NIST SPECIAL PUBLICATION 1800-12C

Derived Personal Identity Verification (PIV) Credentials

Volume C:
How-to Guides

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This publication is available free of charge from:
https://nccoe.nist.gov/projects/building-blocks/piv-credentials

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FEEDBACK

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

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

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NATIONAL CYBERSECURITY CENTER OF EXCELLENCE

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

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

NIST CYBERSECURITY PRACTICE GUIDES

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

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

ABSTRACT

Federal Information Processing Standards (FIPS) Publication 201-2, "Personal Identity Verification (PIV) of Federal Employees and Contractors," establishes a standard for a PIV system based on secure and reliable forms of identity credentials issued by the federal government to its employees and contractors. These credentials are intended to authenticate individuals who require access to federally controlled facilities, information systems, and applications. In 2005, when FIPS 201 was published, logical access was geared toward traditional computing devices (i.e., desktop and laptop computers) where the PIV card provides common multifactor authentication mechanisms through integrated smart card readers across the federal government. With the emergence of computing devices such as tablets, convertible

computers, and in particular mobile devices, the use of PIV cards has proved challenging. Mobile devices lack the integrated smart card readers found in laptop and desktop computers and require separate card readers attached to devices to provide authentication services. To extend the value of PIV systems into mobile devices that do not have PIV Card readers, NIST developed technical guidelines on the implementation and lifecycle of identity credentials that are issued by federal departments and agencies to individuals who possess and prove control over a valid PIV card. These NIST guidelines, published in 2014, describe Derived PIV Credentials (DPCs) which leverage identity proofing and vetting results of current and valid PIV credentials.

To demonstrate the DPCs guidelines, the National Cybersecurity Center of Excellence (NCCoE) at NIST built in its laboratory a security architecture using commercial technology to manage the lifecycle of DPCs demonstrating the process that enables a PIV Card holder to establish DPCs in a mobile device which then can be used to allow the PIV Card holder to access websites that require PIV authentication.

This project resulted in a freely available NIST Cybersecurity Practice Guide which demonstrates how an organization can continue to provide two-factor authentication for users with a mobile device that leverages the strengths of the PIV standard. Although this project is primarily aimed at the Federal sector's needs, it is also relevant to mobile device users with smart card based credentials in the private sector.

KEYWORDS

Cybersecurity; derived PIV credential (DPC); enterprise mobility management (EMM); identity; mobile device; mobile threat; (multifactor) authentication; network/software vulnerability; Personal Identity Verification (PIV); PIV card; smart card

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Poornima Koka	The MITRE Corporation
Matthew Steele	The MITRE Corporation

The technology vendors who participated in this build submitted their capabilities in response to a notice in the Federal Register. Companies with relevant products were invited to sign a Cooperative Research and Development Agreement (CRADA) with NIST, allowing them to participate in a consortium to build this example solution. We worked with:

Technology Partner/Collaborator	Build Involvement
Entrust Datacard	Entrust IdentityGuard, Entrust Managed Services PKI
MobileIron	MobileIron Enterprise Mobility Management Platform

The NCCoE also wishes to acknowledge the special contributions of Intercede for providing us with feedback on the risk assessment section of this practice guide, including risk mitigation and residual risk association with a Derived PIV Credential system.

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1 Introduction

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

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

1.1 Practice Guide Structure

This NIST Cybersecurity Practice Guide demonstrates a standards-based reference design and provides users with the information they need to replicate Derived Personal Identity Verification (PIV) Credential (DPC) lifecycle solution. This reference design is modular and can be deployed in whole or in parts.

This guide contains three volumes:

- NIST SP 1800-12a: *Executive Summary*
- NIST SP 1800-12b: *Approach, Architecture, and Security Characteristics* – what we built and why
- NIST SP 1800-12c: *How-To Guides* – instructions for building the example solution **(you are here)**

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

Business decision makers, including chief security and technology officers will be interested in the *Executive Summary (NIST SP 1800-12a)*, which describes the:

- challenges enterprises face in issuing strong, two-factor credentials to mobile devices
- example solution built at the NCCoE
- benefits of adopting the example solution

Technology or security program managers who are concerned with how to identify, understand, assess, and mitigate risk will be interested in this part of the guide, *NIST SP 1800-12b,* which describes what we did and why. The following sections will be of particular interest:

- Section 3.4.3, Risk, provides a description of the risk analysis we performed
- Section 3.4.4, Security Control Map, maps the security characteristics of this example solution to cybersecurity standards and best practices

You might share the *Executive Summary, NIST SP 1800-12a,* with your leadership team members to help them understand the importance of adopting a standards-based Derived PIV Credential lifecycle solution.

IT professionals who want to implement an approach like this will find the whole practice guide useful. You can use the How-To portion of the guide, *NIST SP 1800-12c*, to replicate all or parts of the build created in our lab. The How-To guide provides specific product installation, configuration, and integration instructions for implementing the example solution. We do not recreate 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.

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 Derived PIV Credential lifecycle solution. Your organization's security experts should identify the products that will best integrate with your existing tools and IT system infrastructure. We hope you will seek products that are congruent with applicable standards and best practices. Volume B, Section 4.2, Technologies, lists the products we used and maps them to the cybersecurity controls provided by this reference solution.

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

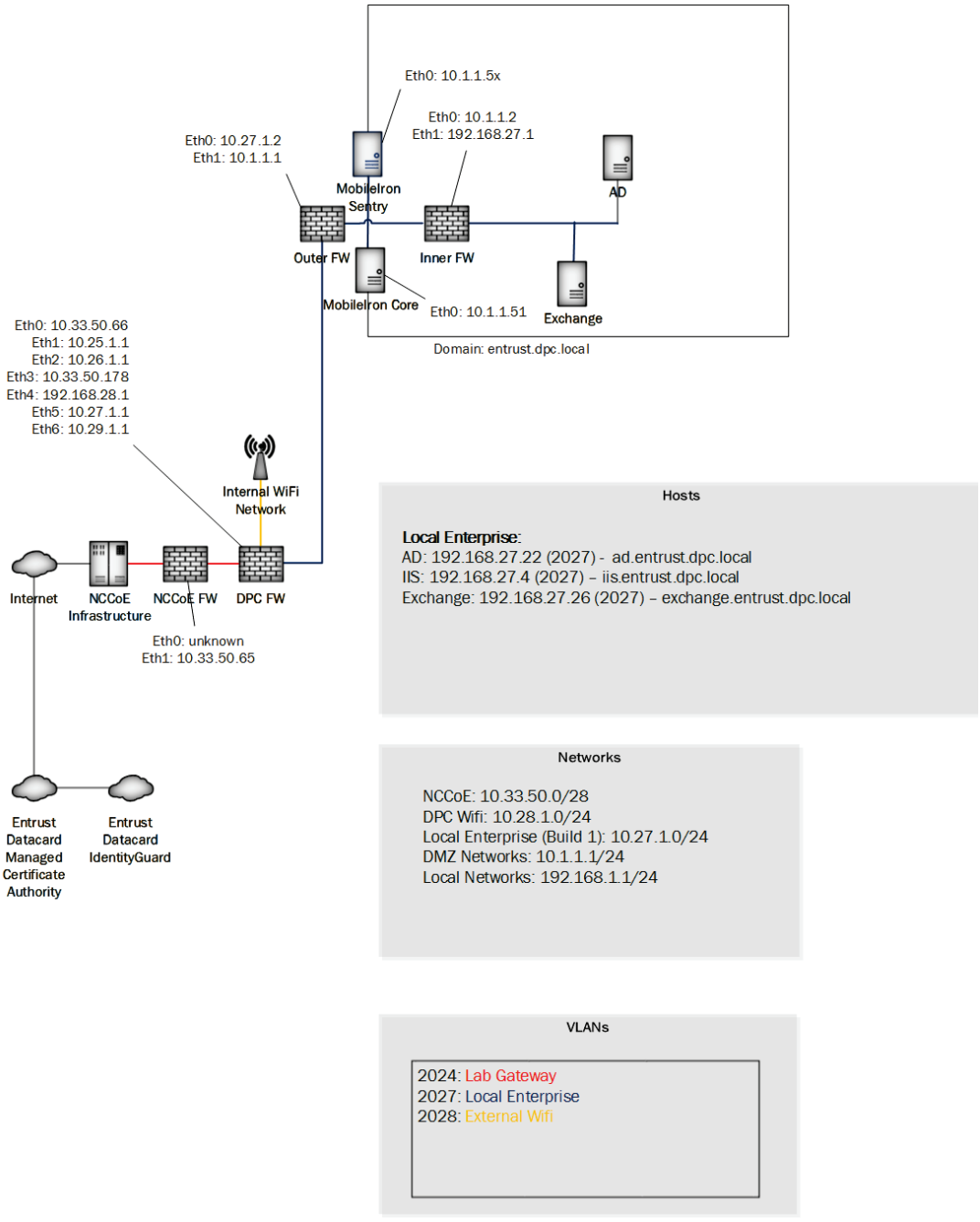
1.2 Build Overview

Unlike desktop computers and laptops that have built-in readers to facilitate the use of PIV Cards, mobile devices pose usability and portability issues because of the lack of a smart card reader.

NIST sought to address this issue with the introduction of the general concept of Derived PIV Credentials in SP 800-63-2, which leverages identity proofing and vetting results of current and valid credentials. Published in 2014, SP 800-157, *Guidelines for Derived Personal Identity Verification (PIV) Credentials* defined requirements for initial issuance and maintenance of Derived PIV Credentials. NIST's Applied Cybersecurity Division then created a NCCoE project to provide an example solution for federal agencies and private entities that follows the requirements in SP 800-157.

In the NCCoE lab, the team built an environment that resembles an enterprise network using commonplace components such as identity repositories, supporting certificate authorities (CA), and web servers. In addition, products and capabilities were identified that, when linked together, provide an example solution that demonstrate lifecycle functions outlined in SP 800-157. Figure 1-1 depicts the final lab environment.

150 **Figure 1-1 Lab Network Diagram**



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1.3 Typographical Conventions

The following table presents typographic conventions used in this volume.

Typeface/ Symbol	Meaning	Example
Italics	filenames and pathnames references to documents that are not hyperlinks, new terms, and placeholders	For detailed definitions of terms, see the *NCCoE Glossary*.
Bold	names of menus, options, command buttons and fields	Choose **File > Edit**.
`Monospace`	command-line input, on-screen computer output, sample code examples, 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 National Cybersecurity Center of Excellence are available at http://nccoe.nist.gov

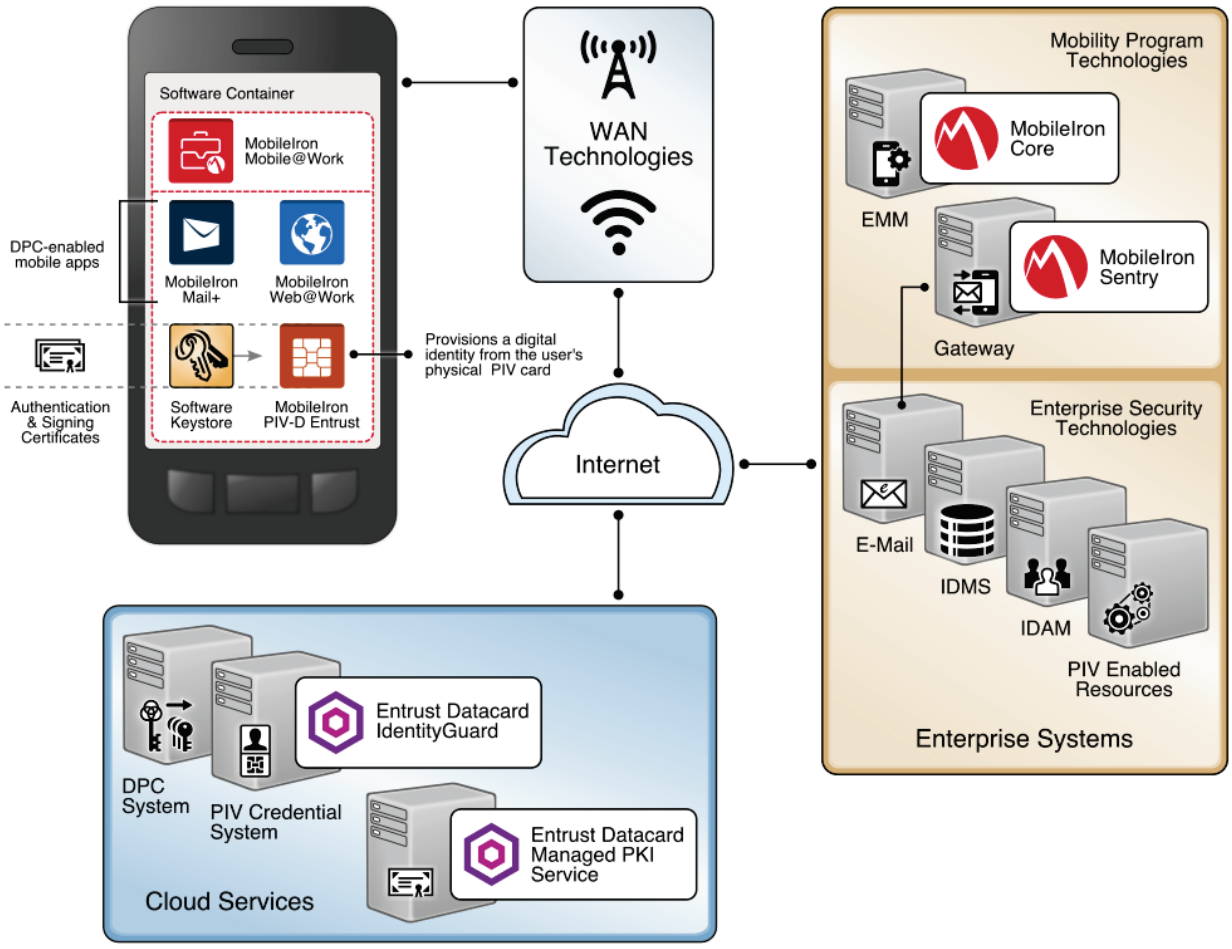
2 Product Installation Guides

This section of the practice guide contains detailed instructions for installing and configuring of key products used for the depicted architecture illustrated below, as well as demonstration of the DPC lifecycle management activities of initial issuance and termination.

In our lab environment, the example solution was logically separated by a Virtual Local Area Network (VLAN) wherein each VLAN represented a mock enterprise environment. The network topology consists of an edge router connected to a Demilitarized Zone (DMZ). An internal firewall separates the DMZ from internal systems that support the enterprise. All routers and firewalls used in the example solution were virtual pfSense appliances.

As a basis, the enterprise network had an instance of Active Directory (AD) to serve as a repository for identities to support DPC vendors.

165 **Figure 2-1 Build 1 Architecture**



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167 2.1 Entrust Datacard IdentityGuard (IDG)

168 Entrust Datacard contributed test instances of their managed Public Key Infrastructure (PKI) service and
169 IdentityGuard products, the latter of which directly integrates with MobileIron to support the use of
170 Derived PIV Credentials with MobileIron Mobile@Work apps. Contact Entrust Datacard
171 (https://www.entrust.com/contact/) to establish service instances in support of a Derived PIV
172 Credentials with MobileIron (https://www.mobileiron.com/).

2.1.1 Identity Management Profiles

To configure services and issue certificates for Derived PIV Credentials that will work with your organization's user identity profiles, Entrust Datacard will need information on how identities are structured and which users will use PKI services. For this lab instance, Entrust Datacard issued PIV Authentication, Digital Signature, and Encryption certificates for PIV Cards and Derived PIV Credentials for two test identities, as represented below.

