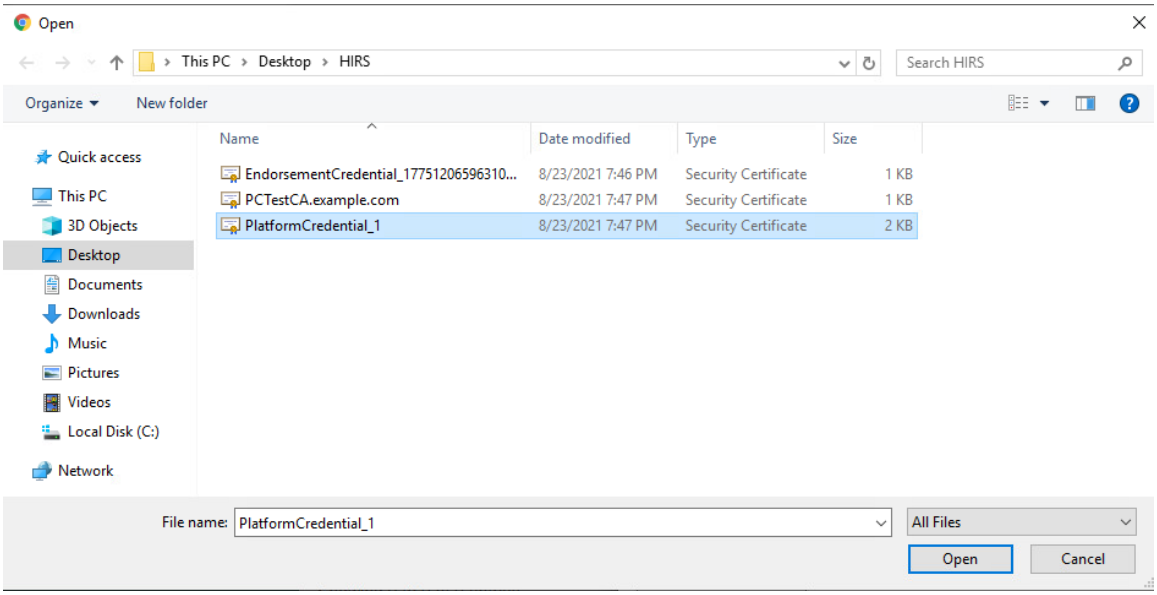


1326 10. Select the icon beside **Import Platform Certificates**.



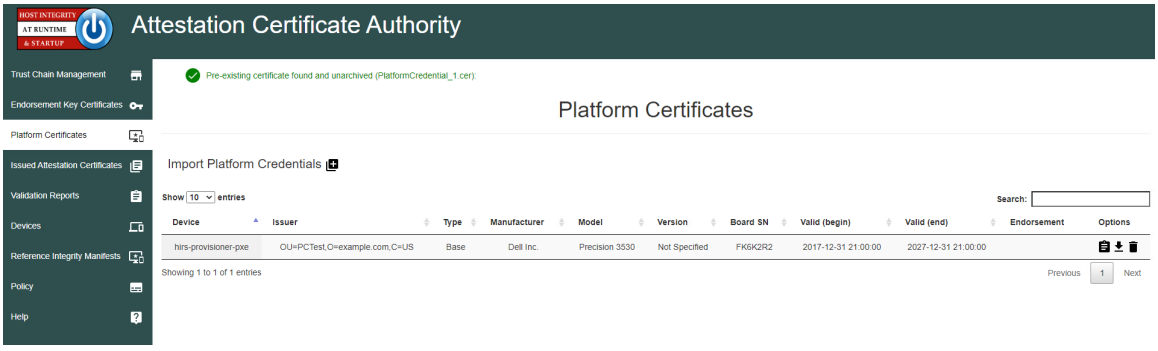
1327 11. Select **Choose Files.**

12. Select the Platform Certificate from the local computer. In the example below, the .crt file is named **PlatformCredential_1**. Select the file and click **Open**.

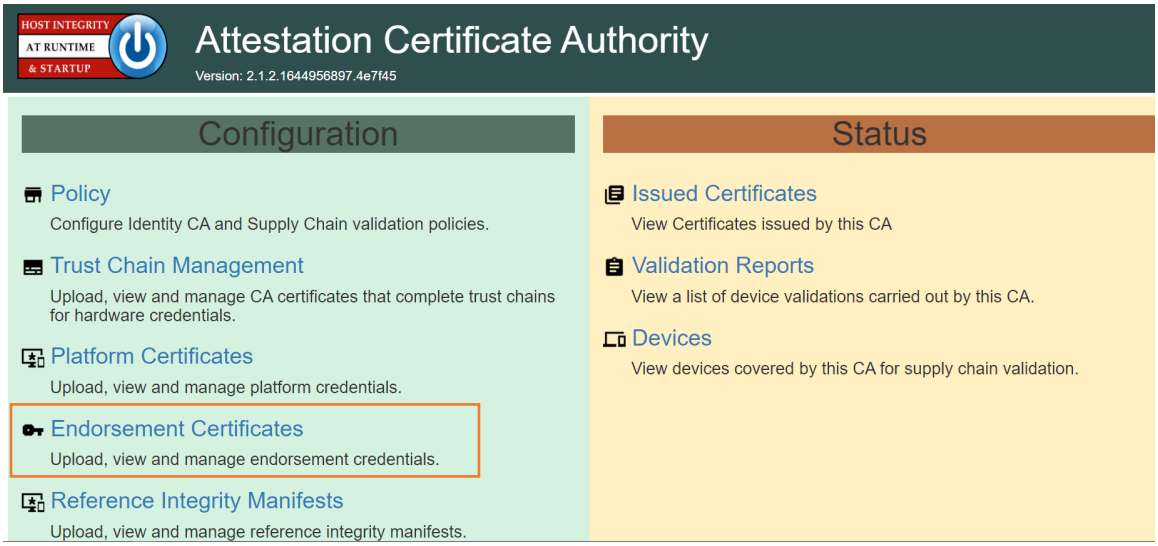


13. Select **Save**.

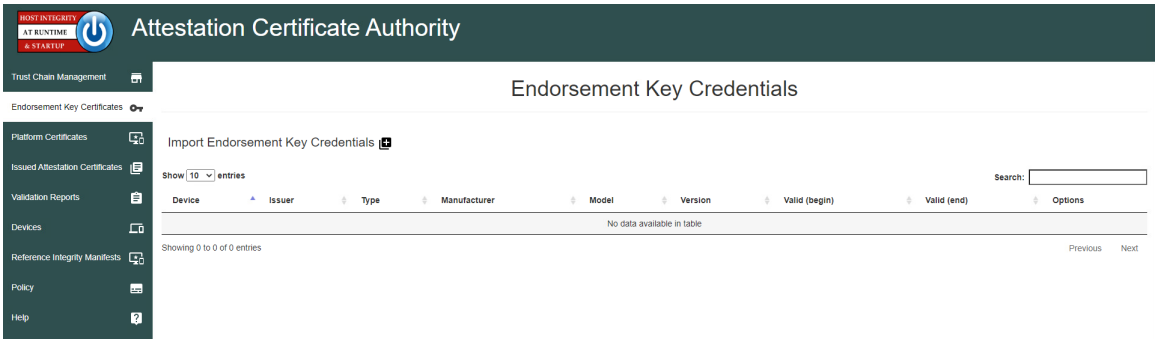
14. The Platform certificate should appear under the **Platform Certificates** tab.



15. Upload the Endorsement Key certificate by navigating to the **Configuration** panel, then selecting **Endorsement Certificates**.

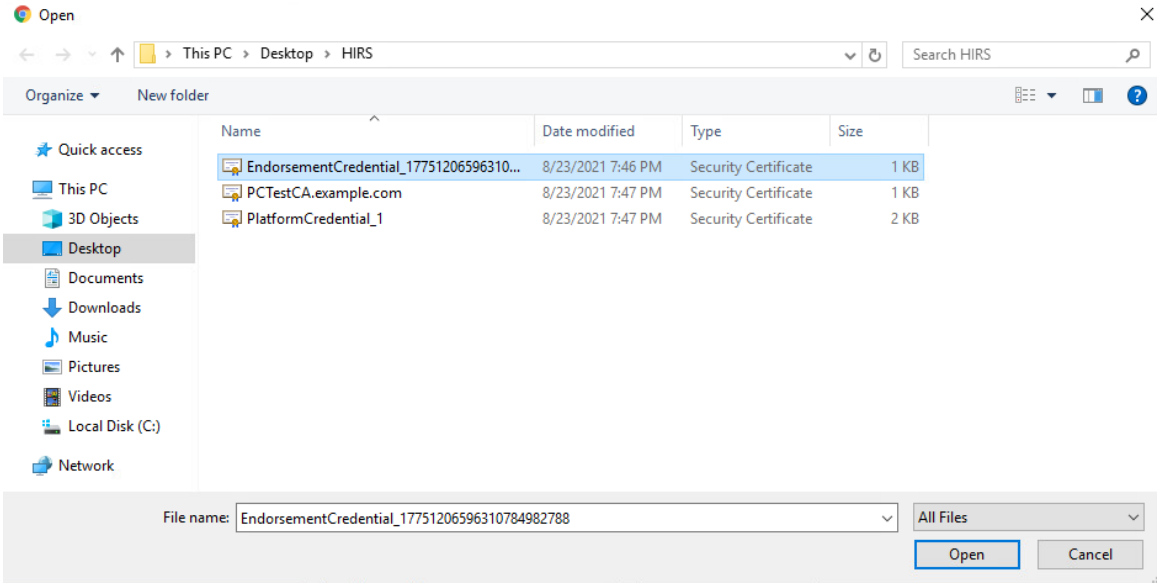


1334 16. Select the icon beside **Import Endorsement Key Certificates**.



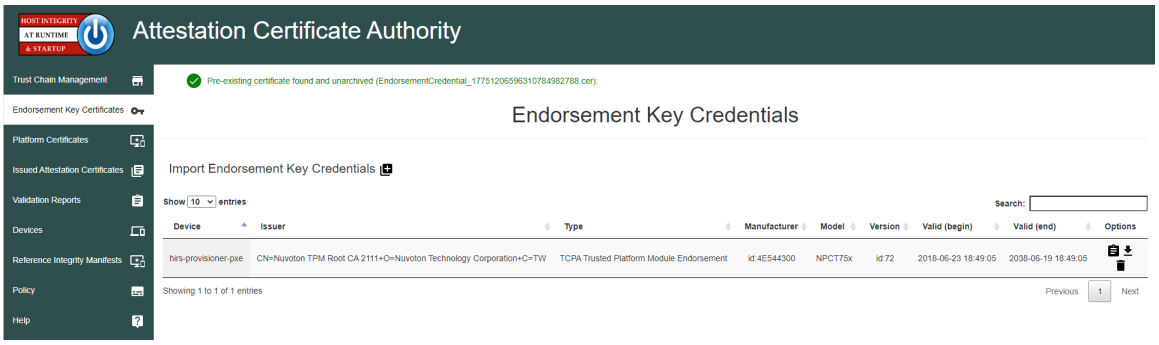
1335 17. Select **Choose Files**.

