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Implementing a Zero Trust Architecture

Volume C:
How-To Guides

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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.

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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

A zero trust architecture (ZTA) focuses on protecting data and resources. It enables secure authorized access to enterprise resources that are distributed across on-premises and multiple cloud environments, while enabling a hybrid workforce and partners to access resources from anywhere, at any time, from any device in support of the organization's mission. Each access request is evaluated by verifying the context available at access time, including the requester's identity and role, the requesting device's health and credentials, and the sensitivity of the resource. If the enterprise's defined access policy is met, a secure session is created to protect all information transferred to and from the resource. A real-time and continuous policy-driven, risk-based assessment is performed to establish and maintain the access. In this project, the NCCoE and its collaborators use commercially available technology to build interoperable, open, standards-based ZTA implementations that align to the concepts and principles in NIST Special Publication (SP) 800-207*, Zero Trust Architecture*. This NIST Cybersecurity Practice Guide explains how commercially available technology can be integrated and used to build various ZTAs.

KEYWORDS

enhanced identity governance (EIG); identity, credential, and access management (ICAM); zero trust; zero trust architecture (ZTA).

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Technology Collaborators

- Appgate
- AWS
- Broadcom Software
- Cisco
- DigiCert
- F5
- Forescout
- Google Cloud
- IBM
- Ivanti
- Lookout
- Mandiant
- Microsoft
- Okta
- Palo Alto Networks
- PC Matic
- Ping Identity
- Radiant Logic
- SailPoint
- Tenable
- Trellix
- VMware
- Zimperium
- Zscaler

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Contents

1 Introduction 1

1.1 How to Use this Guide 1

1.2 Build Overview 3

1.2.1 EIG Crawl Phase Build Features 3

1.2.2 Physical Architecture Overview 4

1.3 Typographic Conventions 6

2 Enterprise 1 Build 1 (EIG E1B1) Product Guides 6

2.1 Okta Identity Cloud 7

2.1.1 Configuration and Integration 7

2.1.2 Okta Verify App 10

2.1.3 Okta Access Gateway 10

2.2 Radiant Logic RadiantOne 11

2.2.1 Installation 11

2.2.2 Configuration 11

2.2.3 Integration 15

2.3 SailPoint IdentityIQ 16

2.3.1 Installation and Configuration 16

2.3.2 Integration with Radiant Logic 26

2.3.3 Integration with AD 27

2.3.4 Integration with Okta 28

2.4 Ivanti Neurons for UEM 29

2.4.1 Installation and Configuration 29

2.4.2 Integration with Ivanti Connector 34

2.4.3 Integration with Okta 35

2.5 Ivanti Sentry 36

2.5.1 Installation and Configuration 36

2.5.2 Ivanti Tunnel Configuration and Deployment 36

2.6 Ivanti Access ZSO 37

2.6.1 Integration with Ivanti Neurons for UEM 37
2.6.2 Integration with Okta 38
2.7 Zimperium Mobile Threat Defense (MTD) 38
2.7.1 Installation, Configuration, and Integration 38
2.8 IBM Cloud Pak for Security 42
2.9 IBM Security QRadar XDR 43
2.10 Tenable.io 43
2.10.1 Installation and Configuration 43
2.10.2 Integration with QRadar 44
2.11 Tenable.ad 45
2.12 Mandiant Security Validation (MSV) 45
2.12.1 MSV Director Installation/Configuration 45
2.12.2 MSV Network Actor Installation/Configuration 46
2.12.3 MSV Endpoint Actor Installation/Configuration 46
2.12.4 MSV Evaluation Configuration 47
2.12.5 MSV Evaluation Execution 48
2.13 DigiCert CertCentral 49
2.14 AWS IaaS 49
3 Enterprise 3 Build 1 (EIG E3B1) Product Guides 49
3.1 Microsoft Azure Active Directory (AD) 49
3.2 Microsoft Endpoint Manager 50
3.2.1 Configuration and Integration 50
3.3 Microsoft Defender for Endpoint 55
3.3.1 Configuration and Integration 55
3.3.2 Microsoft Defender Antivirus 59
3.4 Microsoft Sentinel 60
3.5 F5 BIG-IP 60
3.5.1 Installation, Configuration, and Integration 61
3.6 Lookout Mobile Endpoint Security (MES) 62
3.6.1 Configuration and Integration 62

3.6.2 Create MTD device compliance policy with Intune 64
3.7 PC Matic Pro 65
3.8 Tenable.io 66
3.8.1 Integration with Microsoft Sentinel....66
3.9 Tenable.ad 66
3.10 Mandiant Security Validation (MSV) 67
3.11 Forescout eyeSight 67
3.11.1 Integration with AD....67
3.11.2 Integration with Cisco Switch 67
3.11.3 Integration with Cisco Wireless Controller 67
3.11.4 Integration with Microsoft Sentinel....67
3.11.5 Integration with Palo Alto Networks NGFW 68
3.11.6 Integration with Tenable.io 68
3.12 Palo Alto Next Generation Firewall 68
3.13 DigiCert CertCentral 68
Appendix A List of Acronyms 69

List of Figures

Figure 1-1 Laboratory Infrastructure for the EIG Builds.... 5

1 Introduction

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

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 NIST Cybersecurity Practice Guide will help users develop a plan for migrating to ZTA. It demonstrates a standards-based reference design for implementing a ZTA and provides users with the information they need to replicate two different implementations of this reference design. Each of these implementations, which are known as *builds,* are standards-based and align to the concepts and principles in NIST Special Publication (SP) 800-27, *Zero Trust Architecture*. The reference design described in this practice guide is modular and can be deployed in whole or in part, enabling organizations to incorporate ZTA into their legacy environments gradually, in a process of continuous improvement that brings them closer and closer to achieving the ZTA goals that they have prioritized based on risk, cost, and resources.

NIST is adopting an agile process to publish this content. Each volume is being made available as soon as possible rather than delaying release until all volumes are completed. Work continues on implementing the example solutions and developing other parts of the content. As a preliminary draft, we will publish at least one additional draft for public comment before it is finalized.

When complete, this guide will contain four volumes:

- NIST SP 1800-35A: *Executive Summary* – why we wrote this guide, the challenge we address, why it could be important to your organization, and our approach to solving this challenge
- NIST SP 1800-35B: *Approach, Architecture, and Security Characteristics* – what we built and why
- NIST SP 1800-35C: *How-To Guides* – instructions for building the example implementations, including all the security-relevant details that would allow you to replicate all or parts of this project **(you are here)**
- NIST SP 1800-35D: *Functional Demonstrations* – use cases that have been defined to showcase ZTA security capabilities and the results of demonstrating them with each of the example implementations

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 1800-35A*, which describes the following topics:

- challenges that enterprises face in migrating to the use of ZTA
- example solution built at the National Cybersecurity Center of Excellence (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 this part of the guide, NIST SP 1800-35B, which describes what we did and why.

You might share the *Executive Summary,* NIST SP 1800-35A, with your leadership team members to help them understand the importance of migrating toward standards-based ZTA implementations that align to the concepts and principles in NIST SP 800-207, *Zero Trust Architecture*.

IT professionals who want to implement similar solutions will find the whole practice guide useful. You can use the how-to portion of the guide, NIST SP 1800-35C, to replicate all or parts of the builds created in our lab. The how-to portion of the guide provides specific product installation, configuration, and integration instructions for implementing the example solution. We do not re-create the product manufacturers' documentation, which is generally widely available. Rather, we show how we incorporated the products together in our environment to create an example solution. Also, you can use *Functional Demonstrations,* NIST SP 1800-35D, which provides the use cases that have been defined to showcase ZTA security capabilities and the results of demonstrating them with each of the example implementations.

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 a ZTA. 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.

A NIST Cybersecurity Practice Guide does not describe "the" solution, but example solutions. This is a preliminary draft guide. As the project progresses, the preliminary draft will be updated, and additional volumes will also be released for comment. We seek feedback on the publication's contents and welcome your input. Comments, suggestions, and success stories will improve subsequent versions of this guide. Please contribute your thoughts to nccoe-zta-project@list.nist.gov.

1.2 Build Overview

This NIST Cybersecurity Practice Guide addresses the challenge of using standards-based protocols and available technologies to build a ZTA. In our lab at the NCCoE, we plan to implement and demonstrate a variety of builds that serve as example ZTA solutions, each of which is designed to dynamically and securely manage access to resources across a set of use cases that a medium or large enterprise might typically deploy. Our plan is to implement these builds in a series of phases, starting with a baseline enterprise architecture that represents the typical legacy components that an enterprise might start with when deciding to begin adding zero trust capabilities.

We began with builds for enhanced identity governance (EIG) that were restricted to a limited set of capabilities. We call these *EIG crawl phase builds*. The central capabilities of these builds are identity, credential, and access management (ICAM) and endpoint protection. In particular, these EIG crawl phase builds do not include the separate, centralized policy engine (PE) or policy administration (PA) components. Instead, these initial EIG crawl phase builds rely upon the PE and PA capabilities provided by their ICAM components. After completing the EIG crawl phase builds, our plan is to gradually enhance these implementations by adding specialized PE and PA components, as well as capabilities such as software defined perimeter and micro-segmentation.

This practice guide provides instructions for reproducing the two EIG crawl phase builds that we have implemented so far: EIG Enterprise 1 Build 1 (E1B1) and EIG Enterprise 3 Build 1 (E3B1). The NCCoE worked with members of the ZTA community of interest to develop a diverse but non-comprehensive set of use cases and scenarios to demonstrate the capabilities of the builds. The use cases are summarized in NIST SP 1800-35D, *Functional Demonstrations*.

1.2.1 EIG Crawl Phase Build Features

A general ZTA reference design is depicted in Figure 4-1 of Volume B. It consists of ZTA core components: a policy decision point (PDP), which includes both a PE and a PA, and one or more policy enforcement points (PEPs); and ZTA functional components for ICAM, security analytics, data security, and endpoint security. The EIG crawl phase builds that have been created so far differ from this reference design insofar as they do not include separate, dedicated PDP components. Their ICAM component serves as their PDP, and they include very limited data security and security analytics functionality. These limitations were intentionally placed on the initial builds in an attempt to demonstrate the ZTA functionality that an enterprise that currently has ICAM and endpoint protection solutions deployed will be able to support without having to add additional ZTA-specific capabilities.

Each EIG crawl phase build is instantiated in a unique way, depending on the equipment used and the capabilities supported. Briefly, the two builds are as follows:

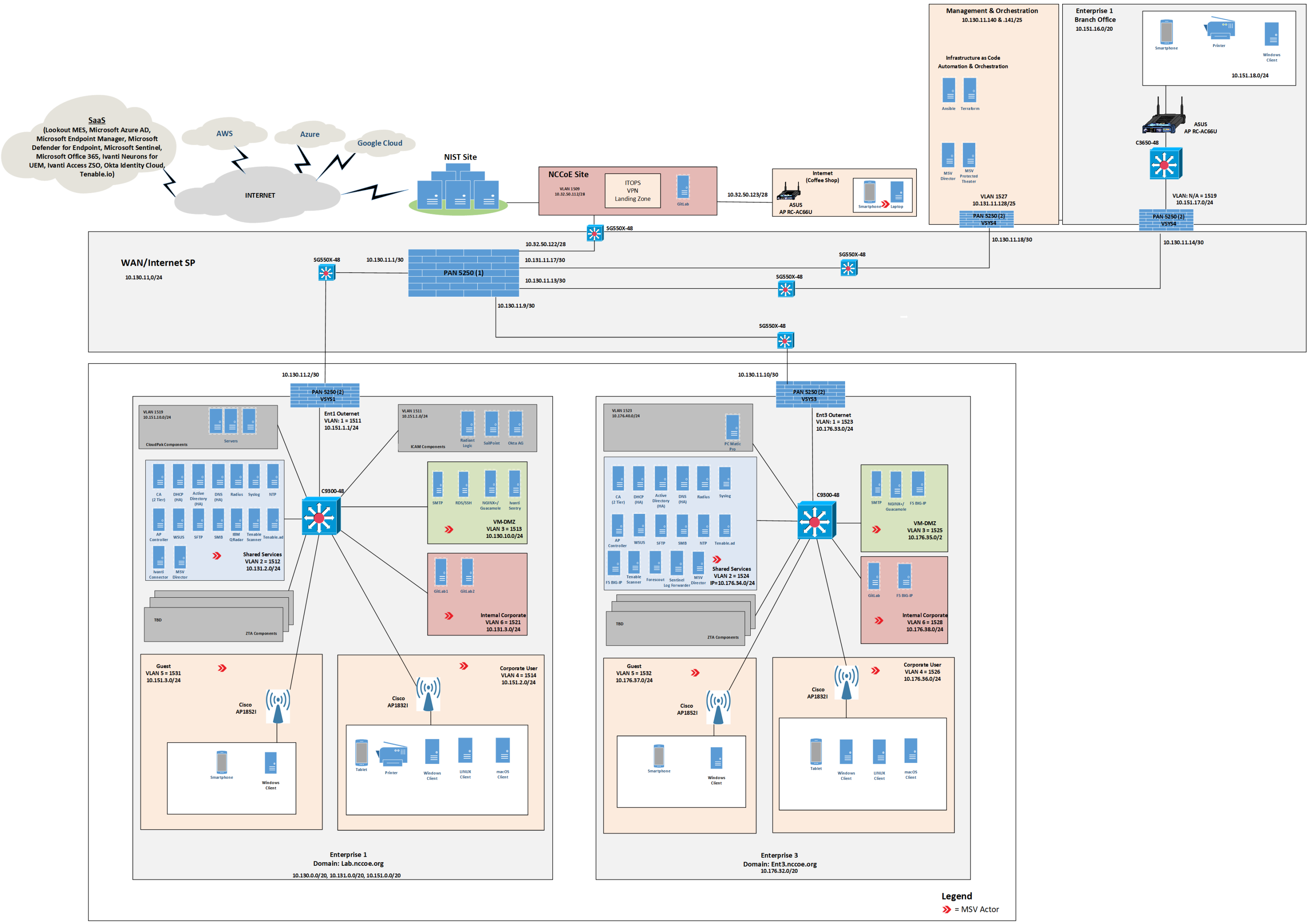
- EIG E1B1 uses products from IBM, Ivanti, Mandiant, Okta, Radiant Logic, SailPoint, Tenable, and Zimperium. Certificates from DigiCert are also used.

- EIG E3B1 uses products from F5, Forescout, Lookout, Mandiant, Microsoft, Palo Alto Networks, PC Matic, and Tenable. Certificates from DigiCert are also used.

1.2.2 Physical Architecture Overview

The laboratory environment in which the builds have been implemented is depicted and described in detail in Section 4.3 of Volume B. The laboratory architecture drawing from that volume is reproduced here in Figure 1-1. As shown, this laboratory environment includes two separate enterprise environments that each hosts its own distinct implementation of a ZTA architecture. The enterprises may interoperate as needed by a given use case, and the baseline enterprise environments have the flexibility to support enhancements. The laboratory environment also includes a management virtual local area network (VLAN) on which the following components are installed: Ansible, Terraform, MSV Director, and MSV Protected Theater. These management components support infrastructure as code (IaC) automation and orchestration.

Figure 1-1 Laboratory Infrastructure for the EIG Builds



The following two EIG crawl phase builds are supported within the physical architecture depicted in Figure 1-1 and documented in the remainder of this guide:

- EIG E1B1 components consist of DigiCert CertCentral, IBM Cloud Pak for Security, IBM Security QRadar XDR, Ivanti Access ZSO, Ivanti Neurons for UEM, Ivanti Sentry, Ivanti Tunnel, Mandiant Advantage Security Validation (MSV), Okta Identity Cloud, Okta Verify App, Radiant Logic RadiantOne Intelligent Identity Data Platform, SailPoint IdentityIQ, Tenable.ad, Tenable.io, and Zimperium MTD.
- EIG E3B1 components consist of DigiCert CertCentral, F5 BIG-IP, Forescout eyeSight, Lookout MES, Mandiant MSV, Microsoft Azure AD, Microsoft Defender for Endpoint, Microsoft Endpoint Manager, Microsoft Sentinel, Palo Alto Networks NGFW, PC Matic Pro, Tenable.ad, and Tenable.io.

For a detailed description of the architecture of each build, see Volume B, Appendices D and F. The remainder of this guide describes how to implement the EIG crawl phase builds E1B1 and E3B1.

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.

2 Enterprise 1 Build 1 (EIG E1B1) Product Guides

This section of the practice guide contains detailed instructions for installing, configuring, and integrating all of the products used to implement EIG E1B1. For additional details on EIG E1B1's logical and physical architectures, please refer to Volume B.

2.1 Okta Identity Cloud

The Okta Identity Cloud is a software as a service (SaaS) solution that provide ICAM capabilities to an enterprise. The following sections describe the setup of the Okta Identity Cloud, the Okta Access Gateway, and the Okta Verify application. Okta integrates with Radiant Logic for identity information, SailPoint to receive governance information, and Ivanti to delegate authentication for users accessing resources using mobile devices.

2.1.1 Configuration and Integration

The purpose is to set up integrations with other ICAM tools so Okta can manage authentication and authorization of users accessing resources.

1. Sign up for an account with Okta (okta.com).
2. Set up an admin account, then set up Okta Verify for the admin account. (Repeat this step if needed so each administrator has a unique account.)
3. Log in to the Okta instance that was just created and into the admin account.
4. Set up directory integration with Radiant Logic. User identity information is pulled from Radiant Logic into Okta for authentication and authorization. Note: This step should be completed after Radiant Logic is configured.
    a. Review the background information and check the prerequisites.
    b. Install the Okta LDAP Agent on the Radiant Logic server and configure LDAP integration settings.
    c. Configure the LDAP Interface. Note that the service account and password that was created in Radiant Logic is used in this step.
    d. Once LDAP integration is successful, users from Radiant Logic can be imported into Okta.
5. Create Groups for Okta to apply a specific set of users to specific services or applications. From the main menu, navigate to **Directory > Groups** and click on the **Add Group** button. Create the name and description of the group and click **Save**.
6. Create API tokens to be used by SailPoint and Radiant Logic for communication.
    a. From the main menu, navigate to **Security > API** and click on the **Create Token** button. Type in the name for SailPoint and click **Create Token**.

   b. Copy the token. It will be used in the SailPoint configuration. Once we configure SailPoint, the integration is complete. Please refer to the "Integration with Okta" subsection within SailPoint for integration configuration.

   c. Repeat these steps to create a token for Radiant Logic.

7. Create a delegated authentication for Okta to be able to import users from Radiant Logic via LDAP. Note that a service account, created in the Radiant Logic Integration section of this document, needs to be created and used in this configuration.

8. Okta Access Gateway needs to be installed in order to configure on-premises applications. See Section 2.1.3 for installation instructions, which include information on configuring on-premises applications.

9. Create application integration for Ivanti Neurons for UEM.

   a. From the Okta admin page, select **Applications** from the **Application** drop-down menu.

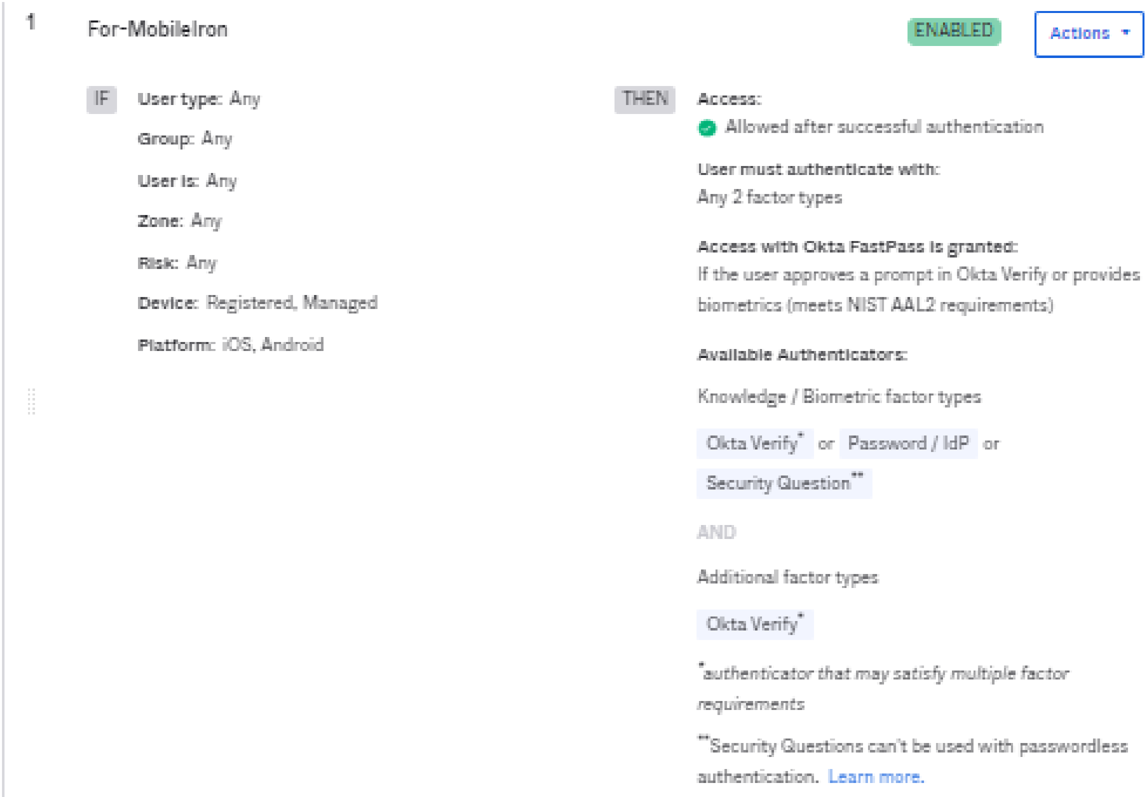
   b. Click on the **Browse App Catalog** button. Type "MobileIron" and select the "MobileIron Cloud" app.

   c. Follow the step-by-step instructions to configure the app.

10. Create Identity Provider integration for Ivanti Access ZSO. This involves creating a custom application using SAML and then creating a SAML Identity Provider.

11. Configure Device Trust on iOS and Android devices to create device integrations.

12. Create authentication policies. By default, a "Catch All" policy is created when an application is created. We are creating an authentication policy that will allow Okta to trust Ivanti Access ZSO to be the delegated Identity Provider (IdP). To do this, when Okta checks that Okta Verify is a managed application on a device, it will delegate authentication to Ivanti Access ZSO. The screenshots below show the current policy created for the GitLab1 application. Note that iOS and Android devices are managed in the first policy.



1 For-MobileIron

IF

User type: Any

Group: Any

User is: Any

Zone: Any

Risk: Any

Device: Registered, Managed

Platform: iOS, Android

THEN

Access:
✓ Allowed after successful authentication

User must authenticate with:
Any 2 factor types

Access with Okta FastPass is granted:
If the user approves a prompt in Okta Verify or provides biometrics (meets NIST AAL2 requirements)

Available Authenticators:

Knowledge / Biometric factor types

Okta Verify* or Password / IdP or Security Question**

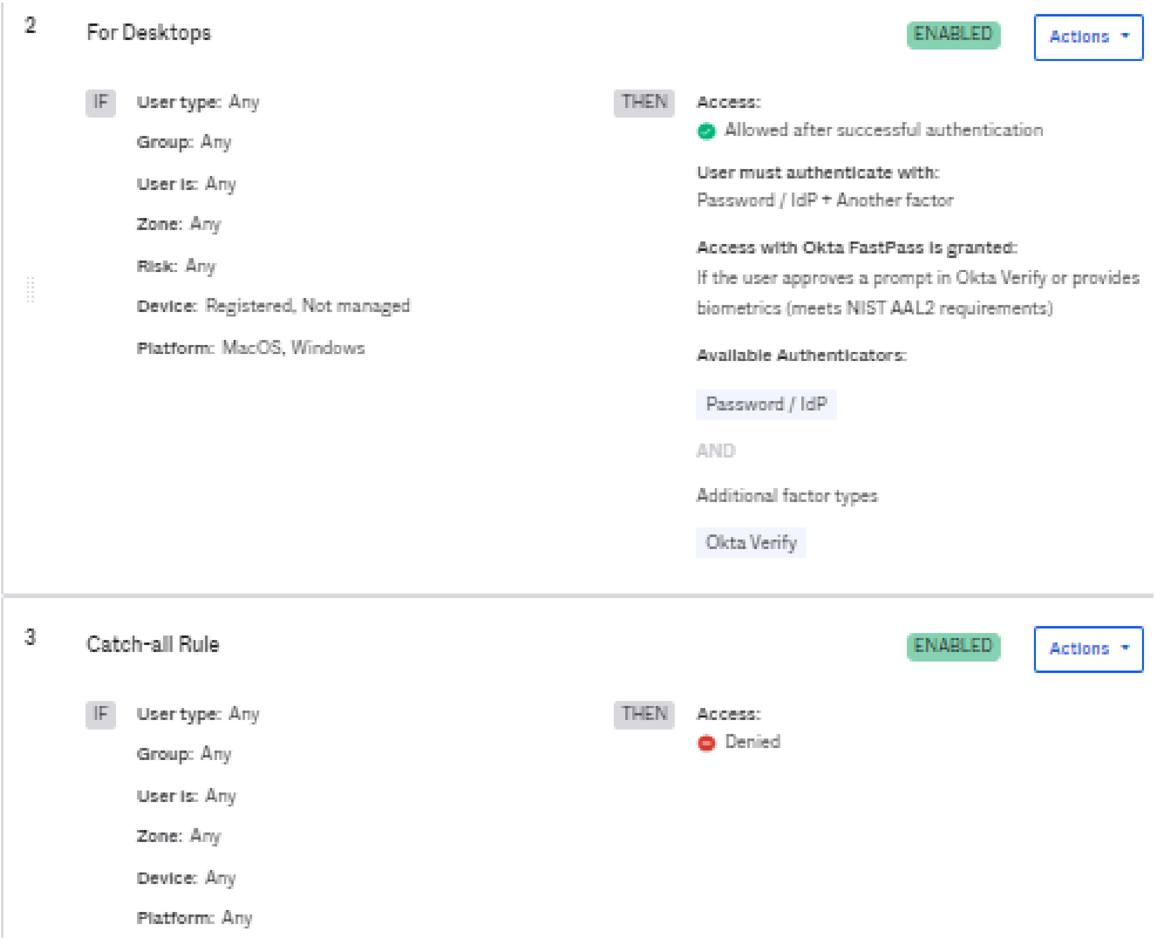
AND

Additional factor types

Okta Verify*

**authenticator that may satisfy multiple factor requirements*

**Security Questions can't be used with passwordless authentication. Learn more.



2 For Desktops

IF User type: Any
Group: Any
User is: Any
Zone: Any
Risk: Any
Device: Registered, Not managed
Platform: MacOS, Windows

THEN Access:
✓ Allowed after successful authentication
User must authenticate with:
Password / IdP + Another factor
Access with Okta FastPass is granted:
If the user approves a prompt in Okta Verify or provides biometrics (meets NIST AAL2 requirements)
Available Authenticators:
Password / IdP
AND
Additional factor types
Okta Verify

3 Catch-all Rule

IF User type: Any
Group: Any
User is: Any
Zone: Any
Device: Any
Platform: Any

THEN Access:
⊖ Denied

2.1.2 Okta Verify App

The Okta Verify app is installed when a new user is onboarded. The user can log in to the Okta Identity Cloud for the first time. For this setup, the user will be asked to change their password and perform setup. After the password update, the user can set up Okta Verify. Follow the instructions for Android or iOS devices to install Okta Verify and complete the process.