User Name	Email Address	User Principal Name (UPN)
Patel, Asha	asha@entrust.dpc.nccoe.org	asha@entrust.dpc.nccoe.org
Tucker, Matteo	matteo@entrust.dpc.nccoe.org	matteo@entrust.dpc.nccoe.org

2.2 MobileIron Core

MobileIron Core is the central product in the MobileIron suite. The following sections describe the steps for installation, configuration, and integration with Active Directory and the Entrust Datacard IdentityGuard cloud service. Key configuration files used in this build are listed below and are available from the NCCoE DPC project website.

Filename	Description
core.dpc.nccoe.org-Default AppConnect Global Policy-2017-08-14 16-48-36.json	Configures policies such as password strength for the container
core.dpc.nccoe.org-Default Privacy Policy-2017-08-14 16-52-33.json	Configures privacy settings for each enrolled device
core.dpc.nccoe.org-DPC Security Policy-2017-08-14 16-51-07.json	Configures device level security management settings
shared_mdm_profile.mobileconfig	iOS MDM profile used when issuing DPCs to devices

2.2.1 Installation

Follow the steps below to install MobileIron Core:

1. Obtain a copy of the *On-Premise Installation Guide for MobileIron Core, Sentry, and Enterprise Connector* from the MobileIron support portal.

2. Follow the MobileIron Core pre-deployment and installation steps in Chapter 1 of the *On-Premise Installation Guide for MobileIron Core, Sentry, and Enterprise Connector* for the version of MobileIron being deployed in your environment. In our lab implementation, we deployed MobileIron Core 9.2.0.0 as a Virtual Core running on VMware 6.0.

2.2.2 General MobileIron Core Set Up

The following steps are necessary for mobile device administrators or users to register devices with MobileIron, which is a prerequisite to issuing Derived PIV Credentials.

1. Obtain a copy of *MobileIron Core Device Management Guide for iOS Devices* from the MobileIron support portal.
2. Complete all instructions provided in Chapter 1, Setup Tasks.

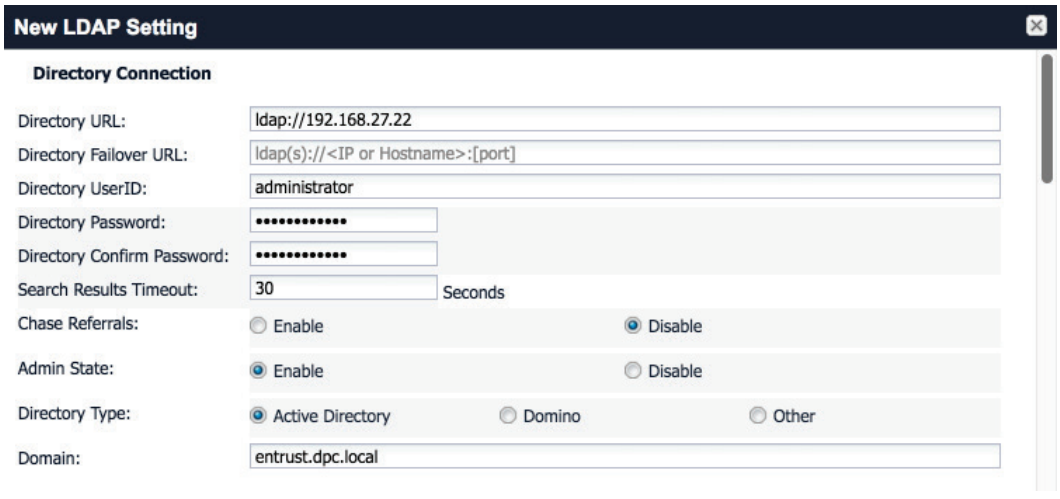
2.2.3 Configuration of MobileIron Core for DPC

The following steps will reproduce this configuration of MobileIron Core.

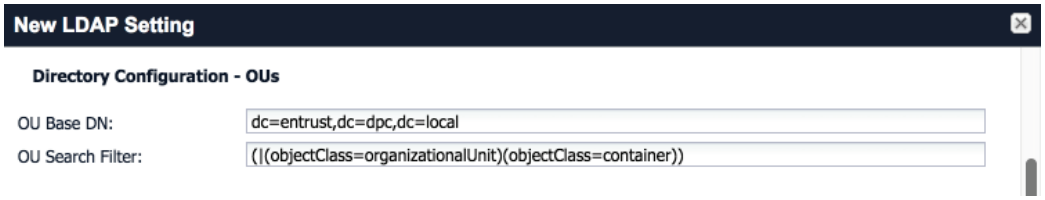
2.2.3.1 Integration with Active Directory

In our implementation, we chose to integrate MobileIron Core with Active Directory using LDAP. This is optional. General instructions for this process are covered in the *Configuring LDAP Servers* section in Chapter 2 of *On-Premise Installation Guide for MobileIron Core, Sentry, and Enterprise Connector*. The configuration details used during our completion of selected steps (retaining original numbering) from that guide are given below:

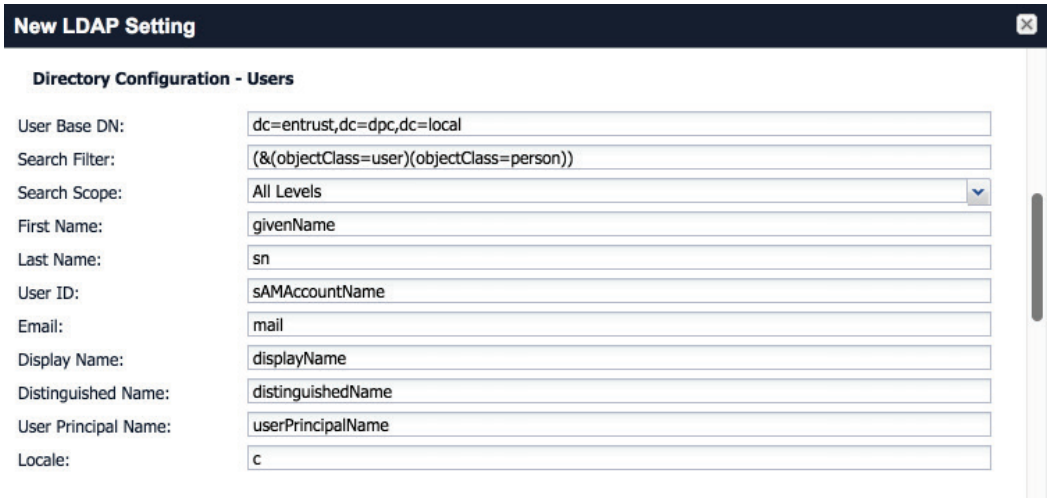
1. From Step 4 in the MobileIron guide, in the **New LDAP Server** dialog:
    a. Directory Connection:



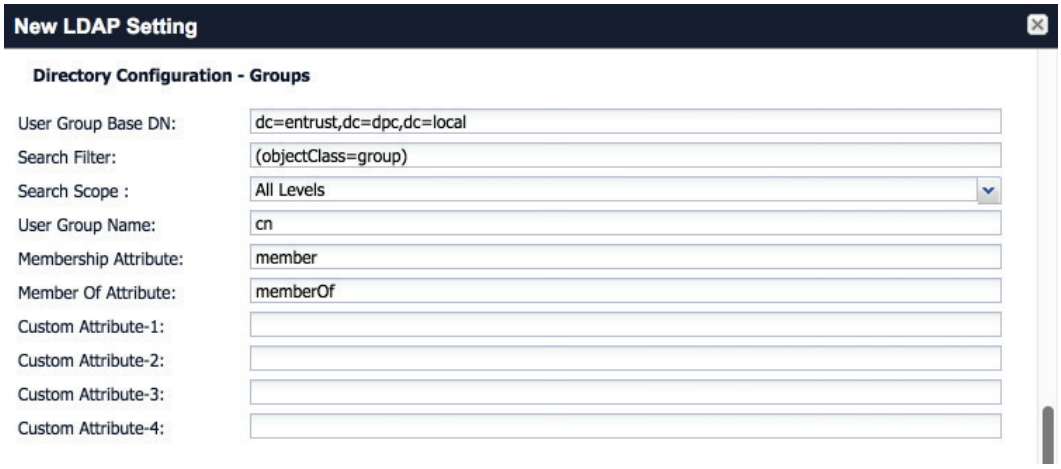
b. Directory Configuration - OUs:



c. Directory Configuration - Users:



d. Directory Configuration - Groups:



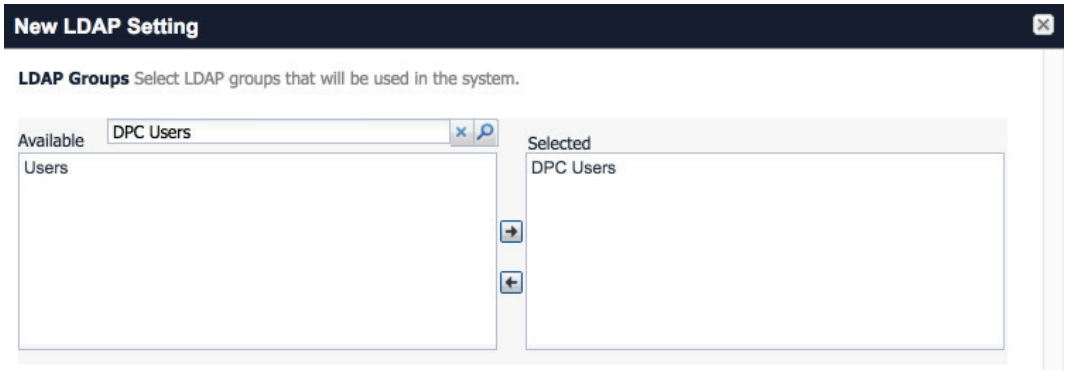
e. LDAP Groups:

i. As a prerequisite step, we used Active Directory Users and Computers to create a new security group for DPC-authorized users on the Domain Controller for the entrust.dpc.local domain. In our example, this group is named **DPC Users**.

ii. In the search bar, enter the name of the LDAP group for DPC-authorized users and click the **magnifying glass** button; the group name should be added to the **Available** list.

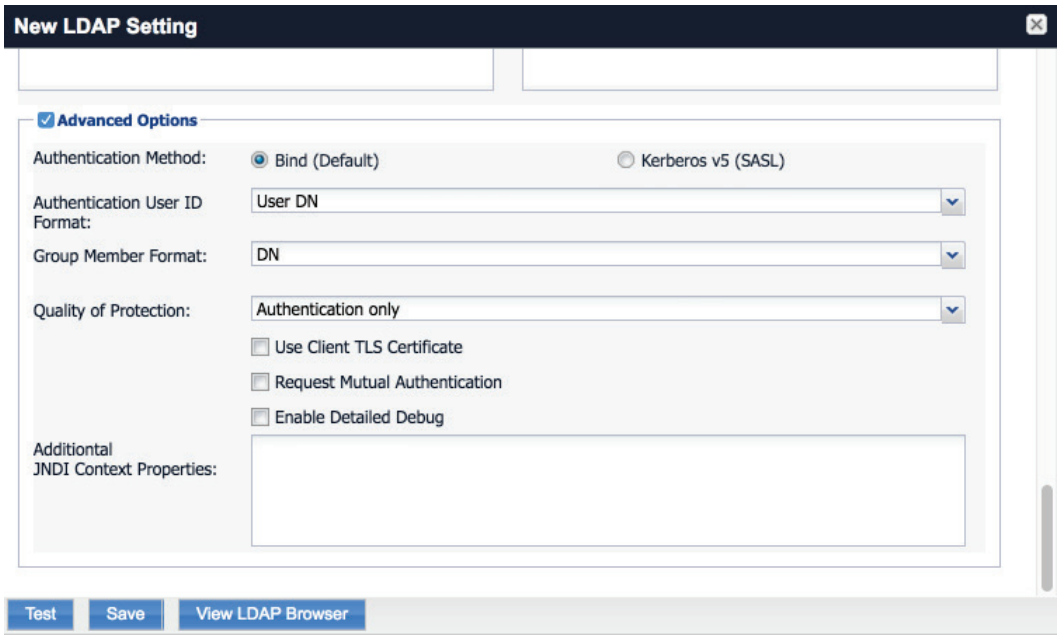
iii. In the **Available** list, select **DPC Users** and click the **right-arrow** button to move it to the **Selected** list.

iv. In the **Selected** list, select the default **Users** group and click the **left-arrow** button to move it to the **Available** list.



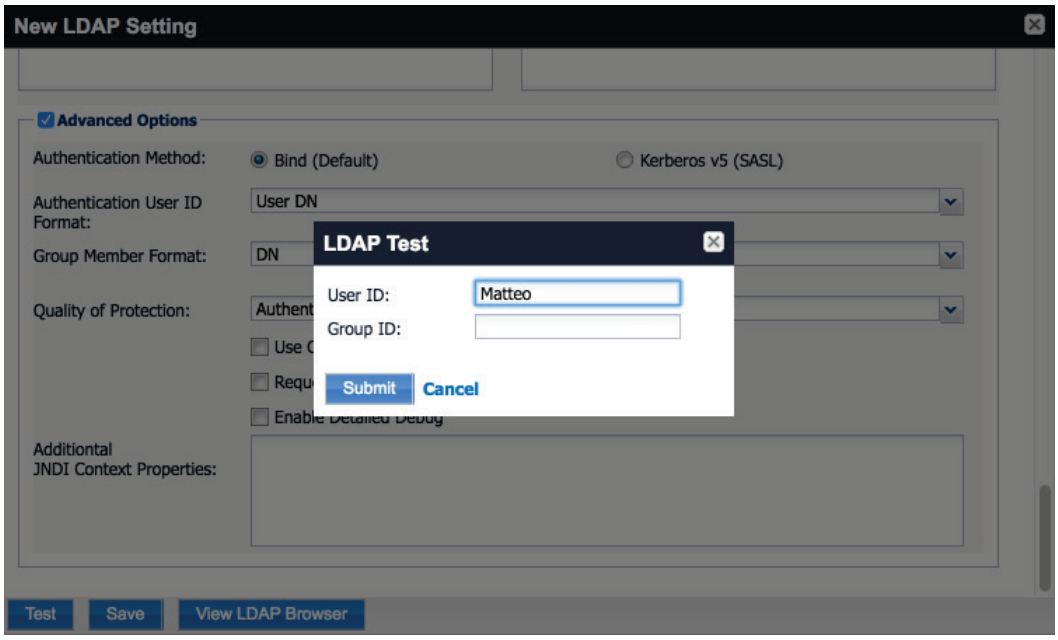
f. Custom Settings: custom settings were not specified.

g. Advanced Options:



Note: In our lab environment, we did not enable stronger Quality of Protection or enable the Use of Client TLS Certificate or Request Mutual Authentication features. However, we recommend implementers consider using those additional security mechanisms to secure communication with the LDAP server.

2. From Steps 19-21 from the MobileIron guide, we tested that MobileIron can successfully query LDAP for DPC Users.
    a. In the **New LDAP Setting** dialog, click the **Test** button to open the **LDAP Test** dialog.
    b. In the **LDAP Test dialog**, enter a **User ID** for a member of the DPC Users group then click the **Submit** button. A member of the DPC Users group in our environment is **Matteo**.