1336 18. Select the Endorsement Credential from the local computer. For this project, the .crt file is
1337 *EndorsementCredential_177512065963107849827 88*. Select the file and click **Open**.



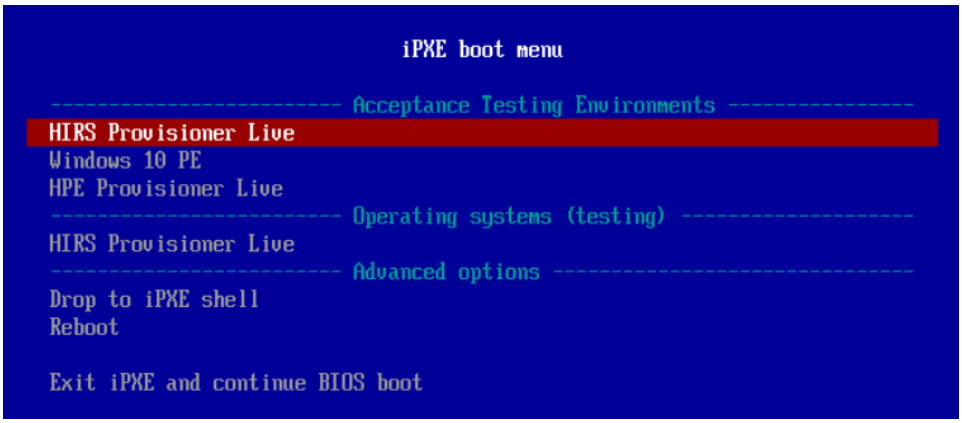
19. Select **Save.**

20. The Endorsement Key certificate should appear under the **Endorsement Key Credentials** tab.



3.1.1.2 Dell and HP Inc. Laptops

1. Boot the target laptop into the CentOS 7 acceptance testing environment via iPXE. This typically requires a one-time boot execution to prevent the laptop from loading the native OS. Consult the manufacturer's documentation for the appropriate steps. Choose HIRS Provisioner Live from the iPXE boot menu.



2. Once the live environment has loaded, log in as a user with root privileges. Run the provision.sh script. The script will attempt to:

    a. Change the hostname of the live environment. This assists the administrator in locating the target machine in the Eclypsium console.

    b. Run the Eclypsium scanner and submit results to the Eclypsium Analytic cloud platform.

    c. Run the HIRS provisioning script. If successful, post the results to the PMCS.

    The script will exit at any point an error is detected. Refer to the comments in the script to set this up in your own environment. Up-to-date information related to debugging the HIRS provisioning process can be found on the project site.

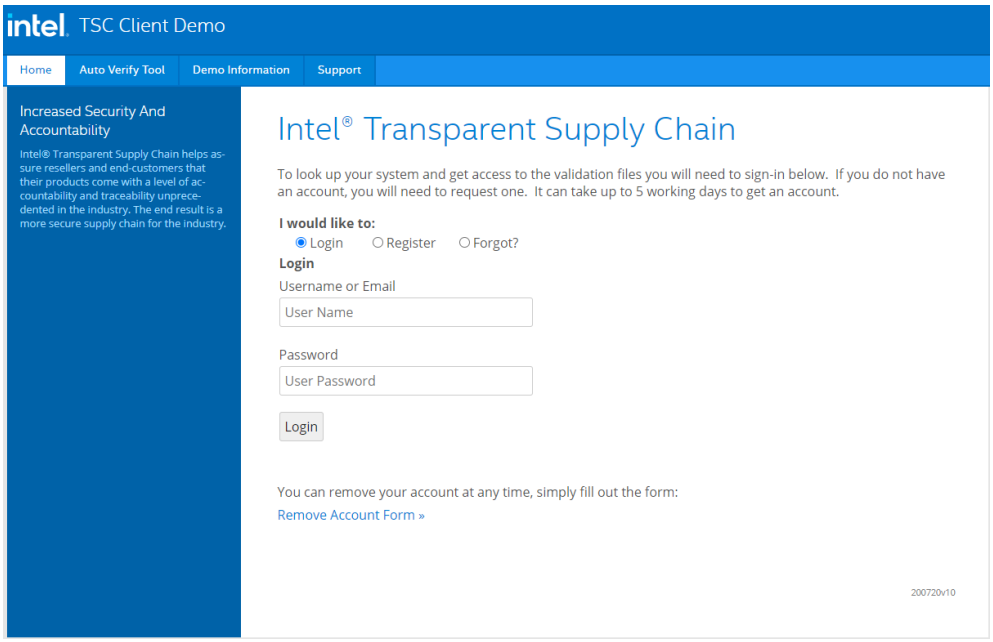
3.1.1.3 Intel-Contributed Laptops

The Auto Verify tool is central to scenario 2 acceptance testing. The tool compares the Direct Platform Data (DPD), allowing the customer to identify certain system changes from the time of manufacturing to the time of first boot. Install the Auto Verify Tool on the target system before attempting to execute the steps in this section.

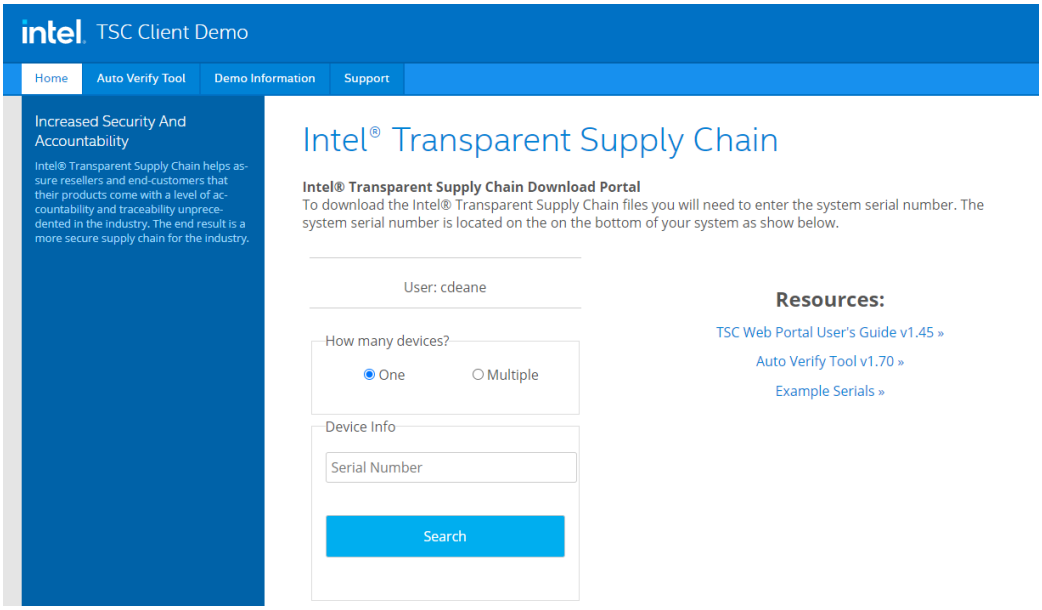
The DPD files and platform certificate files for the target laptop are available from Intel's Transparent Supply Chain demo page, https://tsc.intel.com/client-demo/. Work with your Intel representative to obtain credentials for your organization.

3.1.1.3.1 Download DPD File and Platform Certificate

1. Authenticate to the Intel TSC Client Demo portal page.



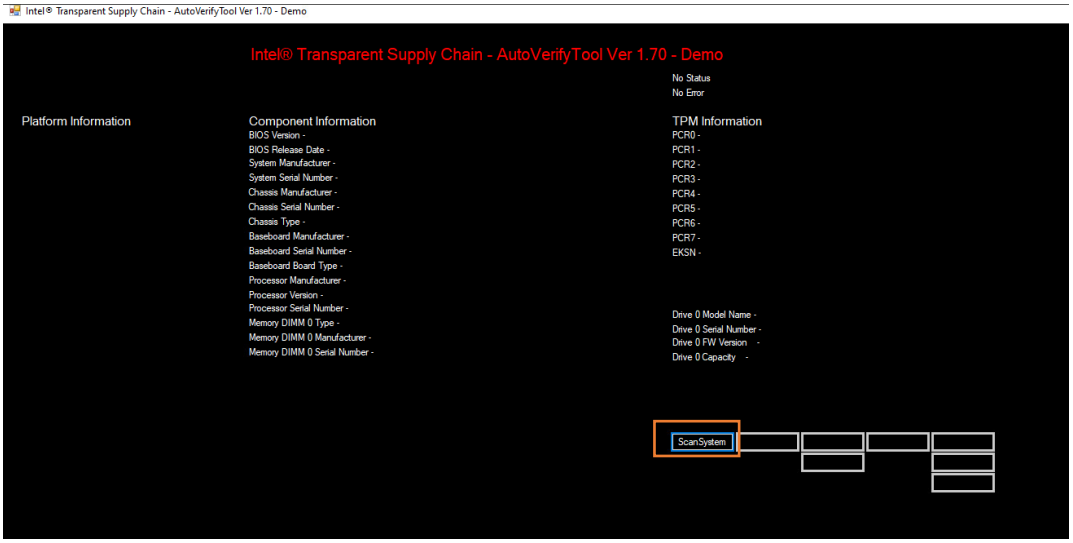
1364 2. Enter the serial number of the Intel laptop. Select **Search.**



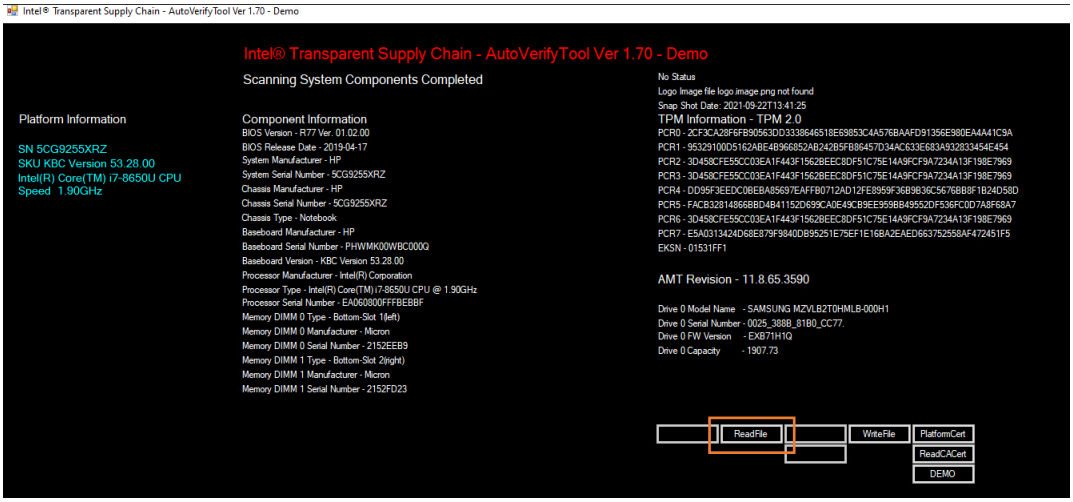
1365 3. Download the zip file containing the DPD files and platform certificate. Save and unzip the file
1366 on the target laptop. These files will be used with the Auto Verify tool to determine if any
1367 components have been changed.