2.1.3 Okta Access Gateway

The Okta Access Gateway is part of the Okta Identity Cloud. It can be leveraged to integrate legacy, on-prem applications into the Okta Identity Cloud. More information on installing and configuring the Okta Access Gateway (AG) is available online. Tasks to perform include:

1. First, download and deploy the latest OVA image.
2. Once installed, start the server, log in to the Okta AG, and configure the Okta AG.

3. Next, log into the Okta admin console via a web browser (i.e.: https://zta-eig1-ad-min.okta.com/). Configure Okta as the Identity Provider for the AG.
4. Log into Okta AG via a web browser and configure enterprise applications in Okta AG.

2.2 Radiant Logic RadiantOne

Radiant Logic RadiantOne is an ICAM solution that unifies identity data, making access reusable and scalable for the enterprise.

2.2.1 Installation

RadiantOne is to be installed on a Microsoft Windows 2019 server. See the RadiantOne v7.4.1 documentation from the Radiant Logic website for system specifications. Prerequisites are in Chapter 1 of the *RadiantOne Installation Guide*. Note: You need to create an account within the Radiant Logic website in order to access the installation and configuration documentation.

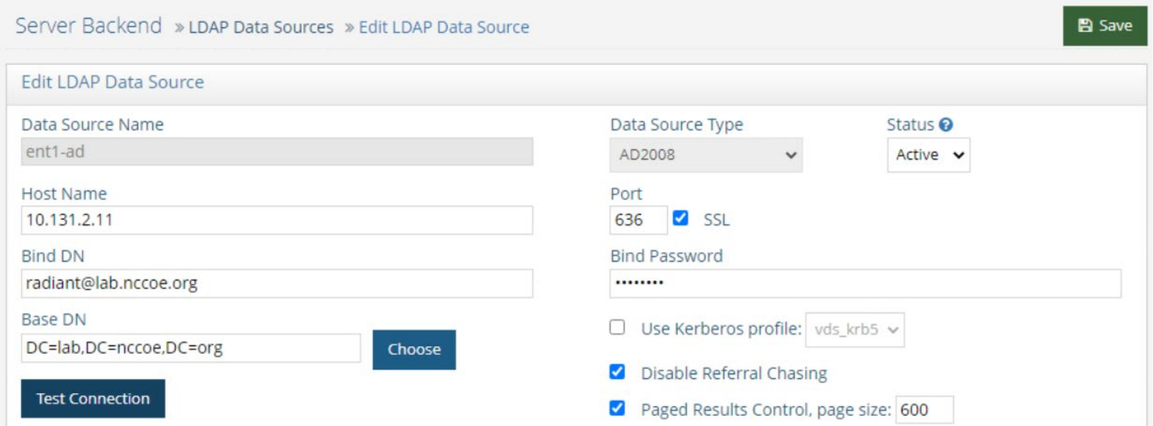
Once you download and launch the executable for a Windows server installation, follow the step-by-step instructions provided on the screen. We used default settings unless specified below. Instructions can also be found in Chapter 2 of the *RadiantOne Installation Guide*.

- Choose **RadiantOne Federated Identity Suite New Cluster/Standalone** for the **Install Set.**
- Provide a name and password for the **Cluster settings.**
- For the **Server Configuration** step, use the following ports: LDAP = 389, LDAPS = 636, and Scheduler Port = 1099.

2.2.2 Configuration

2.2.2.1 Sync with an LDAP server

1. Once installation is complete, log in to RadiantOne from a web browser on the Radiant Logic server, https://localhost:7171. Note: ensure the proper SSL certificate is on the server for HTTPS.
2. Initial configuration is to sync up with an LDAP server. Go to **Settings > Server Backend > LDAP Data Sources.** The screenshot below shows the information created for Enterprise 1 AD. See the *RadiantOne Namespace Configuration Guide* Chapter 3 for details.



Server Backend » LDAP Data Sources » Edit LDAP Data Source

Edit LDAP Data Source

Data Source Name: ent1-ad

Data Source Type: AD2008

Status: Active

Host Name: 10.131.2.11

Port: 636 ☑ SSL

Bind DN: radiant@lab.nccoe.org

Bind Password: ••••••••

Base DN: DC=lab,DC=nccoe,DC=org

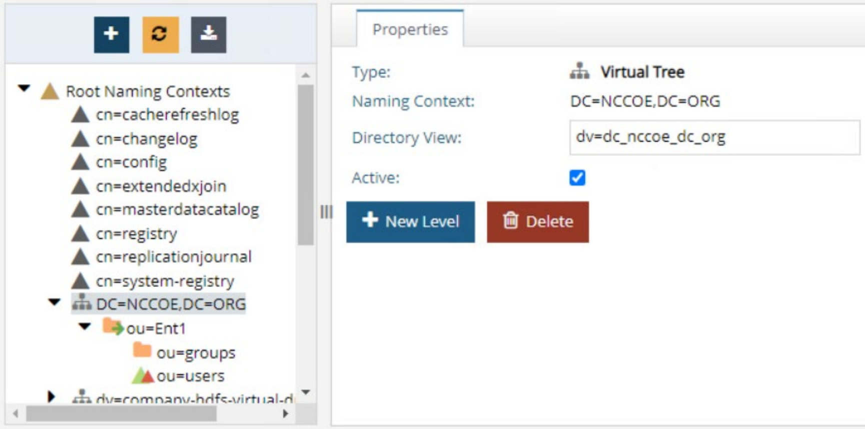
☐ Use Kerberos profile: vds_krb5

☑ Disable Referral Chasing

☑ Paged Results Control, page size: 600

3. Once the connection is tested and successful, the integration is completed.

4. Next, create a Directory Namespace by going to **Directory Namespace** and selecting **Create New Naming Context.** Click **Next** and click **OK.**



Root Naming Contexts
- cn=cacherefreshlog
- cn=changelog
- cn=config
- cn=extendedxjoin
- cn=masterdatacatalog
- cn=registry
- cn=replicationjournal
- cn=system-registry
- DC=NCCOE,DC=ORG
  - ou=Ent1
    - ou=groups
    - ou=users
- dv=company-hdfs-virtual-d

Properties

Type: Virtual Tree

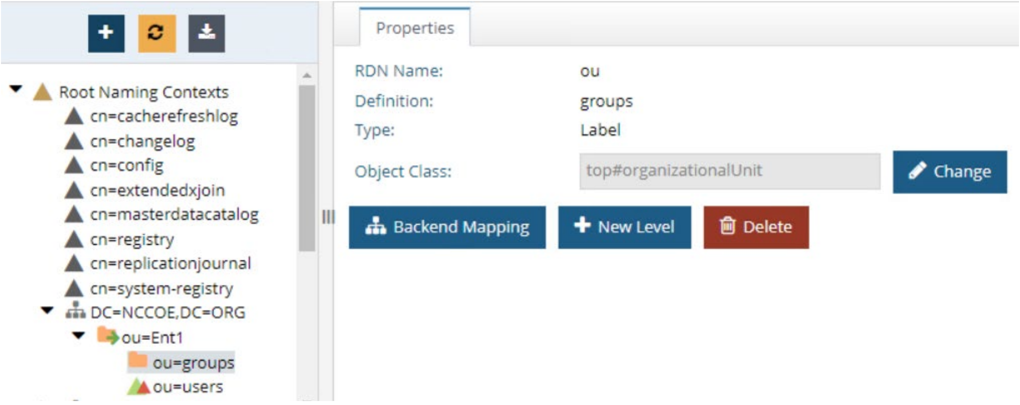
Naming Context: DC=NCCOE,DC=ORG

Directory View: dv=dc_nccoe_dc_org

Active: ☑

5. Find **DC=NCCOE,DC=ORG** under **Root Naming Contexts** on the left side of the screen. Click the **New Level** button. Enter **ent1** as the name for the **OU** and click **OK.**

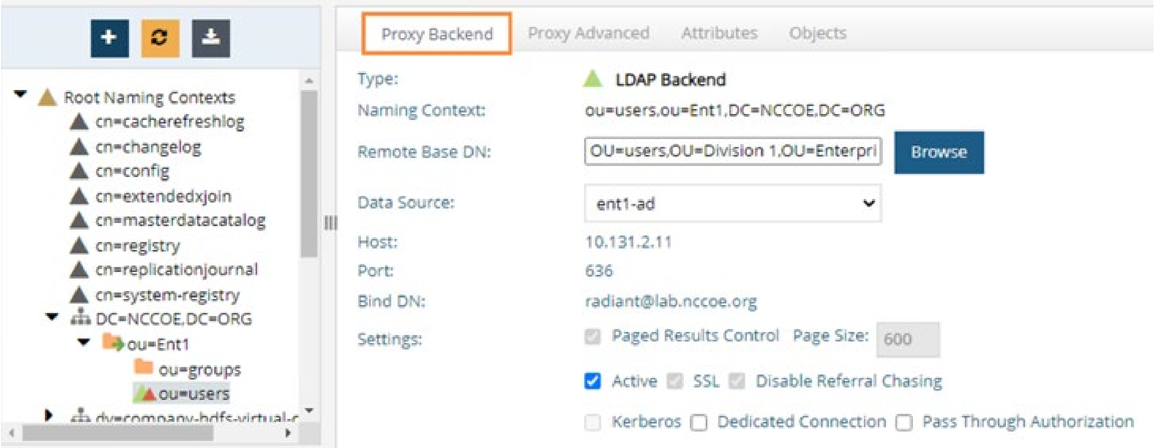
6. Click on **ou=ent1** on the left side and click the **New Level** button on the right to create a sub-ou called **groups.**



RDN Name: ou
Definition: groups
Type: Label
Object Class: top#organizationalUnit

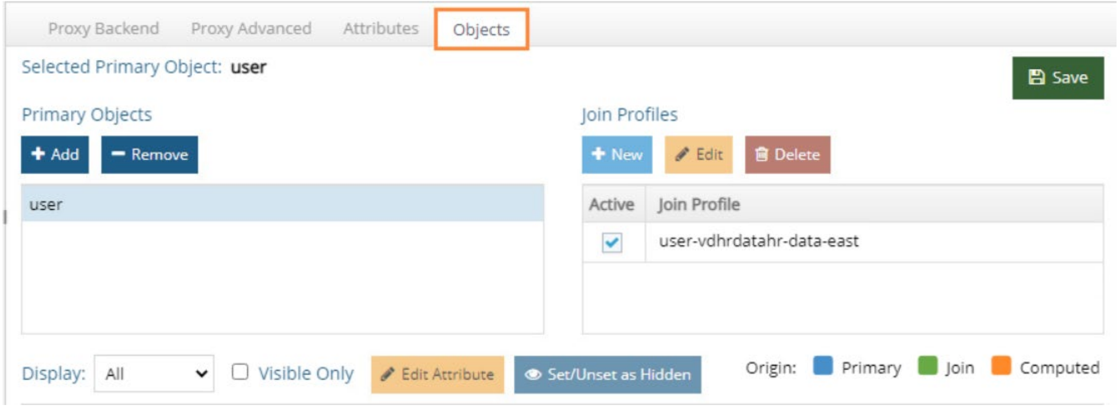
7. Click on **ou=ent1** on the left side as shown below and click the **New Level** button on the right to create a sub-ou called **users.**

8. Once configured and saved, click on **ou=users** and click on **Backend Mapping** on the right. Select **LDAP Backend.** Click **Next** and **Browse** for the proper **Remote Base DN.** Then click **OK.** The screenshot is the completed configuration for the sub-ou users Proxy Backend.



Type: LDAP Backend
Naming Context: ou=users,ou=Ent1,DC=NCCOE,DC=ORG
Remote Base DN: OU=users,OU=Division 1,OU=Enterpri
Data Source: ent1-ad
Host: 10.131.2.11
Port: 636
Bind DN: radiant@lab.nccoe.org
Settings: ☑ Paged Results Control Page Size: 600
☑ Active ☑ SSL ☑ Disable Referral Chasing
□ Kerberos □ Dedicated Connection □ Pass Through Authorization

9. Go to **Objects** and create a primary object and Join Profile by clicking **Add** on each. Click **Save.** Now we have data sources from LDAP and our database.



Selected Primary Object: user

Primary Objects: user

Active	Join Profile
☑	user-vdhrdatahr-data-east

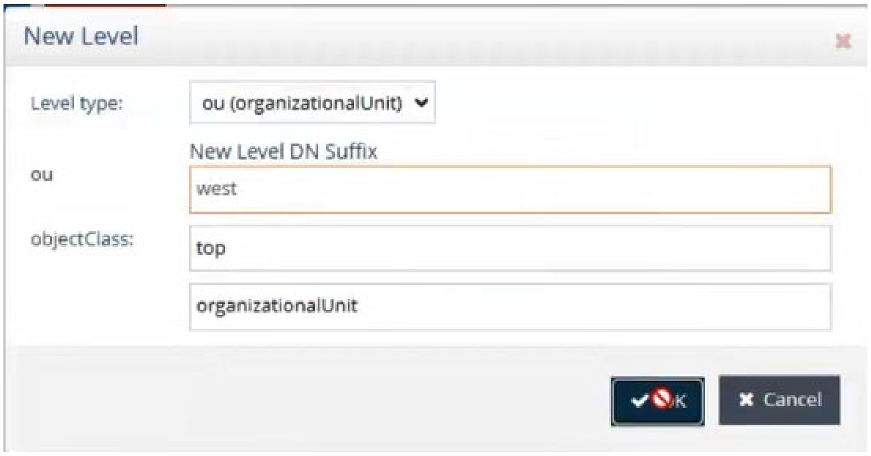
Display: All ☐ Visible Only

2.2.2.2 Create a namespace to bring in users

1. In **Directory Namespace**, click the **+** sign. Create a naming context: `ou=hr,ou=lab,ou=nccoe,ou=org` and select **Virtual Tree** for the naming context type, then click **Next.**

2. Configure the Virtual Tree by choosing **Create a new view (.dvx),** setting the **Directory View** to `dv=ou_hr_ou_lab_ou_nccoe_ou_org` and clicking **OK**.

3. Next, create a sub-Namespace by clicking the **+ New level** button and entering the information depicted below.



Level type: ou (organizationalUnit)

New Level DN Suffix

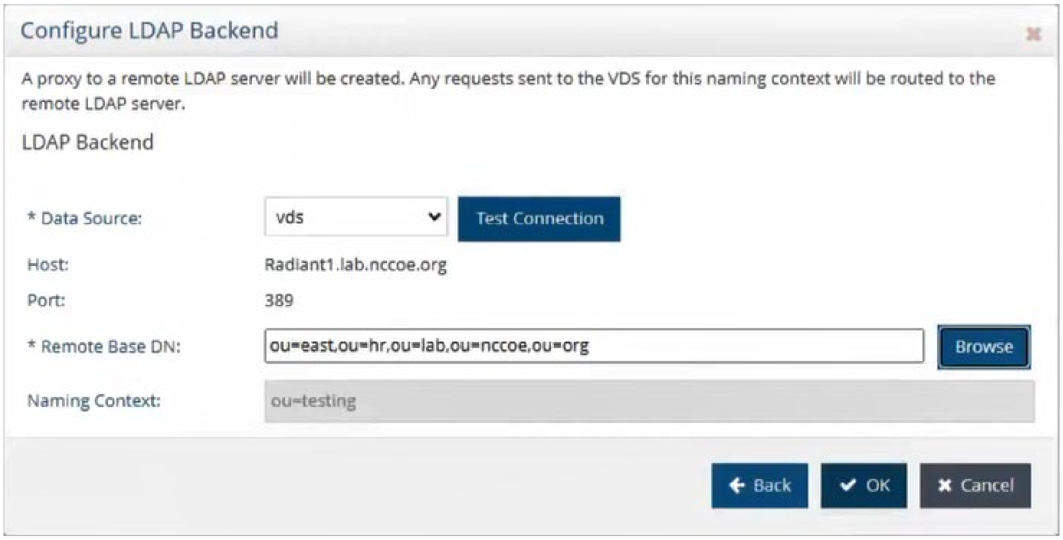
ou: west

objectClass: top

organizationalUnit

4. Click on the sub-Namespace that was just created and click on **Backend Mapping**. Specify `ou=east,ou=hr,ou=lab,ou=nccoe,ou=org` as the naming context and select **HDAP Store** as the type, then click **Next**. Note: Instead of having an actual HR database, we are importing sample users from a text file.

5. Click on **ou=east** to edit properties. Scroll down to the bottom of the screen and click on the **Initialize** button. Then select a file with database users to import for initializing the HDAP store. Note: We are emulating an HR database with this file.
6. Go to the **Directory Browser** tab and refresh the data by clicking the **Refresh Tree** button.
7. Go to the OU that you just configured and expand it. The new users should now be available.
8. Go to **Directory Namespace** and click the **+** button to add new naming context (in our build, we used `ou=testing`). This is used to map to the LDAP backend the database information that was imported.
9. Click on the OU that was created. Click **OK** and **Save**.



Configure LDAP Backend

A proxy to a remote LDAP server will be created. Any requests sent to the VDS for this naming context will be routed to the remote LDAP server.

LDAP Backend

* Data Source: vds

Host: Radiant1.lab.nccoe.org

Port: 389

* Remote Base DN: ou=east,ou=hr,ou=lab,ou=nccoe,ou=org

Naming Context: ou=testing

10. Go to **Directory Browser** and hit the **Refresh** button.
11. Go to **Settings > Configuration > ORX Schema**, and find **OU=Testing** and check it. Click on **Generate LDAP Schema** at the bottom of the screen and click **OK**.

2.2.3 Integration

Other applications, including SailPoint and Okta, will need the following information in order to integrate with Radiant Logic and pull information from it:

- Hostname: radiant1.lab.nccoe.org (hostname of the Radiant Logic server)
- Port: 389 (LDAP) and 636 (LDAPS)

Also, a service account and password need to be created on Radiant Logic for each application to be integrated. The service account is in the form of: `uid=sailpointadmin,ou=globalusers,cn=config`. Follow these steps to create each service account for SailPoint, Okta, and any other desired applications:

1. Go to **Directory Browser.**
2. On the left, go to **cn=config,** then **ou=globalusers** underneath it. Right-click on **ou=globalusers,** click **Add,** then click **New InetOrgPerson.**
3. Fill in the necessary entries. Click **Confirm** to save the configuration.

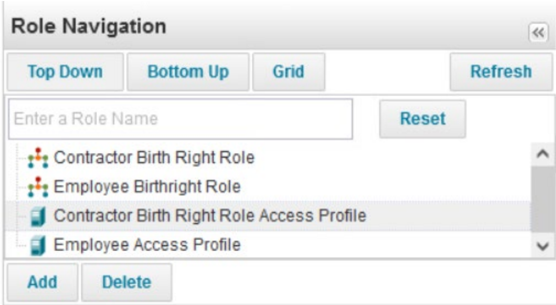
2.3 SailPoint IdentityIQ

SailPoint IdentityIQ is the identity and access management software platform for governing the lifecycle of the enterprise user's identity.

2.3.1 Installation and Configuration

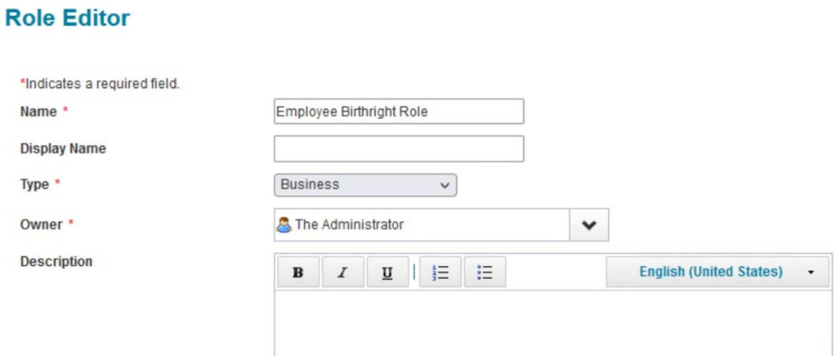
The steps below explain the installation of the IdentityIQ server, initial configuration to import users from the Radiant Logic identity store, and configuration to manage the lifecycle of users.

1. To install IdentityIQ, first identify the platform and prerequisites. For this build, we used Windows 2019 with Apache Tomcat 9.0, and MS SQL Server 2019 as recommended requirements for release 8.2. Download the installation file from the SailPoint website and follow the installation instructions.
2. Login into IdentityIQ from a web browser (http://localhost:8080) using the default login and password. Make sure to change the default password.
3. Configure IQService. This is needed in order to set up integration with AD.
4. Govern permissions by pushing both employee and contractor users and groups to AD and Okta. Note: This step should be completed after the integration with AD and Okta is completed. Steps to configure integration are in Sections 2.3.3 and 2.3.4. After integration with AD and Okta is completed, navigate to the **Setup** drop-down menu and select **Roles**. Here we will create birthright role and access profile for employees and contractors.
    a. Select **New Role** drop-down button and select Role. The screenshot lists the four roles that are created for this build.

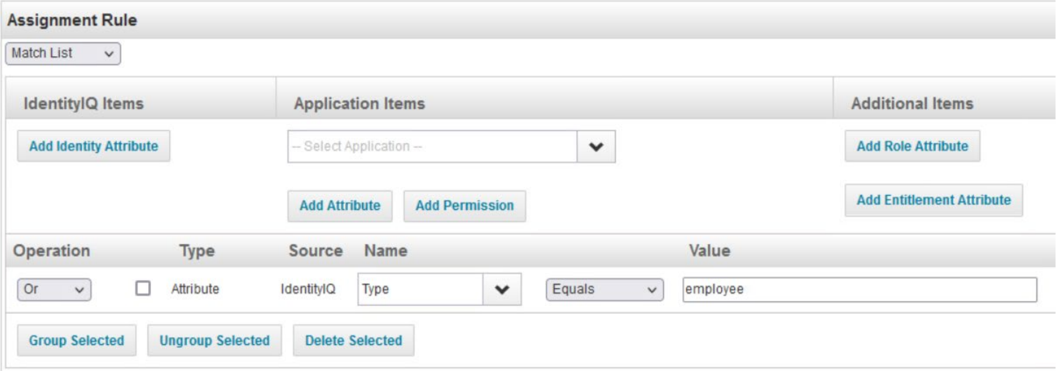


Contractor Birth Right Role
Employee Birthright Role
Contractor Birth Right Role Access Profile
Employee Access Profile

b. For the **Employee Birthright Role**, use the configuration shown in the next two screenshots. Note that the **Assignment Rule** is where the value of **employee** is used to identify the users. This will push users into AD as a birthright. Once that role is configured, configure the corresponding contractor role the same way. Note that the **Assignment Rule** should be different for the contractor based on user information in SailPoint.



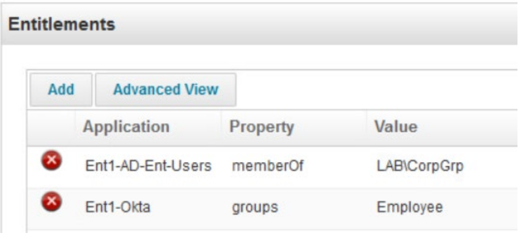
Name *: Employee Birthright Role
Display Name:
Type *: Business
Owner *: The Administrator
Description:



Match List

Operation		Type	Source	Name		Value
Or	□	Attribute	IdentityIQ	Type	Equals	employee

c. For the **Employee Access Profile** role, add the groups that the employees belong to. This means that these users will have access to these groups as a birthright. Perform the same for the corresponding contractor role. Note that the **Entitlements** should be different for the contractor based on group information in Okta and AD.



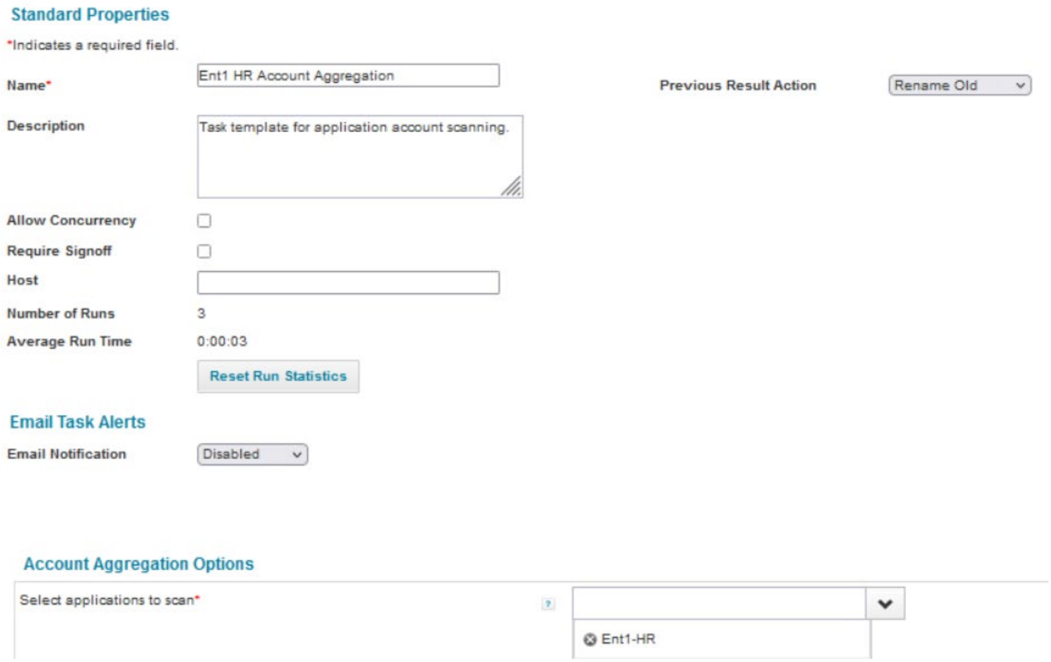
Entitlements

Add | Advanced View

	Application	Property	Value
⊗	Ent1-AD-Ent-Users	memberOf	LAB\CorpGrp
⊗	Ent1-Okta	groups	Employee

5. The next step is to synchronize users and groups. To begin, navigate to the **Setup** tab and select **Tasks**.

   a. To create user aggregation, select the **New Task** drop down button and select **Account Aggregation**. The figure below depicts the aggregation configuration for Radiant Logic. This allows SailPoint to sync with Radiant Logic on any updates made to users. Repeat this step for AD and Okta accounts. Note that the **Account Aggregation Options** section is where the AD and Okta applications need to be selected to create the proper account aggregation.