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240 c. The **LDAP Test** dialog indicates the query was successful:

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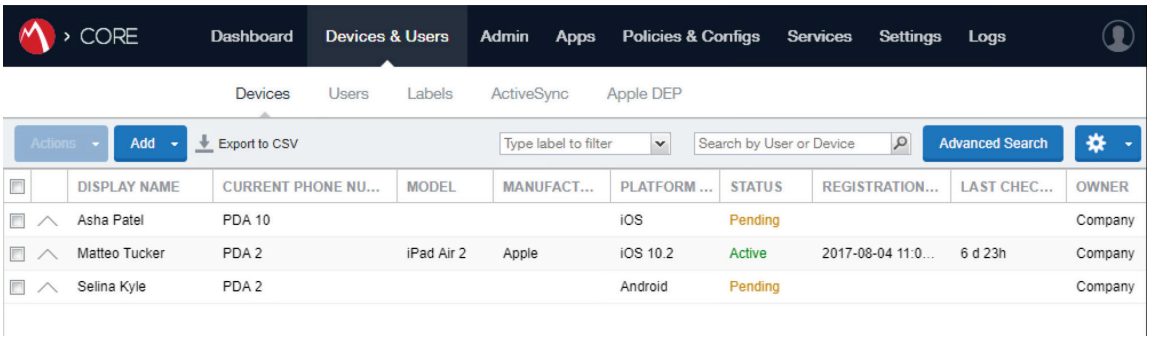
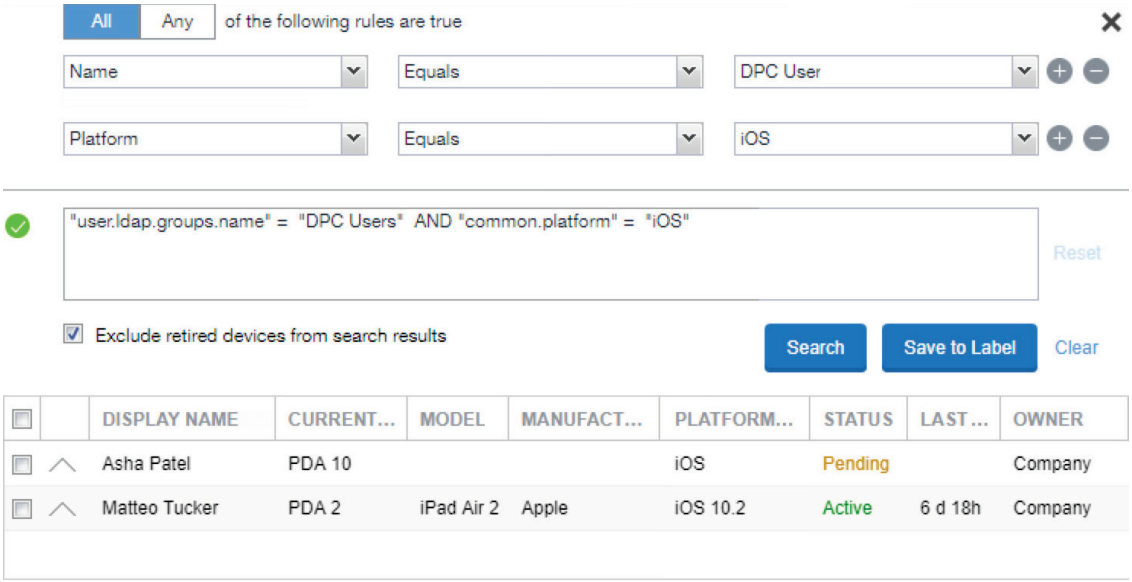
2.2.3.2 Create a DPC Users Label

MobileIron uses labels to link policies and device configurations with users and mobile devices. Creating a unique label for DPC users allows mobile device administrators to apply controls applicable to mobile devices provisioned with a derived credential specifically to those devices. We recommend applying DPC-specific policies and configurations to this label, in addition to any others appropriate to your organization's mobile device security policy.

1. In the **MobileIron Core Admin Portal**, navigate to **Devices & Users > Devices**.
2. Select **Advanced Search** (far right).



3. In the **Advanced Search** pane:
   a. In the blank rule:
      i. In the **Field** drop-down menu, select **User > LDAP > Groups > Name**.
      ii. In the **Value** drop-down menu, select the Active Directory group created to support DPC-specific MobileIron policies (named **DPC User** in this example).
   b. Select the **plus sign icon** to add a blank rule.
   c. In the newly created blank rule:
      i. In the **Field** drop-down menu, select **Common > Platform**.
      ii. In the **Value** drop-down menu, select **iOS**.
   d. Optionally, select **Search** to view matching devices.
   e. Select **Save to Label**.

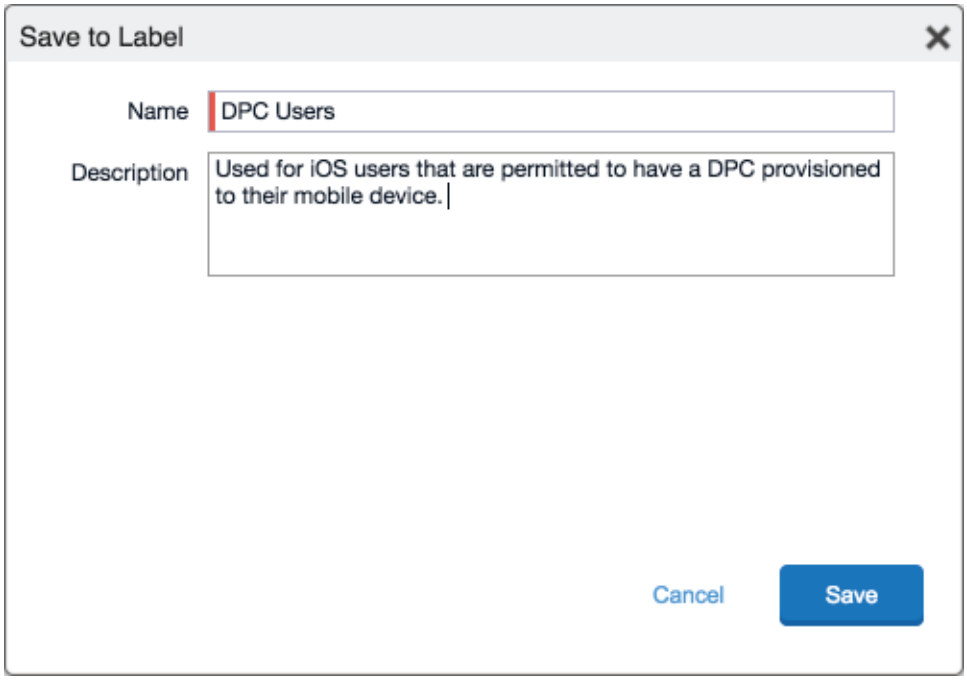


f. In the Save to Label dialog:

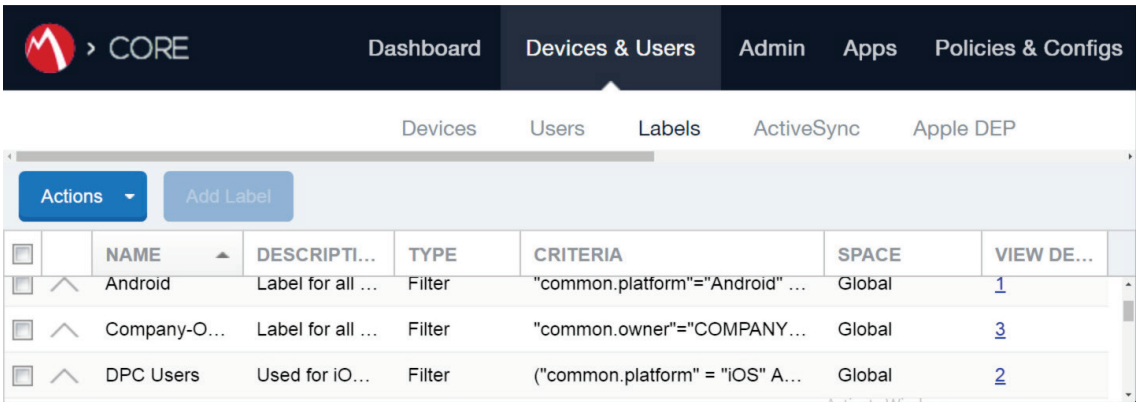
i. In the **Name** field, enter a descriptive name for this label (**DPC Users** in this example).

ii. In the **Description** field, provide additional information to convey the purpose of this label.

iii. Click **Save**.



4. **Navigate to Devices & Users > Labels** to confirm the label was successfully created. It can be applied to Derived PIV Credential-specific MobileIron policies and configurations in future steps.



2.2.3.3 Implement MobileIron Guidance

The following provides the sections from the *MobileIron Derived Credentials with Entrust Guide* that were used in configuring this instance of MobileIron Derived PIV Credentials. Sections for which there may be configuration items tailored to a given instance (e.g., local system hostnames), this configuration is provided only as a reference. We noted any sections in which the steps performed to configure our systems varies from those in the *MobileIron Derived Credentials with Entrust Guide*.

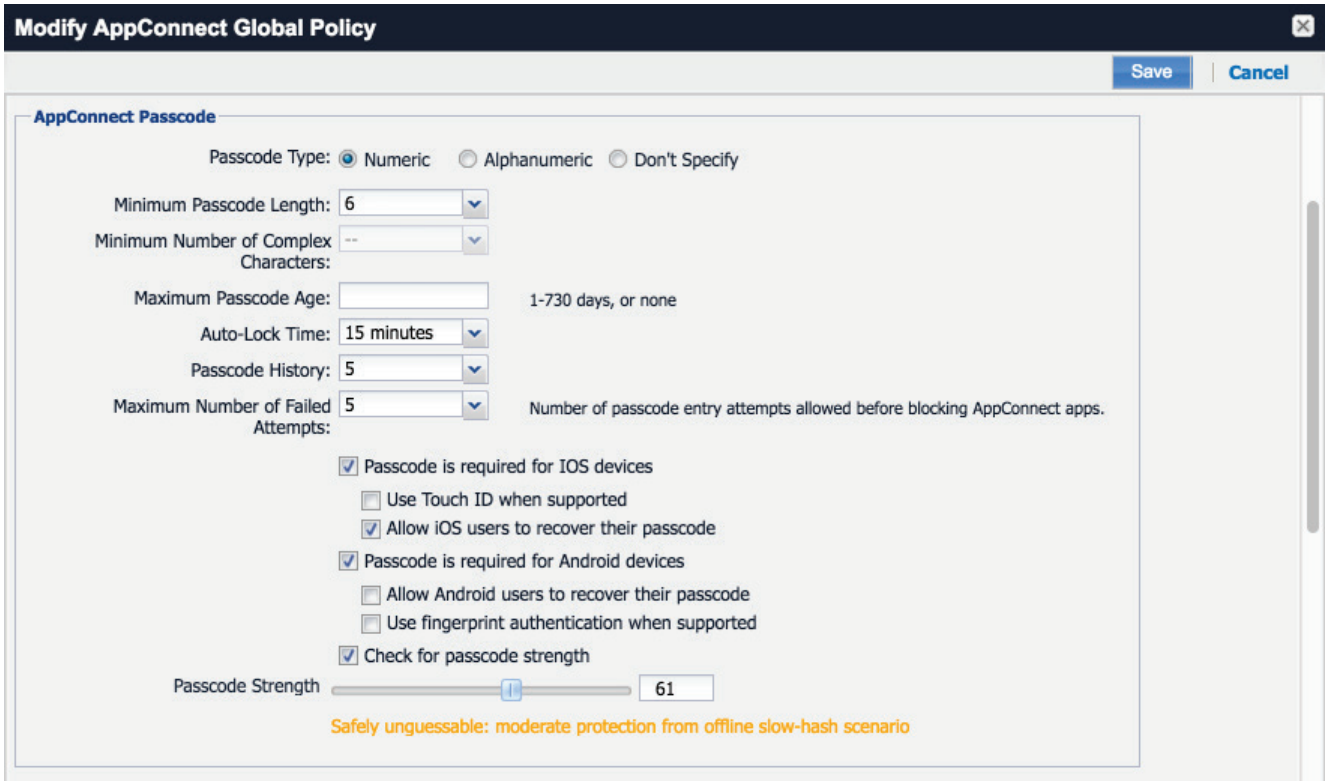
Complete these sections in Chapter 2 of the *MobileIron Derived Credentials with Entrust Guide:*

1. Before beginning:
    a. Configuring certificate authentication to the user portal.

        Note: The root CA certificate or trust chain file can be obtained from Entrust Datacard.

    b. Configuring the Entrust IdentityGuard Self-Service Module (SSM) Module Universal Resource Locator (URL).

        Note: The URL will be specific to your organization's instance of the IDG service and can be obtained from Entrust Datacard.
2. Configuring PIN-based registration.
3. Configuring user portal roles.
4. Adding the PIV-D Entrust app to the App Catalog.
    a. Adding Web@Work for iOS.
5. Configuring Apps@Work.
    a. Setting authentication options.
    b. Sending the Apps@Work web clip to devices.
6. Configuring AppConnect.
    a. Configuring AppConnect licenses.
    b. Configuring the AppConnect global policy. The **AppConnect Passcode** policy settings for our implementation are presented below.



Note that based on our testing, a **Passcode Strength** of 61/100 or higher prevents easily guessable derived credential passcode combinations (e.g., abc123) from being set by a DPC Applicant.

7. Configuring the PIV-D Entrust app.
8. Configuring client-provided certificate enrollment settings. Note that the configuration items created by completing this section will be used in the following section. Replace **Step 2** in this section of the *MobileIron Derived Credentials with Entrust Guide* with the following:
    a. Select **Add New > Certificate Enrollment > SCEP**.
9. Configuring Web@Work to use Derived PIV Credentials.
    a. Require a device password.
    b. Configure a Web@Work setting. The **Custom Configurations** key-value pairs set for our instance in Step 4 are presented below.

    Note: The value for `idCertificate_1` is the descriptive name we applied to the Simple Certificate Enrollment Protocol (SCEP) certificate enrollment configuration for derived credential authentication created in the *MobileIron Derived Credentials with Entrust Guide* section referenced in **Step 8**.

KEY	VALUE
IdCertificate_1_host	*
IdCertificate_1	DC Authentication

2.3 DPC Lifecycle Workflows

The following sections describe how to perform the DPC lifecycle activities of issuance, maintenance, and termination.

2.3.1 DPC Initial Issuance

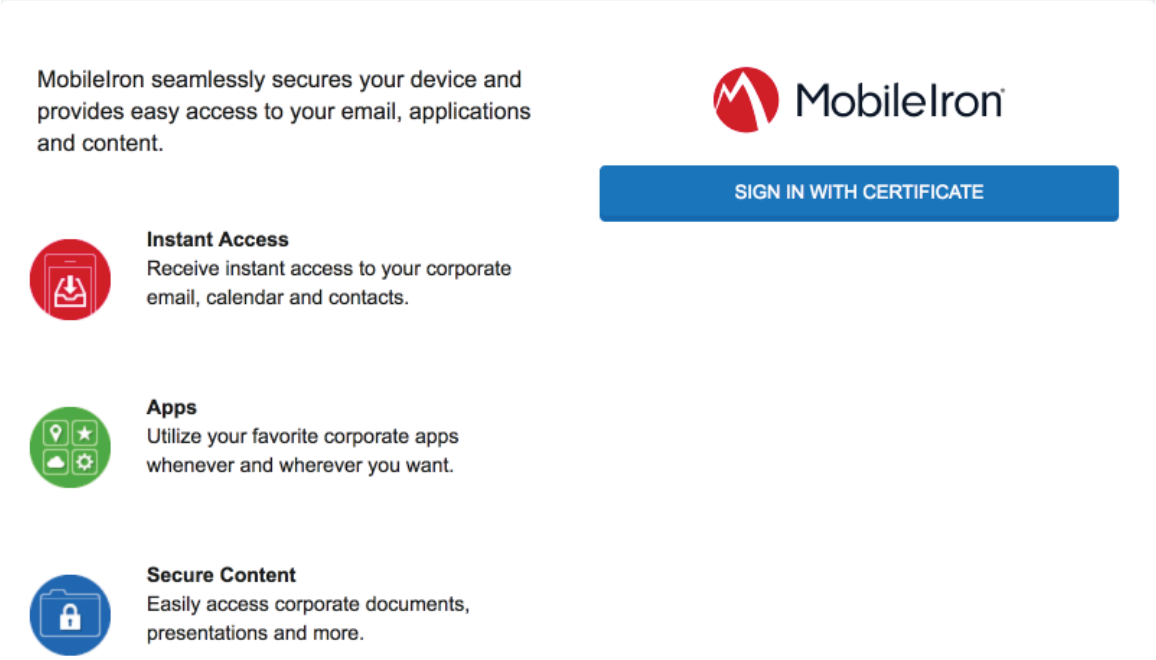
The following sections provide the steps necessary to issue a Derived PIV Credential onto a target mobile device.