1368 4. Launch the Auto Verify Tool.

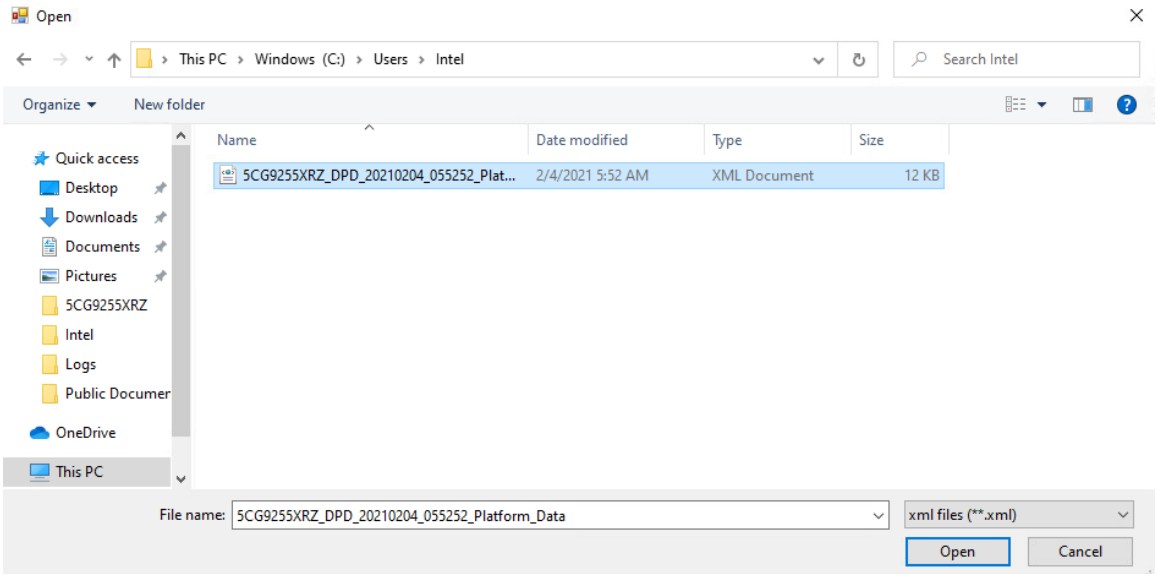
5. Click the **Scan System** button.



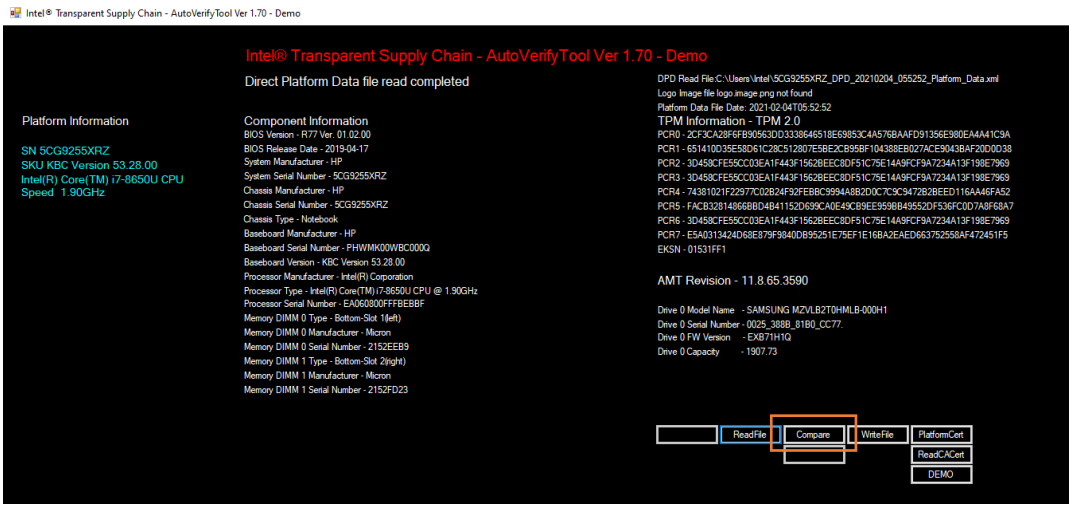
6. The Auto Verify Tool should populate the Component Information entries with the platform details of the computer. To compare the data to the DPD file stored on the local computer, click **ReadFile**.



7. Navigate to the downloaded DPD file and select **Open.**

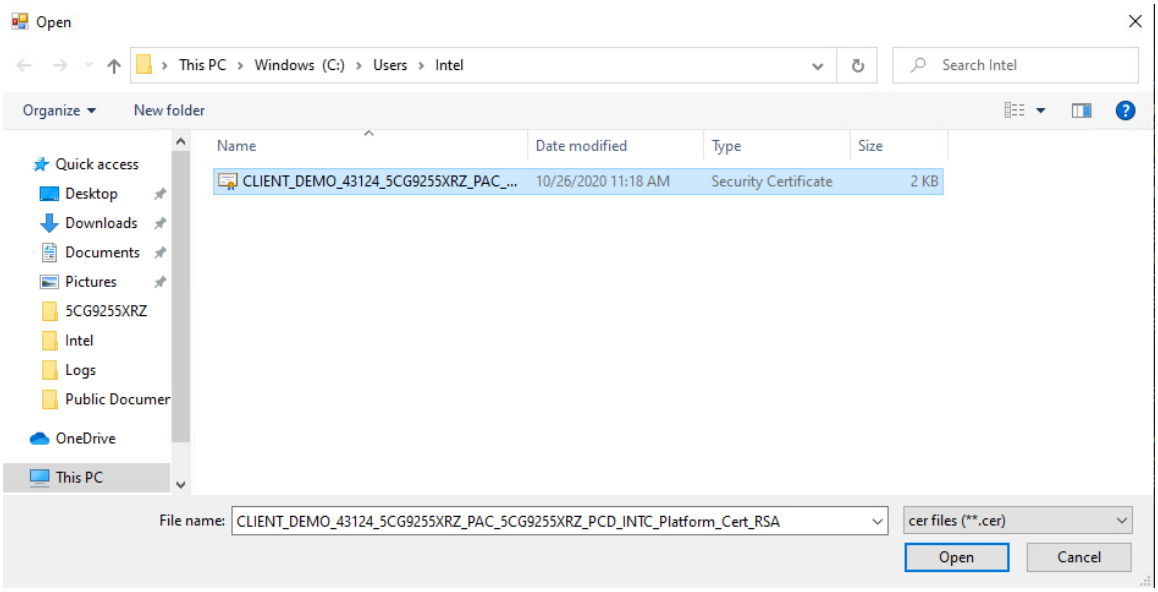


1374 8. Next, click the **Compare** button.



1375 9. If no changes have been made, the Auto Verify tool should output a green message that says,
1376 "**No Component Changes have been detected**." To compare the certificate file, click the
1377 **PlatformCert** button.

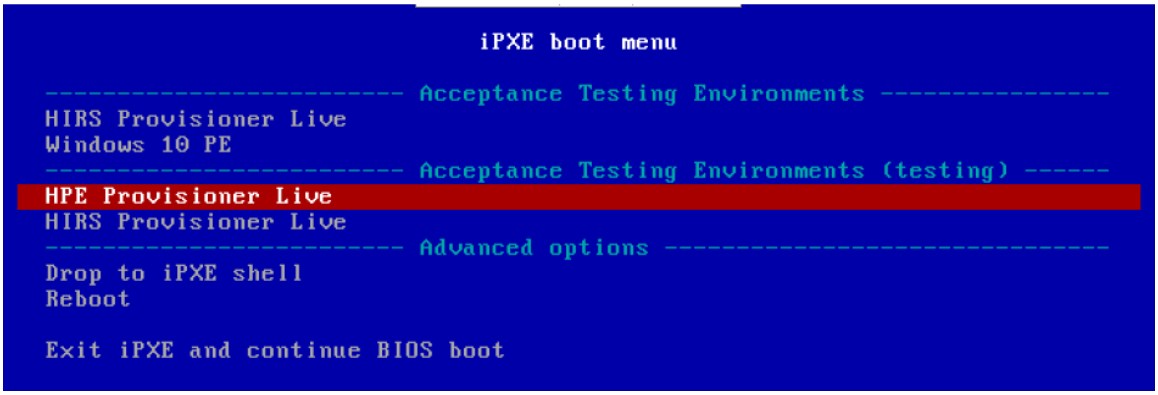
1378 10. Navigate to the location of the platform certificate and select **Open.**



1379 11. If the certificate matches the certificate that the AutoVerify tool detected, the tool will output
1380 another green message that reads "*Platform Certificate Matches*."

1381 *3.1.1.4 HPE Servers*

1382 1. Boot the target HPE server into the CentOS 8 acceptance testing environment via iPXE. This
1383 requires a one-time boot execution to prevent the server from loading the native OS. Press F11
1384 in the POST screen after a server reboot to access the one-time boot menu and choose the
1385 appropriate network interface card. Then choose *HPE Provisioner Live* from the iPXE boot menu.