Standard Properties

*Indicates a required field.

Name*: Ent1 HR Account Aggregation

Previous Result Action: Rename Old

Description: Task template for application account scanning.

Allow Concurrency: □

Require Signoff: □

Host:

Number of Runs: 3

Average Run Time: 0:00:03

Reset Run Statistics

Email Task Alerts

Email Notification: Disabled

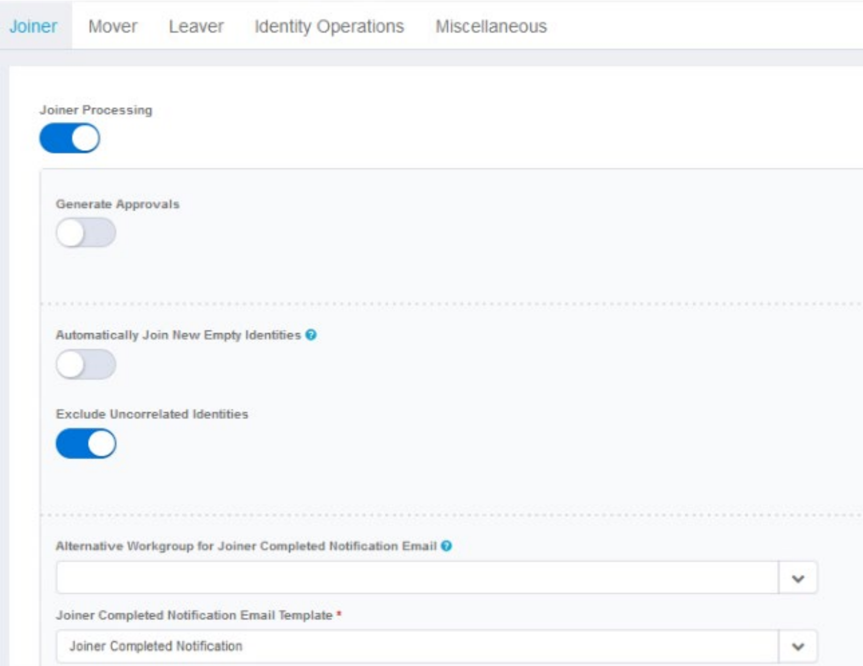
Account Aggregation Options

Select applications to scan*: Ent1-HR

   b. To create group aggregation, select the **New Task** drop down button and select **Account Aggregation**. This allows SailPoint to sync with AD on any updates made to users. Repeat this step for the Okta account. Note that the **Account Group Aggregation Options** section is where the Okta applications need to be selected to create the proper account aggregation.

6. Configure lifecycle processes through Rapid Setup Configuration. Click on the **Setup** cog and select **Rapid Setup** to begin. The Rapid Setup Configuration process allows onboarding of applications and manage functions such as joiner, mover, and leaver of identities. Use the "Using Rapid Setup" section of the IdentityIQ Rapid Setup Guide to guide the configuration.

    a. The following screen captures show the configuration we used for **Joiner**.



Joiner Processing: ●

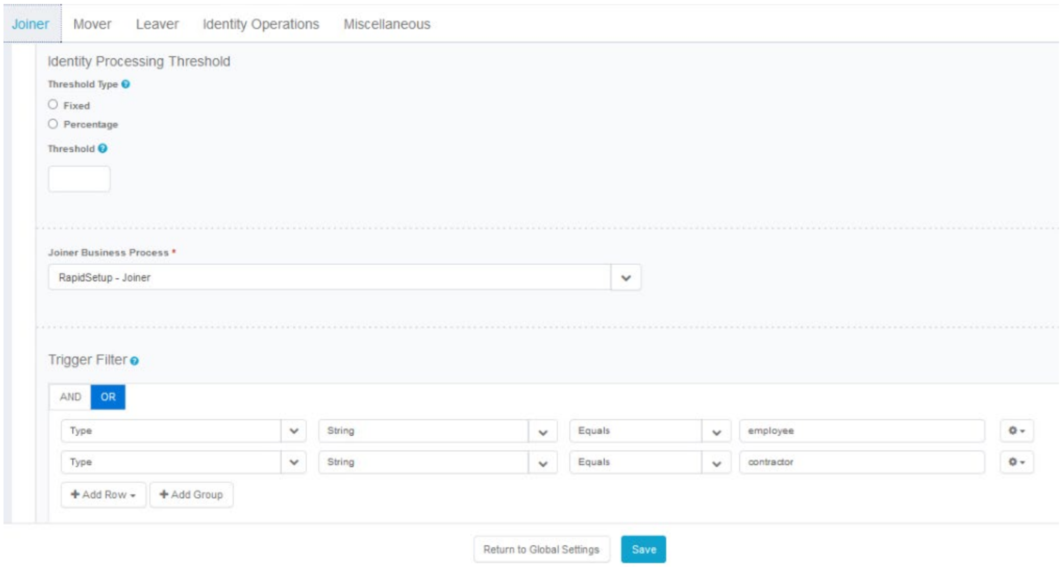
Generate Approvals: ○

Automatically Join New Empty Identities: ○

Exclude Uncorrelated Identities: ●

Alternative Workgroup for Joiner Completed Notification Email:

Joiner Completed Notification Email Template *: Joiner Completed Notification



Identity Processing Threshold

Threshold Type

○ Fixed

○ Percentage

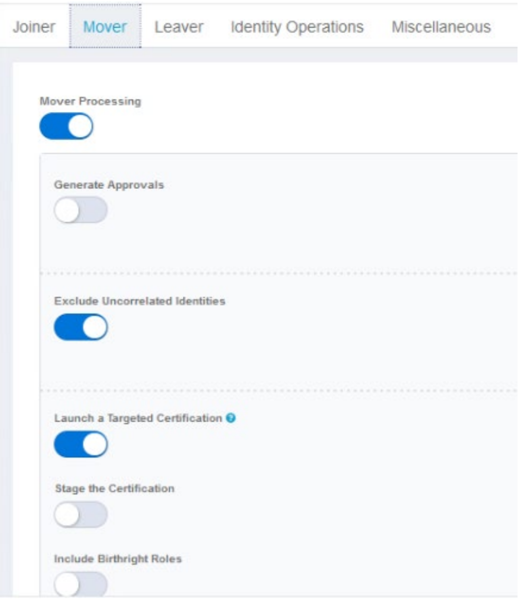
Threshold

Joiner Business Process *: RapidSetup - Joiner

Trigger Filter

Type	String	Equals	employee
Type	String	Equals	contractor

506 b. The following screen captures show the configuration we used for **Mover**.



Mover Processing ☑

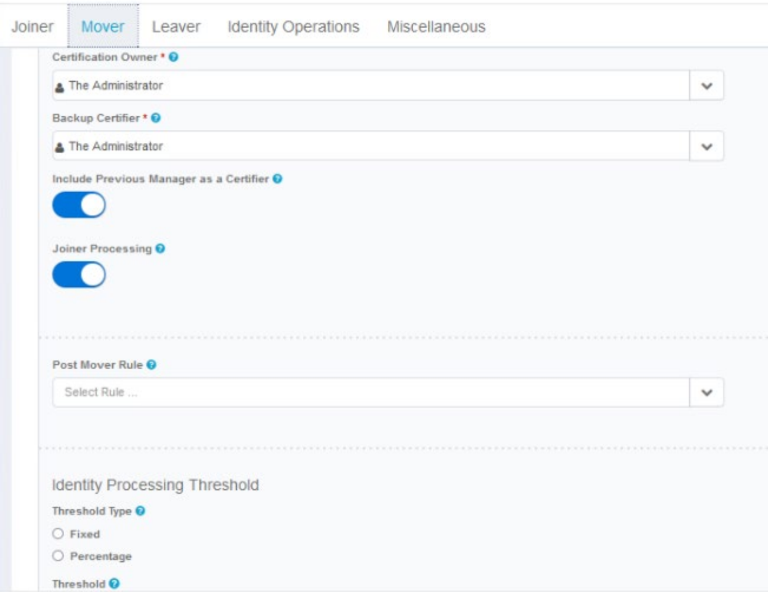
Generate Approvals ☐

Exclude Uncorrelated Identities ☑

Launch a Targeted Certification ☑

Stage the Certification ☐

Include Birthright Roles ☐



Certification Owner *: The Administrator

Backup Certifier *: The Administrator

Include Previous Manager as a Certifier ☑

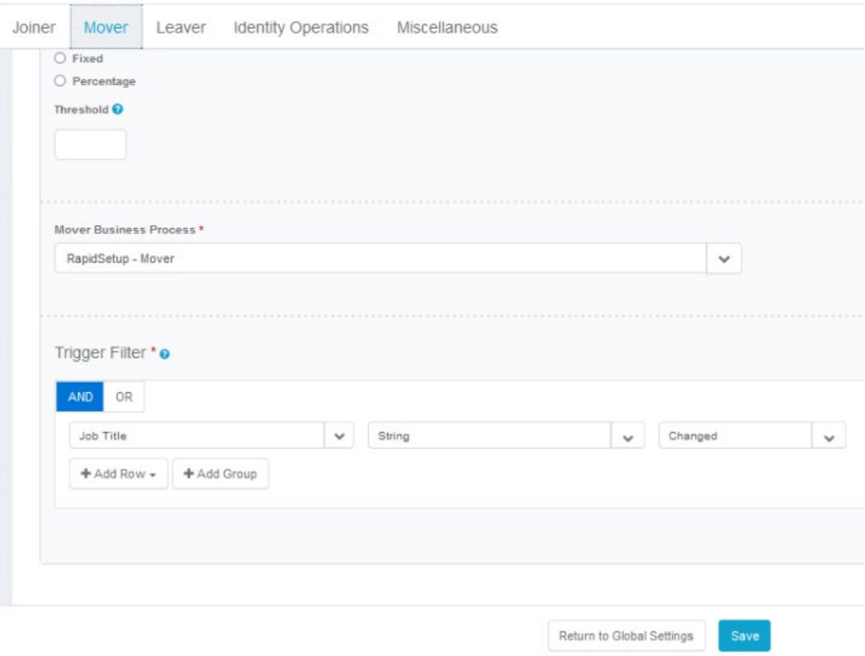
Joiner Processing ☑

Post Mover Rule: Select Rule ...

Identity Processing Threshold

Threshold Type
○ Fixed
○ Percentage

Threshold



○ Fixed

○ Percentage

Threshold

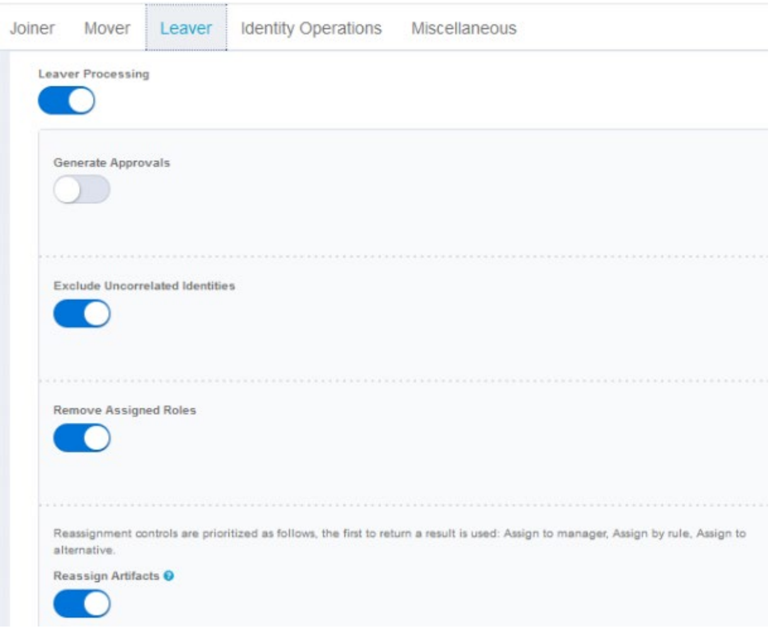
Mover Business Process *
RapidSetup - Mover

Trigger Filter *

AND | OR

Job Title | String | Changed

c. The following screen captures show the configuration we used for **Leaver**.



Leaver Processing: on

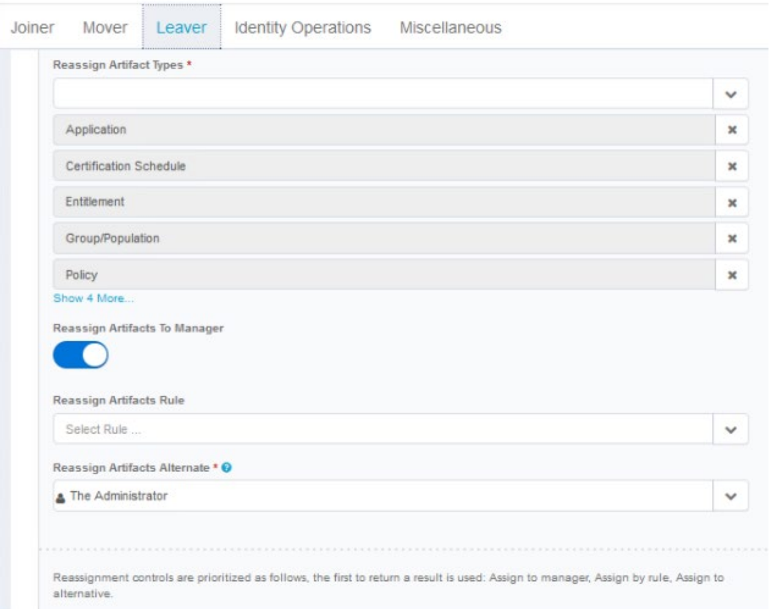
Generate Approvals: off

Exclude Uncorrelated Identities: on

Remove Assigned Roles: on

Reassignment controls are prioritized as follows, the first to return a result is used: Assign to manager, Assign by rule, Assign to alternative.

Reassign Artifacts: on



Reassign Artifact Types *

- Application
- Certification Schedule
- Entitlement
- Group/Population
- Policy

Show 4 More...

Reassign Artifacts To Manager

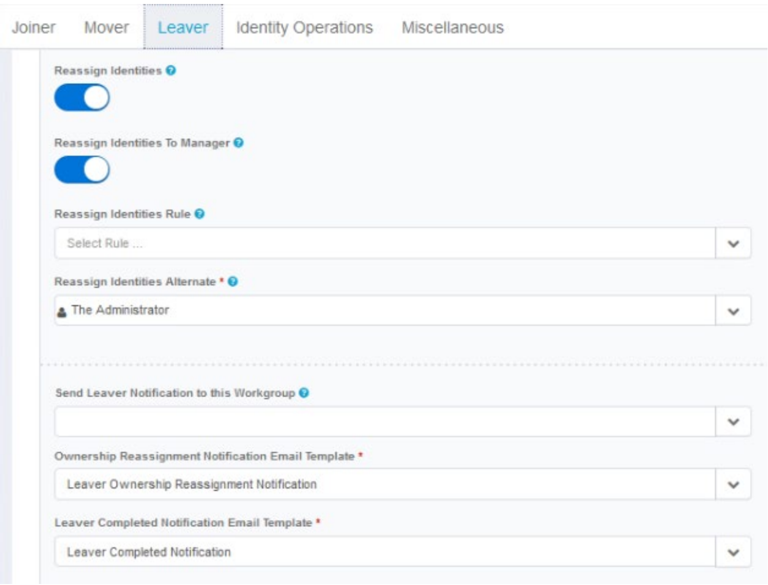
Reassign Artifacts Rule

Select Rule ...

Reassign Artifacts Alternate *

The Administrator

Reassignment controls are prioritized as follows, the first to return a result is used: Assign to manager, Assign by rule, Assign to alternative.



Reassign Identities

Reassign Identities To Manager

Reassign Identities Rule

Select Rule ...

Reassign Identities Alternate *

The Administrator

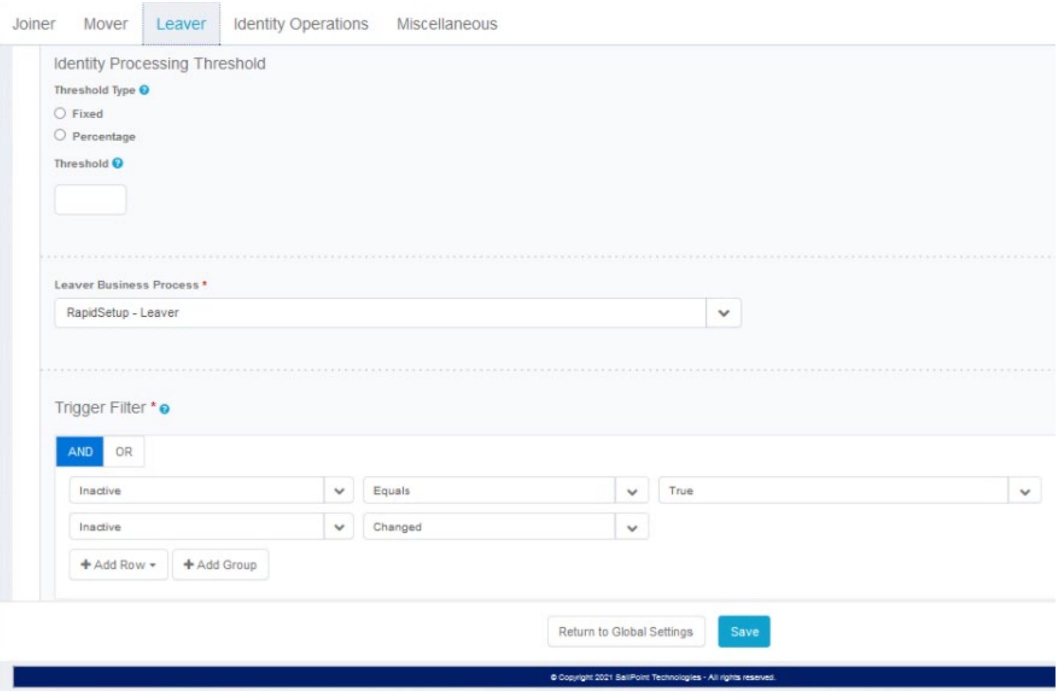
Send Leaver Notification to this Workgroup

Ownership Reassignment Notification Email Template *

Leaver Ownership Reassignment Notification

Leaver Completed Notification Email Template *

Leaver Completed Notification



Identity Processing Threshold

Threshold Type

○ Fixed

○ Percentage

Threshold

Leaver Business Process *

RapidSetup - Leaver

Trigger Filter *

Inactive	Equals	True
Inactive	Changed	

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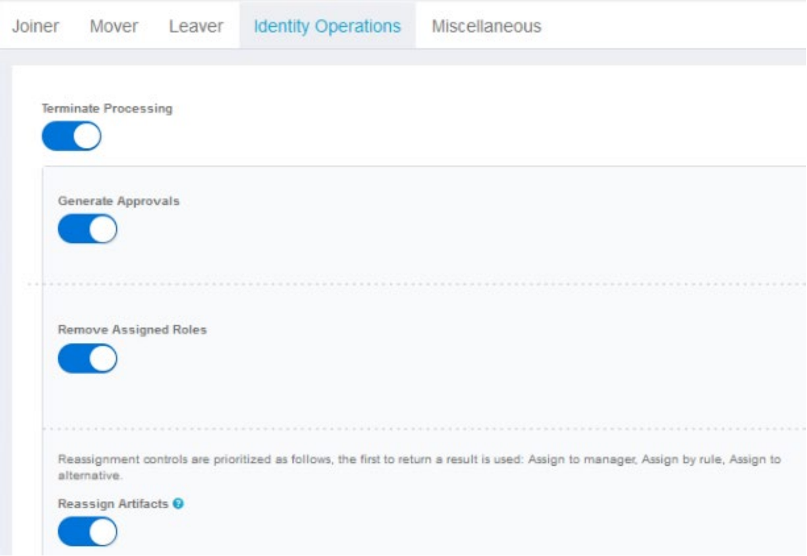
508 d. The following screen captures show the configuration we used for **Identity Operations**.



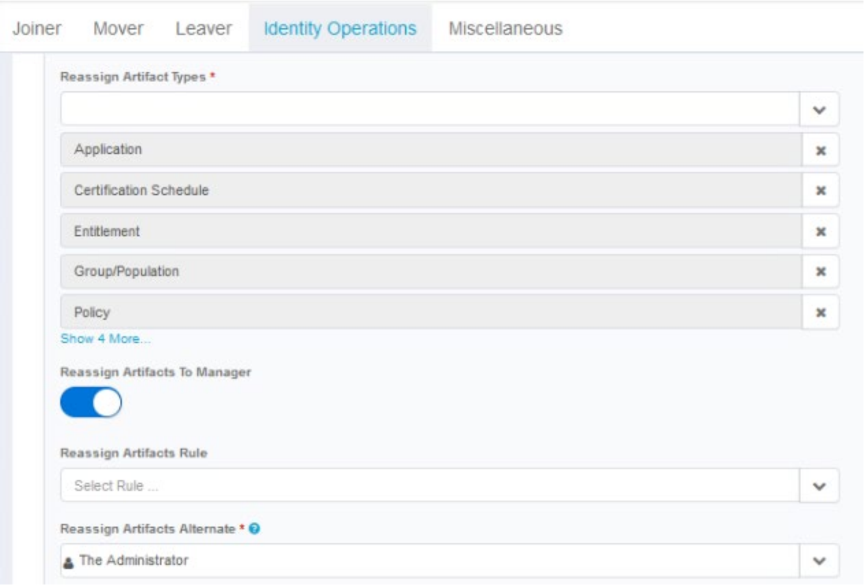
Terminate Processing

Generate Approvals

Remove Assigned Roles

Reassignment controls are prioritized as follows, the first to return a result is used: Assign to manager, Assign by rule, Assign to alternative.

Reassign Artifacts



Reassign Artifact Types *

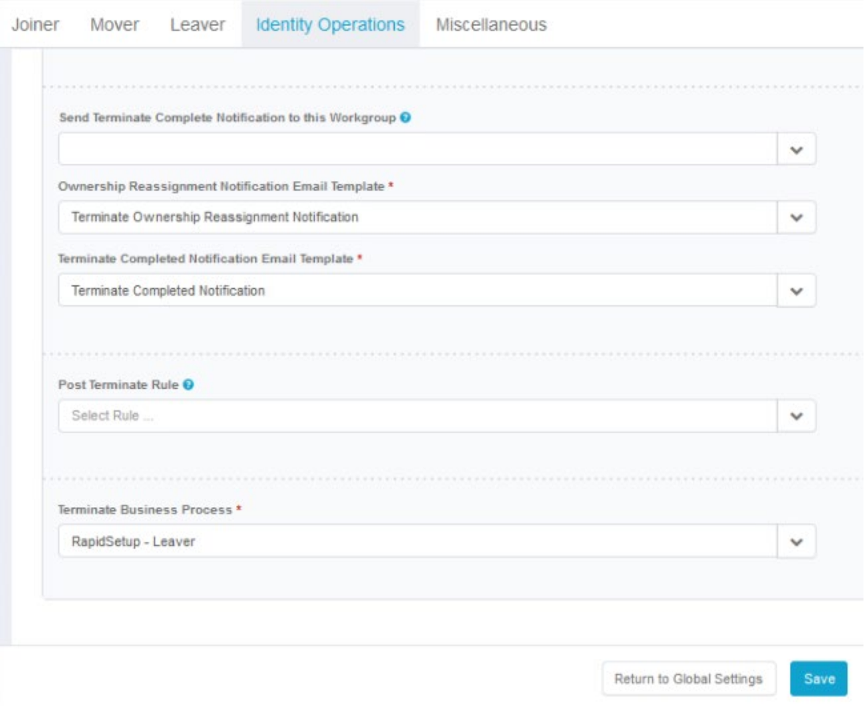
- Application
- Certification Schedule
- Entitlement
- Group/Population
- Policy

Show 4 More...

Reassign Artifacts To Manager: ●

Reassign Artifacts Rule: Select Rule ...

Reassign Artifacts Alternate *: The Administrator



Send Terminate Complete Notification to this Workgroup:

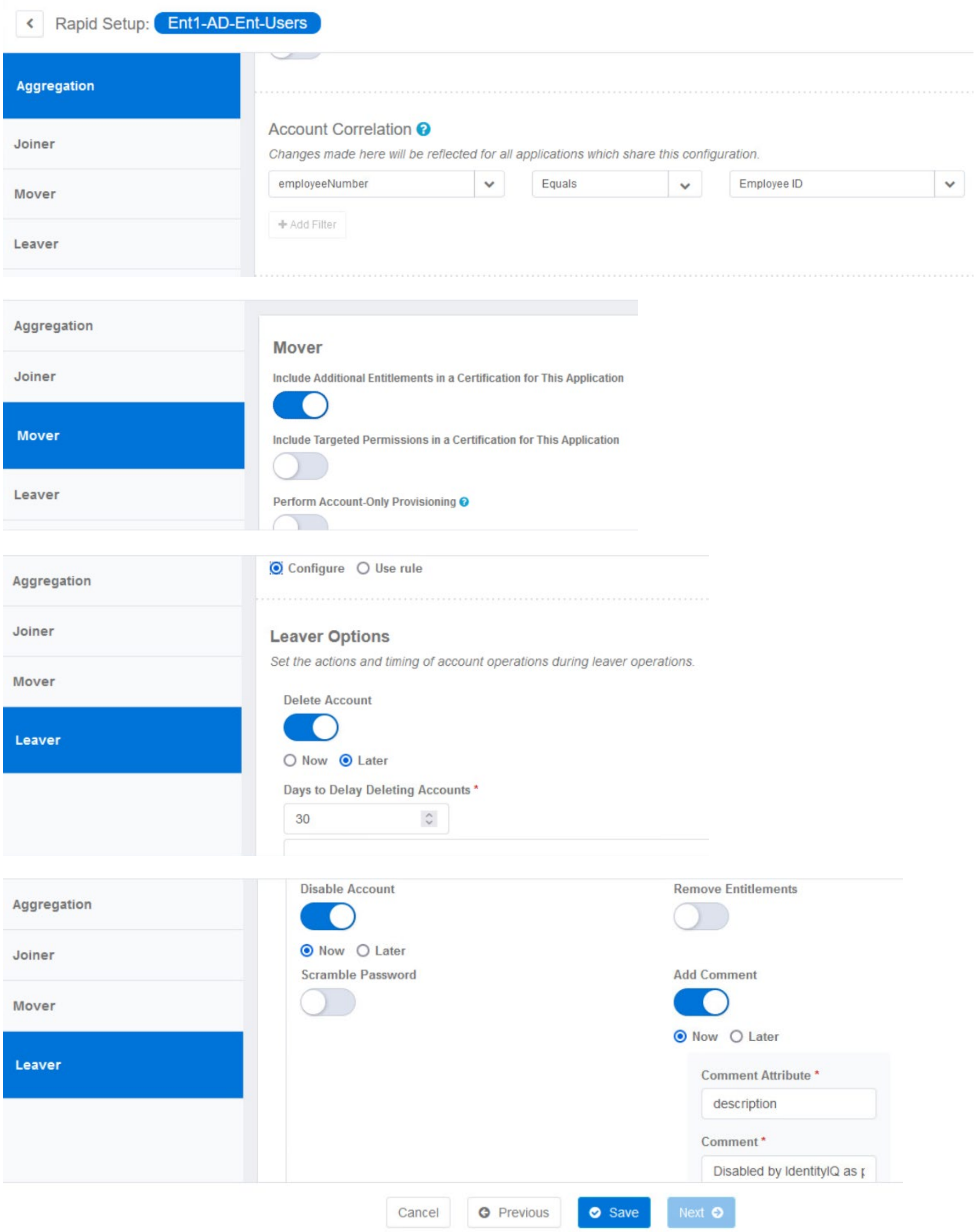
Ownership Reassignment Notification Email Template *: Terminate Ownership Reassignment Notification

Terminate Completed Notification Email Template *: Terminate Completed Notification

Post Terminate Rule: Select Rule ...