2.3.1.1 Register Target Device with MobileIron

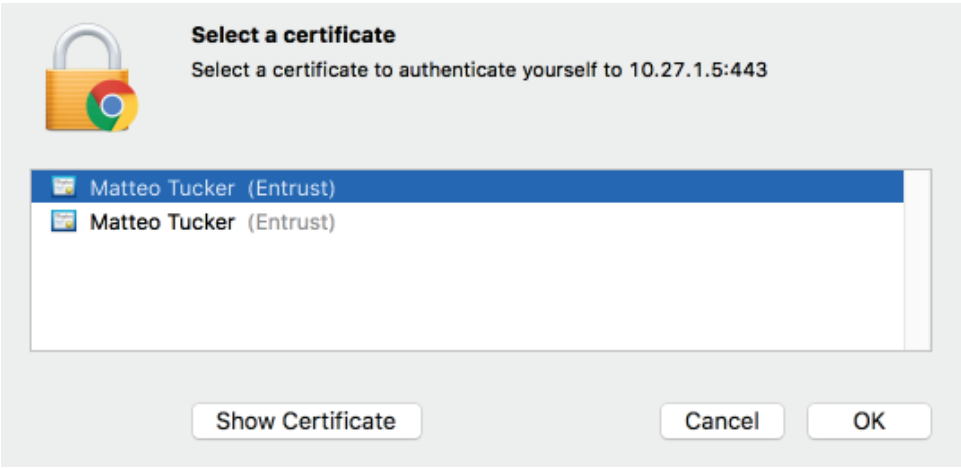
The following steps will register the target mobile device with MobileIron, which will create the secure Mobile@Work container into which a Derived PIV Credential is later provisioned.

1. Insert your valid PIV Card into the card reader attached to, or integrated into, your laptop or computer workstation.
2. Using a web browser, visit the MobileIron Self-Service Portal URL provided by your administrator.

3. In the MobileIron Self-Service Portal, click **Sign in with certificate**.



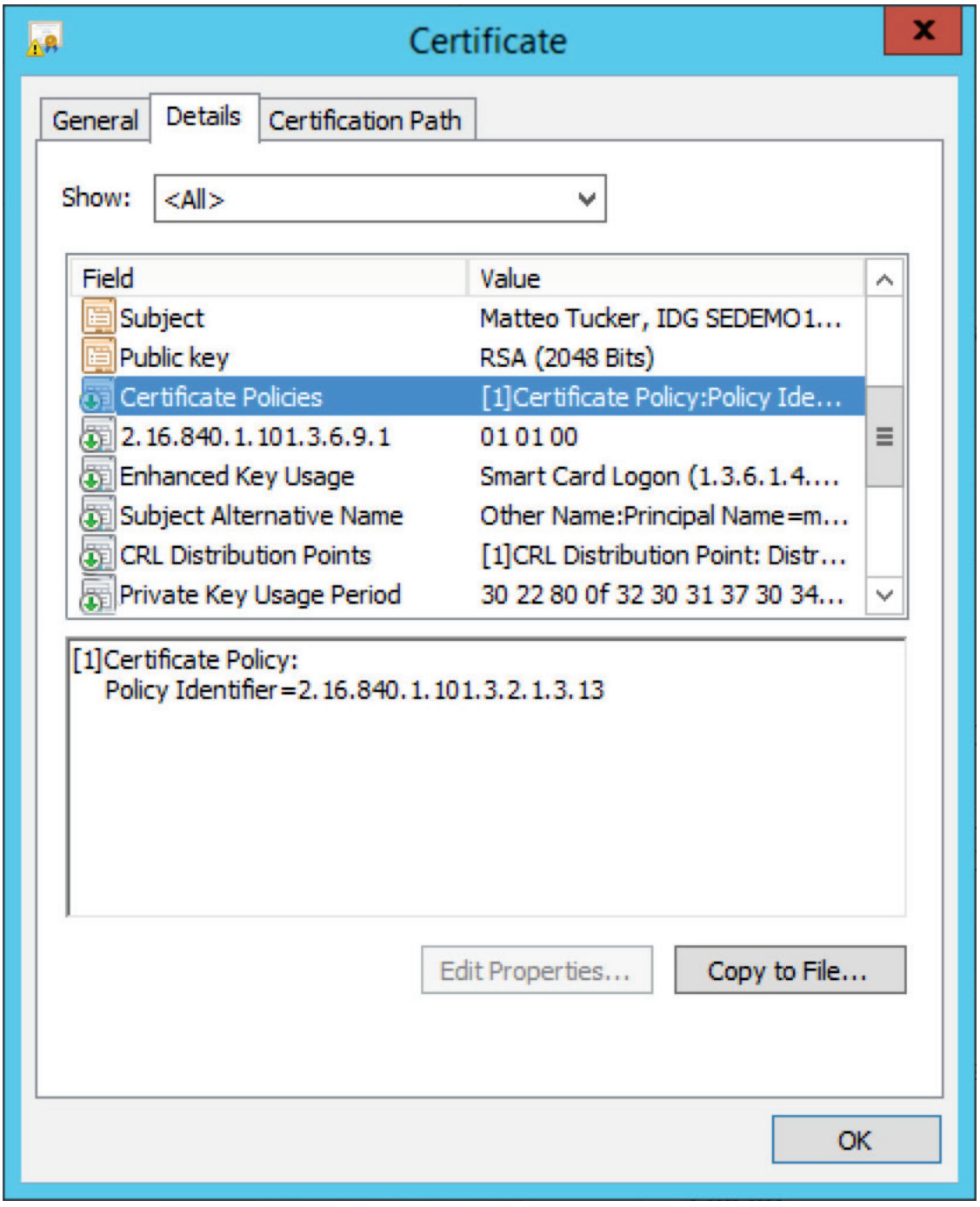
4. In the certificate selection dialog:
   a. If necessary, identify your PIV Authentication certificate:
      i. Highlight a certificate.
      ii. Select **Show Certificate**.



      iii. Navigate to the **Details** tab.

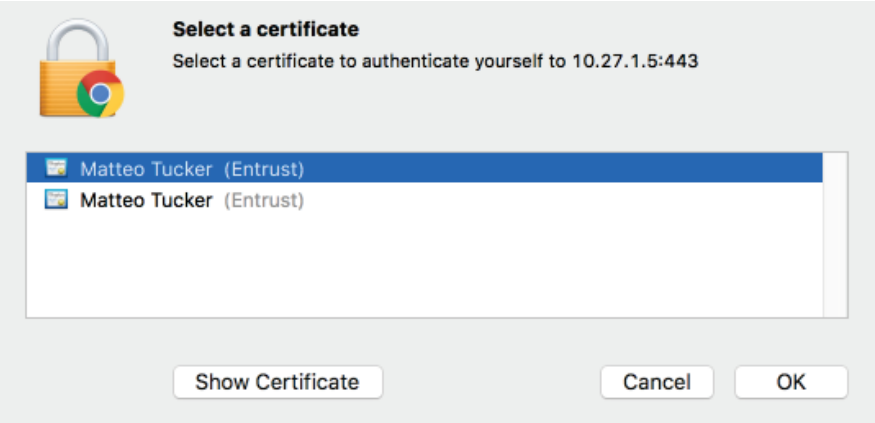
iv. The PIV Authentication certificate contains a **Field** named **Certificate Policies** with a **Value** that contains **Policy Identifier=2.16.840.1.101.3.2.1.3.13**.

v. Repeat **Steps i-iii** above as necessary.



b. Select your PIV Authentication certificate in the list of available certificates.

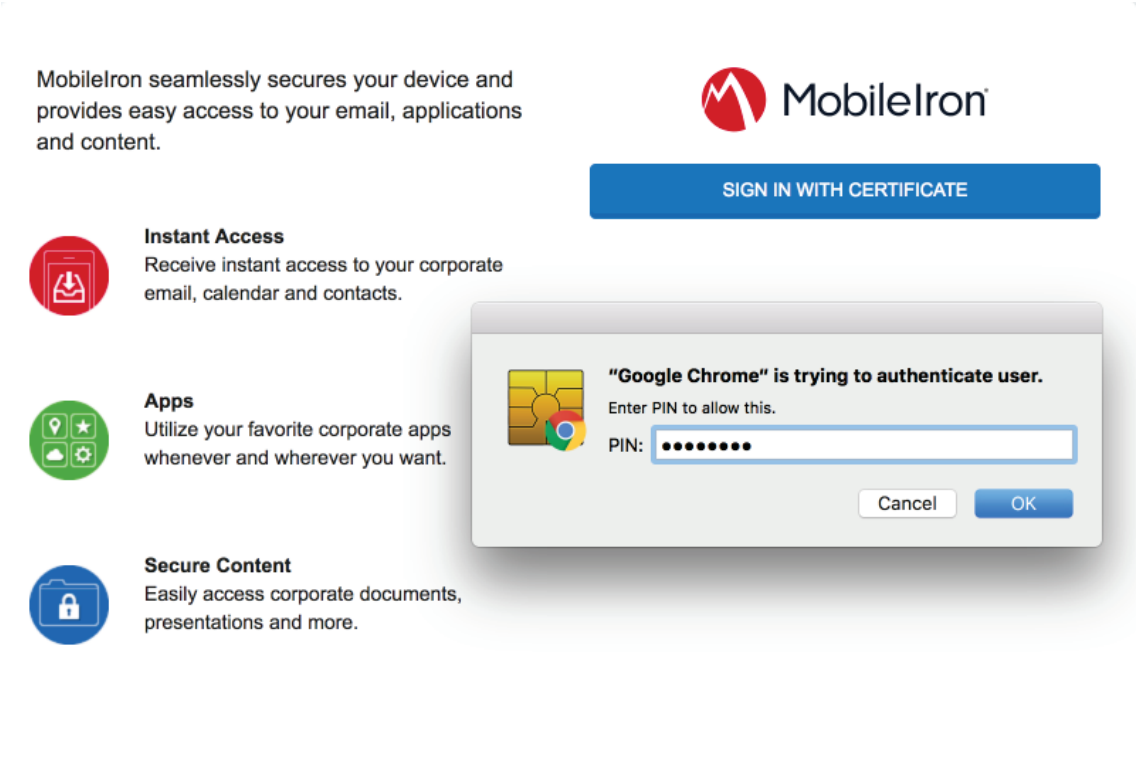
c. Click **OK**.



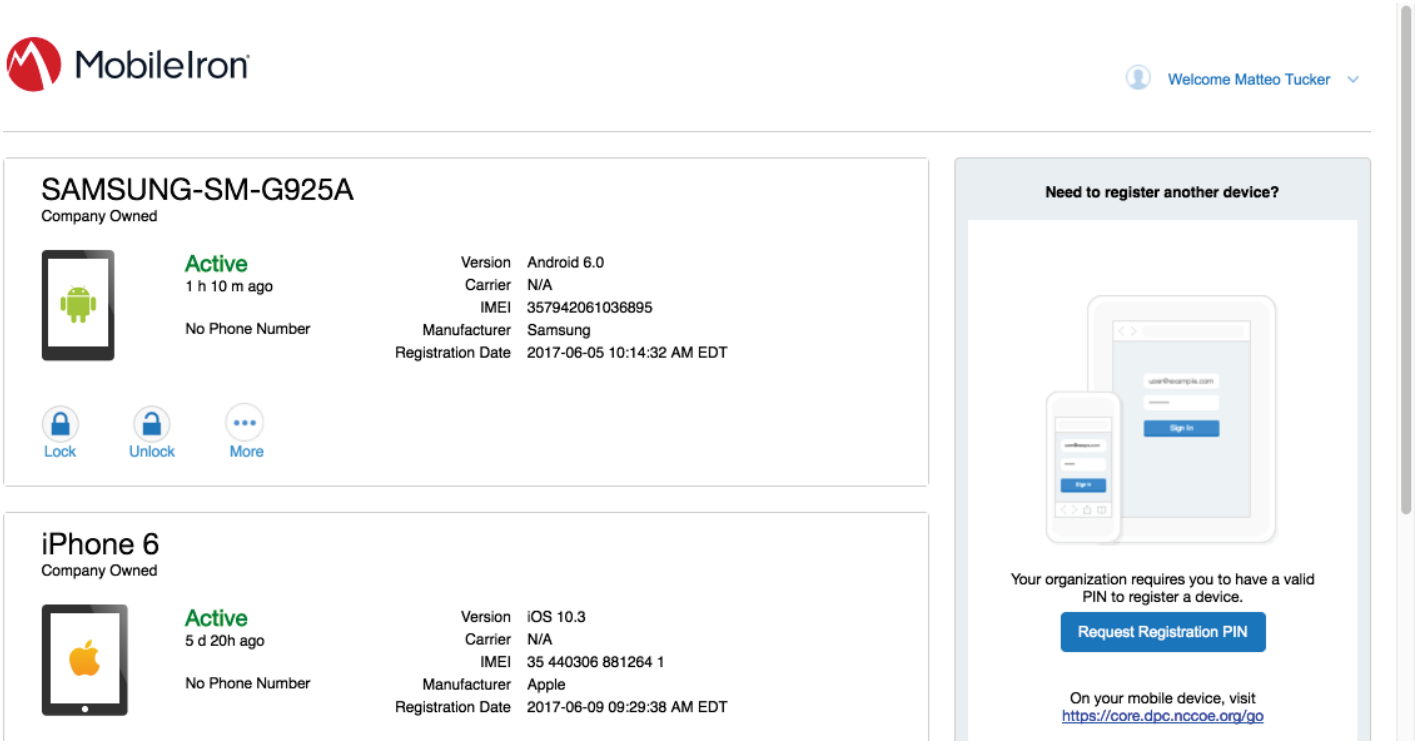
5. In the authentication dialog:

a. In the **PIN** field, enter your PIV Card PIN.

b. Click **OK**.