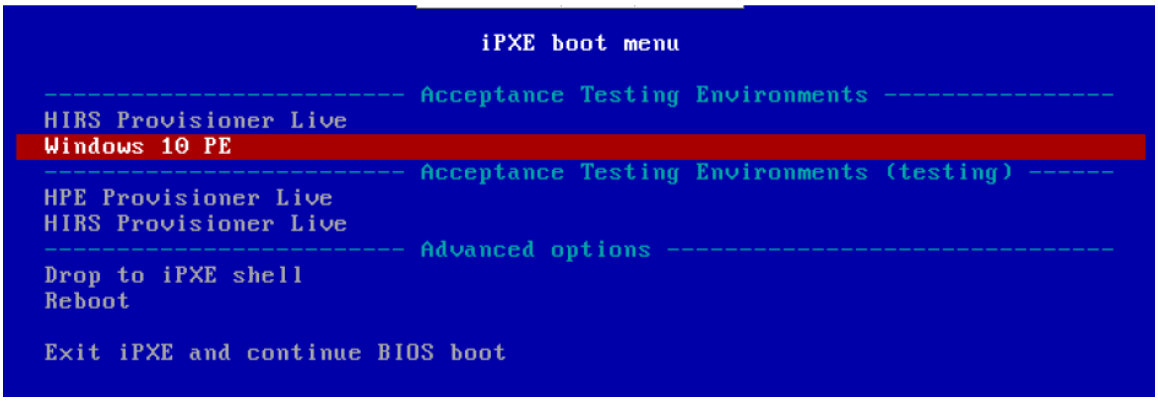


2. Once the live environment has loaded, log in as a user with root privileges. Run the *hpe_provision.sh script*. The script will attempt to execute the PCVT against the verifiable artifacts stored in the image. If successful, the script posts the platform manifest to the PMCS.

   The script will exit when an error is detected. Refer to the comments in the script to set this up in your own environment.

3.1.1.5 Dell Servers

1. Boot the target Dell server into the Windows PE acceptance testing environment via iPXE. This requires a one-time boot execution to prevent the server from loading the native OS. Press F12 in the POST screen after a server reboot to access the one-time PXE boot option and choose the appropriate network interface card. Then choose *Windows 10 PE* from the iPXE boot menu.



2. Once the live environment has loaded, log in as a user with root privileges. Run the *dell-server-scv.ps1* script. The script will attempt to execute the Dell Secured Component Verification (SCV) tool against the verifiable artifacts stored on the server. If successful, the script posts the platform manifest to the PMCS.

The script will exit when an error is detected. Refer to the comments in the script to set this up in your own environment.

3.1.1.6 Intel Server

3. Boot the Intel Server into the CentOS 8 host OS environment. Note that for the demonstration Intel server, a network-booted acceptance testing environment was not implemented.

4. Once the operating system has completed booting, log in as a user with root privileges. Run the *provision.sh* script. The script will attempt to execute the *TSCVerifyUtil* against the verifiable artifacts stored on the server. If successful, the script posts the platform manifest to the PMCS.

   The script will run *TSCVerifyUtil* again with different command arguments which directs the program to access the Seagate drive APIs. If successful, the drive attestation data and measurements are posted to the PMCS.

   The script will exit when an error is detected. Refer to the comments in the script to set this up in your own environment.

3.1.2 Asset Inventory and Discovery

Organizational members with access to the enterprise database of computing devices can access a listing by authenticating to the Archer system. We have configured our instance to display only the relevant Archer solution menus. In Figure 3-1, the administrator clicks the *SCA Devices* menu link to retrieve the listing.

Figure 3-1 Archer Solution Menu

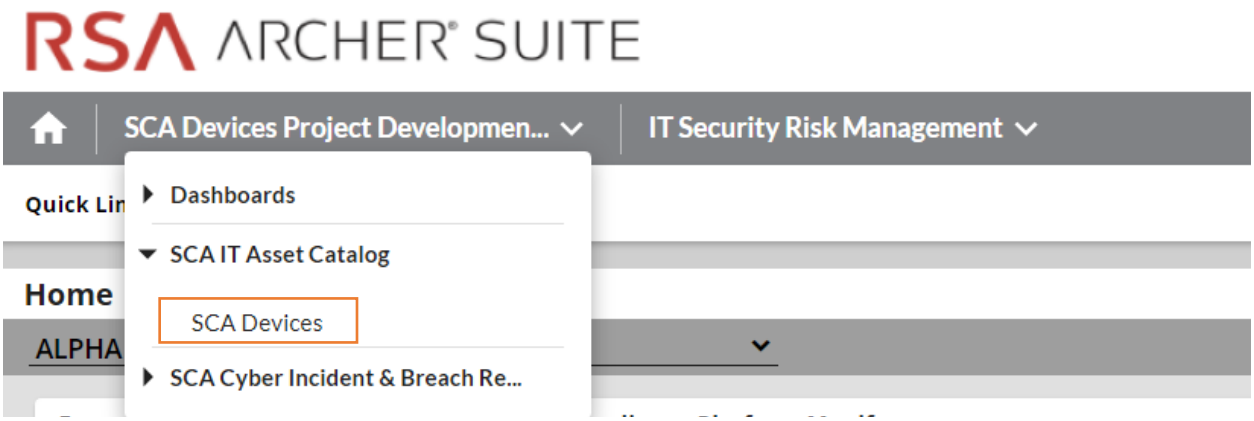
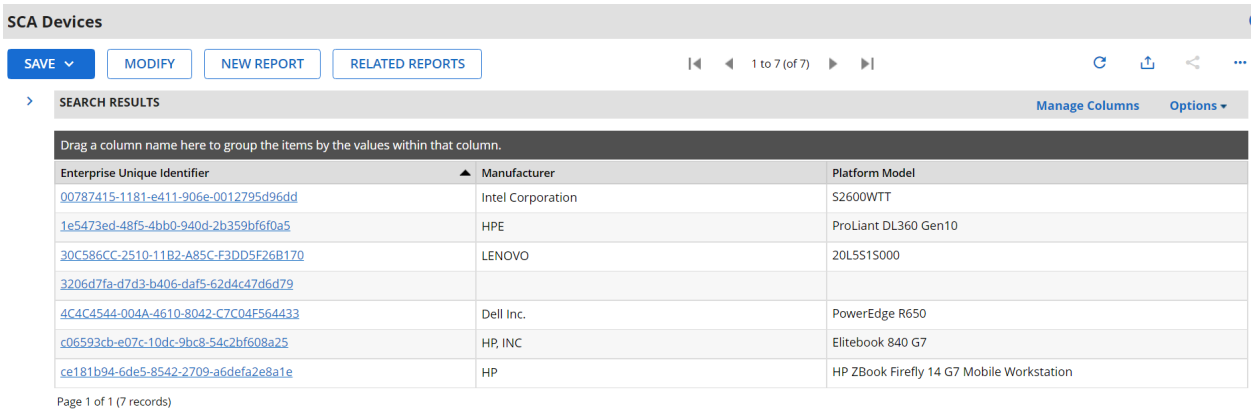


Figure 3-2 shows a listing of all enterprise computing devices that have had their platform validated in accordance with Scenario 2. The computing device *Enterprise Unique Identifier* is hyperlinked and when clicked displays additional data, as described below.

Figure 3-2 Enterprise Computing Devices Listing



SCA Devices

SAVE | MODIFY | NEW REPORT | RELATED REPORTS | 1 to 7 (of 7)

SEARCH RESULTS — Manage Columns — Options

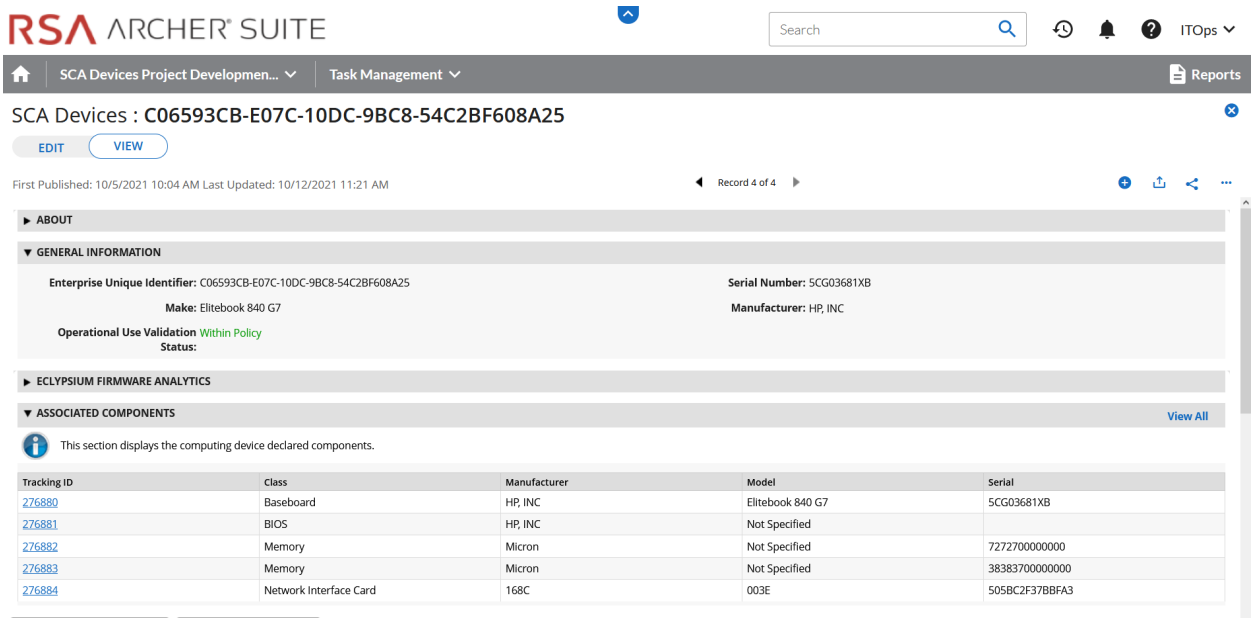
Drag a column name here to group the items by the values within that column.

Enterprise Unique Identifier	Manufacturer	Platform Model
00787415-1181-e411-906e-0012795d96dd	Intel Corporation	S2600WTT
1e5473ed-48f5-4bb0-940d-2b359bf6f0a5	HPE	ProLiant DL360 Gen10
30C586CC-2510-11B2-A85C-F3DD5F26B170	LENOVO	20L5S1S000
3206d7fa-d7d3-b406-daf5-62d4c47d6d79		
4C4C4544-004A-4610-8042-C7C04F564433	Dell Inc.	PowerEdge R650
c06593cb-e07c-10dc-9bc8-54c2bf608a25	HP, INC	Elitebook 840 G7
ce181b94-6de5-8542-2709-a6defa2e8a1e	HP	HP ZBook Firefly 14 G7 Mobile Workstation

Page 1 of 1 (7 records)

Figure 3-3 shows a representative laptop computing device that has completed the acceptance testing process by an IT administrator. In the **General Information** section, we have opted to display characteristics that are common across all the manufacturers in our project such as the serial number and the make of the computing device. Separately in the **Associated Components** section, we store and track the components from the initial manufacturer manifest. We will continue to iterate on the asset inventory user interface to surface meaningful and easily understandable information that is appropriate for individuals responsible for IT security.