Terminate Business Process *: RapidSetup - Leaver

e. Configure Rapid Setup specific to AD users: Aggregation, Joiner, Mover, and Leaver based on the following screenshots. Note: The Joiner setup used the default configuration, so it is not included in the screenshots.



Rapid Setup: Ent1-AD-Ent-Users

Account Correlation

Changes made here will be reflected for all applications which share this configuration.

employeeNumber | Equals | Employee ID

Mover

Include Additional Entitlements in a Certification for This Application: on

Include Targeted Permissions in a Certification for This Application: off

Perform Account-Only Provisioning

● Configure ○ Use rule

Leaver Options

Set the actions and timing of account operations during leaver operations.

Delete Account: on

○ Now ● Later

Days to Delay Deleting Accounts *: 30

Disable Account: on

● Now ○ Later

Scramble Password: off

Remove Entitlements: off

Add Comment: on

● Now ○ Later

Comment Attribute *: description

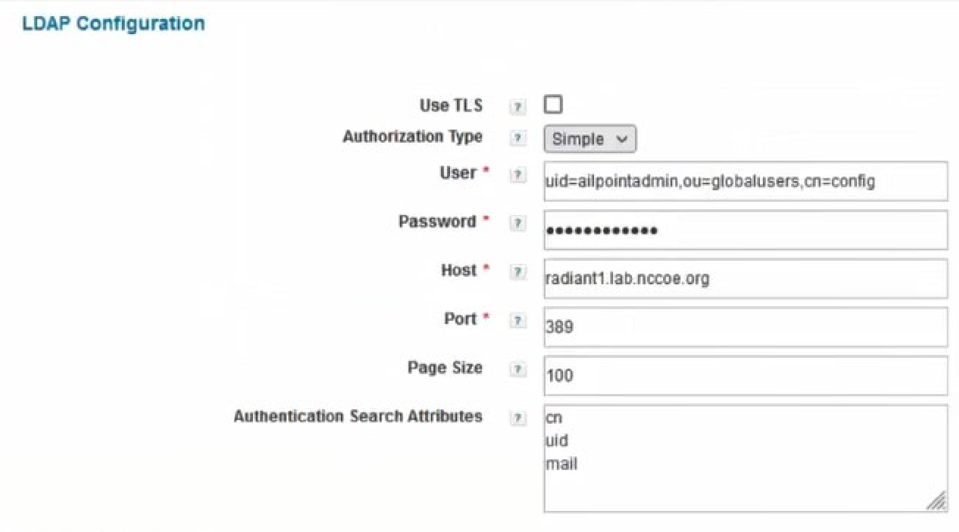
Comment *: Disabled by IdentityIQ as p

7. Govern user permissions to applications on an individual basis. Configure procedures to provision and approve user access to resources. For Enterprise 1, the process is for an administrator or user to request approval to access an application. That request goes to the user's manager

for review and approval. Once the manager approves the request, SailPoint kicks off an API call to Okta to configure access for that user.

2.3.2 Integration with Radiant Logic

1. In the **Applications** tab, select **Application Definition.** When the screen comes up, click on the **Add New Application** button.
2. Enter values for the **Name** (e.g., “Ent1-HR”) and **Owner** (e.g., “The Administrator”) fields. Select **LDAP** as the **Application Type** and ensure that **Authoritative Application** is enabled.
3. Click on the **Configuration** tab next to the current tab. The credentials that were created in Radiant Logic will need to be added.

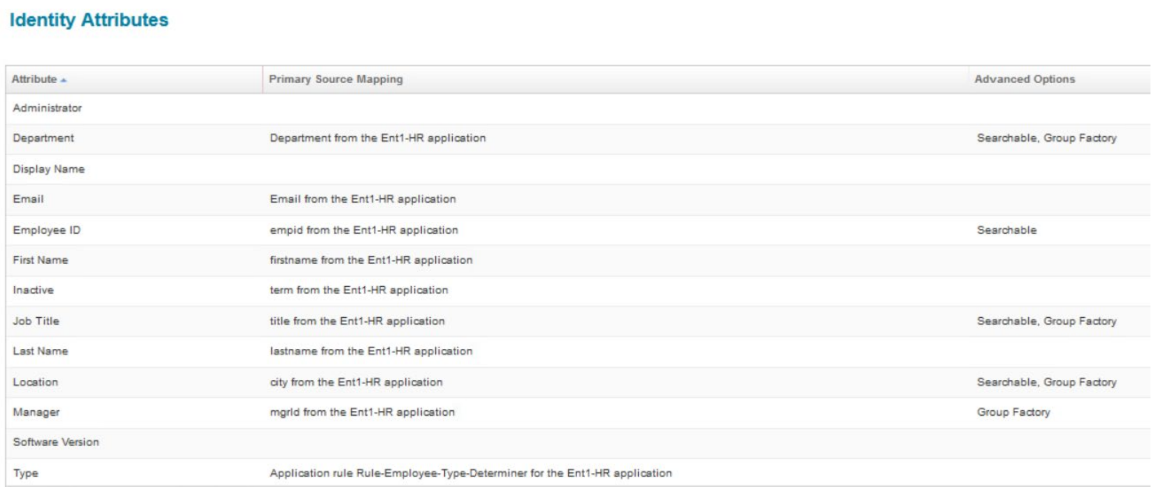


LDAP Configuration

Use TLS □
Authorization Type Simple
User * uid=ailpointadmin,ou=globalusers,cn=config
Password * •••••••••••••
Host * radiant1.lab.nccoe.org
Port * 389
Page Size 100
Authentication Search Attributes cn
uid
mail

4. Scroll down the screen and under the **Account** tab, add the Search DN, which is the one created from Radiant Logic.
5. Click on **Test Connection** to make sure that SailPoint is able to connect to Radiant Logic. Click **Save.**
6. You can go back into the **Configuration** tab and **Schema** sub-tab. Toward the bottom of the screen, there is a **Preview** button. You can click on that to preview attributes imported. Note: We manually added schema attributes. This can be completed from Radiant Logic and imported. Please ensure that you have the correct attributes to integrate this.
7. To complete the setup, click **Save** to finish and import users from Radiant Logic.
8. Go to the **Setup** tab and click **Tasks.** Once in the new tab, click on the **New Task** button at the top right corner to create the account aggregation for Radiant Logic.

9. Perform identity attribute mapping. The screen capture shows mappings specific to this build only.



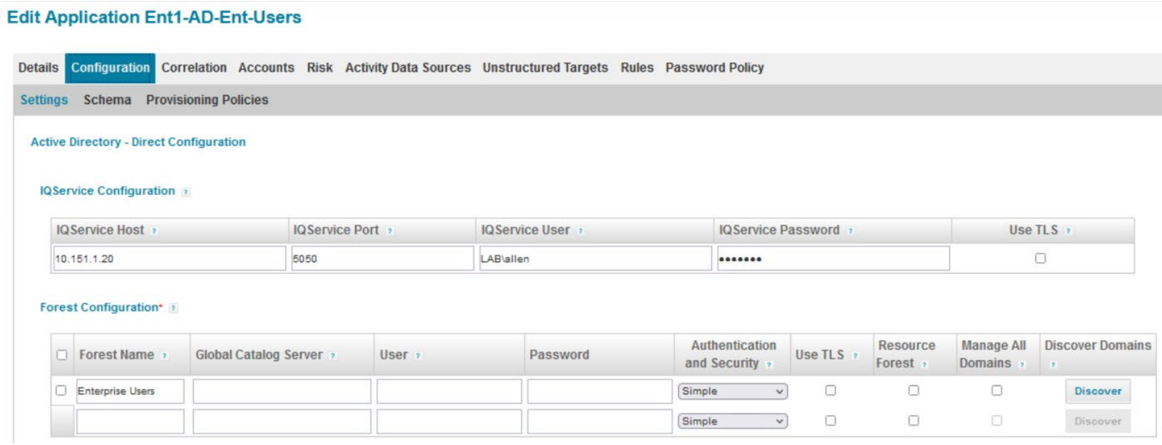
Identity Attributes

Attribute ▲	Primary Source Mapping	Advanced Options
Administrator		
Department	Department from the Ent1-HR application	Searchable, Group Factory
Display Name		
Email	Email from the Ent1-HR application	
Employee ID	empid from the Ent1-HR application	Searchable
First Name	firstname from the Ent1-HR application	
Inactive	term from the Ent1-HR application	
Job Title	title from the Ent1-HR application	Searchable, Group Factory
Last Name	lastname from the Ent1-HR application	
Location	city from the Ent1-HR application	Searchable, Group Factory
Manager	mgrId from the Ent1-HR application	Group Factory
Software Version		
Type	Application rule Rule-Employee-Type-Determiner for the Ent1-HR application	

2.3.3 Integration with AD

1. Navigate to the **Applications** tab, click on **Application Definition**, then click the **Add New Application** button. Fill out the **Name** (e.g., “Ent1-AD-Ent-Users”), **Owner** (e.g., “The Administrator”), and **Application Type** (“Active Directory – Direct”).

2. Navigate to the **Configuration** tab. From here, input information for the IQ Service Host. The IP address is this server, the IdentityIQ server. IQ Service User is a user that was created in AD for this integration.



Edit Application Ent1-AD-Ent-Users

Active Directory - Direct Configuration

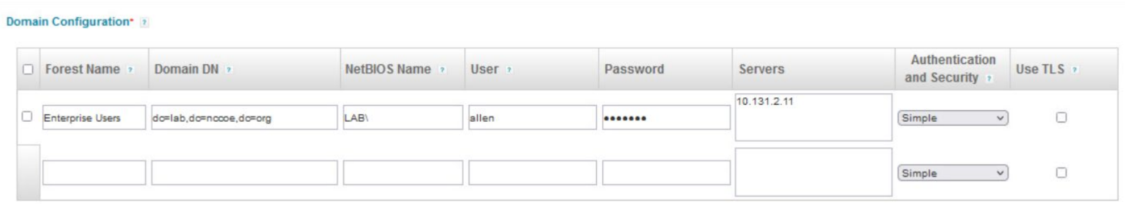
IQService Configuration

IQService Host	IQService Port	IQService User	IQService Password	Use TLS
10.151.1.20	5050	LAB\allen	•••••••	□

Forest Configuration*

□	Forest Name	Global Catalog Server	User	Password	Authentication and Security	Use TLS	Resource Forest	Manage All Domains	Discover Domains
□	Enterprise Users				Simple	□	□	□	Discover
					Simple	□	□	□	Discover

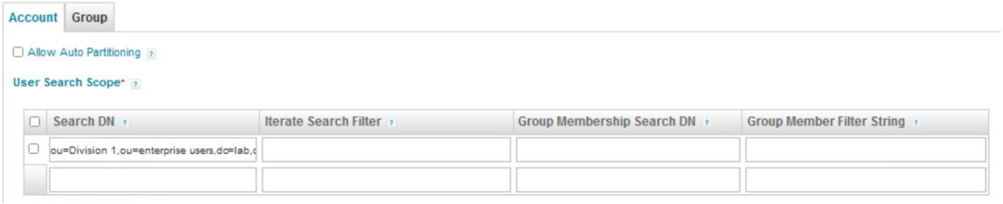
3. Scroll down to the **Domain Configuration** section. Input the domain information for where the users will be provisioned.



Domain Configuration*

☐	Forest Name	Domain DN	NetBIOS Name	User	Password	Servers	Authentication and Security	Use TLS
☐	Enterprise Users	dc=lab,dc=nccoe,dc=org	LAB\	allen	•••••••	10.131.2.11	Simple	☐
							Simple	☐

4. Scroll down to the **User Search Scope** section and input the Search DN information. This should be the AD domain location for your enterprise.



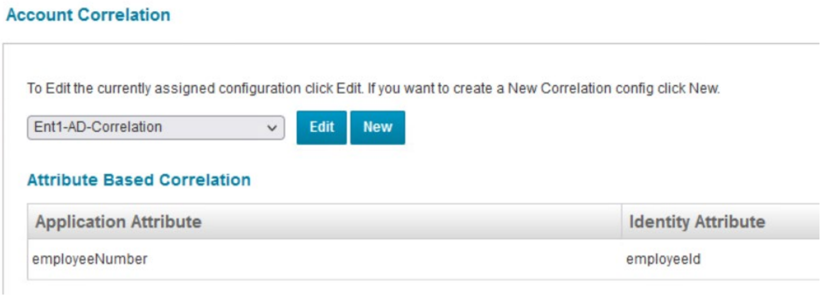
☐ Allow Auto Partitioning

User Search Scope*

☐	Search DN	Iterate Search Filter	Group Membership Search DN	Group Member Filter String
☐	ou=Division 1,ou=enterprise users,dc=lab,c			

5. Navigate to the **Schema** and **Provisioning Policies** sub-tabs, and update information as necessary.

6. Then navigate to the **Correlation** tab to configure the correlation for application and identity attributes between SailPoint and AD.



Account Correlation

To Edit the currently assigned configuration click Edit. If you want to create a New Correlation config click New.

Ent1-AD-Correlation

Attribute Based Correlation

Application Attribute	Identity Attribute
employeeNumber	employeeId

7. Click **Save** to complete the configuration.

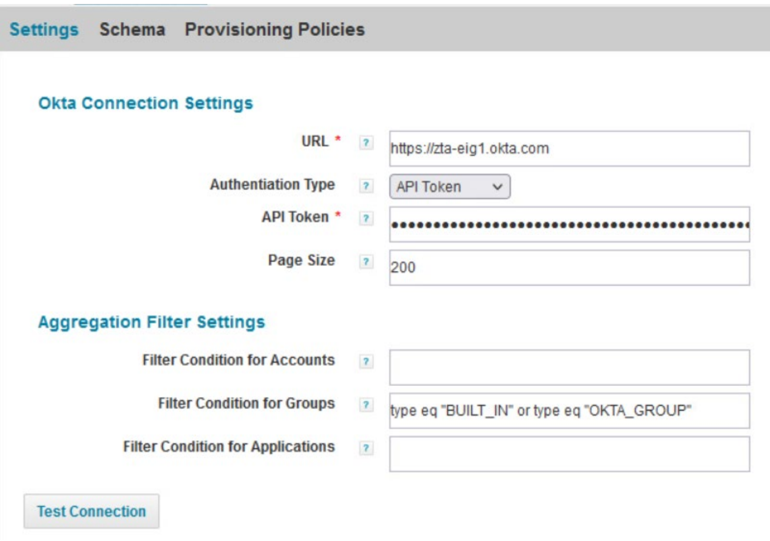
8. Go to **Setup** tab and click **Tasks**. Once in the new tab, click on the **New Task** button at the top right corner to create the account aggregation for AD.

2.3.4 Integration with Okta

1. Go into the **Applications** tab and select **Application Definition.** When the screen comes up, click on the **Add New Application** button.

2. Fill out the **Name** (e.g., “Ent1-Okta”) and **Owner** (“The Administrator”), select **Okta** as the **Application Type,** and enable the **Authoritative Application** option.

3. In the **Configuration** settings tab, the Okta URL and API token are needed. Note that the API token is created in Okta. Click **Save** to finish the setup.



Okta Connection Settings

URL * https://zta-eig1.okta.com

Authentiation Type API Token

API Token * ••

Page Size 200

Aggregation Filter Settings

Filter Condition for Accounts

Filter Condition for Groups type eq "BUILT_IN" or type eq "OKTA_GROUP"

Filter Condition for Applications

2.4 Ivanti Neurons for UEM

Ivanti Neurons for UEM is a unified endpoint management (UEM) solution which is used to provision endpoints, grant access to enterprise resources, protect data, distribute applications, and enforce measures as required.

2.4.1 Installation and Configuration

2.4.1.1 Install an MDM certificate for Apple devices

The Apple Push Notification service (APNs) certificate needs to be installed in Ivanti Neurons for UEM to communicate with Apple devices. Apple devices use an APNs certificate to learn about updates, MDM policies, and incoming messages.

To acquire and install the MDM certificate:

1. Open the Ivanti Neurons for UEM console and go to **Admin > Apple > MDM Certificate** page to download a certificate signing request (CSR).
2. Upload the CSR to Apple Push Certificates Portal to create a new certificate.
3. Save the resulting certificate.
4. Install the certificate for Ivanti Neurons for UEM tenant.

2.4.1.2 Configure Android Enterprise

Android Enterprise allows personal and corporate applications on the same Android device. Android Enterprise configuration depends on the type of Google subscription. Please follow Ivanti documentation to set up the integration.

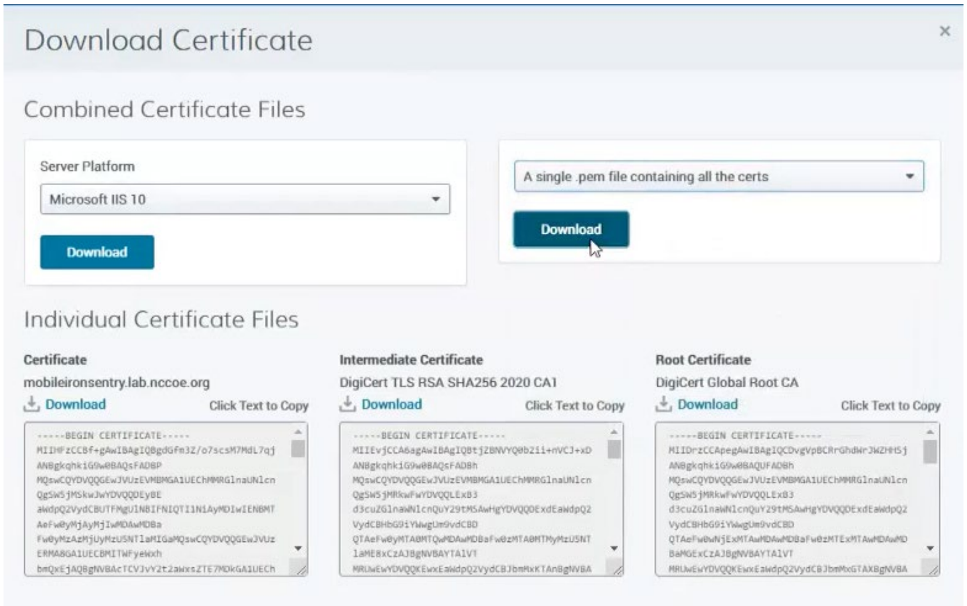
The Android Enterprise Work Profile configuration defines which features and apps are allowed, and which are restricted on Android enterprise devices. Do the following to configure the profile:

1. In the Cloud portal, go to **Configurations** and click **Add.**
2. Select the **Lockdown & Kiosk: Android Enterprise** configuration.
3. Enter a configuration name and description.
4. Click the **Work Profile** lockdown type.
5. Select the lockdown settings for Android devices.

2.4.1.3 Add a Certificate Authority

A certificate authority (CA) generates self-signed certificates to be used by the devices that Ivanti Neurons for UEM manages. For this implementation we used an external certificate authority (DigiCert) and a Connector to access it. Ivanti Cloud Connector provides access from the Ivanti Neurons for UEM service to corporate resources, such as an LDAP server or CA.

1. Install and configure a Connector (**Admin > Connector**).
2. In the **Certificate Management** page, click **Add** under the **Certificate Authority** section.
3. Choose **Connect to a publicly-trusted Cloud Certificate Authority.**
4. Enter a name for the CA.
5. Download the certificate from DigiCert and upload it to Ivanti Neurons for UEM.



Download Certificate

Combined Certificate Files

Server Platform: Microsoft IIS 10

A single .pem file containing all the certs

Individual Certificate Files

Certificate

mobileironsentry.lab.nccoe.org

```
-----BEGIN CERTIFICATE-----
MIIHFzCCBf+gAwIBAgIQBgdGfm3Z/o7scsM7MdL7qj
ANBgkqhkiG9w0BAQsFADBP
MQswCQYDVQQGEwJVUzEVMBMGA1UEChMMRGlnaUNlcn
QgSW5jMSkwJwYDVQQDEyBE
aWdpQ2VydCBUTFMgU1NBIFNIQTI1NiAyMDIwIENBMT
AeFw0yMjAyMjIwMDAwMDBa
Fw0yMzAzMjUyMzU5NTlaMIGaMQswCQYDVQQGEwJVUz
ERMA8GA1UECBMITWFyeWxh
bmQxEjAQBgNVBAcTCVJvY2t2aWxsZTE7MDkGA1UECh
```

Intermediate Certificate

DigiCert TLS RSA SHA256 2020 CA1

```
-----BEGIN CERTIFICATE-----
MIIEvjCCA6agAwIBAgIQBtjZBNVYQ0b2ii+nVCJ+xD
ANBgkqhkiG9w0BAQsFADBh
MQswCQYDVQQGEwJVUzEVMBMGA1UEChMMRGlnaUNlcn
QgSW5jMRkwFwYDVQQLExB3
d3cuZGlnaWNlcnQuY29tMSAwHgYDVQQDExdEaWdpQ2
VydCBHbG9iYWwgUm9vdCBD
QTAeFw0yMTA0MTQwMDAwMDBaFw0zMTA0MTMyMzU5NT
laME8xCzAJBgNVBAYTAlVT
MRUwEwYDVQQKEwxEaWdpQ2VydCBJbmMxKTAnBgNVBA
```

Root Certificate

DigiCert Global Root CA

```
-----BEGIN CERTIFICATE-----
MIIDrzCCApegAwIBAgIQCDvgVpBCRrGhdWrJWZHHSj
ANBgkqhkiG9w0BAQUFADBh
MQswCQYDVQQGEwJVUzEVMBMGA1UEChMMRGlnaUNlcn
QgSW5jMRkwFwYDVQQLExB3
d3cuZGlnaWNlcnQuY29tMSAwHgYDVQQDExdEaWdpQ2
VydCBHbG9iYWwgUm9vdCBD
QTAeFw0wNjExMTAwMDAwMDBaFw0zMTExMTAwMDAwMD
BaMGExCzAJBgNVBAYTAlVT
MRUwEwYDVQQKEwxEaWdpQ2VydCBJbmMxGTAXBgNVBA
```

2.4.1.4 Configure user settings

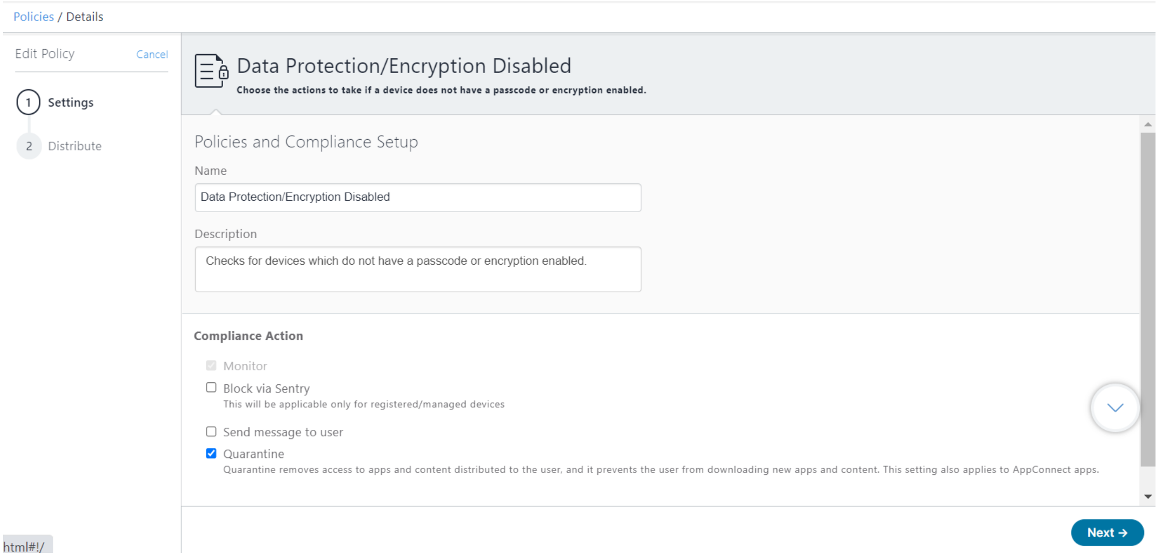
User settings define device registration options. Access them by opening Ivanti Neurons for UEM and going to **Users** > **User Settings**. Configure device and password settings there.

2.4.1.5 Add a policy

Policies define requirements for devices and compliance actions (what happens if the rule is violated). To add a policy:

1. Go to **Policies** and click **+Add** (upper right).
2. Select a policy type and complete the settings. Policy types include Compromised Devices, Data Protection/Encryption Disabled, MDM/Device Administration Disabled, Out of Contact, and Allowed Apps.
3. Select the device groups that will receive this policy.

The following screenshots show an example of a Data Protection policy to be distributed to a custom group of devices.



Policies / Details

Edit Policy Cancel

1 Settings

2 Distribute

Data Protection/Encryption Disabled

Choose the actions to take if a device does not have a passcode or encryption enabled.

Policies and Compliance Setup

Name: Data Protection/Encryption Disabled

Description: Checks for devices which do not have a passcode or encryption enabled.