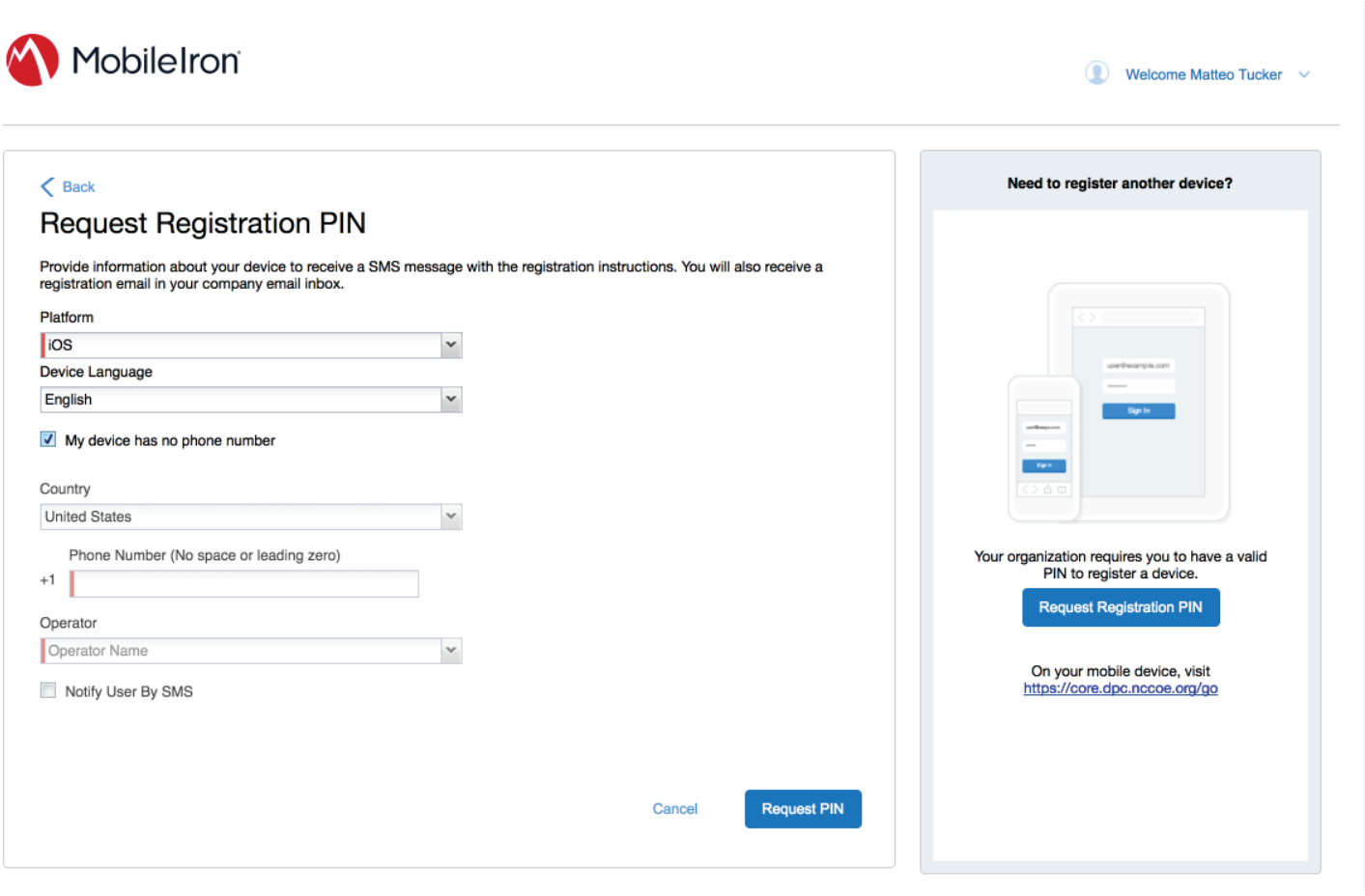


6. In the right-hand sidebar of the device summary screen, click **Request Registration PIN**.



7. In the **Request Registration PIN** page:
   a. Select **iOS** from the **Platform** drop-down menu.
   b. If your device does not have a phone number, check **My device has no phone number.**
   c. If your device has a phone number, enter it in the **Phone Number** field.

353 d. Click **Request PIN**.

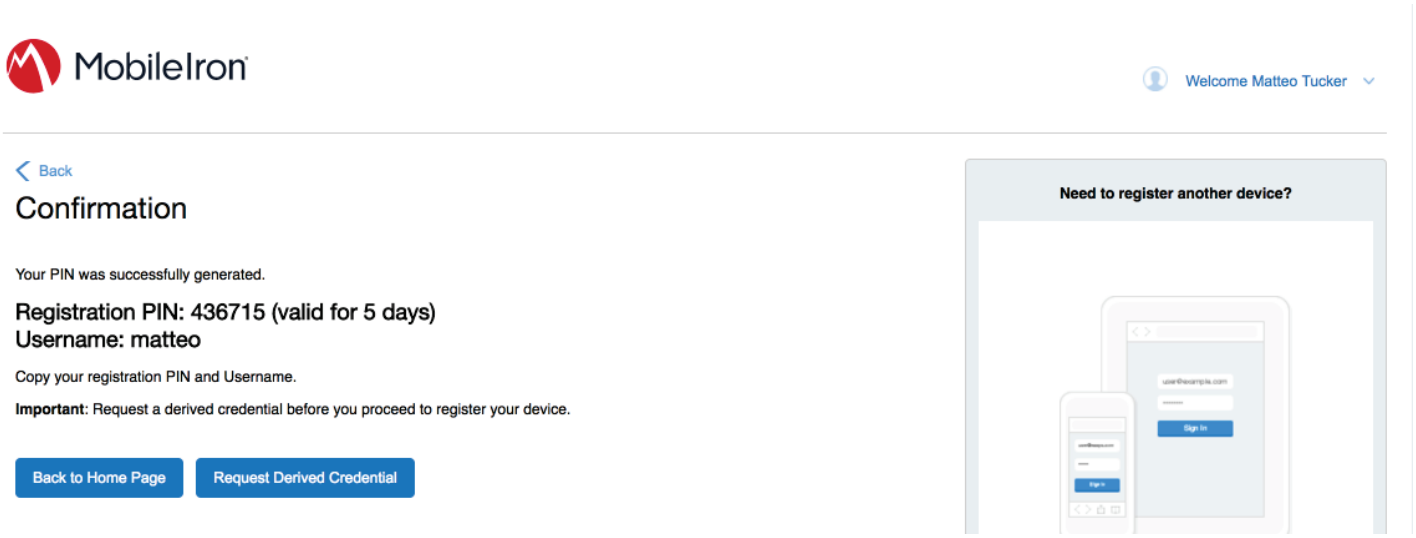


354

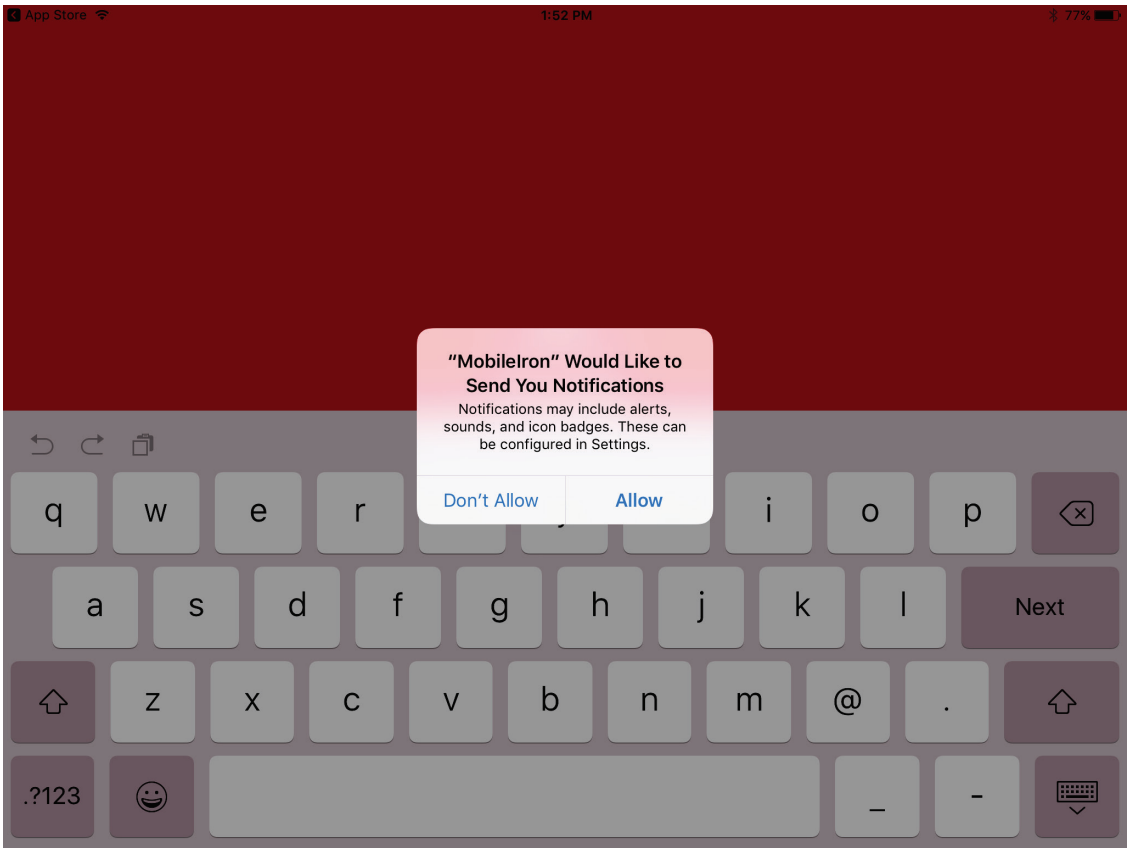
e. The **Confirmation** page, shown in Figure 2-2 displays a unique device **Registration PIN.** Leave this page open while additional registration steps are performed on the target mobile device.

Note: This page may also facilitate the workflow for initial DPC issuance, covered in Section 2.3.1.2.

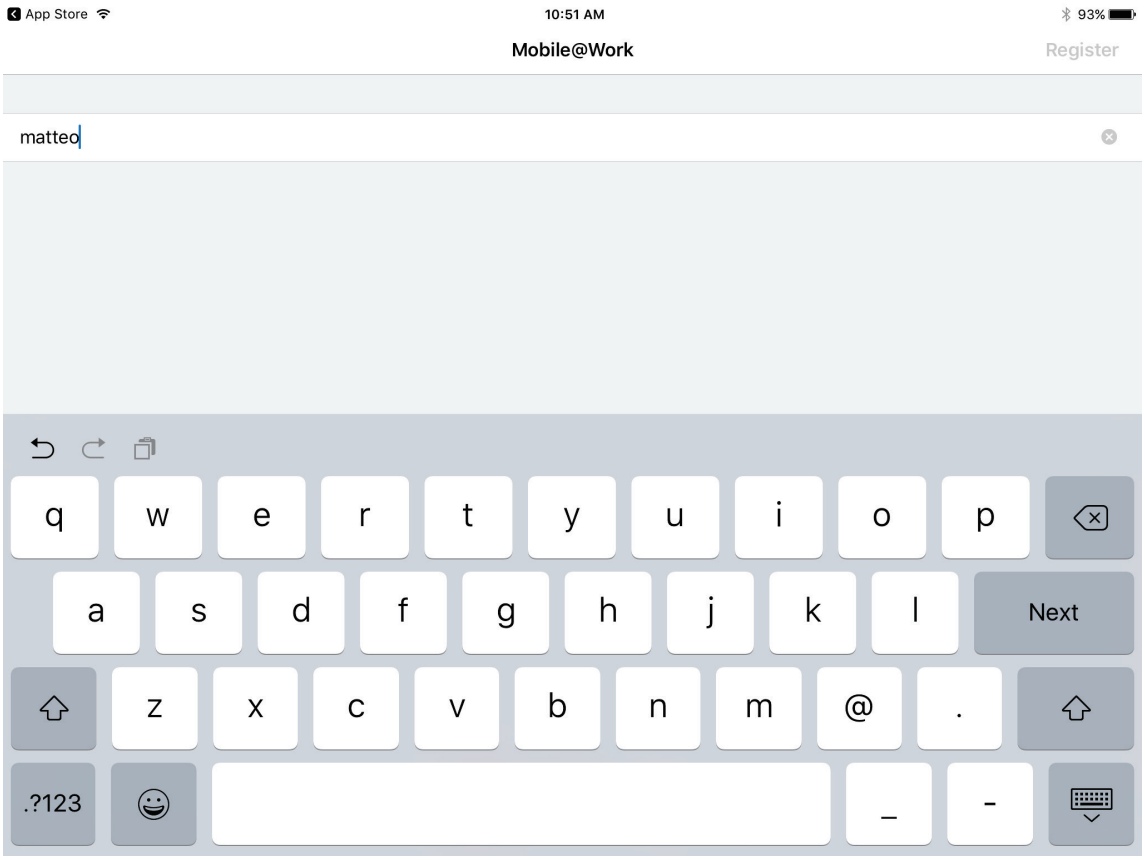
Figure 2-2 MobileIron Registration Confirmation Page



8. Using the target mobile device, launch the MobileIron **Mobile@Work** app.
9. In the request to grant MobileIron permission to receive push notifications, tap **Allow**.



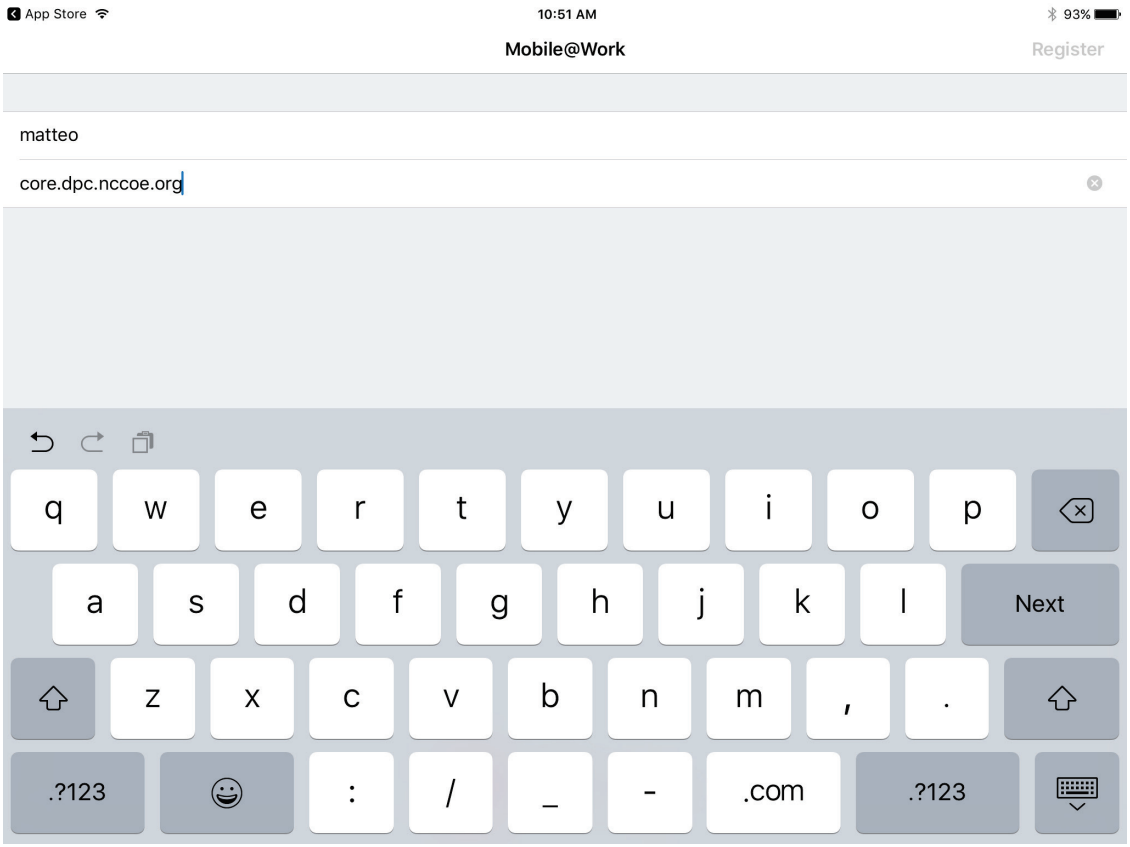
10. In **Mobile@Work**:
    a. In the **User Name** field, enter your LDAP or MobileIron user ID.
    b. Tap **Next**.