Figure 3-3 Asset Inventory Screenshot



RSA ARCHER SUITE — Search — ITOps

SCA Devices Project Developmen... | Task Management | Reports

SCA Devices : **C06593CB-E07C-10DC-9BC8-54C2BF608A25**

EDIT | VIEW

First Published: 10/5/2021 10:04 AM Last Updated: 10/12/2021 11:21 AM — Record 4 of 4

▶ ABOUT

▼ GENERAL INFORMATION

Enterprise Unique Identifier: C06593CB-E07C-10DC-9BC8-54C2BF608A25
Serial Number: 5CG03681XB
Make: Elitebook 840 G7
Manufacturer: HP, INC
Operational Use Validation Status: Within Policy

▶ ECLYPSIUM FIRMWARE ANALYTICS

▼ ASSOCIATED COMPONENTS — View All

This section displays the computing device declared components.

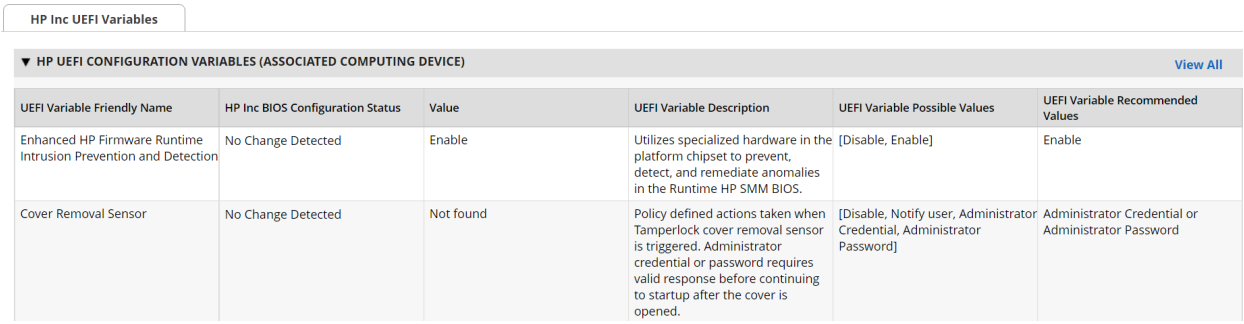
Tracking ID	Class	Manufacturer	Model	Serial
276880	Baseboard	HP, INC	Elitebook 840 G7	5CG03681XB
276881	BIOS	HP, INC	Not Specified	
276882	Memory	Micron	Not Specified	7272700000000
276883	Memory	Micron	Not Specified	38383700000000
276884	Network Interface Card	168C	003E	505BC2F37BBFA3

For those computing devices that support Eclypsium during acceptance testing, Archer retrieves the initial firmware data from the Eclypsium backend (cloud or on-premises) and displays it in the Eclypsium Firmware Analytics section of the record as shown in Figure 3-4.

Figure 3-4 Eclypsium Acceptance Testing Firmware Data

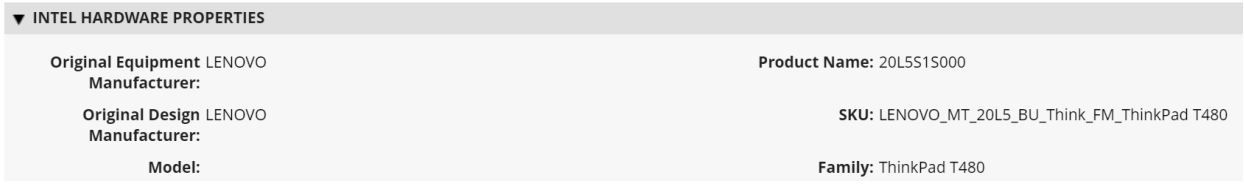
3.1.2.1 Manufacturer-Specific Attributes

As described in Volume B of this guide, this demonstration also collects manufacturer-specific platform integrity attributes in addition to the agnostic data described above. For HP Inc. laptops, BIOS configuration settings, represented as UEFI variables, are associated with the laptop in the asset inventory when available. From this perspective the security operator is able to view each variable value, description, and the recommended setting for each value. The operator is also alerted if the variable value has changed since the initial baseline (column 2), where a remediation action could be initiated.



UEFI Variable Friendly Name	HP Inc BIOS Configuration Status	Value	UEFI Variable Description	UEFI Variable Possible Values	UEFI Variable Recommended Values
Enhanced HP Firmware Runtime Intrusion Prevention and Detection	No Change Detected	Enable	Utilizes specialized hardware in the platform chipset to prevent, detect, and remediate anomalies in the Runtime HP SMM BIOS.	[Disable, Enable]	Enable
Cover Removal Sensor	No Change Detected	Not found	Policy defined actions taken when Tamperlock cover removal sensor is triggered. Administrator credential or password requires valid response before continuing to startup after the cover is opened.	[Disable, Notify user, Administrator Credential, Administrator Password]	Administrator Credential or Administrator Password

Computing devices that use the Intel Transparent Supply Chain platform declare (if present) additional attributes such as values for the OEM, original design manufacturer (ODM), model, product name, stock keeping unit (SKU), and product family. The screenshot below is an example from a demonstration laptop asset inventory record.



Finally, each Seagate drive asset inventory entry displays associated data from its firmware attestation and measurement capabilities. The security operator can view the currently running version of the firmware and click on the Tracking ID hyperlink for more details associated with the firmware. In the lower section, the Firmware Hash Status column informs the operator if measurement values have changed since the baseline, which may indicate an integrity issue that requires remediation.

▼ SEAGATE FIRMWARE ATTESTATION (SEAGATE DRIVE SERIAL)

First Published	Firmware Version	Tracking ID
5/2/2022 4:26 PM	0x01	277346
5/2/2022 4:26 PM	0x01	277348
5/2/2022 4:26 PM	0x01	277349

▼ SEAGATE FIRMWARE HASH (SEAGATE DRIVE)

Firmware Hash Status	Tracking ID
No Change Detected	277347

3.2 Scenario 3: Verification of Components During Use

In this scenario, the computing device has been accepted by the organization (Scenario 2) and has been provisioned for the end user. The computing device components are verified against the attributes and measurements declared by the manufacturer or purchasing organization during operational usage.

The general execution steps are as follows:

1. The end user takes ownership of the computing device from the IT department and uses it to perform daily work tasks within the scope of normal duties.
2. The computing device creates a report that attests to the platform attributes, such as device identity, hardware components, and firmware measurements that can be identified by interrogating the platform.
3. The attestation is consumed and validated by existing configuration management systems used by the IT organization as part of a continuous monitoring program.
4. The measured state of the device is maintained and updated as the authorized components of the device are being maintained and associated firmware is updated throughout the device's operational life cycle.
5. Optionally, the IT administrator takes a remediation action against the computing device if it is deemed out of compliance. For example, the computing device could be restricted from accessing certain corporate network resources.

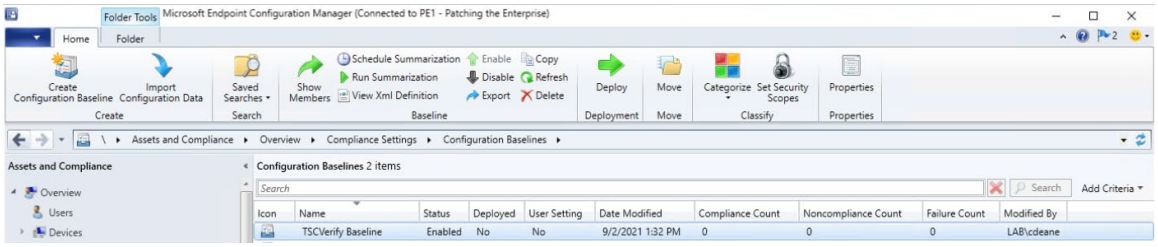
3.2.1 Technology Configurations

3.2.1.1 Monitoring Using Intel and HIRS-ACA Validation Clients

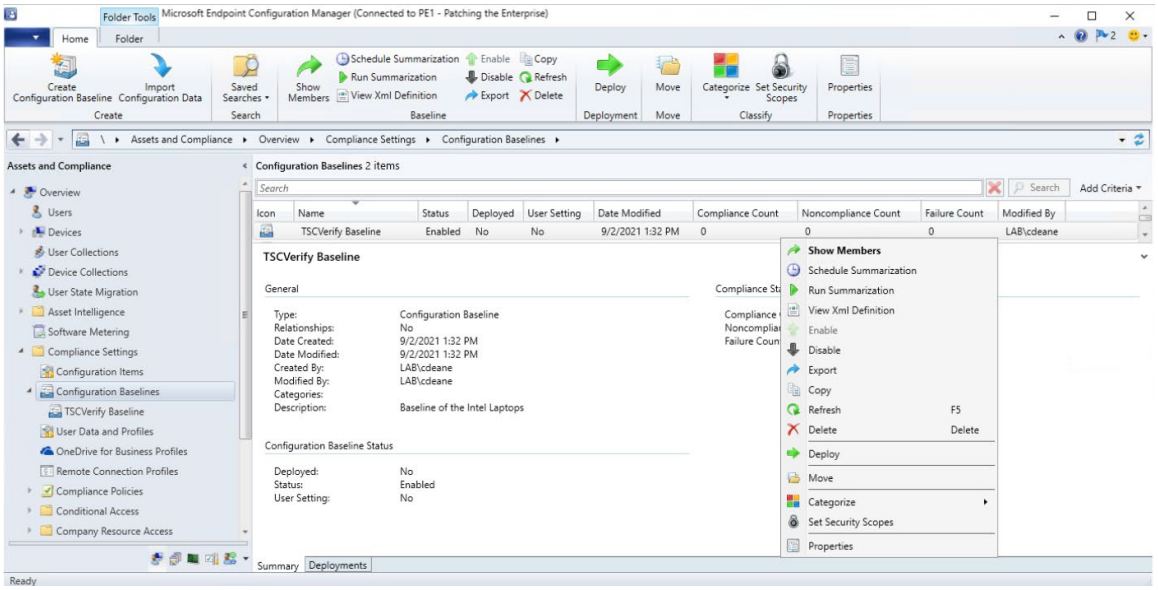
This section describes the steps that monitor for unexpected component changes using Intel TSC/HIRS-ACA tooling and Microsoft Configuration Manager capabilities.