Compliance Action

☑ Monitor

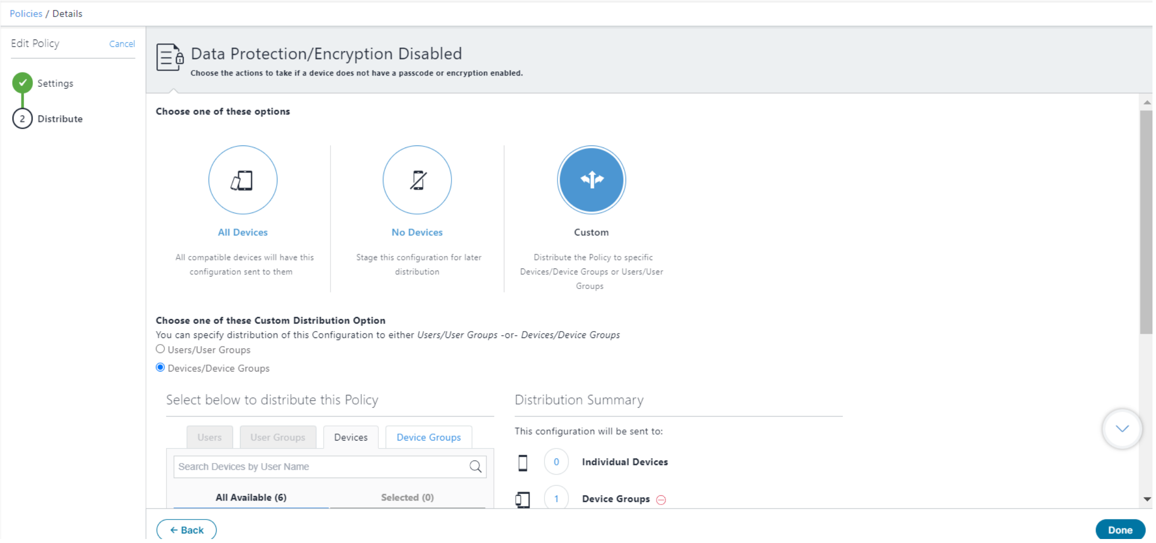
□ Block via Sentry

This will be applicable only for registered/managed devices

□ Send message to user

☑ Quarantine

Quarantine removes access to apps and content distributed to the user, and it prevents the user from downloading new apps and content. This setting also applies to AppConnect apps.



Policies / Details

Edit Policy Cancel

✓ Settings

2 Distribute

Data Protection/Encryption Disabled

Choose the actions to take if a device does not have a passcode or encryption enabled.

Choose one of these options

All Devices: All compatible devices will have this configuration sent to them

No Devices: Stage this configuration for later distribution

Custom: Distribute the Policy to specific Devices/Device Groups or Users/User Groups

Choose one of these Custom Distribution Option

You can specify distribution of this Configuration to either *Users/User Groups* -or- *Devices/Device Groups*

○ Users/User Groups

● Devices/Device Groups

Select below to distribute this Policy

Distribution Summary

This configuration will be sent to:

0 Individual Devices

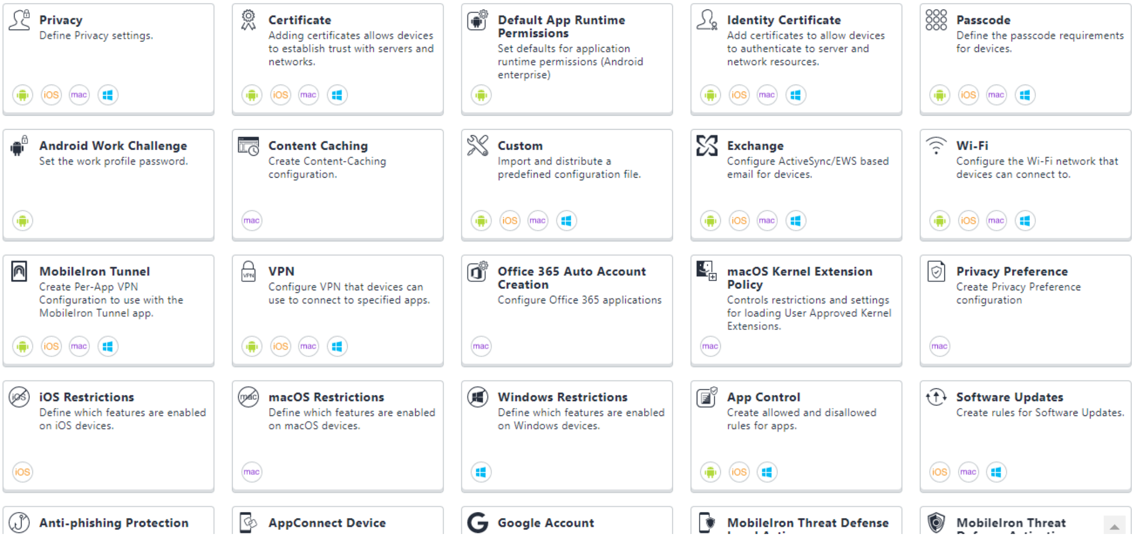
1 Device Groups

2.4.1.6 Add a configuration for managed devices

Configurations are collections of settings that Ivanti Neurons for UEM sends to devices. To add a configuration:

1. Click **Add.**

2. Select the type of configuration. There are numerous types of configurations available, including Privacy, Certificate, Default App Runtime Permissions, Passcode, Exchange, Wi-Fi, VPN, iOS/macOS/Windows Restrictions, and Software Updates.



Privacy
Define Privacy settings.

Certificate
Adding certificates allows devices to establish trust with servers and networks.

Default App Runtime Permissions
Set defaults for application runtime permissions (Android enterprise)

Identity Certificate
Add certificates to allow devices to authenticate to server and network resources.

Passcode
Define the passcode requirements for devices.

Android Work Challenge
Set the work profile password.

Content Caching
Create Content-Caching configuration.

Custom
Import and distribute a predefined configuration file.

Exchange
Configure ActiveSync/EWS based email for devices.

Wi-Fi
Configure the Wi-Fi network that devices can connect to.

MobileIron Tunnel
Create Per-App VPN Configuration to use with the MobileIron Tunnel app.

VPN
Configure VPN that devices can use to connect to specified apps.

Office 365 Auto Account Creation
Configure Office 365 applications

macOS Kernel Extension Policy
Controls restrictions and settings for loading User Approved Kernel Extensions.

Privacy Preference
Create Privacy Preference configuration

iOS Restrictions
Define which features are enabled on iOS devices.

macOS Restrictions
Define which features are enabled on macOS devices.

Windows Restrictions
Define which features are enabled on Windows devices.

App Control
Create allowed and disallowed rules for apps.

Software Updates
Create rules for Software Updates.

Anti-phishing Protection

AppConnect Device

Google Account

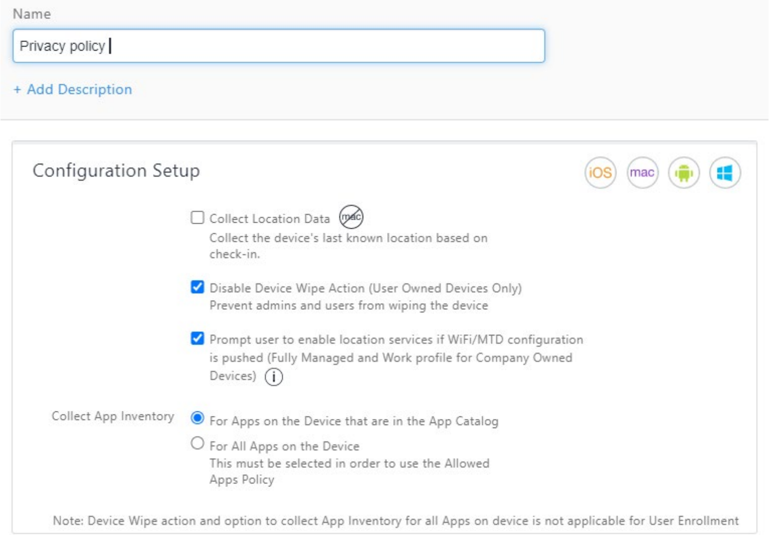
MobileIron Threat Defense

MobileIron Threat

3. Click **Next.**

4. Select a distribution level for the configuration.

Here is an example of a Privacy configuration:



Name
Privacy policy

+ Add Description

Configuration Setup

☐ Collect Location Data
Collect the device's last known location based on check-in.

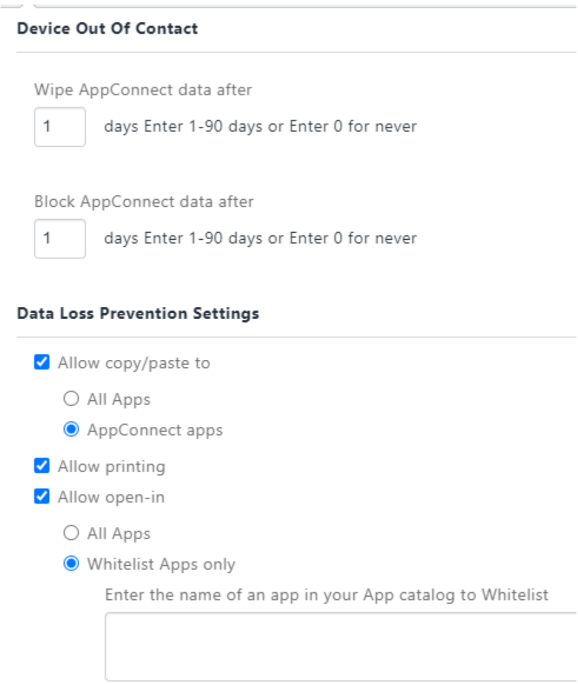
☑ Disable Device Wipe Action (User Owned Devices Only)
Prevent admins and users from wiping the device

☑ Prompt user to enable location services if WiFi/MTD configuration is pushed (Fully Managed and Work profile for Company Owned Devices)

Collect App Inventory
● For Apps on the Device that are in the App Catalog
○ For All Apps on the Device
This must be selected in order to use the Allowed Apps Policy

Note: Device Wipe action and option to collect App Inventory for all Apps on device is not applicable for User Enrollment

This is an example of an iOS AppConnect configuration:



Device Out Of Contact

Wipe AppConnect data after

1 days Enter 1-90 days or Enter 0 for never

Block AppConnect data after

1 days Enter 1-90 days or Enter 0 for never

Data Loss Prevention Settings

☑ Allow copy/paste to

- ○ All Apps
- ● AppConnect apps

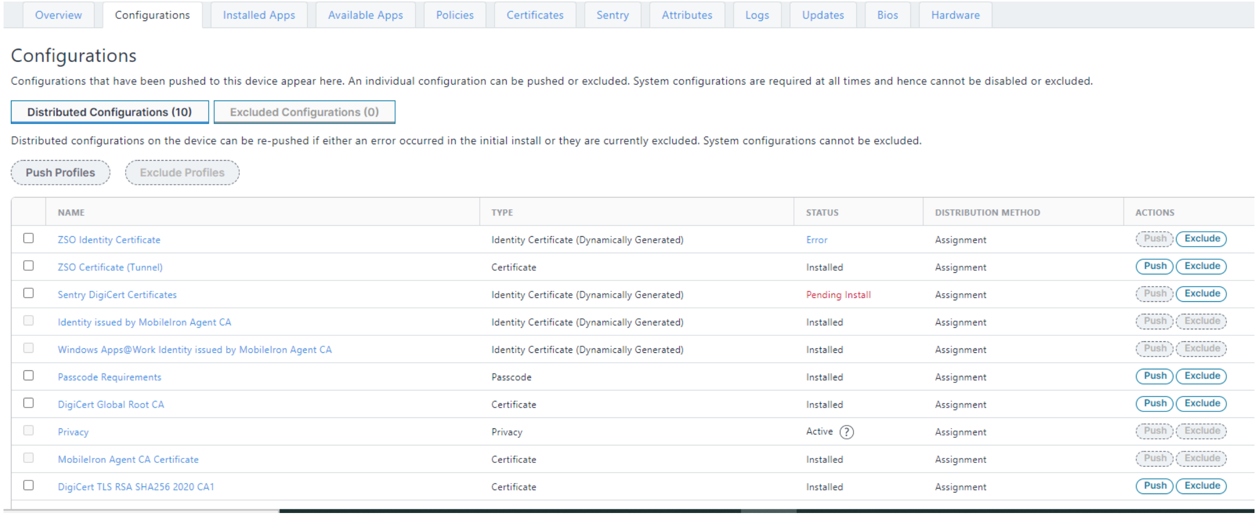
☑ Allow printing

☑ Allow open-in

- ○ All Apps
- ● Whitelist Apps only

Enter the name of an app in your App catalog to Whitelist

622 This screenshot shows a list of configurations pushed to a device:



Configurations

Configurations that have been pushed to this device appear here. An individual configuration can be pushed or excluded. System configurations are required at all times and hence cannot be disabled or excluded.

Distributed configurations on the device can be re-pushed if either an error occurred in the initial install or they are currently excluded. System configurations cannot be excluded.

	NAME	TYPE	STATUS	DISTRIBUTION METHOD	ACTIONS
□	ZSO Identity Certificate	Identity Certificate (Dynamically Generated)	Error	Assignment	Push Exclude
□	ZSO Certificate (Tunnel)	Certificate	Installed	Assignment	Push Exclude
□	Sentry DigiCert Certificates	Identity Certificate (Dynamically Generated)	Pending Install	Assignment	Push Exclude
□	Identity issued by MobileIron Agent CA	Identity Certificate (Dynamically Generated)	Installed	Assignment	Push Exclude
□	Windows Apps@Work Identity issued by MobileIron Agent CA	Identity Certificate (Dynamically Generated)	Installed	Assignment	Push Exclude
□	Passcode Requirements	Passcode	Installed	Assignment	Push Exclude
□	DigiCert Global Root CA	Certificate	Installed	Assignment	Push Exclude
□	Privacy	Privacy	Active ?	Assignment	Push Exclude
□	MobileIron Agent CA Certificate	Certificate	Installed	Assignment	Push Exclude
□	DigiCert TLS RSA SHA256 2020 CA1	Certificate	Installed	Assignment	Push Exclude

623 2.4.2 Integration with Ivanti Connector

624 Ivanti Connector provides access from Ivanti Neurons for UEM to corporate resources, such as an LDAP
625 server. For the latest Connector installation instructions, select the appropriate version of the Cloud
626 Connector Guide.

1. Once the Ivanti Connector has been set up and configured, navigate to the Ivanti Neurons for UEM console.
2. Connect to an LDAP Server to import users and groups. Navigate to **Admin > Infrastructure > LDAP > Add Server.** Complete configurations and save. Users can now be imported from the LDAP server.

2.4.3 Integration with Okta

2.4.3.1 IdP setup

1. Go to **Admin > Infrastructure > Identity > Add IdP.**
2. Generate a key for uploading to Okta IdP.
3. Log in to Okta IdP. Search IdP for the **MobileIron Cloud App** and add it to the IdP account.
4. Configure the **MobileIron Cloud App** on the IdP by pasting the above-generated key and the host information.
5. Export metadata from Okta to the Ivanti Neurons for UEM console.
6. In **Admin > Infrastructure > Identity > Add IdP,** select **Choose File** to import the downloaded metadata file to Ivanti Neurons for UEM and complete the setup.
7. When an IdP is added, user authentication automatically switches from LDAP to IdP.

2.4.3.2 Okta Verify app configuration preparation

1. In the Okta Admin console, navigate to **Security > Device Integrations** and click **Add Platform.**
2. Select platform and click **Next.**
3. Copy the **Secret Key** for later usage and enter Device Management Provider and Enrollment Link settings.
4. Repeat for any other device platforms.

2.4.3.3 Okta Verify app configuration - Android

1. In the Ivanti Neurons for UEM console, navigate to **Apps > App Catalog.** Click **Add.**
2. Select the Google Play Store and search for **Okta Verify.** Select the official **Okta Verify** app.
3. Continue through the wizard until you reach the App Configurations page. Click the **+** button in the Managed Configurations for Android section.

4. Add desired settings. Under **Managed Configurations,** add the **Org URL** and **Management Hint** from the Okta Admin console. The Management hint will be the **Secret Key** you saved from the Okta console during preparation.

5. Click **Next,** then click **Done.**

2.4.3.4 Okta Verify app configuration - iOS

1. In the Ivanti Neurons for UEM console, navigate to **Apps > App Catalog**. Click **Add**.

2. Select the iOS Store and search for **Okta Verify**. Select the official **Okta Verify** app.

3. Continue through the wizard until you reach the App Configurations page. Click the **+** button in the Apple Managed App Configuration section.

4. Add desired settings. Under **Apple Managed App Settings**, click **Add** and add two items.

    a. For the first item, the key will be **domainName**, the value will be your Org URL, and the type will be STRING.

    b. For the second item, the key will be **managementHint**, the value will be the **Secret Key** you saved from the Okta console during preparation, and the type will be STRING.

5. Click **Next,** then click **Done**.

2.5 Ivanti Sentry

Ivanti Sentry is an in-line gateway that manages, encrypts, and secures traffic between the mobile device and back-end enterprise systems. In this build, Ivanti Sentry acts as a PEP that controls access to enterprise resources.

2.5.1 Installation and Configuration

For this implementation we used a Standalone Sentry installation on-premises. For the latest Sentry installation instructions, select the appropriate version of the *Standalone Sentry On-Premises Installation Guide* at https://www.ivanti.com/support/product-documentation.

Next, create a profile for Standalone Sentry in the Ivanti Neurons for UEM console. For information on how to create a profile for Standalone Sentry and configure Standalone Sentry for ActiveSync and AppTunnel, see the *Sentry Guide for Cloud*.

2.5.2 Ivanti Tunnel Configuration and Deployment

Ivanti Tunnel is an application that connects a mobile device to the Ivanti Sentry. The process to deploy this app is similar to the deployment of the Okta Verify app in Section 2.1.2.

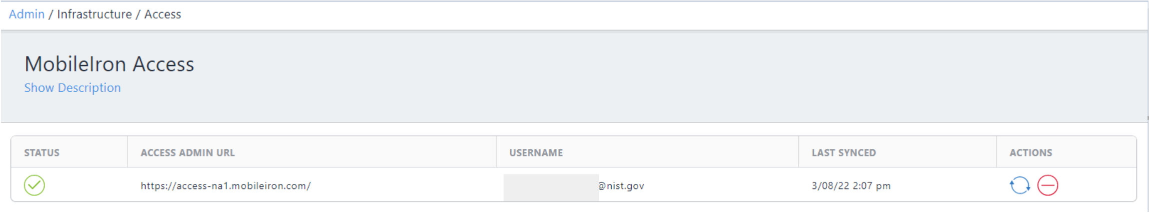
1. On the **App Configurations** page for the Tunnel app, create a Managed Configuration.
2. Set the **Tunnel Profile Mode** to **MobileIron Sentry + Access.**
3. Set the **Sentry Server** to the Sentry instance you created previously.
4. Set the **SentryService** to the name of the IP Tunnel defined on the Sentry.
5. Set the **ClientCertAlias** to the Sentry certificates you defined during Sentry configuration.
6. Set any other options as needed.
7. Save the Managed Configuration and deploy to devices as needed.

2.6 Ivanti Access ZSO

Ivanti Access ZSO is a cloud-based service that allows access to enterprise cloud resources based on user and device posture, and whether apps are managed or not. In this build, Ivanti Access ZSO functions as a delegated IdP, with Okta passing certain responsibilities to Ivanti Access ZSO.

2.6.1 Integration with Ivanti Neurons for UEM

1. Ensure that you have the **Manage MobileIron Access Integration** role in Ivanti Neurons for UEM enabled at **Admin > System > Roles Management.**
2. Navigate to **Users > Users** and click **Add > API User.**
3. Next, navigate to **Users > Users** and click on the username of the user you just created. Navigate to the **Roles** tab of that user and add the **Manage MobileIron Access Integration** role.
4. In the Ivanti Neurons for UEM console, go to **Admin > Infrastructure > Access.**
5. Enter the following: **Access Admin URL, Access Admin Username** (username for the Access administrator account created for Access integration), and **Access Admin Password.**
6. Click **Register.**
7. When Access is registered with Ivanti Neurons for UEM, you should see the following:



STATUS	ACCESS ADMIN URL	USERNAME	LAST SYNCED	ACTIONS
✓	https://access-na1.mobileiron.com/	[redacted]@nist.gov	3/08/22 2:07 pm	⟳ ⊖

2.6.2 Integration with Okta

1. In the Okta Admin console, navigate to **Security > API** and generate an API token. Save this token for use in Access.
2. In the Ivanti Access ZSO console, navigate to **Profile > Federation.**
3. Select **Add Pair > Delegated IDP** and choose **Okta.**
4. Enter the Okta Domain URL and the Okta API Token you generated in Step 1. Click **Verify.**
5. Once the verification is complete, select the routing rules you'd like configured and click **Next.**
6. Verify the Signing Certificate settings and Encryption Certificate settings are correct and click **Next.**
7. Choose the desired **Unmanaged Device Authentication** setting and click **Done.**
8. You will see Okta in the Delegated IDP section, and Okta will route authentication requests based on your settings.

2.7 Zimperium Mobile Threat Defense (MTD)

Zimperium can retrieve various device attributes, such as device name, model, OS, OS version, and owner's email address. It then continuously monitors the device's risk posture and reports any changes in the posture to Ivanti Neurons for UEM.

2.7.1 Installation, Configuration, and Integration

2.7.1.1 Create an API user

To configure a Zimperium MTD console to work with Ivanti Neurons for UEM, an API user needs to be created and assigned a few roles.

1. In the Ivanti Neurons for UEM admin console, select **Users.**
2. Click **+ Add > API user.** The Add API User dialog page opens.
3. Enter the following details: **Username, Email, First Name, Last Name, Display Name,** and **Password.**
4. Confirm the password.
5. Deselect the **Cisco ISE Operations** option.
6. Click **Done.**

2.7.1.2 Assign roles to the API user

1. From the admin console, go to **Users.**
2. Select the new API user created previously.
3. Click **Actions.**
4. From the User details page, select **Assign Roles.**
5. Select the following roles: **App & Content Management, App & Content Read Only, Common Platform Services (CPS), Device Actions, Device Management, Device Read Only, System Read Only,** and **User Read Only.**

2.7.1.3 Add an MDM server to the Zimperium console

1. Log in to the Zimperium MTD console.
2. Navigate to **Manage > Integrations > Add MDM.**
3. Select **Cloud** to add it to the MTD console as an MDM server.
4. Enter the following required information: **URL, Username/Password, MDM Name,** and **Background Sync.**
5. Click **Finish.**

2.7.1.4 Activate MTD on Ivanti Neurons for UEM

1. From the Ivanti Neurons for UEM admin console, go to **Configurations.**
2. Click **+Add.**
3. Click **Mobile Threat Defense Activation.**
4. In the **Create Mobile Threat Defense Configuration** page, enter a name for the configuration.
5. In the Configuration Setup section, select the vendor **Zimperium.**
6. In the **License Key** field, enter a unique encrypted Mobile Threat Defense activation code.
7. In the **Wake up Intervals (mins)** field, set a time.
8. Click **Next.**
9. Select the **Enable this configuration** option.
10. Select **All Devices.**

11. Click **Done.**

2.7.1.5 Add custom attributes in Ivanti Neurons for UEM

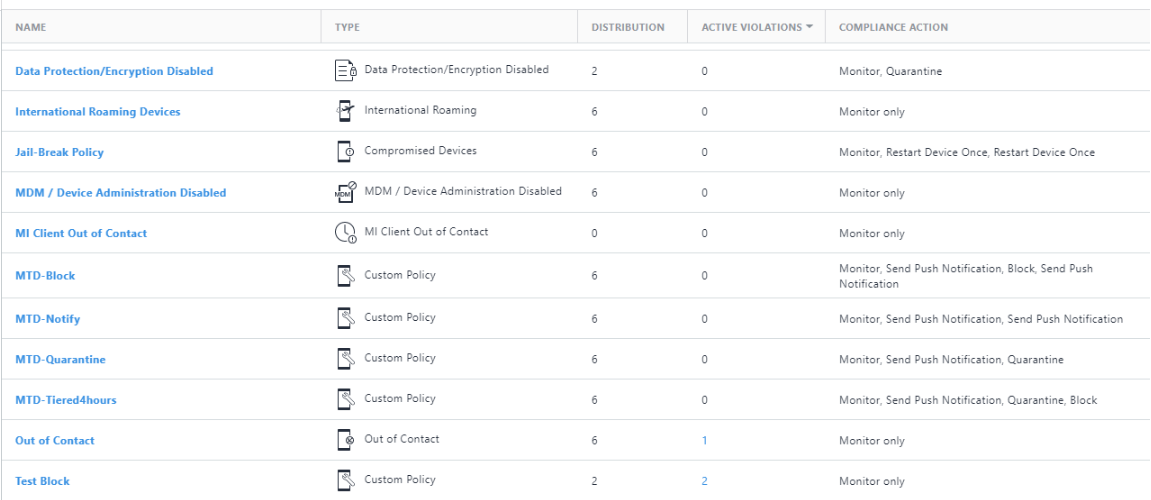
Custom device attributes will be applied to both Android and iOS devices based on threat severity.

1. To create custom attributes, in the Ivanti Neurons for UEM admin console go to **Admin > System > Attributes.** Enter each attribute name in lower case.
2. Create the custom attribute **mtdnotify** for **Low or Normal** severity threats:
    a. Click **Add New.** The **Attribute Name** and **Attribute Type** fields are displayed.
    b. Select **Device** as the attribute type.
    c. Name the custom attribute **mtdnotify.**
    d. Click **Save** to monitor and notify.
3. Create the custom attribute **mtdblock** for **Elevated** or **Critical** severity threats:
    a. Click **Add New.**
    b. Select **Device** as the attribute type.
    c. Name the custom attribute **mtdblock.**
    d. Click **Save** to monitor and notify.
4. Create the custom attribute **mtdquarantine** for **Elevated** or **Critical** severity threats:
    a. Click **Add New.**
    b. Select **Device** as the attribute type.
    c. Name the custom attribute **mtdquarantine.**
    d. Click **Save** to monitor, notify, and quarantine.
5. Create the custom attribute **mtdtiered4hours** for **Low, Normal, Elevated,** or **Critical** severity threats:
    a. Click **Add New.**
    b. Select **Device** as the attribute type.
    c. Name the custom attribute **mtdtiered4hours.**
    d. Click **Save** to monitor and notify, wait for four hours, block, wait for another four hours, and quarantine.

2.7.1.6 Create Compliance Policy

Create compliance actions using custom policies based on the MTD custom attributes created above.