366

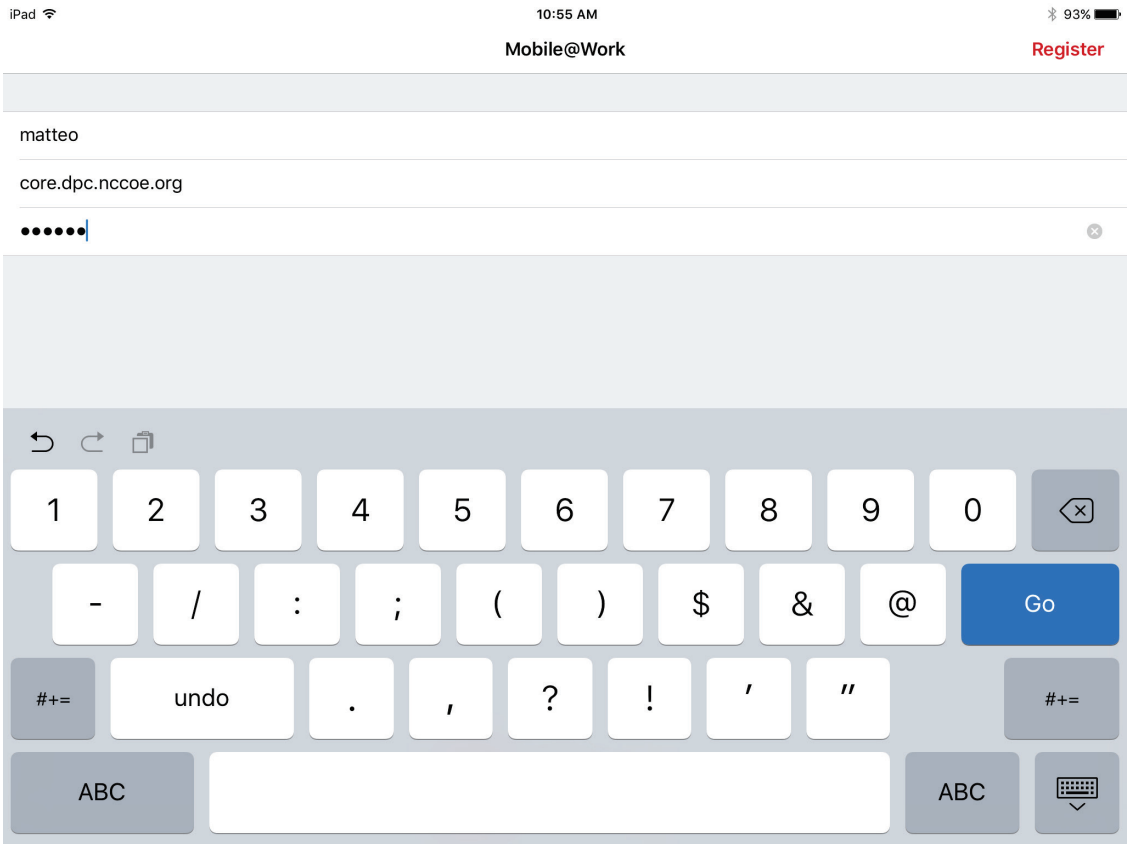
367 c. In the **Server** field, enter the URL for your organization's instance of MobileIron Core as
368 provided by a MobileIron Core administrator.

369 d. Tap **Next**.



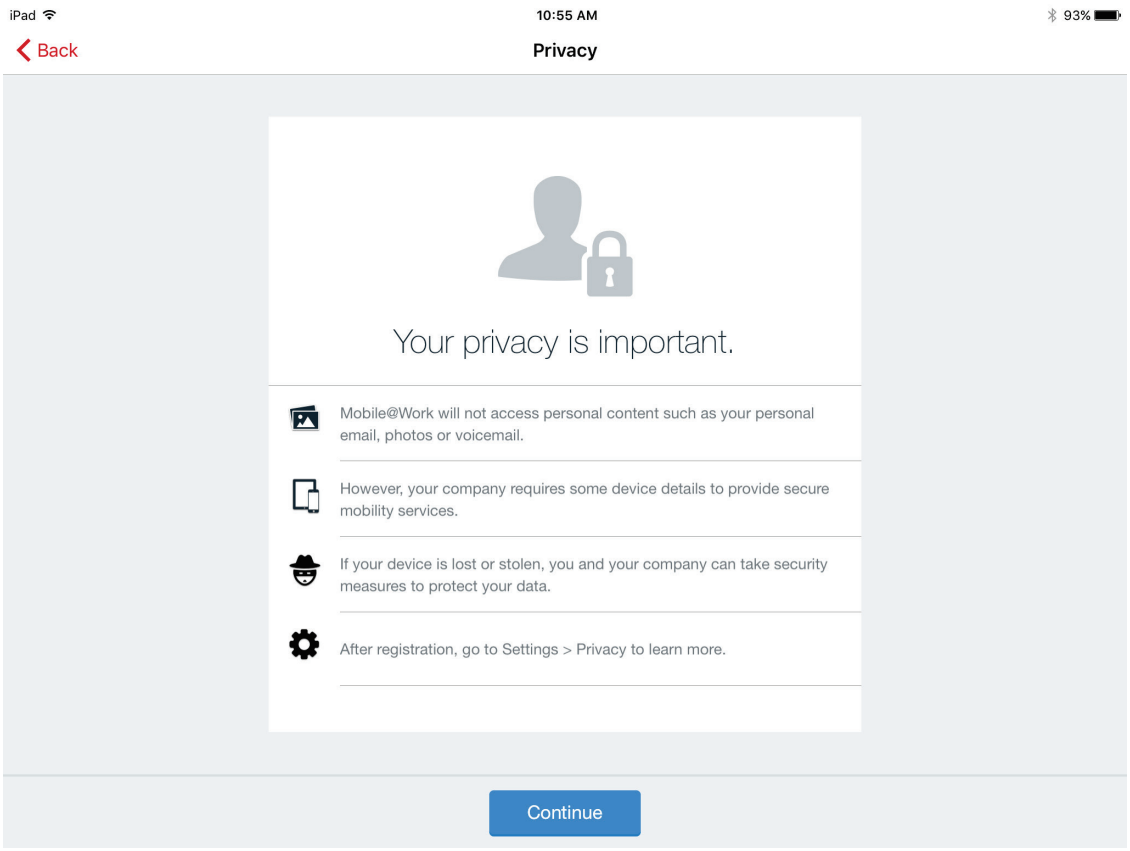
e. In the **PIN** field, enter the **Registration PIN** displayed in the **Confirmation** page (see Figure 2-2) of the MobileIron Self-Service Portal at the completion of **Step 7e**.

f. Tap **Go** on keyboard or **Register** in Mobile@Work.



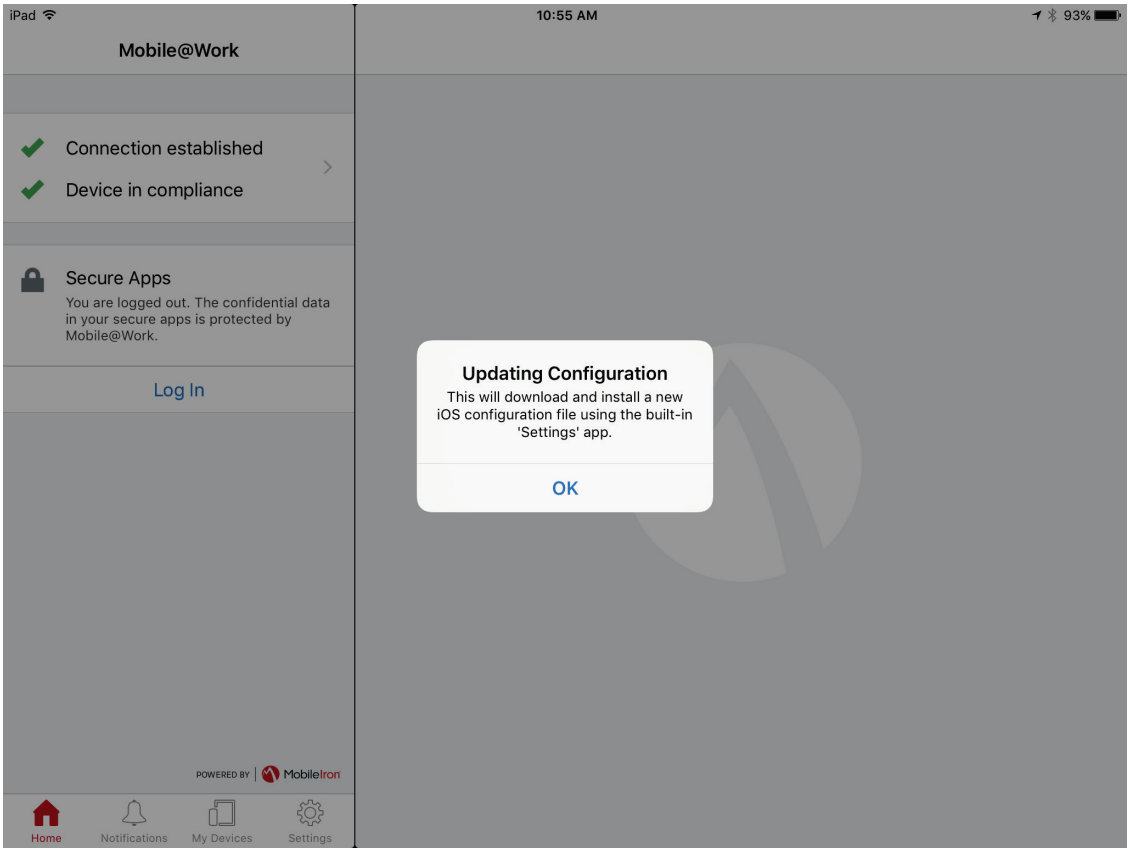
374

375 g. In the Privacy screen, tap **Continue**.



376

377 11. In the **Updating Configuration** dialog, tap **OK**; this will launch the built-in iOS **Settings** app.

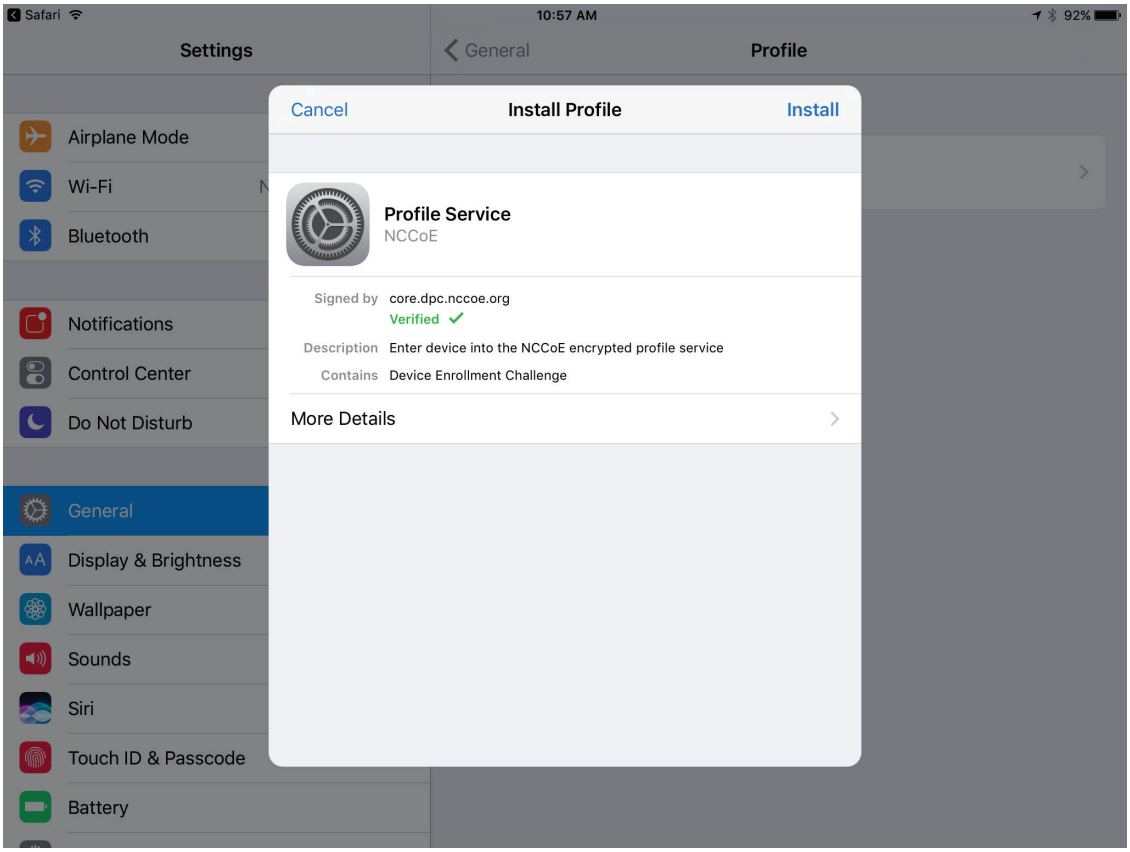


12. In the **Settings** app, in the **Install Profile** dialog:

    a. In the **Signed By** field, confirm the originating server identity shows as **Verified**.

       Note: If verification of the originating server fails, contact your MobileIron administrator before resuming registration.

    b. Tap **Install**.