3.2.1.1.1 Deploy Baseline

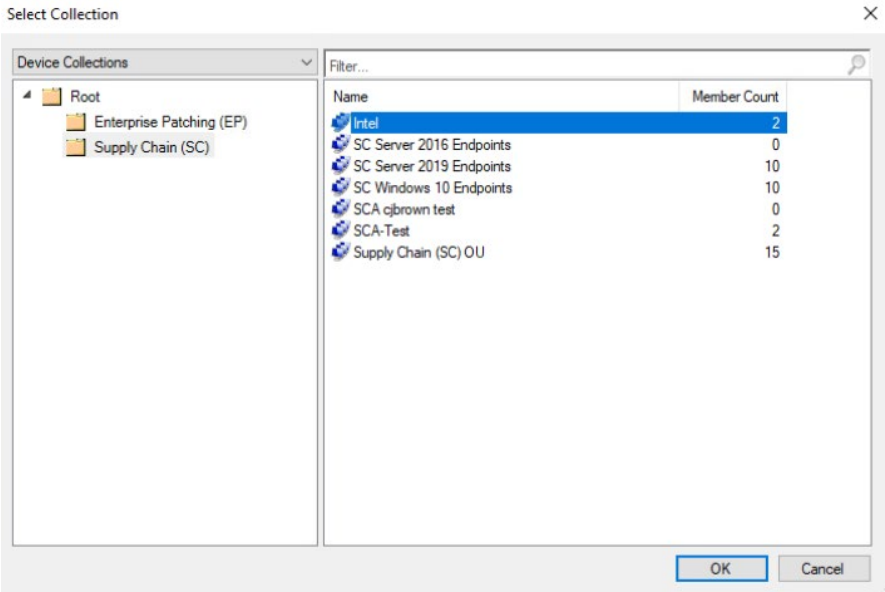
1. Navigate to the newly created configuration baseline located at **Assets and Compliance > Overview > Compliance Settings > Configuration Baselines.**



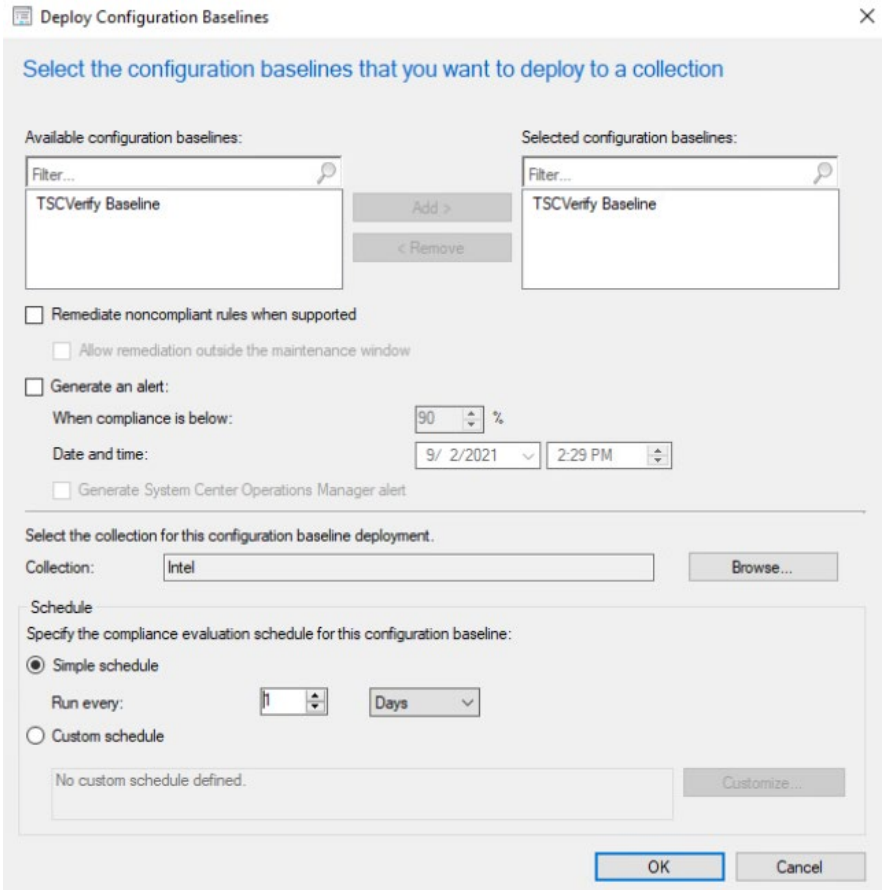
2. Right-click on the configuration baseline and select **Deploy.**



3. Select the device collection for the Intel TSC-supported machines. For this project, the device collection is named **Intel.** Select **OK.**



4. Ensure that the baseline is selected and then select the desired frequency of when to run the baseline. Select **OK.**

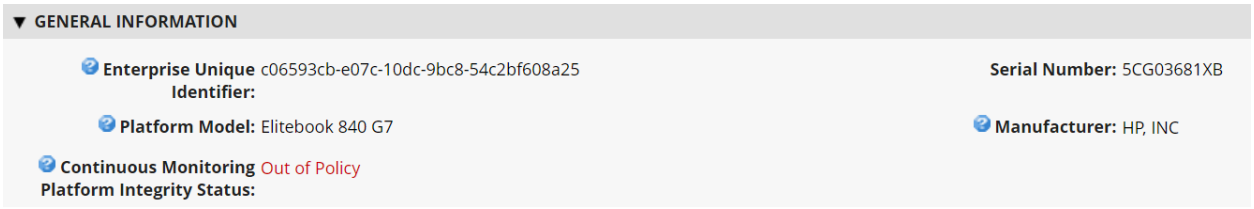


This completes the configuration for Intel TSC platform validation tools. Repeat this section to create a similar baseline for Dell and HP Inc. laptops that leverage HIRS-ACA platform validation tools.

3.2.1.2 Updating the Platform Verifiable Artifact During Operational Use

During the operational use of a computing device, a member of security operations may observe a warning in a computing device's asset record that it is out of compliance. This could indicate that the platform has been updated but the change has not been reflected in the verifiable artifact. Archer will continue to display this warning until the verifiable artifact is updated with the new platform manifest. Figure 3-5 illustrates this scenario.

Figure 3-5 Out of Policy Computing Device



Address the policy warning by using the following procedures to create a Delta Platform Certificate on HP Inc. and Dell laptops which reflects changes in the target platform components. A Delta Platform Certificate can be created in Linux or Windows; however, this demonstration only exercises creation on the Windows platform.

Ensure the following prerequisites are met:

- The administrator has installed PACCOR onto the target laptop.
- A base Platform Certificate has been created and configured in the HIRS ACA. Creation of a Delta Platform Certificate is dependent on the existence of another base Platform Certificate for the same laptop.

Next, complete the following procedures to create a Delta Platform Certificate.

5. Open a command prompt as an Administrator on the target laptop. Change directories to the following:

   ```
   <paccor install folder>\scripts\windows
   ```

6. Create a directory named *pc_testgen* in the working directory from the previous step if it does not already exist.

7. Retrieve the base Platform Certificate from the HIRS ACA portal or other means. Change the filename of the Platform Certificate to *holder.crt* and place it into the *pc_testgen* directory.

8. Execute PACCOR's component gathering script and capture the output with the following command.

   ```
   powershell -ExecutionPolicy Bypass ./allcomponents.ps1 components.json
   ```

9. The component list needs to be manually edited to reflect added, modified, or removed components of the system. Using a JSON file editor, open the *components.json* file.

   a. In the **COMPONENTS** object, identify the objects that represent components to be saved in the new Delta Platform Certificate. Add a **STATUS** field at the end of these components with a value of **ADDED, MODIFIED,** or **REMOVED**. For example, to modify the chassis serial number, create a **COMPONENTS** entry similar to the following.

```
{
  "COMPONENTS": [
    {
      "COMPONENTCLASS": {
        "COMPONENTCLASSREGISTRY": "2.23.133.18.3.1",
        "COMPONENTCLASSVALUE": "00020001"
      },
      "MANUFACTURER": "Example Manufacturer",
      "MODEL": "1",
      "SERIAL": "1234",
      "STATUS": "MODIFIED"
    }
  ]
}
```

b. Delete all other objects under **COMPONENTS.**

c. Once finished editing the *components.json* file, move it to the **pc_testgen** folder.

10. Using a text editor, modify the **pc_certgen** script header variables.

    a. Set the **ekcert** variable to point to **holder.crt** from step 3.

    b. Set the **componentlist** variable to point to **components.json** from step 5.

    c. Change the value of **serialnumber** to 0002.

    d. If you have a specific signing key and cert, move those files to **pc_testgen** as well and update the **sigkey** and **pcsigncert** variables to point to them.

11. Execute the *pc_certgen.ps1* script using the following command:

```
powershell -ExecutionPolicy Bypass ./pc_certgen.ps1
```

12. The resulting Delta Platform Certificate will be stored in the **pc_testgen** folder.

13. Upload the new Delta Platform Certificate to the HIRS-ACA portal.

Note that laptops that are continuously monitored with the Windows-based HIRS Provisioner will be evaluated against this new baseline.

3.2.2 Dashboards

The dashboard created in Section 2.11.2.3 attempts to consolidate and communicate potential integrity issues to the IT administrator while computing devices are in operational use. The timeliness of this information will depend on the cadence that your organization chooses to update the various data feeds from Microsoft Configuration Manager and the Eclypsium Analytic platform. This demonstration displays to the administrator if there are detected component swaps from computing devices that can leverage

Intel TSC and HIRS-ACA platforms. Further, it displays any detected firmware platform integrity issues from the Eclypsium Analytic cloud and on-premises platform across all manufacturers in this prototype.

The Archer IRM dashboard should resemble the screenshots below, where a count of computing devices with potential integrity issues is displayed (Figure 3-6 and Figure 3-7). Your organization's security operations team may also want to access the Eclypsium Analytic platform directly to obtain detailed information, including remediation actions, for computing devices with detected integrity issues.