1. In Ivanti Neurons for UEM admin console, go to **Policies.**
2. Click **+ Add.**
3. Select **Custom Policy.**
4. Enter **mtdnotify** as the policy name.
5. Under **Conditions,** select **Custom Device Attribute.**
6. Select **mtdnotify** from the drop-down box and set the condition **is equal to** 1.
7. Under **Choose Actions,** select **Monitor** and **Send Email and Push Notification.**
8. Under **Email Message** fields, enter the subject and body text.
9. Under **Push Notification,** enter message text.
10. Click **Yes, Next,** and **Done.**
11. Repeat this procedure to add the following policies: **mtdblock, mtdquarantine, mtdtiered4hours.**
12. Add other policies if needed.



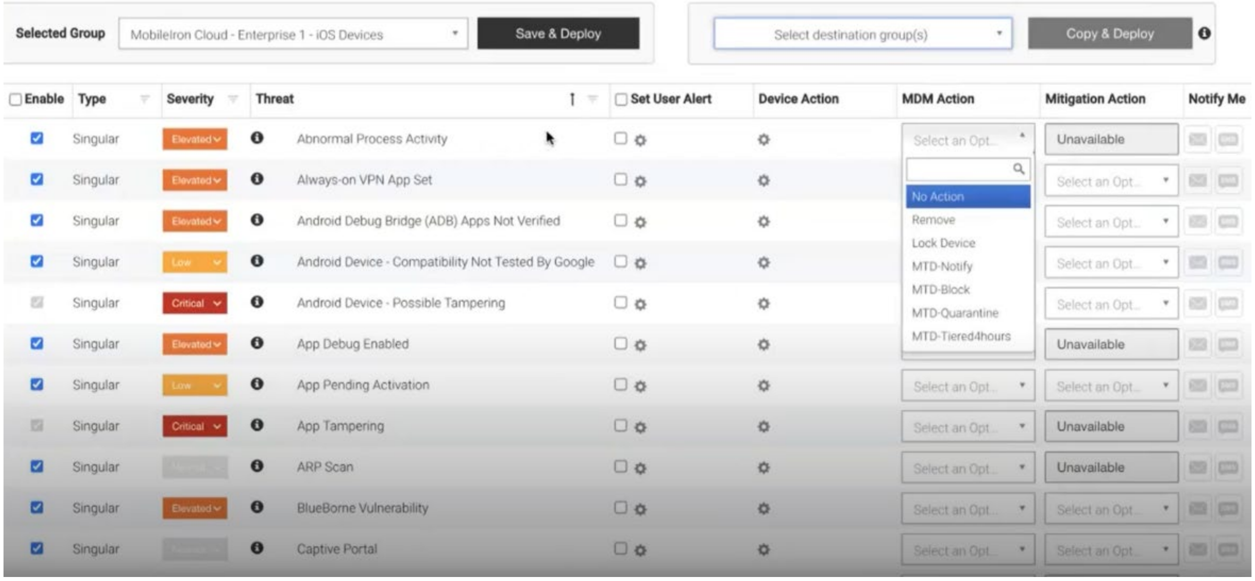
NAME	TYPE	DISTRIBUTION	ACTIVE VIOLATIONS ▾	COMPLIANCE ACTION
Data Protection/Encryption Disabled	Data Protection/Encryption Disabled	2	0	Monitor, Quarantine
International Roaming Devices	International Roaming	6	0	Monitor only
Jail-Break Policy	Compromised Devices	6	0	Monitor, Restart Device Once, Restart Device Once
MDM / Device Administration Disabled	MDM / Device Administration Disabled	6	0	Monitor only
MI Client Out of Contact	MI Client Out of Contact	0	0	Monitor only
MTD-Block	Custom Policy	6	0	Monitor, Send Push Notification, Block, Send Push Notification
MTD-Notify	Custom Policy	6	0	Monitor, Send Push Notification, Send Push Notification
MTD-Quarantine	Custom Policy	6	0	Monitor, Send Push Notification, Quarantine
MTD-Tiered4hours	Custom Policy	6	0	Monitor, Send Push Notification, Quarantine, Block
Out of Contact	Out of Contact	6	1	Monitor only
Test Block	Custom Policy	2	2	Monitor only

2.7.1.7 Create device groups and match with custom policies and custom device attributes created above

1. In Ivanti Neurons for UEM admin console, go to **Devices > Device Groups.**
2. Click **+ Add.**
3. Enter **mtdNotify** as the device group name.
4. Under Dynamically Managed groups, select **Custom Device Attribute.**
5. Select **mtdnotify** from the drop-down box and set the condition **is equal to** 1.
6. Click **Save.**
7. Repeat this procedure to add the following groups: **mtdBlock, mtdQuarantine, mtdTiered4hours.**

2.7.1.8 Configure Zimperium MTD management console

Set up, configure, and use the MTD console for supported MTD activities. When configuring policies in the Zimperium admin console, use the available MDM actions and Mitigation actions.



Selected Group: MobileIron Cloud - Enterprise 1 - iOS Devices

☐ Enable	Type	Severity	Threat	☐ Set User Alert	Device Action	MDM Action	Mitigation Action	Notify Me
☑	Singular	Elevated	Abnormal Process Activity	☐		Select an Opt...	Unavailable	
☑	Singular	Elevated	Always-on VPN App Set	☐			Select an Opt...	
☑	Singular	Elevated	Android Debug Bridge (ADB) Apps Not Verified	☐			Select an Opt...	
☑	Singular	Low	Android Device - Compatibility Not Tested By Google	☐			Select an Opt...	
☑	Singular	Critical	Android Device - Possible Tampering	☐			Select an Opt...	
☑	Singular	Elevated	App Debug Enabled	☐			Unavailable	
☑	Singular	Low	App Pending Activation	☐		Select an Opt...	Select an Opt...	
☑	Singular	Critical	App Tampering	☐		Select an Opt...	Unavailable	
☑	Singular	[illegible]	ARP Scan	☐		Select an Opt...	Unavailable	
☑	Singular	Elevated	BlueBorne Vulnerability	☐		Select an Opt...	Select an Opt...	
☑	Singular	[illegible]	Captive Portal	☐		Select an Opt...	Select an Opt...	

2.8 IBM Cloud Pak for Security

IBM Cloud Pak for Security platform enables the integration of existing security tools and provides understanding and management of threats in the environment.

1. Deploy an OpenShift cluster. OpenShift needs to be in place before Cloud Pak for Security can be installed.
2. Install Cloud Pak for Security.
3. Configure LDAP authentication so Cloud Pak for Security can leverage an existing LDAP directory server for authentication.

Once those steps are complete, open a web browser and navigate to the DNS name for Cloud Pak for Security. Additional documentation can be found at Cloud Pak for Security Documentation.

2.9 IBM Security QRadar XDR

IBM Security QRadar platform provides various security capabilities including threat detection and response, security information and event management (SIEM), and security orchestration, automation and response (SOAR).

Install and configure QRadar following IBM's QRadar Installation and Configuration Guide.

Once that is complete, open a web browser and navigate to the QRadar server web interface by using its IP address or DNS name.

2.10 Tenable.io

Tenable.io is a cloud-based platform that is used in this build to provide network discovery, vulnerability, and scanning capabilities for on-premises components.

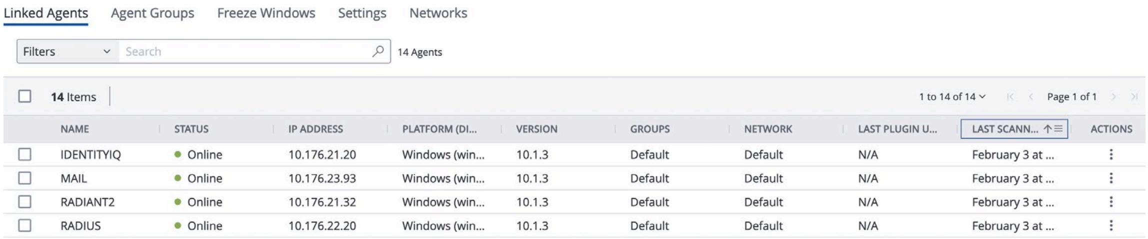
2.10.1 Installation and Configuration

As a cloud-based platform, a license must first be obtained, and a cloud instance deployed by Tenable. Once deployed by a Tenable representative, Tenable.io can be accessed through the web interface located at https://cloud.tenable.com.

2.10.1.1 Deploy an agent

1. In Tenable.io, click the hamburger menu (☰) in the top left corner and navigate to **Settings > Sensors > Nessus Agents.**
2. Click **Add Nessus Agent** and save the Linking Key.
3. On the target endpoint, download the agent from https://downloads.tenable.com. When the download completes, run the executable file.
4. In the setup window, fill in the key from step 2, the server (in our case, cloud.tenable.com:443), and the agent groups that this agent will be part of (in our case, Default). Click **Next.**

5. Click **Install** and approve the request if User Account Control (UAC) comes up.
6. When installation completes, updates will continue running in the background. The update and connection process may take some time. The endpoint will then be shown in the cloud tenant.



	NAME	STATUS	IP ADDRESS	PLATFORM (DI...	VERSION	GROUPS	NETWORK	LAST PLUGIN U...	LAST SCANN...	ACTIONS
□	IDENTITYIQ	● Online	10.176.21.20	Windows (win...	10.1.3	Default	Default	N/A	February 3 at ...	⋮
□	MAIL	● Online	10.176.23.93	Windows (win...	10.1.3	Default	Default	N/A	February 3 at ...	⋮
□	RADIANT2	● Online	10.176.21.32	Windows (win...	10.1.3	Default	Default	N/A	February 3 at ...	⋮
□	RADIUS	● Online	10.176.22.20	Windows (win...	10.1.3	Default	Default	N/A	February 3 at ...	⋮

2.10.1.2 Deploy a scanner

1. In Tenable.io, navigate to **Settings > Sensors > Cloud Scanners.**
2. Click **Add Nessus Scanner** and save the Linking Key.
3. Download the Nessus Scanner .ova file from https://downloads.tenable.com.
4. Deploy the .ova file in your virtual environment.
5. Once the scanner is running, navigate to the IP address shown in the console in a web browser.
6. Login with the default username *wizard* and default password *admin*.
7. Enter new administrator credentials and click **Create Account.**
8. Click **Finish Setup** and authenticate with the new administrator credentials.
9. On the left-side navigation pane, click **Nessus.**
10. Click the URL shown in the *Nessus Installation Info* pane.
11. Click the radio button next to *Managed Scanner* and click Continue.
12. Enter the Linking Key from step 2 and click **Continue.**
13. Enter credentials for a new administrator account and click **Submit.**
14. The scanner will initialize and be visible on tenable.io. Scans can now be scheduled.

2.10.2 Integration with QRadar

For Tenable.io and QRadar integration, follow the Tenable and IBM QRadar SIEM Integration Guide.

2.11 Tenable.ad

Tenable.ad provides AD monitoring to detect attacks and identify vulnerabilities. In this build, Tenable.ad is integrated with the on-premises AD installation and configured to forward alerts to the IBM QRadar SIEM.

For Tenable.ad installation and configuration, follow the Tenable.ad On-Premise Installation Guide.

For Tenable.ad and QRadar integration, follow the Tenable and IBM QRadar SIEM Integration Guide.

2.12 Mandiant Security Validation (MSV)

Mandiant Security Validation (MSV) allows organizations to continuously validate the effectiveness of their cybersecurity controls by running actions that may conflict with the organization's policy and determining if those actions are detected and/or blocked. In this build, MSV is configured to regularly test the build's zero trust policies and report on the results.

2.12.1 MSV Director Installation/Configuration

1. Download the MSV Director software from the Mandiant web portal and deploy it in a virtual environment.
2. Log into the MSV command line interface using credentials provided by Mandiant.
3. Run the command `sudo vsetnet` to apply network configuration.
4. Run the command `sudo vsetdb --password new_password` to set a new password for the Director database.
5. Use a web browser to access the MSV Director web interface at `https://Director IP/`.
6. Sign into the web interface using credentials provided by Mandiant.
7. Accept the End User Licensing Agreement and apply the license provide by Mandiant.
8. Configure the DNS settings by navigating to **Settings > Director Settings > DNS Servers.**
9. Configure the NTP settings by navigating to **Settings > Director Settings > NTP Servers.**
10. Add Security Zones corresponding with the enterprise's network segments by navigating to **Environment > Security Zones.**
11. Download security content from the Mandiant web portal.
12. Navigate to **Settings > Director Settings > Content.**
13. Select **Import,** browse to the downloaded security content, and select the content files.

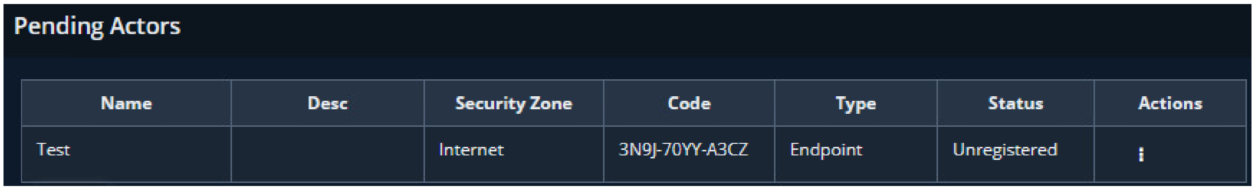
14. Click **Upload Import** and upload the files into the MSV Director web interface.
15. Once the upload is complete, click **Apply Import** to import the content files into MSV.

2.12.2 MSV Network Actor Installation/Configuration

1. Download the MSV Network Actor software from the Mandiant web portal and deploy it in a virtual environment.
2. Log into the MSV command line interface using credentials provided by Mandiant.
3. Run the command `sudo vsetnet` to apply network configuration.
4. In the MSV Director web interface, navigate to **Environment > Actors.**
5. Click **Add Network Actors** and fill out the new **Actor** form.
6. Identify the Actor you just created in the **Pending Actors** table, expand the **Actions** menu, and click **Connect** to initiate a Director-to-Actor registration.
7. Enter the Actor's FQDN or IP address.

2.12.3 MSV Endpoint Actor Installation/Configuration

1. Deploy an endpoint machine running Windows, macOS, or Linux.
2. In the MSV Director web interface, navigate to **Library > Actor Installer Files** and download the relevant installer onto the endpoint.
3. Navigate to **Environment > Actors,** click **Add Endpoint Actors,** and fill out the new Actor form.
4. Execute the Actor installer on the endpoint and proceed through the install process.
5. At the end of the install process, identify the actor you just created in the **Pending Actors** table and enter the value from the **Code** field into the Actor configuration field.



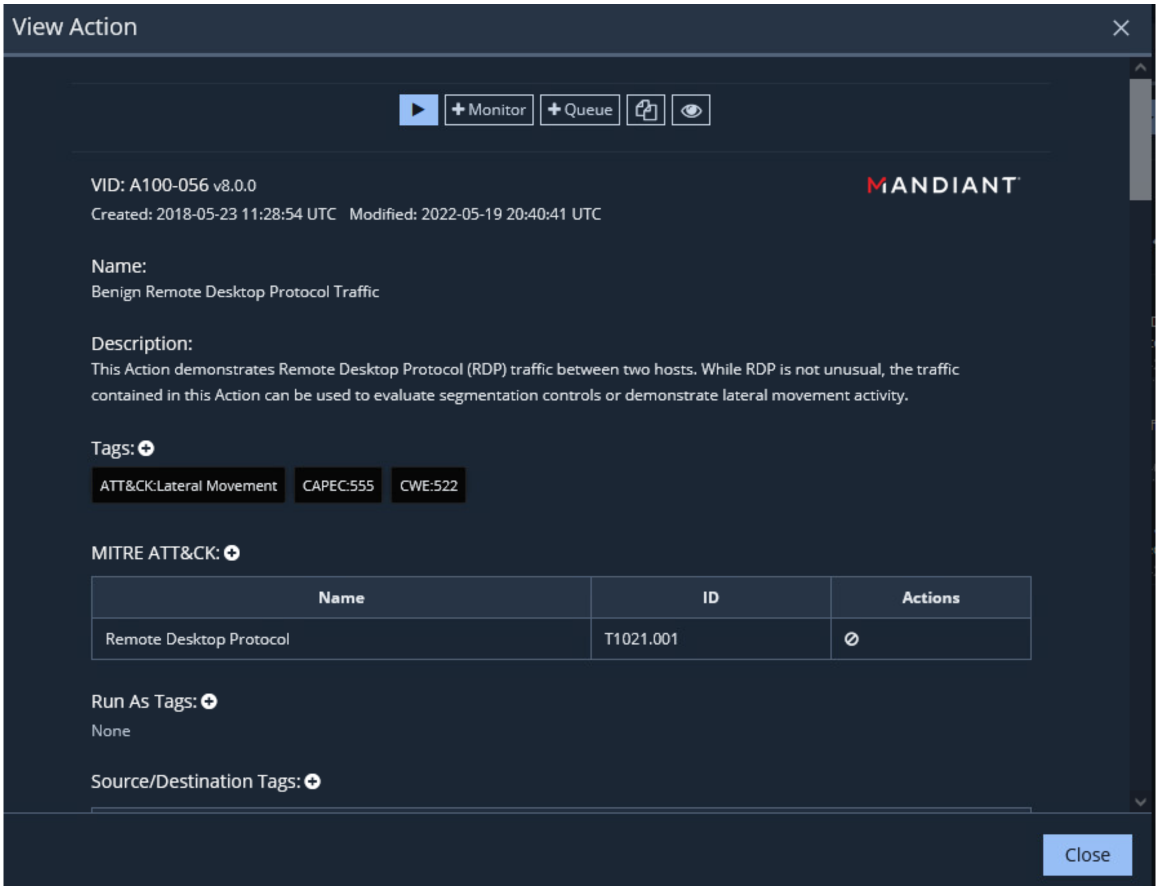
Pending Actors

Name	Desc	Security Zone	Code	Type	Status	Actions
Test		Internet	3N9J-70YY-A3CZ	Endpoint	Unregistered	⋮

6. The endpoint will register itself with the MSV director and setup will be complete.

2.12.4 MSV Evaluation Configuration

1. Once the MSV Director and Actors have been configured, evaluations can be created to test security controls and policies. In the MSV Director web interface, navigate to **Library > Actions.**
2. Find the action(s) you would like to use for the evaluation and select the **+Queue** button to add the action to the Queue. Repeat this process until you have added all needed actions to the Queue.



VID: A100-056 v8.0.0

Created: 2018-05-23 11:28:54 UTC Modified: 2022-05-19 20:40:41 UTC

Name:
Benign Remote Desktop Protocol Traffic

Description:
This Action demonstrates Remote Desktop Protocol (RDP) traffic between two hosts. While RDP is not unusual, the traffic contained in this Action can be used to evaluate segmentation controls or demonstrate lateral movement activity.

Tags:
ATT&CK:Lateral Movement CAPEC:555 CWE:522

MITRE ATT&CK:

Name	ID	Actions
Remote Desktop Protocol	T1021.001	⊘

Run As Tags:
None

Source/Destination Tags:

3. After actions have been added to the Queue, click the **Queue** button in the upper right side of the web interface.
4. Select each of the actions in the **Unassigned** section and drag them to the **Current Actions** section.
5. Scroll up to the top of the page and click the **Save** button.
6. Under the **Test Type** dropdown, choose **Evaluation.**

7. Under the **Name** section, enter a name.

8. Under the **Description** section, enter a description.

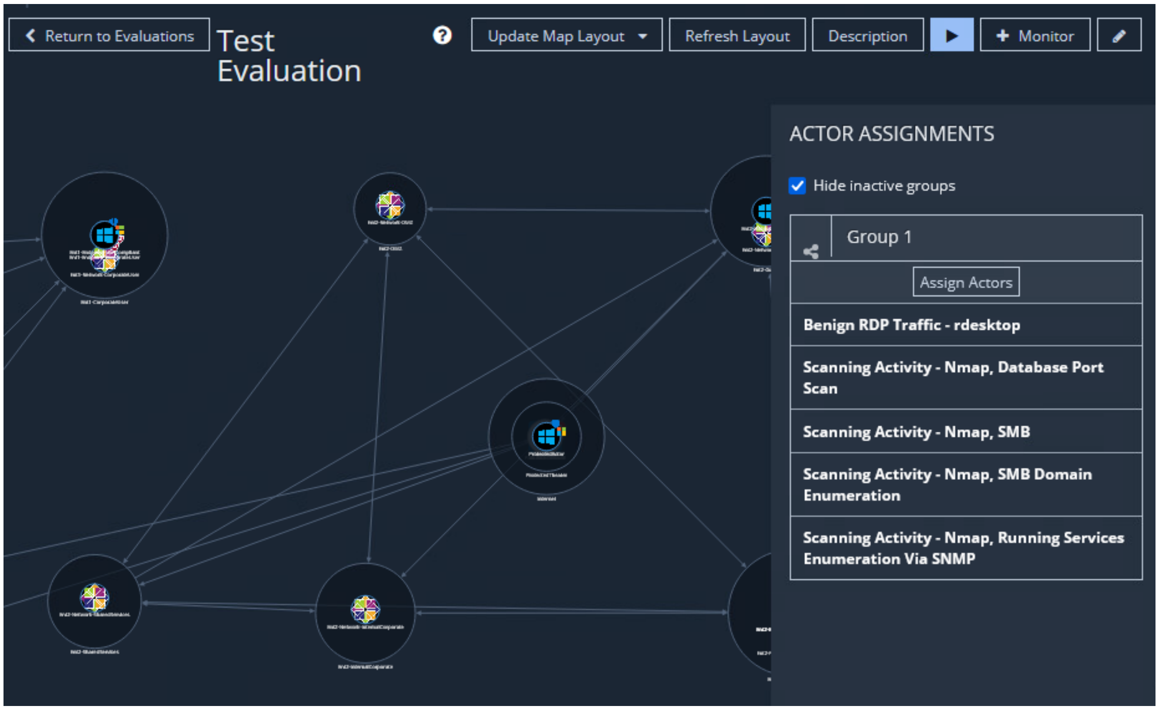
9. Select the **Save** button to save the evaluation.

10. Your new evaluation can be found by navigating to **Library > Evaluations** and filtering on **User Created.**

2.12.5 MSV Evaluation Execution

1. Navigate to **Library > Evaluations** and select the evaluation you'd like to run. Click the **Run** button.

2. From the Evaluation screen, press the **Run Evaluation** button.



☑ Hide inactive groups

Benign RDP Traffic - rdesktop

Scanning Activity - Nmap, Database Port Scan

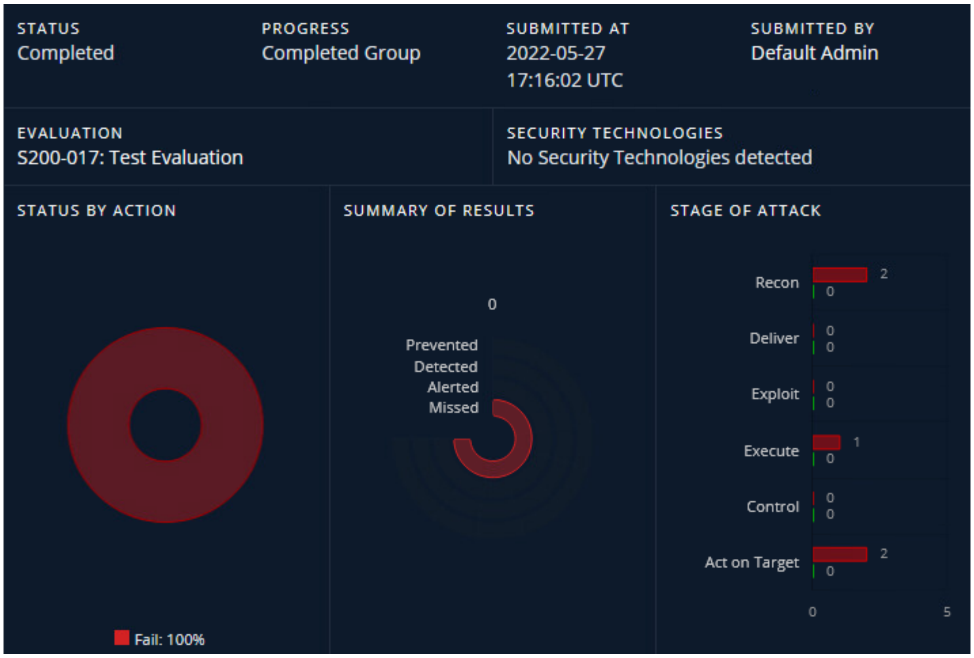
Scanning Activity - Nmap, SMB

Scanning Activity - Nmap, SMB Domain Enumeration

Scanning Activity - Nmap, Running Services Enumeration Via SNMP

3. Select the **Source Actor** and **Destination Actor** from the dropdown menus. Click **Run Now.**

4. The evaluation will run, providing results once the actions have been attempted/completed.



STATUS Completed

PROGRESS Completed Group

SUBMITTED AT 2022-05-27 17:16:02 UTC

SUBMITTED BY Default Admin

EVALUATION S200-017: Test Evaluation

SECURITY TECHNOLOGIES No Security Technologies detected

2.13 DigiCert CertCentral

CertCentral simplifies digital trust and automates certificate management by consolidating tasks for issuing, installing, inspecting, remediating, and renewing TLS/SSL certificates in one place. In this build, CertCentral provided TLS/SSL certificates to any system needing those services.

For the latest CertCentral setup and usage instructions, see https://docs.digicert.com/get-started/.

2.14 AWS IaaS

This section will be part of the EIG run phase and will be included in the next version of the practice guide.

3 Enterprise 3 Build 1 (EIG E3B1) Product Guides

This section of the practice guide contains detailed instructions for installing, configuring, and integrating all of the products used to implement EIG E3B1. For additional details on EIG E3B1's logical and physical architectures, please refer to NIST SP 1800-35B.

3.1 Microsoft Azure Active Directory (AD)

Azure AD is a SaaS Identity and access management platform. No installation steps are required. You will need to create your organization's instance of Azure AD and configure it to allow your users access to applications that use it for authentication and authorization.