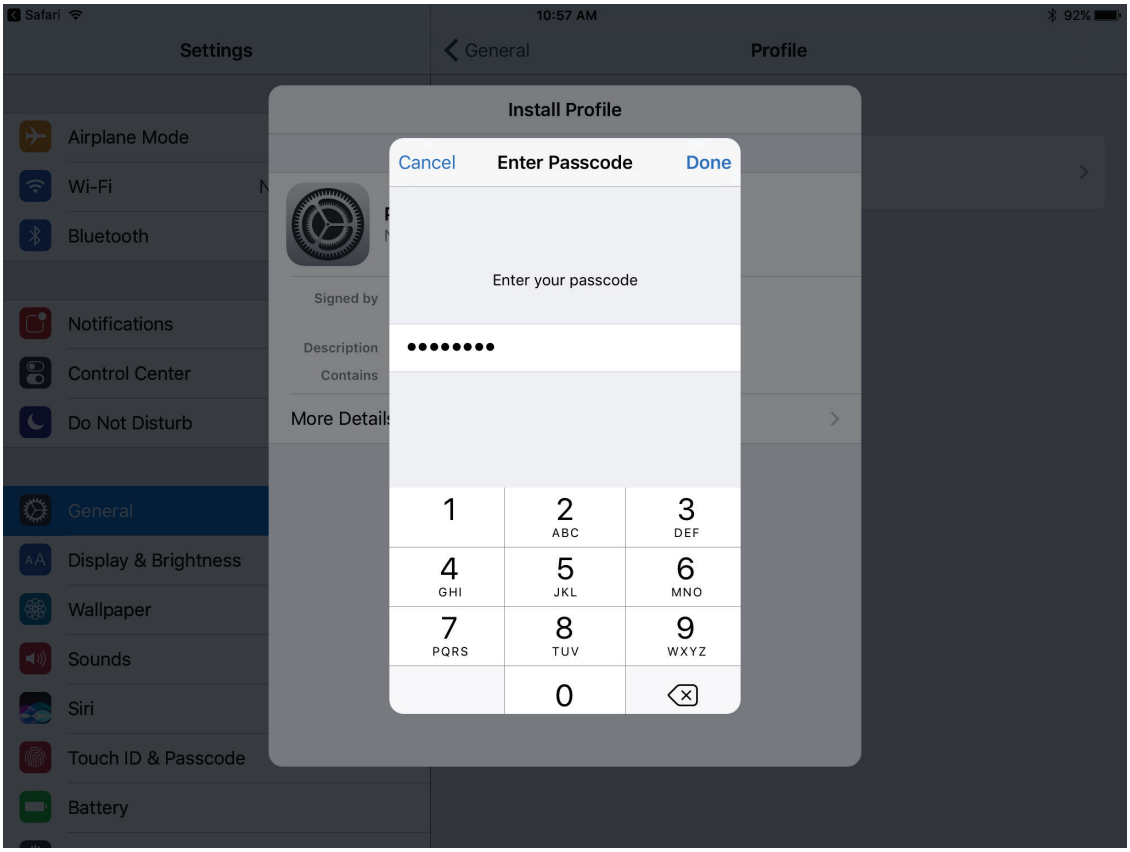


384

385 13. In the Enter **Passcode** dialog:

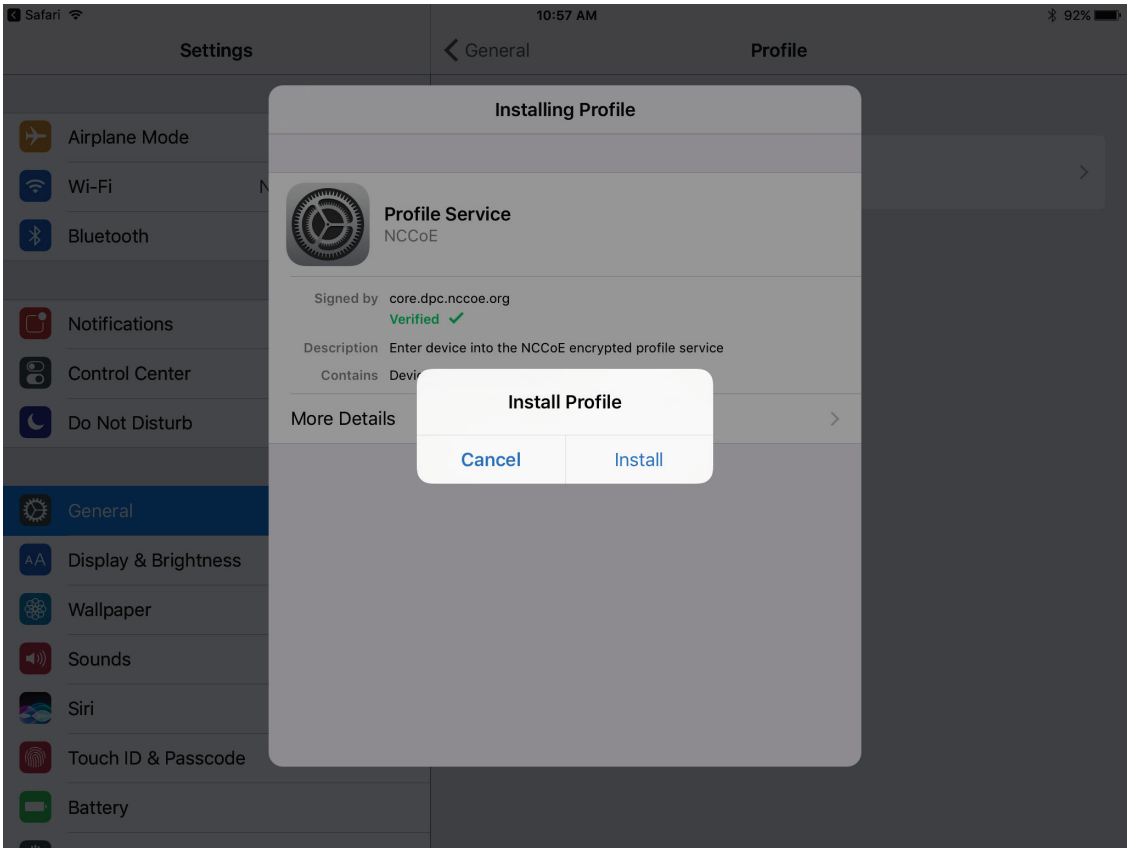
386 a. Enter your device unlock code.

387 b. Tap **Done**.



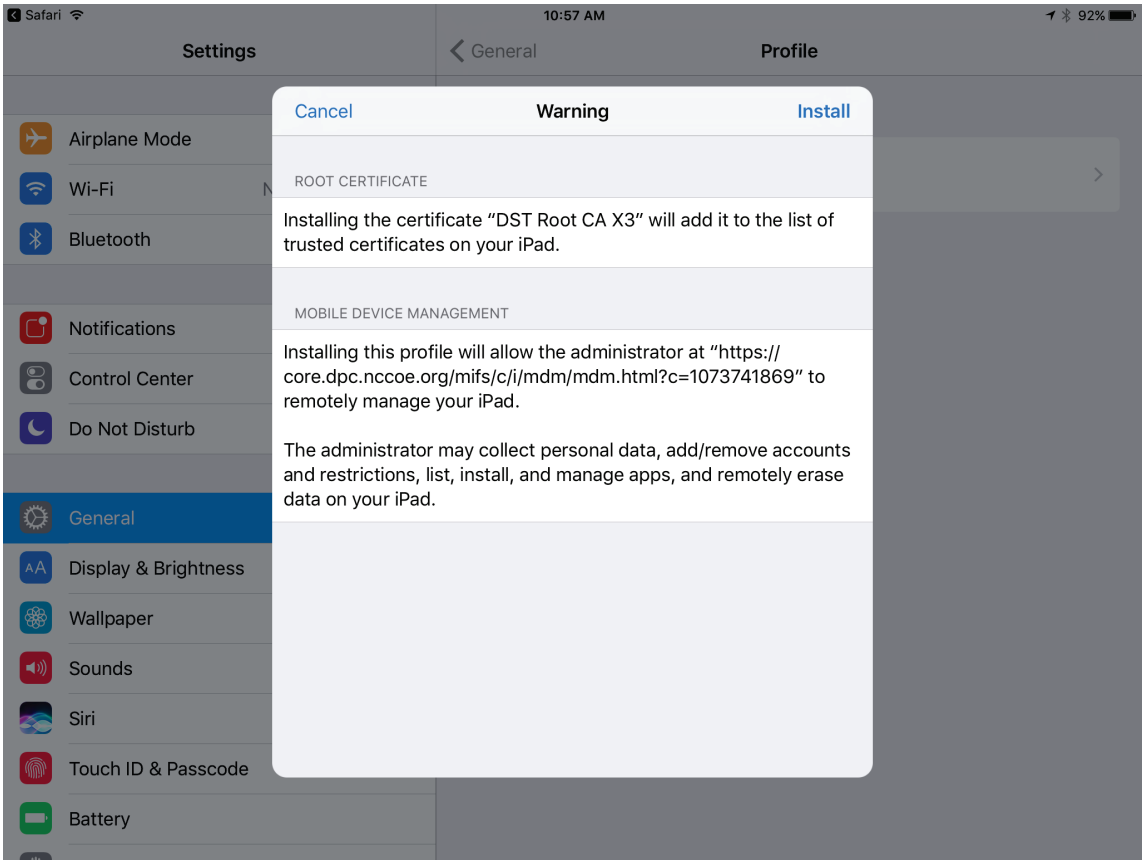
388

389 14. In the **Install Profile** dialog, tap **Install**.



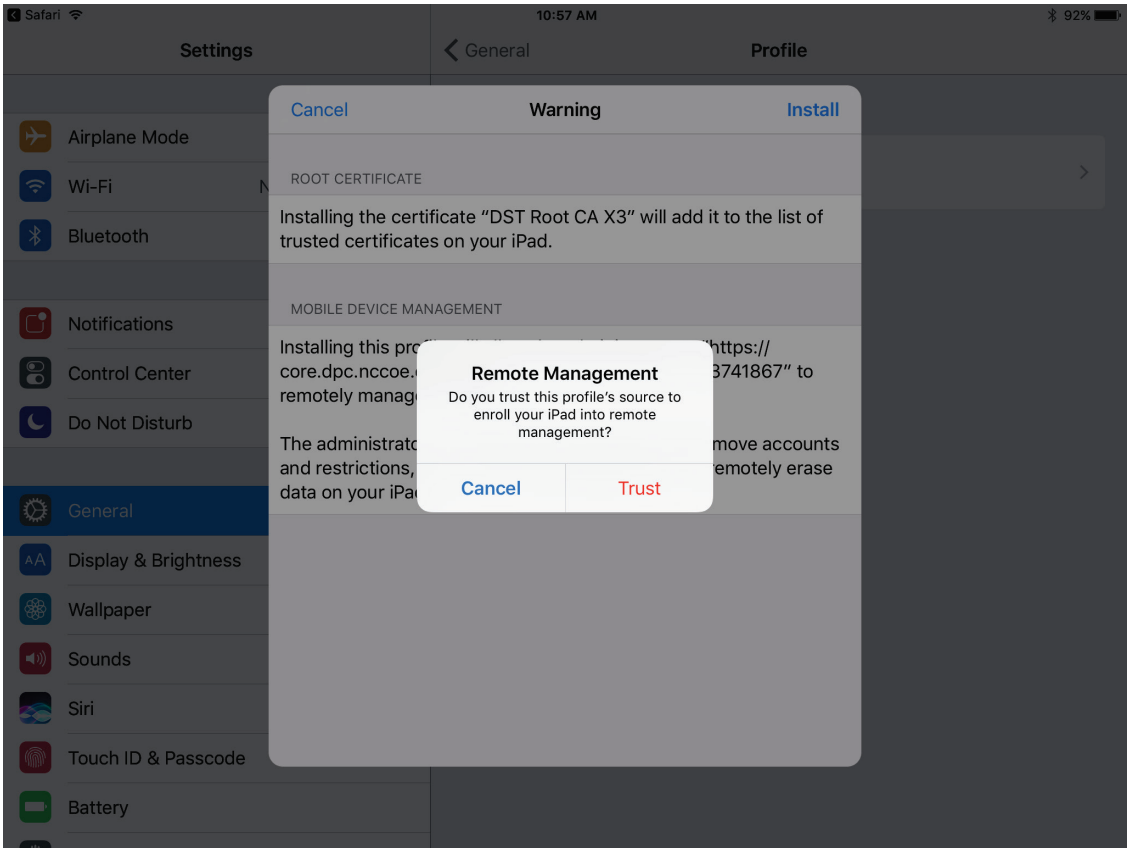
390

391 15. In the **Warning** dialog, tap **Install**.



392

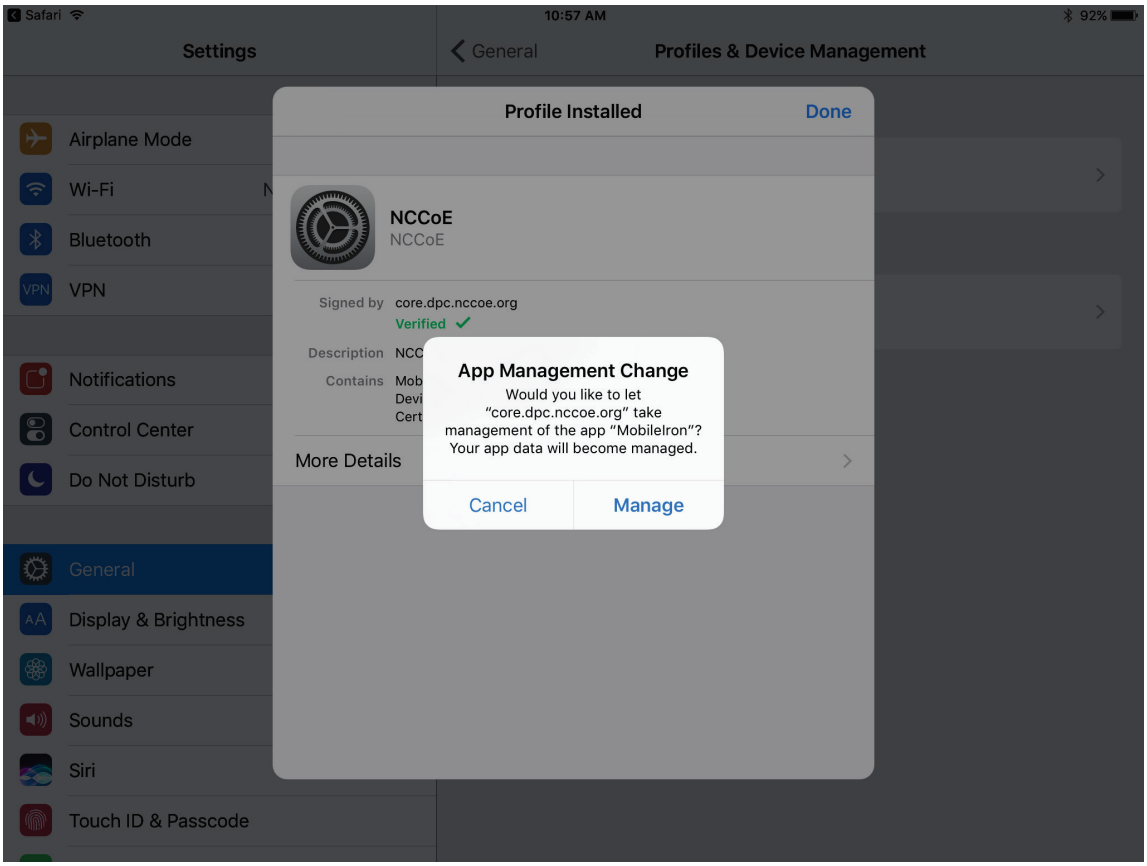
393 16. In the **Remote Management** dialog, tap **Trust**.