Figure 3-6 Dashboard with No Integrity Issues Detected

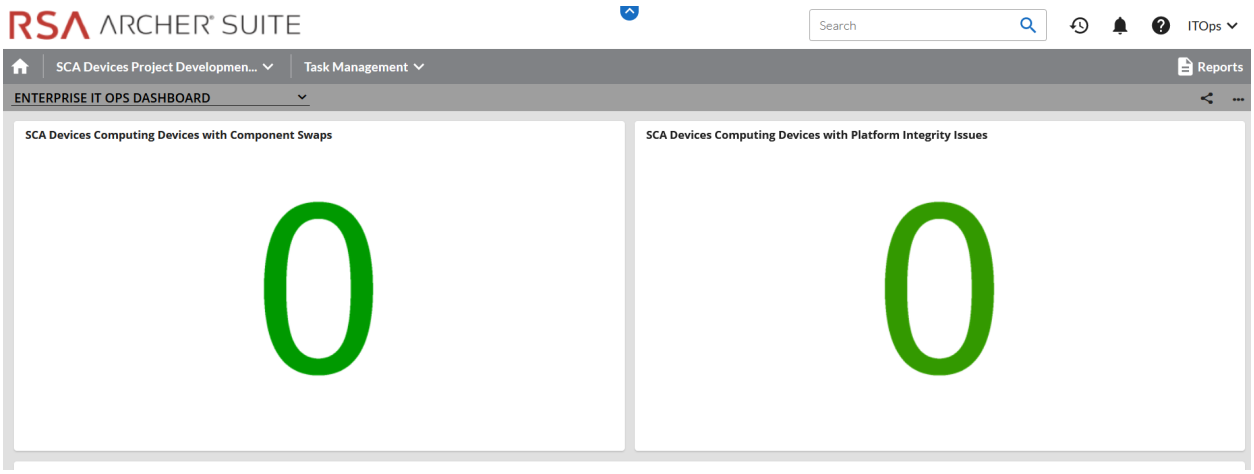
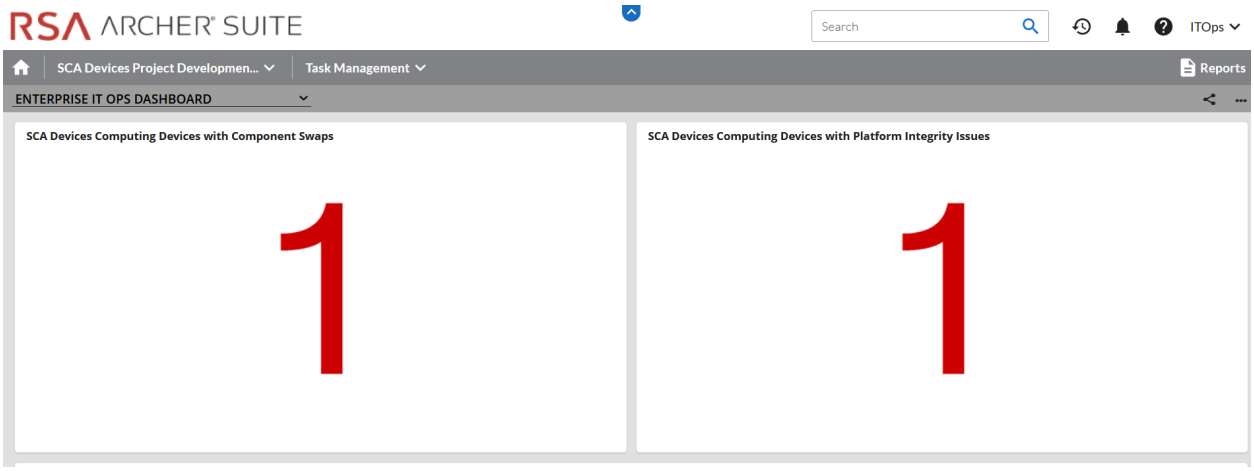
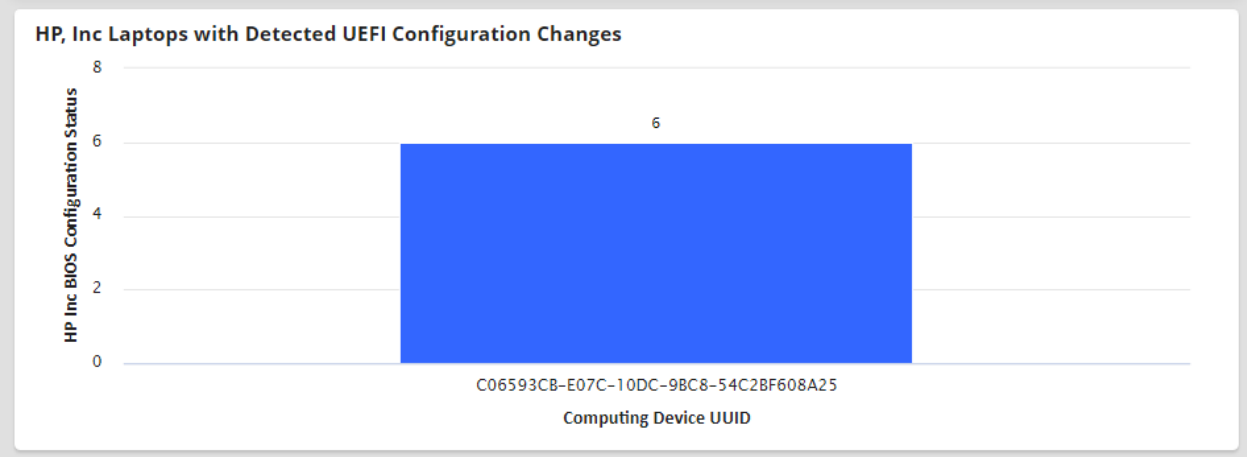


Figure 3-7 Dashboard with Integrity Issues Detected



The demonstration dashboards are also capable of monitoring manufacturer-specific platform integrity datapoints. In Figure 3-8, we show a dashboard component that captures the number of UEFI configuration parameters that have changed from the baseline values (Y-axis) for each HP Inc. computing device (X-axis).

1565 **Figure 3-8 HP Inc. Laptop Continuous Monitoring**

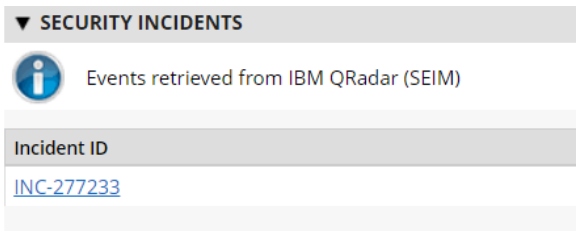


1566 In the final dashboard component, the security operator can display the number of Seagate drives with
1567 firmware hash values that have changed since the initial acceptance testing baseline. In a production
1568 setting, it could be more useful to compare the drive measurements against known values
1569 communicated directly from the manufacturer (Seagate).

1570 3.2.3 Platform Integrity Incident Management

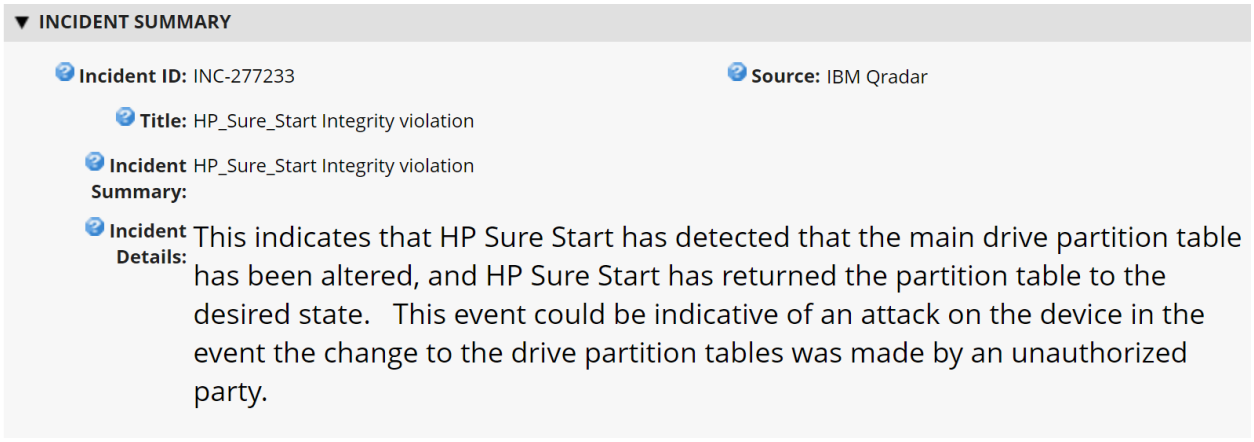
1571 The final continuous monitoring scenario we demonstrate is the automated creation of Archer *Incidents*
1572 when the QRadar continuous monitoring data feed (Section 2.11.2.2.4) retrieves a platform integrity
1573 issue. In the asset inventory record shown in Figure 3-9, we have triggered a platform integrity issue in
1574 one of our demonstration HP Inc. laptops, which has automatically created an Archer *Security Incident*.
1575 Note that the Archer platform offers workflow customization options that are not documented here
1576 that can support more complex organizational structures.

1577 **Figure 3-9 New Security Incident**



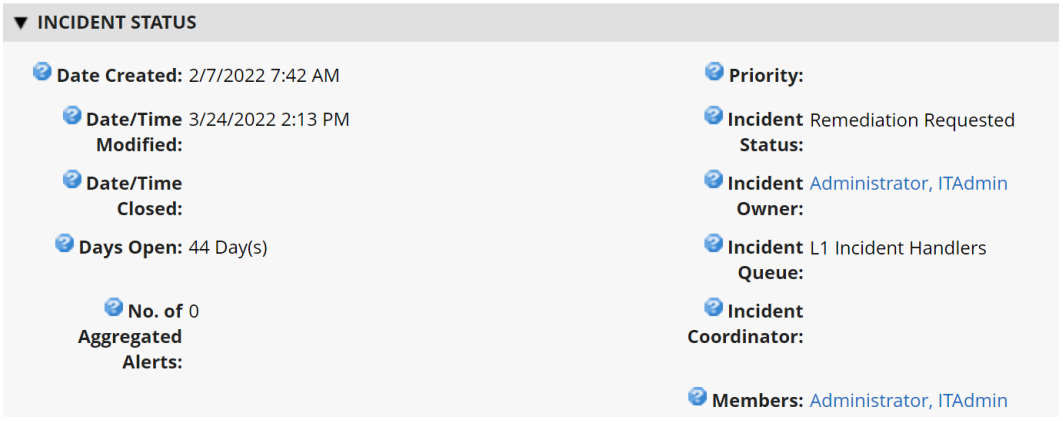
1578 The security operator can click the hyperlink, which displays more detailed information about the issue.
1579 In the case depicted in Figure 3-10, the *HP Sure Start* capability has flagged a potential issue.

1580 **Figure 3-10 Incident Summary**



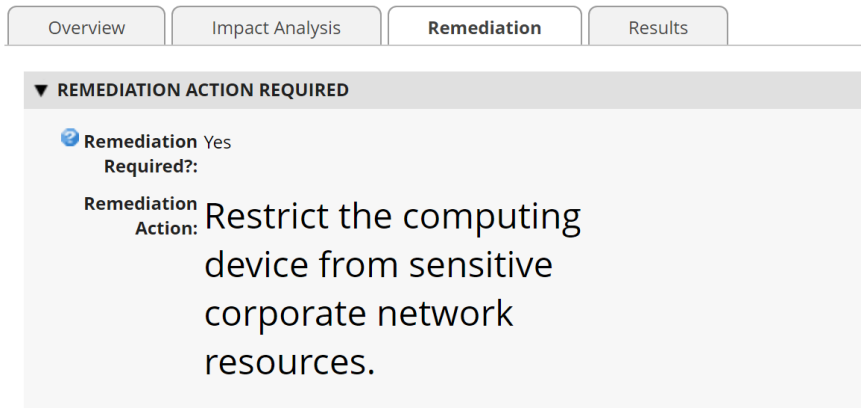
1581 In the *Incident Status* section, metadata associated with the incident is displayed, including whether
1582 remediation is requested by the security operator. Figure 3-11 shown an example of this.