1. After logging in to portal.azure.com, create an Azure AD Tenant.
2. Create a connection between your on-premises AD and Azure AD to replicate user, group, and authentication information from your AD to Azure AD.
3. Configure the Azure AD Tenant to enable Single Sign-On Password Reset (SSPR). This gives users the ability to reset their passwords from https://aka.ms/sspr or from within their profile in Azure AD. This will be effective for both their AD and Azure AD accounts.
4. Configure password writeback, which enables password changes in Azure AD to be replicated back to the on-premises AD.
5. The conditional access feature in Azure AD specifies conditions under which a user would be given access to a resource or application that uses Azure AD for authentication. MFA was configured as a requirement for access to all applications. Configure MFA for all users.
6. Access to resources based on device compliance was implemented as an essential feature in this solution. Access would only be granted to a user if the client device is compliant. Compliance is reported to Azure AD by Microsoft Endpoint Manager. Enable this feature, Conditional Access Device Compliance.
7. Configure an enterprise application, GitLab, to use Azure AD for authentication:
    a. GitLab was configured to directly authenticate to Azure AD using the SAML protocol. GitLab must first be registered in Azure AD before Azure AD can be configured as the application's IdP.
    b. Configure Azure AD as a SAML IdP for the GitLab application. Once that is implemented, access attempts to the target application will be redirected to Azure AD for authentication and authorization.

3.2 Microsoft Endpoint Manager

Microsoft Endpoint Manager is a cloud-based service that focuses on mobile device management (MDM) and mobile application management (MAM).

3.2.1 Configuration and Integration

3.2.1.1 Add and verify a custom domain

To connect an organization's domain name with Intune, a DNS registration needs to be configured. This gives users a familiar domain when connecting to Intune and using resources.

1. Go to the Microsoft 365 Admin Center (admin.microsoft.com) and sign into your administrator account.

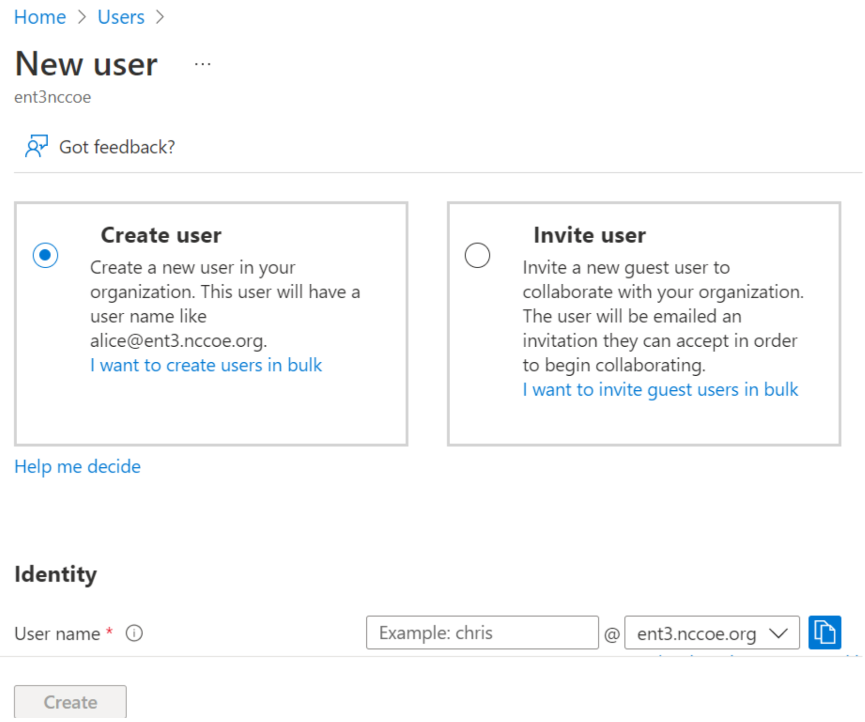
2. Choose **Setup > Domains.**

3. Choose **Add domain** and type a custom domain name. Select **Next.**

4. The **Verify domain** dialog box opens, giving the values to create the TXT record with the DNS hosting provider.

3.2.1.2 Add users

Once you sign into Microsoft Intune, you can add users directly or synchronize users from an on-premises AD. Once added, users can enroll devices and access company resources.



Home > Users >

New user ...

ent3nccoe

Got feedback?

● **Create user**
Create a new user in your organization. This user will have a user name like alice@ent3.nccoe.org.
I want to create users in bulk

○ **Invite user**
Invite a new guest user to collaborate with your organization. The user will be emailed an invitation they can accept in order to begin collaborating.
I want to invite guest users in bulk

Help me decide

Identity

User name * ⓘ Example: chris @ ent3.nccoe.org

Create

3.2.1.3 Enroll devices in Microsoft Intune

Enrolling devices allows them to receive configuration profiles and compliance policies. Configuration profiles configure features and settings on devices. Compliance policies help devices meet an organization’s rules.

1. Get an Apple MDM push certificate and add it to Endpoint Manager. This certificate is required to enroll iOS/iPadOS devices. Then enroll iOS devices in Microsoft Intune.

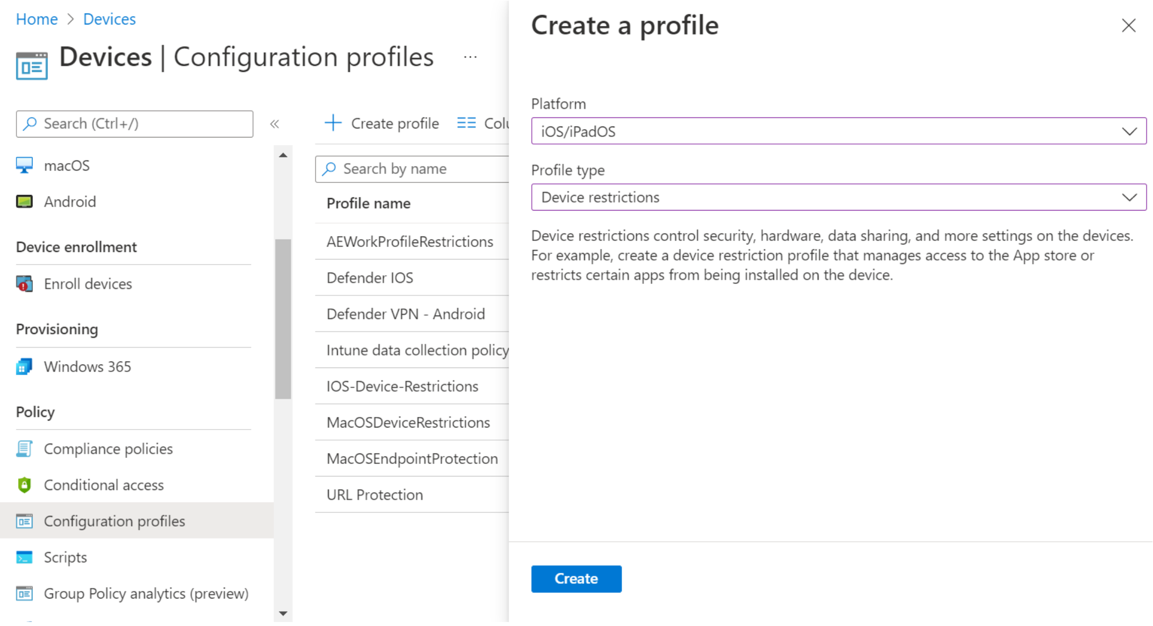
2. Create an iOS enrollment profile. An enrollment profile defines the settings applied to a group of devices during enrollment.

3. Enroll Android devices in Microsoft Intune. To enable Android Enterprise, an administrative Google account needs to be connected to the Intune tenant.

4. Create an iOS compliance policy in Microsoft Intune. It will be evaluated before access is allowed from iOS devices.

5. Create an Android compliance policy in Microsoft Intune. It will be evaluated before access is allowed from Android devices.

6. Create an iOS/macOS configuration profile for iOS or Mac devices.



Profile name
AEWorkProfileRestrictions
Defender IOS
Defender VPN - Android
Intune data collection policy
IOS-Device-Restrictions
MacOSDeviceRestrictions
MacOSEndpointProtection
URL Protection

Create a profile

Platform: iOS/iPadOS

Profile type: Device restrictions

Device restrictions control security, hardware, data sharing, and more settings on the devices. For example, create a device restriction profile that manages access to the App store or restricts certain apps from being installed on the device.

7. Create an Android configuration profile.

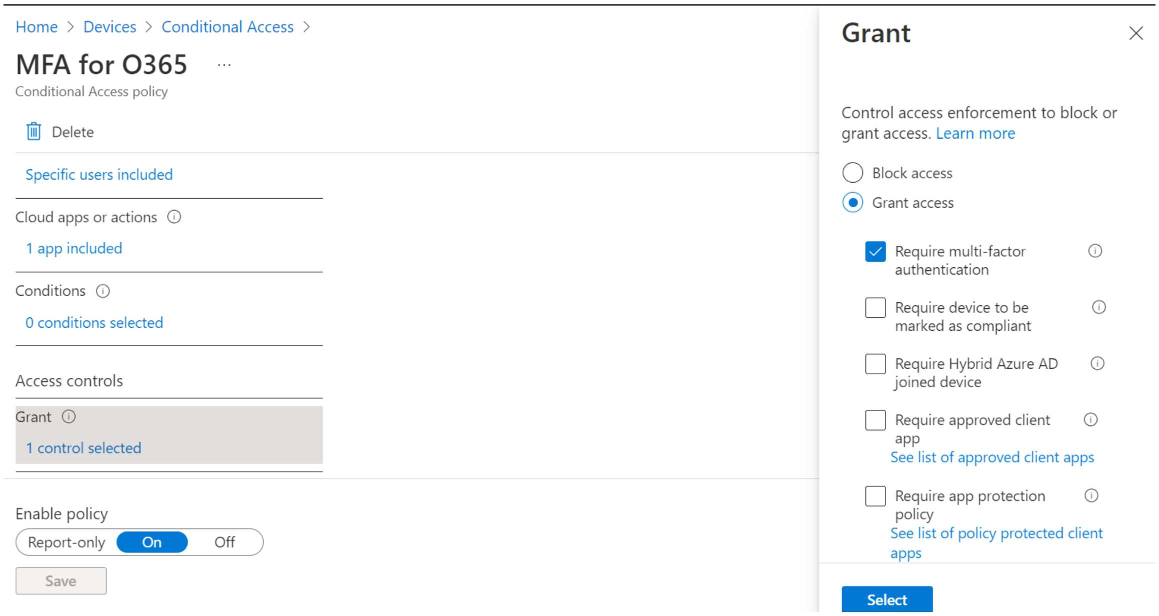
8. Create a Windows configuration profile.

3.2.1.4 Configure Conditional Access rules

Conditional Access is used to control the devices and apps that can connect to company resources.

1. Go to **Devices** > **Conditional Access** and click **New Policy**. Choose cloud apps or actions, conditions, and access controls to create a policy. The screenshot below illustrates this.

2. The multi-factor authentication rule enabled in the screenshot will require MFA before granting access to enterprise Office 365 apps.



Home > Devices > Conditional Access >

MFA for O365 ...

Conditional Access policy

Delete

Specific users included

Cloud apps or actions ⓘ

1 app included

Conditions ⓘ

0 conditions selected

Access controls

Grant ⓘ

1 control selected

Enable policy

Report-only | **On** | Off

Save

Grant

Control access enforcement to block or grant access. Learn more

○ Block access

● Grant access

☑ Require multi-factor authentication ⓘ

□ Require device to be marked as compliant ⓘ

□ Require Hybrid Azure AD joined device ⓘ

□ Require approved client app ⓘ

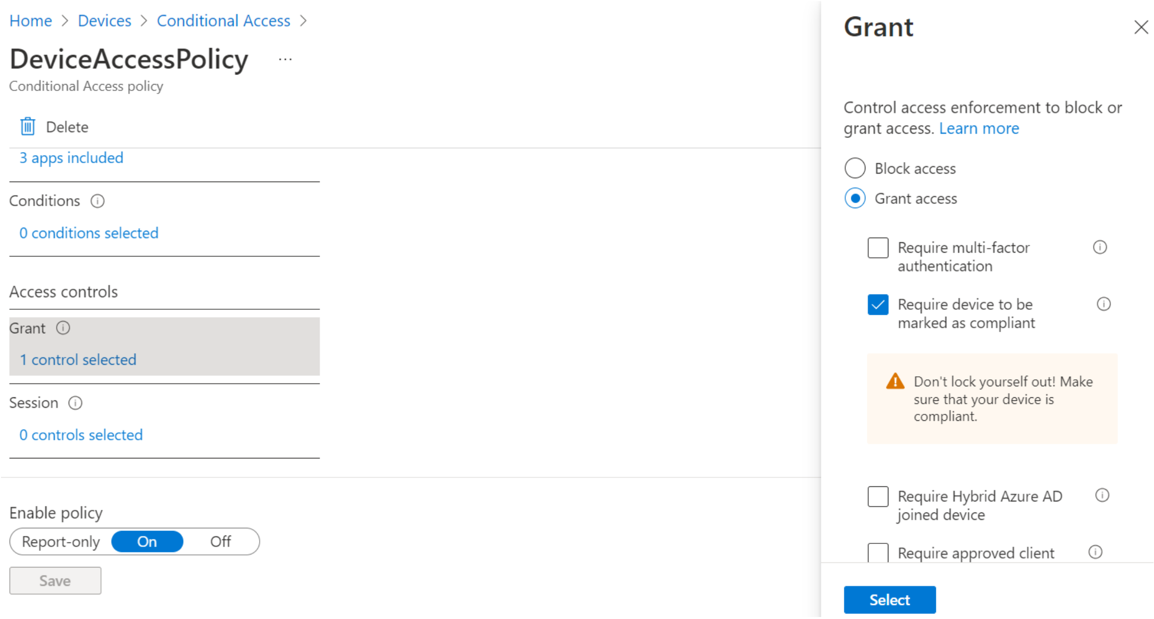
See list of approved client apps

□ Require app protection policy ⓘ

See list of policy protected client apps

Select

3. The Conditional Access Device Access Policy is enabled in the screenshot. It requires devices to be marked as compliant in order to get access to enterprise resources.



Home > Devices > Conditional Access >

DeviceAccessPolicy ...

Conditional Access policy

Delete

3 apps included

Conditions ⓘ

0 conditions selected

Access controls

Grant ⓘ

1 control selected

Session ⓘ

0 controls selected

Enable policy

Report-only | **On** | Off

Save

Grant

Control access enforcement to block or grant access. Learn more

○ Block access

● Grant access

□ Require multi-factor authentication ⓘ

☑ Require device to be marked as compliant ⓘ

⚠ Don't lock yourself out! Make sure that your device is compliant.

□ Require Hybrid Azure AD joined device ⓘ

□ Require approved client ⓘ

Select

3.2.1.5 Managing Applications

iOS/iPadOS: Use the instructions at Add iOS Store Apps to select apps from the iOS/iPadOS store that will be approved for installation on your managed iOS or iPadOS devices.

Android: For this build we added Managed Google Play apps. Managed Google Play is Google's enterprise app store which serves as a source of applications for Android Enterprise in Intune. Use the instructions at [Add Android Store Apps]() to select apps that will be approved for installation and made available to your managed devices.

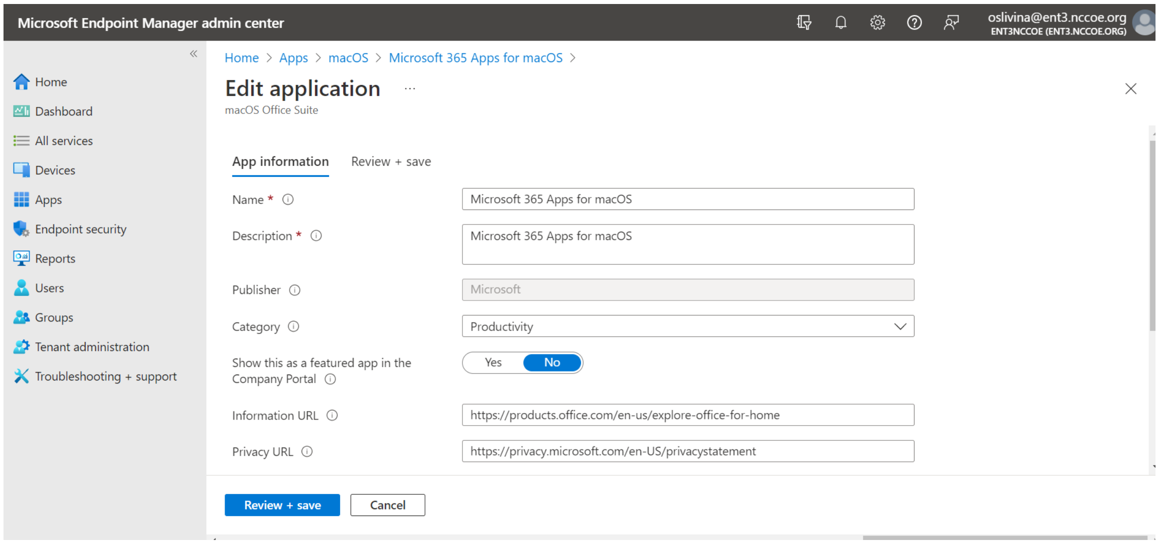
Windows: We tested this build with Microsoft 365 Apps for Windows 10 and later. To add Windows apps:

1. Open the Microsoft Endpoint Manager admin center.
2. Select **Apps** > **All apps** > **Add**.
3. Select **Windows 10 and later** in the **Microsoft 365 Apps** section of the **Select app type** pane.
4. Click **Select**. The **Add Microsoft 365 Apps** steps are displayed.

There is more than one way to configure Windows apps in Intune. We configured the app using App suite information. For other ways, [refer to the Microsoft documentation]().

macOS: Follow these steps to add macOS apps:

1. Open the Microsoft Endpoint Manager admin center.
2. Select **Apps** > **All apps** > **Add**.
3. Select **macOS** in the **Microsoft 365 Apps** section of the **Select app type** pane.
4. Click **Select**. The **Add Microsoft 365 Apps** steps are displayed.
5. Confirm or modify the default values in the **App suite information** page.



Edit application
macOS Office Suite

Name * : Microsoft 365 Apps for macOS

Description * : Microsoft 365 Apps for macOS

Publisher: Microsoft

Category: Productivity

Show this as a featured app in the Company Portal: Yes [✓ No]

Information URL: https://products.office.com/en-us/explore-office-for-home

Privacy URL: https://privacy.microsoft.com/en-US/privacystatement

3.3 Microsoft Defender for Endpoint

Microsoft Defender is an enterprise defense suite. Its main role is to detect and prevent threats and to provide protection to endpoints, identities, email, and applications. Microsoft Defender can provide device health information to the Microsoft Endpoint Manager (Intune).

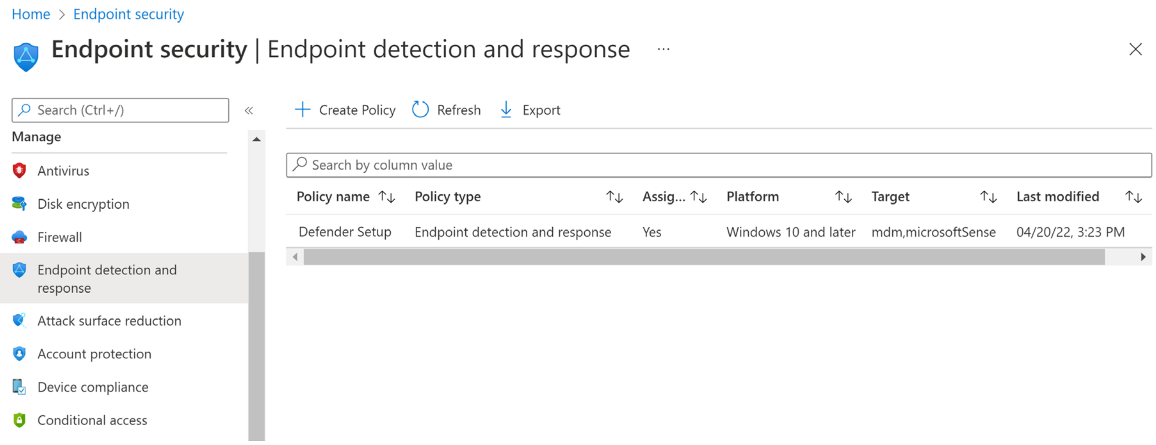
3.3.1 Configuration and Integration

3.3.1.1 Enable Microsoft Defender for Endpoint

1. Open the Microsoft Endpoint Manager admin center.
2. Select **Endpoint security** > **Microsoft Defender for Endpoint**, and then select **Open the Microsoft Defender for Endpoint admin console**. This opens the **Microsoft 365 Defender** portal.
3. Select **Settings > Endpoints > Advanced features**.
4. For **Microsoft Intune connection**, choose **On**.
5. Return to the **Microsoft Defender for Endpoint** page in the Microsoft Endpoint Manager admin center.
6. Under **MDM Compliance Policy Settings,** enable Microsoft Defender connections for Android, iOS, and Windows devices. To be guided through the steps on licensing validation, tenant configuration, and network configuration, follow Microsoft's documentation.
7. Onboard devices that run Android, iOS/iPadOS, and Windows 10/11.

3.3.1.2 Create Endpoint Detection and Response policy (Windows 10 and Later)

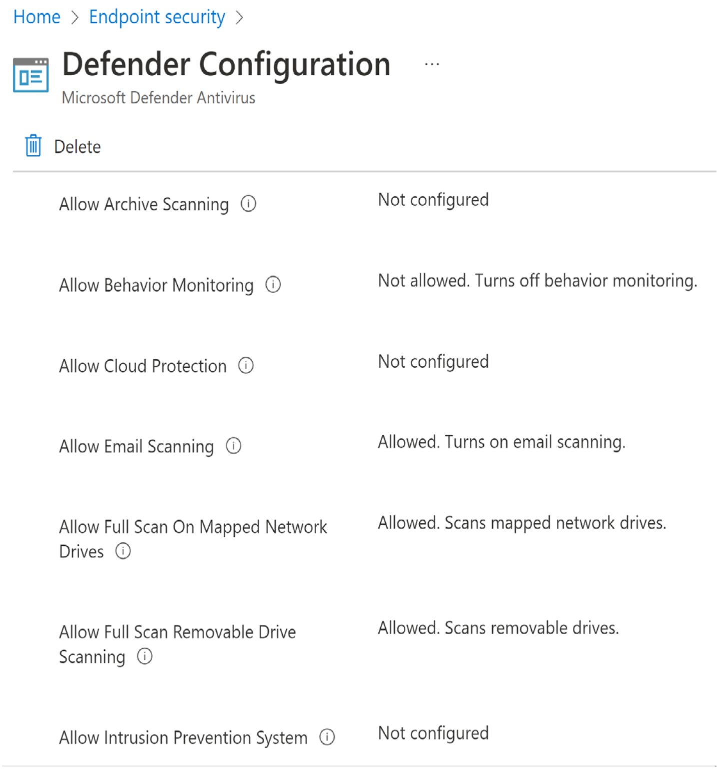
1. Open the Microsoft Endpoint Manager portal.
2. Navigate to **Endpoint security > Endpoint detection and response**. Click on **Create Profile**.
3. Under **Platform, select Windows 10 and Later, Profile - Endpoint detection and response > Create**.
4. Enter a name and description, then select **Next**.
5. Select settings as required, then select **Next**.
6. Add scope tags if necessary, then select **Next**.
7. Click on **Select groups to include** and choose a group, then select **Next.**
8. Review and accept and select **Create**.
9. The completed policy appears in **Endpoint detection and response.**



Policy name	Policy type	Assig...	Platform	Target	Last modified
Defender Setup	Endpoint detection and response	Yes	Windows 10 and later	mdm,microsoftSense	04/20/22, 3:23 PM

3.3.1.3 Create an antivirus policy

1. Open the Microsoft Endpoint Manager portal.
2. Navigate to **Endpoint security > Antivirus > Create Policy**.
3. Select **Platform - Windows 10 and Later - Windows and Profile – Microsoft Defender Antivirus > Create.** Enter name and description, then select **Next**.
4. On the **Configuration settings page**, set the configurations for Microsoft Defender Antivirus
5. Add scope tags and select **Next**.
6. Select and assign groups to include, then select **Next**.
7. Review and then select **Create**.
8. The completed policy appears in **Endpoint security.**



Defender Configuration ...

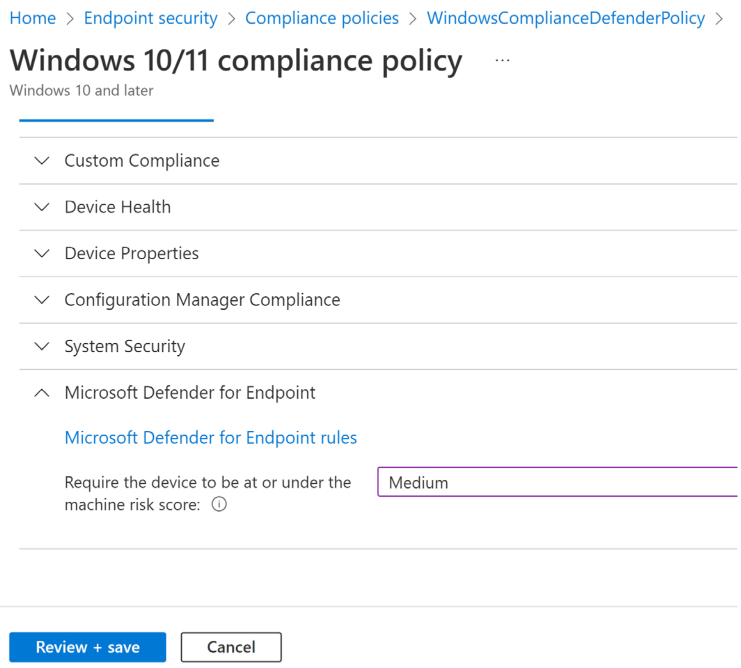
Microsoft Defender Antivirus

Allow Archive Scanning ⓘ	Not configured
Allow Behavior Monitoring ⓘ	Not allowed. Turns off behavior monitoring.
Allow Cloud Protection ⓘ	Not configured
Allow Email Scanning ⓘ	Allowed. Turns on email scanning.
Allow Full Scan On Mapped Network Drives ⓘ	Allowed. Scans mapped network drives.
Allow Full Scan Removable Drive Scanning ⓘ	Allowed. Scans removable drives.
Allow Intrusion Prevention System ⓘ	Not configured

3.3.1.4 Create Microsoft Defender compliance policy

Compliance policies can help protect organizational data by requiring users and devices to meet some requirements.

1. Open the Microsoft Endpoint Manager admin center.
2. Select **Devices** > **Compliance policies** > **Policies** > **Create Policy**.
3. Select a **Platform** for this policy.
4. On the **Basics** tab, specify a **Name for the Policy.**
5. On the **Compliance settings** tab, expand the available categories, and configure settings for the policy.