1583 **Figure 3-11 Incident Status**



1584 If remediation is requested, the security operator clicks the *Remediation* tab within the *Security Incident*
1585 where a suggested action is displayed (see Figure 3-12).

1586 **Figure 3-12 Incident Remediation Action**



Appendix A List of Acronyms

ACA	Attestation Certificate Authority
AD	Active Directory
ADK	(Windows) Assessment and Deployment Kit
API	Application Programming Interface
AQL	(IBM QRadar) Ariel Query Language
BIOS	Basic Input/Output System
CMSL	(HP) Client Management Script Library
DHCP	Dynamic Host Configuration Protocol
DNS	Domain Name System
DPD	Direct Platform Data
DTD	Dell Trusted Device
FQDN	Fully Qualified Domain Name
HIRS	Host Integrity at Runtime and Start-Up
HPE	Hewlett Packard Enterprise
HTTP	Hypertext Transfer Protocol
IIS	(Microsoft) Internet Information Services
IP	Internet Protocol
IRM	(Archer) Integrated Risk Management
IT	Information Technology
JDK	Java Development Kit
JSON	JavaScript Object Notation
NCCoE	National Cybersecurity Center of Excellence
NIST	National Institute of Standards and Technology
NTP	Network Time Protocol
ODM	Original Design Manufacturer

OEM	Original Equipment Manufacturer
OS	Operating System
PC	Personal Computer
PCVT	(HPE) Platform Certificate Verification Tool
PM2	Process Manager 2
PMCS	Platform Manifest Correlation System
PXE	Preboot Execution Environment
REST	Representational State Transfer
SAS	Serial Attached SCSI
SCA	Supply Chain Assurance
SCRM	Supply Chain Risk Management
SCSI	Small Computer System Interface
SCV	(Dell) Secured Component Verification
SKU	Stock Keeping Unit
SP	Special Publication
SSMS	(Microsoft) SQL Server Management Studio
TB	Terabyte
TCG	Trusted Computing Group
TEI	(NCCoE) Trusted Enterprise Infrastructure
TFTP	Trivial File Transfer Protocol
TPM	Trusted Platform Module
TSC	(Intel) Transparent Supply Chain
UEFI	Unified Extensible Firmware Interface
UI	User Interface
URL	Uniform Resource Locator
UUID	Universally Unique Identifier

WinPE	Windows Preinstallation Environment
XML	Extensible Markup Language

Appendix B Archer Applications

The following tables detail the data fields in each Archer application for use in Section 2.11.2.1. The first column is the name of the data field we used in this demonstration and the second column is the data type. Data fields that are calculated are indexed in the third column and available in the subsequent table. Bolded rows are *Key Fields*, similar to a primary key.

Table 3-1 Devices Application

Data Field Name	Data Field Type	Calculated
Associated Components	Cross-Reference	
Last Event Timestamp	Date	
Last System Scan Date	Date	
System Firmware Date	Date	
Firmware Integrity Aggregation Status	Numeric	
Firmware Integrity Check Status	Numeric	
Count of Failed Configuration Scan Results	Text	
Count of Configuration Scans	Text	
Enterprise Unique Identifier	**Text**	
Family	Text	
Platform Model	Text	
Model	Text	
Original Design Manufacturer	Text	
Original Equipment Manufacturer	Text	
Product Name	Text	
SKU	Text	
System Firmware Version	Text	
Manufacturer	Values List	
Device Scan State	Values List	1
Eclypsium Integrity Scan Status	Values List	2
Continuous Monitoring Platform Integrity Status	Values List	3

1595 **Table 3-2 Calculated Fields (Devices)**

Index	Calculation
1	`IF (ISEMPTY([Helper Previous Last Scanned Date Calc]), VALUEOF([Device Scan State],"New"), IF (DATEDIF([Helper Max Last Scanned Date Calc],[Helper Previous Last Scanned Date Calc])=0, [Device Scan State], VALUEOF([Device Scan State], "Matched")))`
2	`IF (ISEMPTY([Firmware Integrity Check Status]), VALUEOF([Eclypsium Integrity Scan Status], "No Data"), IF ([Firmware Integrity Check Status]=1, VALUEOF([Eclypsium Integrity Scan Status], "No Integrity Issues Detected"), IF ([Firmware Integrity Check Status]=0, VALUEOF([Eclypsium Integrity Scan Status], "Integrity Issue Detected - Action Recommended"))))`
3	`IF (ISEMPTY([Continuous Monitoring Platform Integrity Status]), VALUEOF([Continuous Monitoring Platform Integrity Status], "No Data from Configuration Management System"))`

1596 **Table 3-3 Components Application**

Data Field Name	Data Field Type
Addresses	Text
Class	Text
Field Replaceable	Text
First Published	First Published Date
Free Text	Text
Last Updated	Last Updated Date
Manufacturer	Text
Model	Text
Platform Certificate	Text
Platform Certificate URI	Text
Revision	Text
SCA Devices (Associated Components)	Related Records
Seagate Firmware Attestation (Seagate Drive Serial)	Related Records
Seagate Firmware Hash (Seagate Drive)	Related Records
Serial	Text
Tracking ID	**Tracking ID**
Version	Text
Associated Components	Cross-Reference

1597 **Table 3-4 HP UEFI Configuration Variables Application**

Data Field Name	Data Field Type	Calculated
Associated Computing Device	Cross-Reference	
CompositeUUIDVariable	Text	1
Computing Device UUID	**Text**	
First Published	First Published Date	
HP Inc BIOS Configuration Status	Values List	
Last Updated	Last Updated Date	
Tracking ID	Tracking ID	
UEFI Variable Description	Text	2
UEFI Variable Friendly Name	Text	
UEFI Variable Name	Text	
UEFI Variable Possible Values	Text	3
UEFI Variable Recommended Values	Text	4
Value	Text	

1598 **Table 3-5 Calculated Fields (HP UEFI Configuration Variables)**

Index	Calculation
1	`CONCATENATE([Computing Device UUID],[UEFI Variable Name])`
2	`IF ([First Published]<>[Last Updated], "Change Detected",` `IF ([First Published]=[Last Updated], "No Change Detected"))`

3	`IF ([UEFI Variable Name]="SS_SB_KeyProt", "Provides enhanced protection of the secure boot databases and keys used by BIOS to verify the integrity and authenticity of the OS bootloader before launching it at boot.",`
	`IF ([UEFI Variable Name]="FW_RIPD", "Utilizes specialized hardware in the platform chipset to prevent, detect, and remediate anomalies in the Runtime HP SMM BIOS.",`
	`IF ([UEFI Variable Name]="TL_Power_Off", "HP Tamperlock feature: The system immediately turns off if the cover is removed while the system is On or in Sleep state S3 or Modern Standby.",`
	`IF ([UEFI Variable Name]="TL_Clear_TPM", "TPM is cleared on the next startup after the cover is removed. Be aware that all customer keys in the TPM are cleared. This setting should only be Enabled in a situation where manual recovery is possible using remote backups, or no recovery is desired. In the case of BitLocker being enabled, the BitLocker recovery key is required to decrypt the drive.",`

Index	Calculation

	IF ([UEFI Variable Name]="SS_GPT_HDD", "HP Sure Start maintains a protected backup copy of the MBR/GPT partition table from the primary drive and compares the backup copy to the primary on each boot. If a difference is detected, the user is prompted and can choose to recover from the backup to the original state, or to update the protected backup copy with the changes.",
	IF ([UEFI Variable Name]="SS_GPT_Policy", "Defines Sure Start behavior to either Local User Control or Automatic to restore the MBR/GPT to the saved state any time differences are encountered.",
	IF ([UEFI Variable Name]="DMA_Protection", "BIOS will configure IOMMU hardware for use by operating systems that support DMA protection.",
	IF ([UEFI Variable Name]="PreBoot_DMA", "IOMMU hardware-based DMA protection is enabled in a BIOS pre-boot environment for Thunderbolt and / or all internal and external PCI-e attached devices.",
	IF ([UEFI Variable Name]="Cover_Sensor", "Policy defined actions taken when Tamperlock cover removal sensor is triggered. Administrator credential or password requires valid response before continuing to startup after the cover is opened.",
	IF ([UEFI Variable Name]="", "No Description", "No Description")
	))))))))

4	IF ([UEFI Variable Name]="SS_SB_KeyProt", "[Disable, Enable]",
	IF ([UEFI Variable Name]="FW_RIPD", "[Disable, Enable]",
	IF ([UEFI Variable Name]="TL_Power_Off", "[Disable, Enable]",
	IF ([UEFI Variable Name]="TL_Clear_TPM", "[Disable, Enable]",
	IF ([UEFI Variable Name]="SS_GPT_HDD", "[Disable, Enable]",
	IF ([UEFI Variable Name]="SS_GPT_Policy", "[Local user control, Recover in event of corruption]",
	IF ([UEFI Variable Name]="DMA_Protection", "[Disabled, Enabled]",
	IF ([UEFI Variable Name]="PreBoot_DMA", "[Thunderbolt Only, All PCI-e Devices]",
	IF ([UEFI Variable Name]="Cover_Sensor", "[Disable, Notify user, Administrator Credential, Administrator Password]",
	IF ([UEFI Variable Name]="", "No Possible Values", "No Possible Values")
	))))))))

1599 **Table 3-6 Seagate Firmware Attestation Application**

Data Field Name	Data Field Type
Assessor Identifier	Text
Associated Computing Device	Cross-Reference
Device Nonce	Text
Firmware Version	Text
First Published	First Published Date
Last Updated	Last Updated Date
Root of Trust Identifier	Text

Data Field Name	Data Field Type
Root of Trust Nonce	Text
Seagate Drive Serial	Cross-Reference
Secure Boot Device State	Text
Signing Auth Database	Text
Tracking ID	**Tracking ID**

1600 **Table 3-7 Seagate Firmware Hash Application**

Data Field Name	Data Field Type	Calculated
Associated Computing Device	Cross-Reference	
BFW IDBA Hash	Text	
BFW ITCM Hash	Text	
CFW Hash	Text	
Drive Serial Number	Text	
Firmware Hash Status	Values List	1
First Published	First Published Date	
History	History Log	
Last Updated	Last Updated Date	
Seagate Drive	Cross-Reference	
SEE Firmware Hash	Text	
SEE Signing AuthN Key Certificate Hash	Text	
SERVO Firmware Hash	Text	
Signing AuthN Key Certificate Hash	Text	
Tracking ID	**Tracking ID**	

1601 **Table 3-8 Calculated Fields (Seagate Firmware Hash)**

Index	Calculation
1	`IF ([First Published]<>[Last Updated], "Change Detected",` `IF ([First Published]=[Last Updated], "No Change Detected"))`