Home > Endpoint security > Compliance policies > WindowsComplianceDefenderPolicy >
Windows 10/11 compliance policy ...
Windows 10 and later
Custom Compliance
Device Health
Device Properties
Configuration Manager Compliance
System Security
Microsoft Defender for Endpoint
Microsoft Defender for Endpoint rules
Review + save
Cancel

Require the device to be at or under the machine risk score: Medium

3.3.1.5 Deploy Defender for Endpoint on iOS via Intune company portal

1. In the Microsoft Endpoint Manager admin center, go to **Apps** > **iOS/iPadOS** > **Add** > **iOS store app** and click **Select**.
2. On the **Add app** page, click on **Search the App Store,** type **Microsoft Defender for Endpoint** in the search bar, and click **Select**.
3. Select the desired value for the **Minimum operating system.** Review the rest of information about the app and click **Next**.
4. In the **Assignments** section, go to the **Required** section and select **Add group**. Click **Select** and then **Next**.
5. In the **Review + Create** section, verify that all the information entered is correct and then select **Create**.

3.3.1.6 Configure supervised mode for iOS devices via Intune

1. Open Microsoft Endpoint Manager admin center and go to **Apps > App configuration policies > Add.** Select **Managed devices.**
2. In the **Create app configuration policy** page, provide **Policy Name, Platform:** iOS/iPadOS, **Targeted app:** Microsoft Defender for Endpoint.

3. In the next screen, select **Use configuration designer** as the configuration settings format. Specify the following property:
   a. **Configuration key:** issupervised
   b. **Value type:** String
   c. **Configuration value:** {{issupervised}}

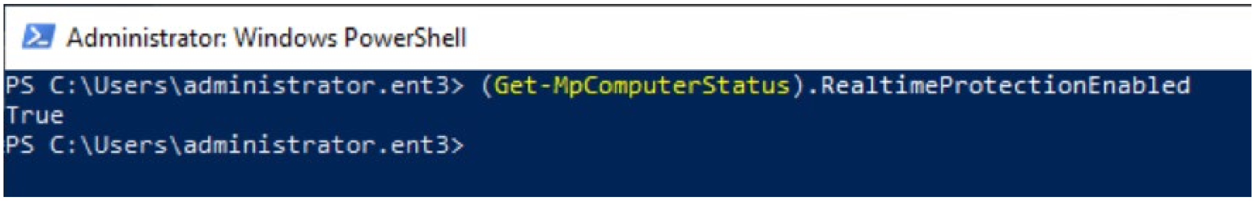
3.3.1.7 Deploy Microsoft Defender for Endpoint on Android with Microsoft Intune

1. In the Microsoft Endpoint Manager admin center, go to **Apps** > **Android Apps** > **Add > Android store app** and choose **Select**.
2. On the **Add app** page enter: **Name, Description, Publisher** as Microsoft, **App store URL** as https://play.google.com/store/apps/details?id=com.microsoft.scmx (Defender for Endpoint app Google Play Store URL).
3. Select **Next**.
4. In the **Assignments** section, go to the **Required** section and select **Add group, Select group** and click **Next**.
5. The completed Android app configuration policy appears under **All services > Apps.**
6. On the Android mobile device, tap the Microsoft Defender for Endpoint app icon and follow the on-screen instructions to complete onboarding the app.

3.3.2 Microsoft Defender Antivirus

Microsoft Defender Antivirus is leveraged by Microsoft Defender by Endpoint, which is anti-malware software built into Windows client devices. It detects threats and malware on client devices and quarantines infected files. Defender Antivirus is enabled by default.

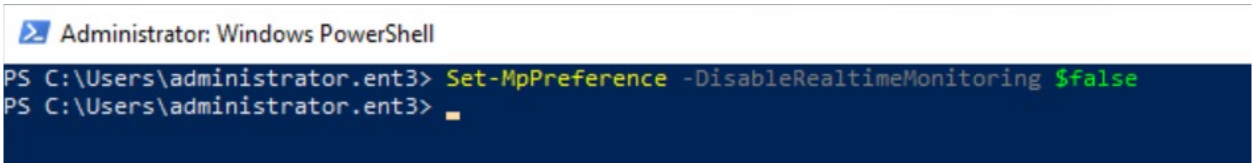
Ensure that real-time protection is enabled by running
`(Get-MpComputerStatus).RealtimeProtectionEnabled`
at an elevated PowerShell prompt as shown in the screenshot below.



Administrator: Windows PowerShell

```
PS C:\Users\administrator.ent3> (Get-MpComputerStatus).RealtimeProtectionEnabled
True
PS C:\Users\administrator.ent3>
```

If real-time protection is off, it can be turned back on by executing `Set-MpPreference -DisableRealtimeMonitoring $false` at an elevated PowerShell prompt as shown in the screenshot below.



```
PS C:\Users\administrator.ent3> Set-MpPreference -DisableRealtimeMonitoring $false
PS C:\Users\administrator.ent3> _
```

Verify that real-time protection is on by going to **Control Panel > System and Security > Security and Maintenance > Security > Virus Protection.**

3.4 Microsoft Sentinel

Microsoft Sentinel is a cloud-native SIEM and SOAR system. It can be used for security analytics, threat intelligence, attack detection, and threat response.

There is no need to install Sentinel, as it is a managed service. Instead, it needs to be enabled and configured in your Azure environment. It also needs a workspace to store and correlate ingested data.

1. Enable Sentinel and configure a workspace.

2. Use the general instructions found at Connector to Data Sources to enable log forwarding to Sentinel from various devices, systems, and services. Each data source will have to be connected independently from other data sources, so you must perform this step once per data source. In this build, Azure AD, Endpoint Manager, Defender for Endpoint, Office365, and Tenable.io were configured to send logs using this method.

3. The Log Analytics Agent is a log forwarder that accepts syslog and common event format (CEF) formatted logs and then forwards the logs to Sentinel. If you have a product or device without a native Sentinel integration, install and configure the Log Analytics Agent on a virtual machine. Once completed, the log forwarder will be able to receive syslog data on UDP port 514. Then configure the product or device that will be the data source to send logs via syslog to the log forwarder using the product's instructions.

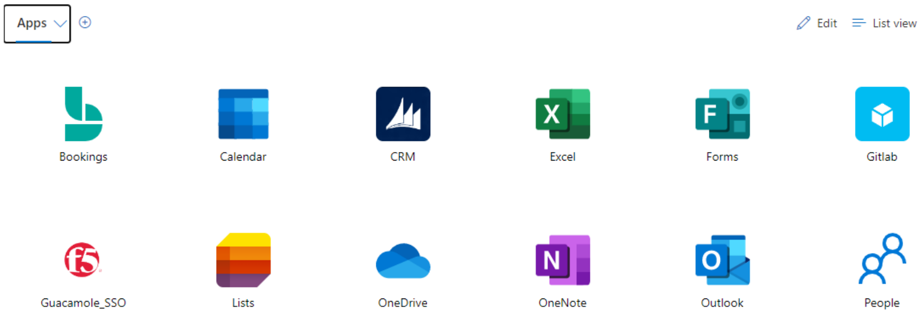
3.5 F5 BIG-IP

BIG-IP is both a load balancer and an identity-aware proxy. In this phase of the build, it was primarily used as an identity-aware reverse proxy that forwarded or denied traffic to protected back-end applications.

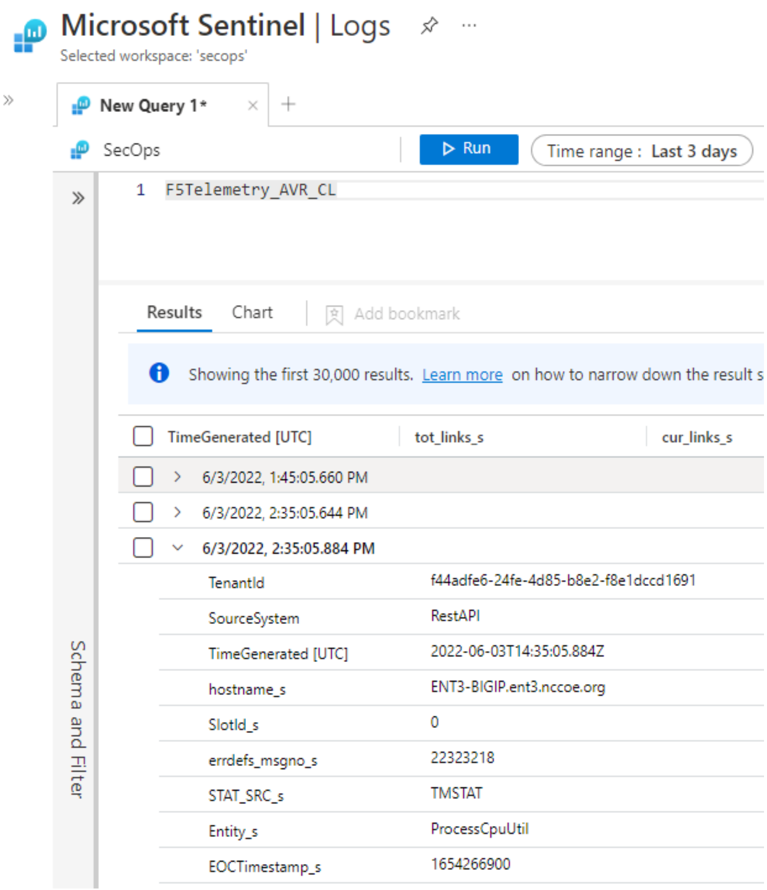
3.5.1 Installation, Configuration, and Integration

BIG-IP was deployed into the environment using a virtual machine image or open virtual appliance (OVA) file. Once this OVA import operation is complete, you would log into the virtual machine console and assign an IP address to a network interface, then continue configuration by connecting to its web interface. This BIG-IP image has both the Access Policy Manager (APM) and the Local Traffic Manager modules installed.

1. Deploy BIG-IP OVA into your VMWare environment.
2. Access the BIG-IP web interface by entering the IP address or DNS name into a web browser. Then complete the initial setup and configuration of BIG-IP.
3. Create virtual servers which map to back-end protected applications—in this build, to our Guacamole application server.
4. Configure BIG-IP to use Azure AD as the SAML IdP for external authentication to access back-end applications. The instructions at Configure BIG-IP Easy Button for Header Based SSO and the video at Azure AD and BIG-IP APM Integration Video provide additional references.
5. Once these instructions are completed, BIG-IP, leveraging Azure AD for external authentication, will only allow successfully authenticated and authorized users to access Guacamole. Access to the backend application is either done by connecting directly via the DNS name of the application or by going to **myapps.microsoft.com** and selecting the backend application icon, such as **F5 Guacamole_SSO** as shown below.



6. For this build, configure BIG-IP to send logs to Microsoft Sentinel. Then you can observe BIG-IP logs in Sentinel, as shown below.



```
F5Telemetry_AVR_CL
```

Showing the first 30,000 results. Learn more on how to narrow down the result s

□	TimeGenerated [UTC]	tot_links_s	cur_links_s
□	› 6/3/2022, 1:45:05.660 PM		
□	› 6/3/2022, 2:35:05.644 PM		
□	⌄ 6/3/2022, 2:35:05.884 PM		

TenantId	f44adfe6-24fe-4d85-b8e2-f8e1dccd1691
SourceSystem	RestAPI
TimeGenerated [UTC]	2022-06-03T14:35:05.884Z
hostname_s	ENT3-BIGIP.ent3.nccoe.org
SlotId_s	0
errdefs_msgno_s	22323218
STAT_SRC_s	TMSTAT
Entity_s	ProcessCpuUtil
EOCTimestamp_s	1654266900

3.6 Lookout Mobile Endpoint Security (MES)

Lookout Mobile Endpoint Security (MES) solution is used to control mobile device access to corporate resources based on risk assessment. Risk is assessed based on information collected from devices by the Lookout service. Lookout then communicates this risk level to Mobile Device Management (Microsoft Endpoint Manager (Intune)) which determines whether the device is compliant or not.

3.6.1 Configuration and Integration

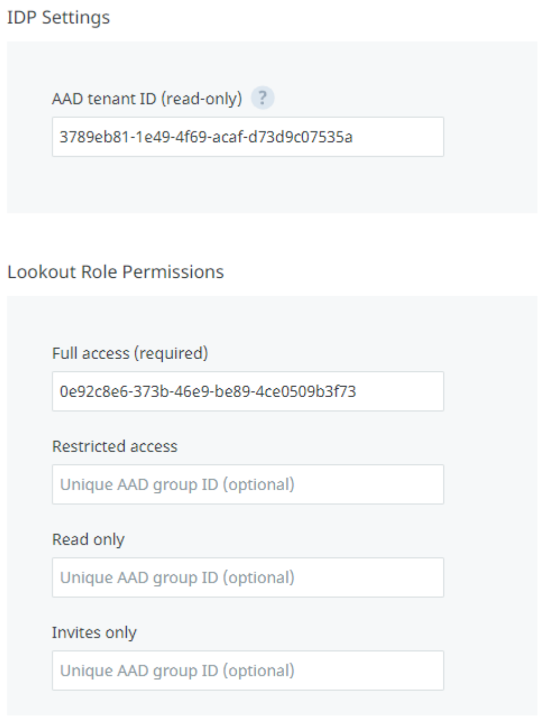
Before configuring Lookout, collect the following information from Azure AD: **Azure AD tenant ID** and **Azure AD group object ID**.

1. Go to **Azure Active Directory** > **Properties** and locate **Tenant ID.** Copy and save it to the text file.
2. Go to **Azure Active Directory** > **Groups** to open the **Groups | All groups** pane.
3. Select the group with full access *rights* (Lookout Admin group).

4. Copy the (group) **Object Id,** and then save it in a text file.

The following steps are to be completed in the Lookout Enterprise admin console and will enable a connection to Lookout's service for Intune enrolled devices.

1. Sign in to the Lookout for Work console and go to **System** > **Integrations**, and then select **Choose a product to set up**. Select **Microsoft Azure**. Copy and paste the Azure AD (AAD) tenant ID and group object ID from the text file that was created in previous steps.



IDP Settings

AAD tenant ID (read-only) ?

3789eb81-1e49-4f69-acaf-d73d9c07535a

Lookout Role Permissions

Full access (required)

0e92c8e6-373b-46e9-be89-4ce0509b3f73

Restricted access

Unique AAD group ID (optional)

Read only

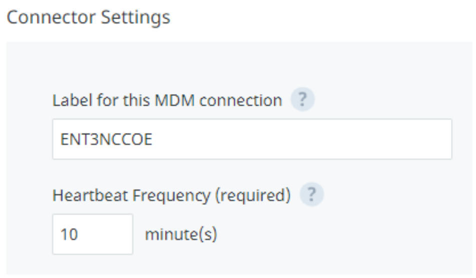
Unique AAD group ID (optional)

Invites only

Unique AAD group ID (optional)

2. Stay in **System** > **Integrations**, and then select **Choose a product to set up.** Select Microsoft **Intune**.

3. Configure Intune connector settings.



Connector Settings

Label for this MDM connection ?

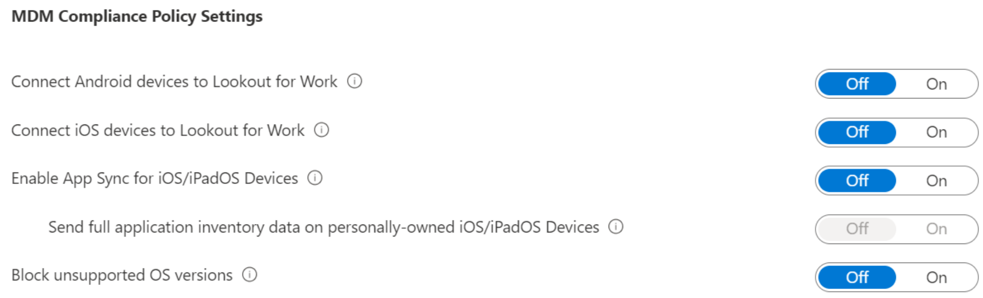
ENT3NCCOE

Heartbeat Frequency (required) ?

10 minute(s)

After Lookout MES is enabled, a connection to Lookout in Intune needs to be set up.

1. Go back to Microsoft Endpoint Manager and enable the Mobile Threat Defense connector there.
2. Select **Tenant administration > Connectors and tokens > Mobile Threat Defense.**
3. On the **Mobile Threat Defense** pane, select **Add.**
4. For **Mobile Threat Defense connector to setup,** select **Lookout** MTD solution from the drop-down list.
5. Configure the toggle options according to the organization's requirements. This screenshot shows examples.



MDM Compliance Policy Settings

Connect Android devices to Lookout for Work ⓘ [✓ Off] On

Connect iOS devices to Lookout for Work ⓘ [✓ Off] On

Enable App Sync for iOS/iPadOS Devices ⓘ [✓ Off] On

Send full application inventory data on personally-owned iOS/iPadOS Devices ⓘ Off On

Block unsupported OS versions ⓘ [✓ Off] On

When Lookout is integrated with Intune MTD and the connection to Intune is enabled, Intune creates a classic conditional access policy in Azure AD. To view classic conditional access policy, go to **Azure Active Directory > Conditional Access > Classic policies**. Classic conditional access policy is used by Intune MTD to require that devices are registered in Azure AD so that they have a device ID before communicating to Lookout MTD. The ID is required so that devices can report their status to Intune.

3.6.2 Create MTD device compliance policy with Intune

Compliance policy is needed to detect threats and assess risks on mobile devices to determine if the device is compliant or not.

1. Open the Microsoft Endpoint Manager admin center.
2. Select **Endpoint security > Device Compliance > Create Policy.**
3. Select the **Platform,** and then **Create.**
4. On **Basics,** provide **Name,** and **Description.** Select **Next** to continue.
5. On **Compliance settings,** expand and configure **Device Health.** Choose the Mobile Threat Level from the drop-down list for **Require the device to be at or under the Device Threat Level.** Choose the level for compliance.

6. Select **Next** to go to **Assignments.** Select the groups or users to assign this policy.

3.7 PC Matic Pro

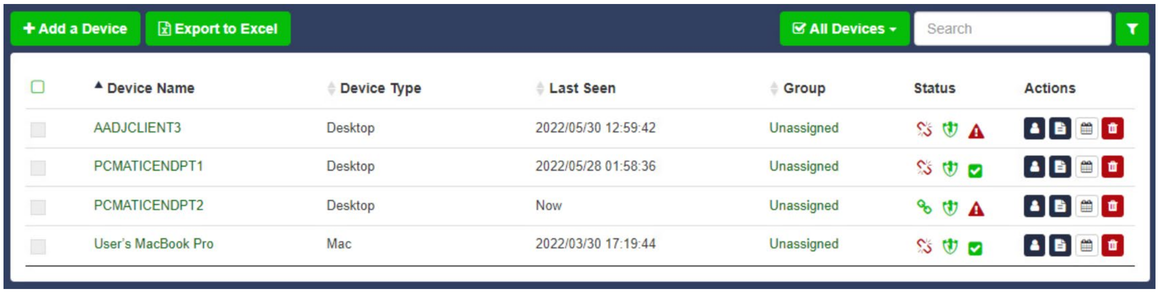
PC Matic Pro is an endpoint protection system that consists of a server for centralized management and agents installed on endpoints. In addition to scanning for malware, it uses a default-deny approach in preventing malicious or unauthorized programs and processes from executing. To configure PC Matic Pro, you will need to install the server, install the agents, and configure a list of allowed software.

PC Matic Pro Server needs to be installed on a server with Windows 2019 Server and SQL server preinstalled.

1. Obtain the *OnPremInstallerRun.ps1* installation script from the vendor and open an elevated PowerShell window.
2. Execute the *OnPremInstallerRun.ps1* script by entering `.\OnPremInstallerRun.ps1 registryUser pcmatic -registryPwd <insert_password_here> -localDBUser pcm-app` to install docker, pull down the container images, and deploy the container instances that make up the PC Matic Pro server.
3. Navigate to the PC Matic web server and verify that it is operational by opening a web browser and going to *https://<pcmaticDNSName>/web_portal.* In this build, the DNS name is nist.pcmaticfederal.com; as such, to access the server's web interface, we would go to https://nist.pcmaticfederal.com/web_portal.

Follow these steps to install PC Matic Endpoint Agents:

1. Open a web browser on a Windows or macOS client device. Navigate to the PC Matic Server web interface by browsing to https://nist.pcmaticfederal.com from the client device and log on with your credentials.
2. Click **Add a Device** and then click **Windows Installer** or **Mac Installer,** as appropriate, to download the PC Matic Endpoint Agent.
3. Install the agent.
4. Once installed, the agent will establish communications with the server and show up on the list of managed devices once you log on to the server as previously described.
5. Devices with an agent will register and come online.



□	Device Name	Device Type	Last Seen	Group	Status	Actions
□	AADJCLIENT3	Desktop	2022/05/30 12:59:42	Unassigned	⚠	
□	PCMATICENDPT1	Desktop	2022/05/28 01:58:36	Unassigned	✓	
□	PCMATICENDPT2	Desktop	Now	Unassigned	⚠	
□	User's MacBook Pro	Mac	2022/03/30 17:19:44	Unassigned	✓	

3.8 Tenable.io

For installation, configuration, and integration instructions, refer to Section 2.10.

3.8.1 Integration with Microsoft Sentinel

1. In Tenable.io, click the hamburger menu (☰) in the top left corner and navigate to **Settings > Access Control > Users.**
2. (Optional) Click **Create User** and create a new API user for Microsoft Sentinel. In this implementation, a standard administrator account was used.
3. Click the user who needs API keys generated. Then click **API KEYS > Generate > Continue.** Save the Access and Secret Keys, as they will not be shown again.
4. In Microsoft Sentinel, navigate to **Data Connectors.** Search *tenable* and click **Tenable.io Vulnerability Management (Preview) > Open Connector Page.**
5. Scroll down in the Instructions panel and save the Workspace ID and Primary Key.
6. Click **Deploy to Azure.**
7. Select the appropriate resource group.
8. In the Workspace ID and Workspace Key fields, enter the values obtained in step 5.
9. In the Tenable Access Key and Tenable Secret Key fields, enter the values obtained in step 3.
10. Click **Review + create.**
11. Click **Create.** Function deployment will begin. Once deployment is complete, it will take some time before Sentinel begins making calls to Tenable.io.

3.9 Tenable.ad

For installation, configuration, and integration instructions, refer to Section 2.11.

3.10 Mandiant Security Validation (MSV)

For installation, configuration, and integration instructions, refer to Section 2.12.

3.11 Forescout eyeSight

Forescout eyeSight provides asset discovery with both active and passive techniques, and through integrations with network and security infrastructure. In this build, Forescout eyeSight was deployed on-premises in two virtual hosts: an Enterprise Manager and Forescout Appliance.

For Forescout eyeSight installation instructions, visit the Forescout Installation Overview.

3.11.1 Integration with AD

1. In AD, create a domain administrator service account for Forescout and save the credentials.
2. In the Forescout console, navigate to **Tools > Options > HPS Inspection Engine.**
3. In the **Domain Credentials** section, click the **Add** button.
4. Enter the domain information and credentials you saved earlier. Click **OK.**
5. Click **Apply.** After the new configuration is saved, click **Test** to verify that the credentials are working as expected.

3.11.2 Integration with Cisco Switch

For Cisco Switch integration instructions, visit the Switch Plugin Configuration Guide.

3.11.3 Integration with Cisco Wireless Controller

For Cisco Wireless Controller integration instructions, visit the Wireless Plugin Configuration Guide.

3.11.4 Integration with Microsoft Sentinel

1. In the Forescout console, navigate to **Tools > Options > CEF.**
2. Click **Add.**
3. In the Add Server dialog, enter a Name, select **Use UDP for Connection,** and enter the IP address of the Sentinel Log Forwarder. Click **Next.**
4. Click the **Assign CounterACT Devices** radio button, and check all of the checkboxes next to the listed devices.
5. Click **Finish.** Verify that logs are being received by the Sentinel Log Forwarder.

3.11.5 Integration with Palo Alto Networks NGFW

For Palo Alto Networks Next-Generation Firewall (NGFW) integration instructions, visit the eyeExtend for Palo Alto Networks Next-Generation Firewall Configuration Guide.

3.11.6 Integration with Tenable.io

For Tenable.io integration instructions, visit the eyeExtend for Tenable.io Vulnerability Management Configuration Guide.

3.12 Palo Alto Next Generation Firewall

In this build, a virtualized Palo Alto Next Generation Firewall was deployed on-premises as a security and access control device. The firewall provides zone-based network filtering for both inbound and outbound traffic, including remote access virtual private networks (VPNs) using the GlobalProtect clients.

For GlobalProtect VPN access installation instructions, visit: https://knowledgebase.paloaltonetworks.com/KCSArticleDetail?id=kA10g000000ClFbCAK

3.13 DigiCert CertCentral

For setup and usage instructions, refer to Section 2.13.

Appendix A List of Acronyms

AAD	(Microsoft) Azure Active Directory
AD	Active Directory
AG	(Okta) Access Gateway
API	Application Programming Interface
APM	Access Policy Manager
APNs	Apple Push Notification service
CA	Certificate Authority
CEF	Common Event Format
CRADA	Cooperative Research and Development Agreement
CSR	Certificate Signing Request
DN	Domain Name
DNS	Domain Name System
E1B1	EIG Enterprise 1 Build 1
E3B1	EIG Enterprise 3 Build 1
EIG	Enhanced Identity Governance
FQDN	Fully Qualified Domain Name
HDAP	High-Availability Directory Access Protocol
HR	Human Resources
IaC	Infrastructure as Code
ICAM	Identity, Credential, and Access Management
IdP	Identity Provider
IP	Internet Protocol
IT	Information Technology
ITL	Information Technology Laboratory
LDAP	Lightweight Directory Access Protocol

MAM	Mobile Access Management
MDM	Mobile Device Management
MEM	Microsoft Endpoint Manager
MES	(Lookout) Mobile Endpoint Security
MFA	Multi-Factor Authentication
MSV	Mandiant Security Validation
MTD	Mobile Threat Defense
NCCoE	National Cybersecurity Center of Excellence
NGFW	Next-Generation Firewall
NIST	National Institute of Standards and Technology
NTP	Network Time Protocol
OS	Operating System
OU	Organizational Unit
OVA	Okta Verify App, Open Virtual Appliance
PA	Policy Administration
PDP	Policy Decision Point
PE	Policy Engine
PEP	Policy Enforcement Point
SaaS	Software as a Service
SAML	Security Assertion Markup Language
SIEM	Security Information and Event Management
SOAR	Security Orchestration, Automation, and Response
SP	Special Publication
SSL	Secure Sockets Layer
SSO	Single Sign-On
SSPR	Single Sign-On Password Reset

TLS	Transport Layer Security
UAC	User Account Control
UDP	User Datagram Protocol
UEM	Unified Endpoint Management
URL	Uniform Resource Locator
VLAN	Virtual Local Area Network
VPN	Virtual Private Network
ZSO	Zero Sign-On
ZTA	Zero Trust Architecture