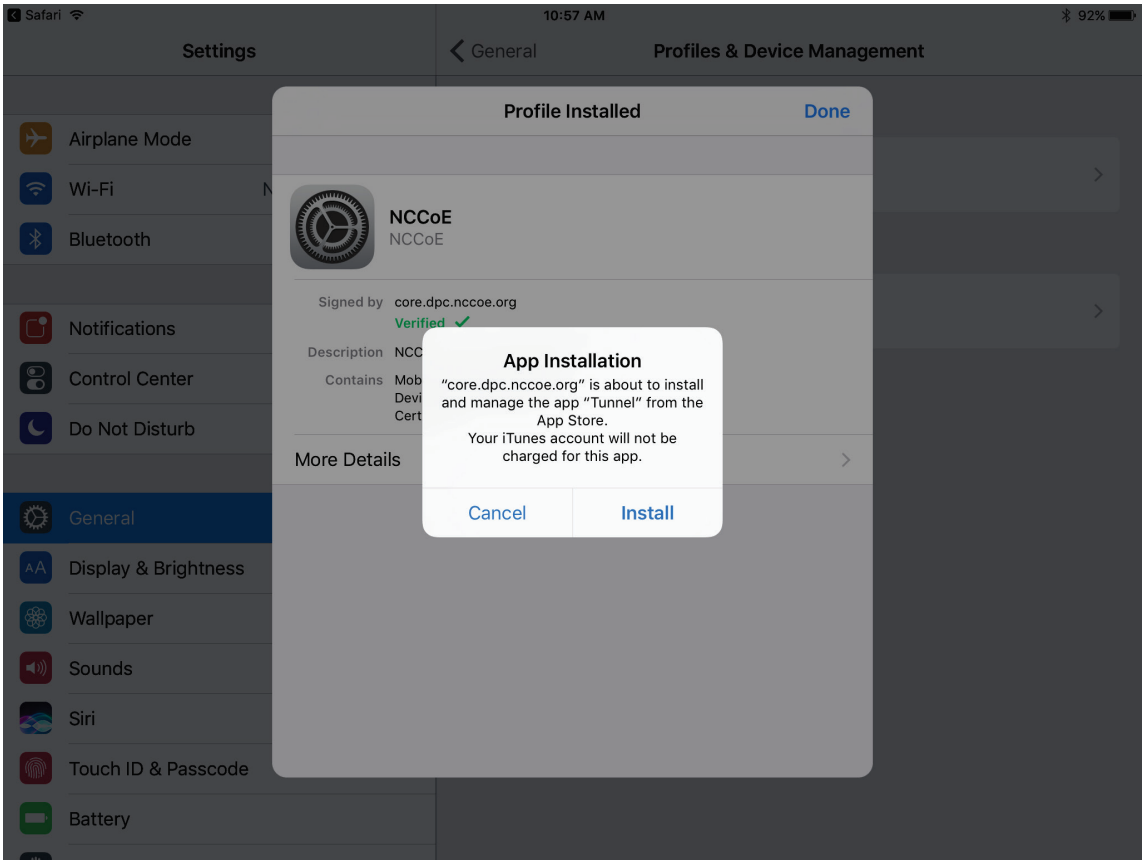
394

395 17. In the **Profile Installed** dialog, tap **Done**.

396 18. In the **App Management Change** dialog, tap **Manage**.

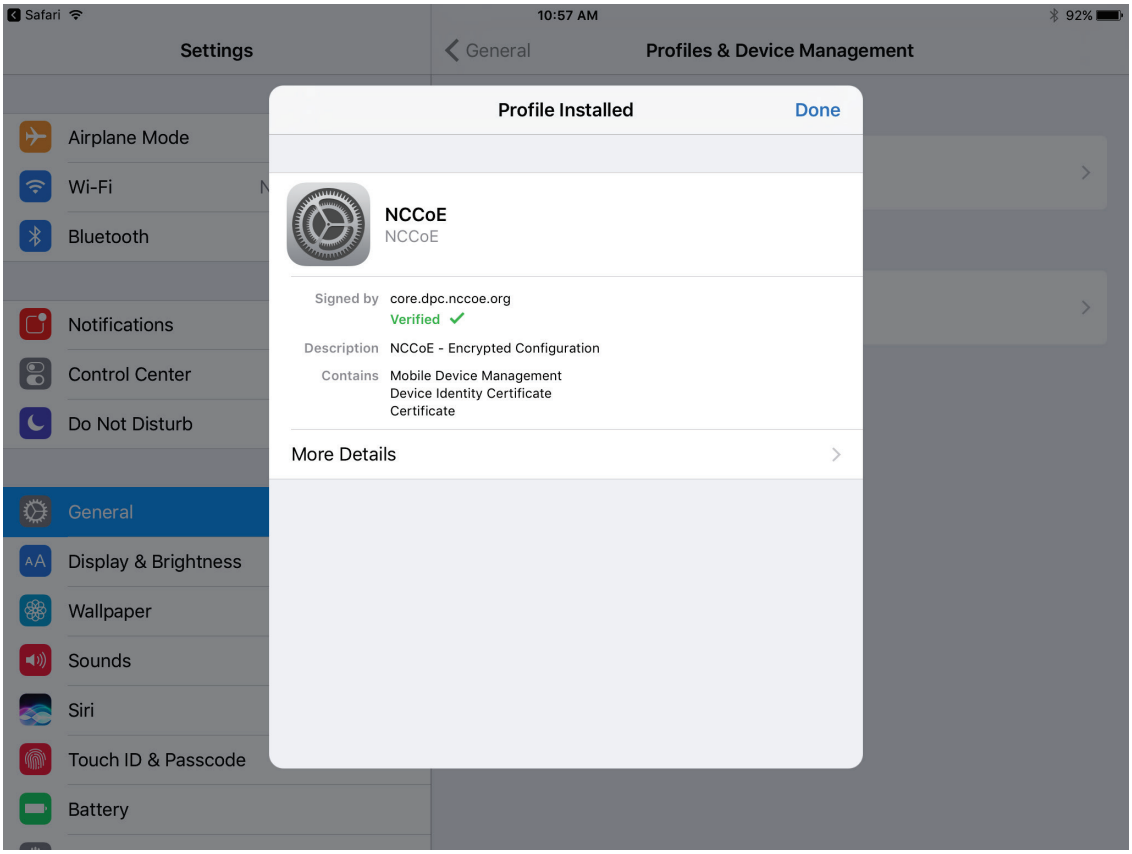


19. If additional Mobile@Work apps (e.g., Email+) are installed as part of the MobileIron management profile (based on your organization's use case), an **App Installation** dialog will appear for each app. To confirm, tap **Install**.

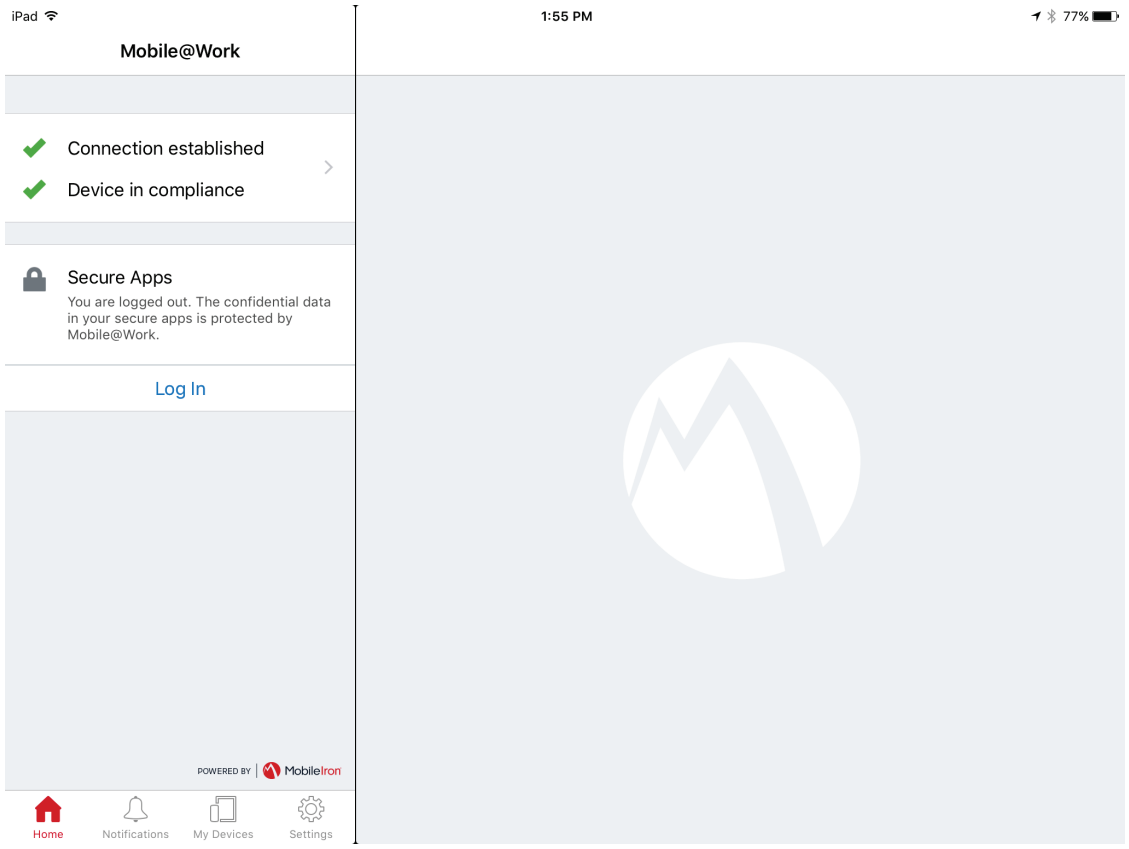


401

402 20. In the **Profile Installed** dialog, tap **Done**.



21. The **Mobile@Work > Home** screen should now display checkmarks for both status indicators of **Connection established** (with MobileIron Core) and **Device in compliance** (with the MobileIron policies that apply to your device).

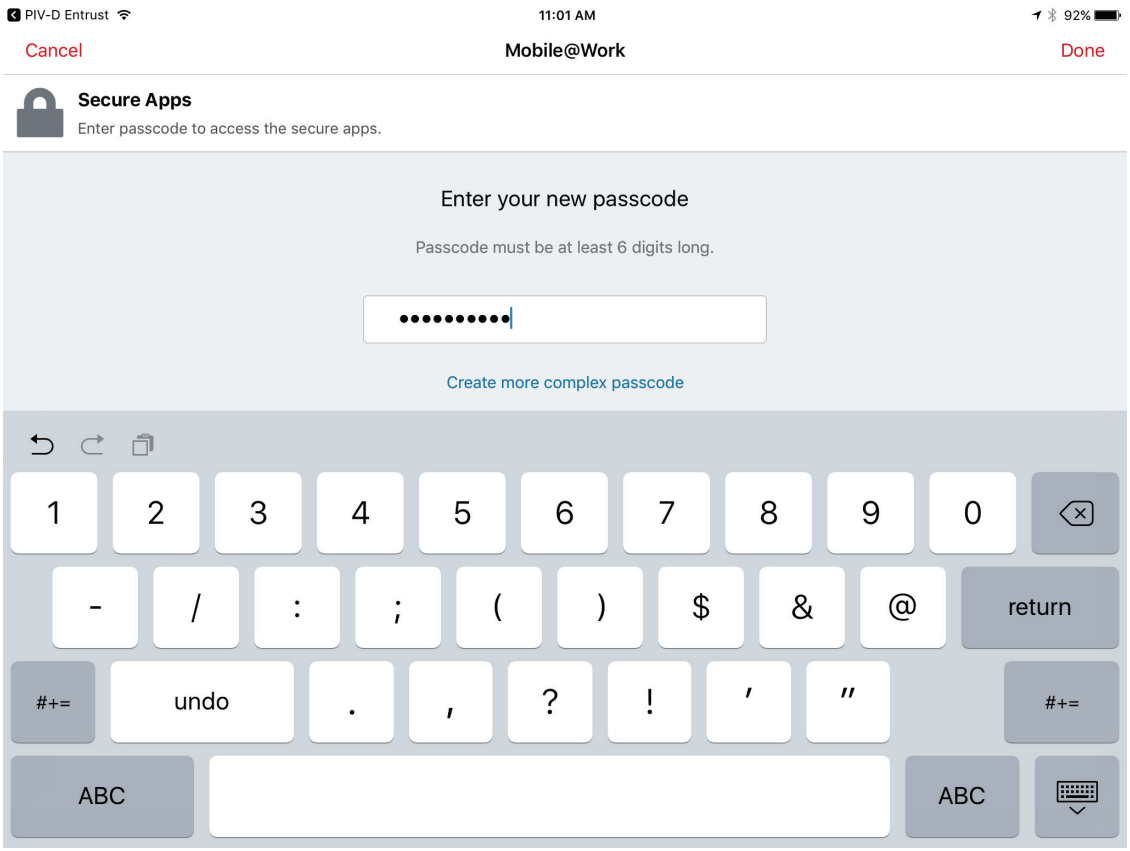


2.3.1.2 DPC Initial Issuance

The following steps demonstrate how a DPC is issued to an applicant's mobile device. It assumes the target mobile device is registered with MobileIron (see Register Target Device with MobileIron) and the MobileIron PIV-D Entrust app is installed (see Implement MobileIron Guidance). These steps are completed by the mobile device user who is receiving a DPC.

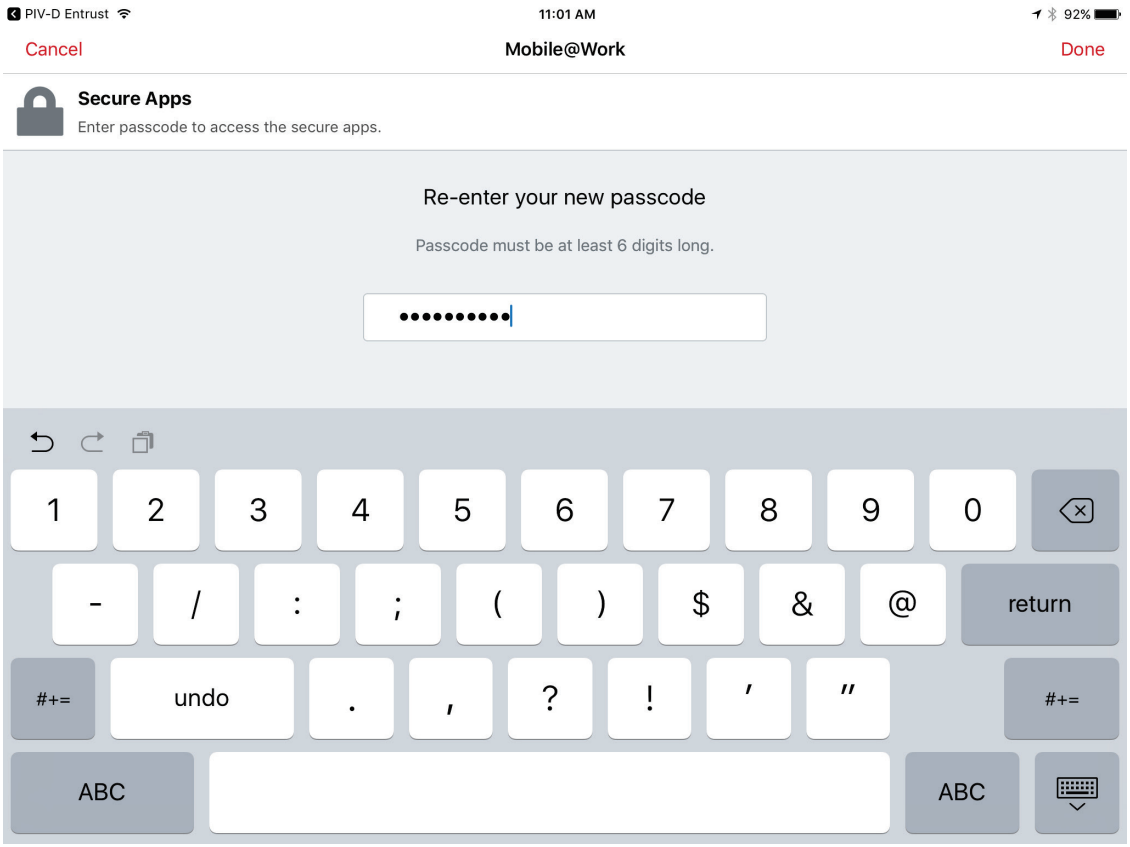
1. Launch the **MobileIron PIV-D Entrust** app on the target mobile device.
2. If a Mobile@Work Secure Apps passcode has not been set, you will be prompted to create one. In the **Mobile@Work Secure Apps** screen:
    a. In the **Enter your new passcode** field, enter a password consistent with your organization's DPC password policy. This password will be used to activate your DPC (password-based Subscriber authentication) for use by Mobile@Work secure apps.

Note: NIST SP 800-63-3 increased the minimum DPC password length to eight characters.



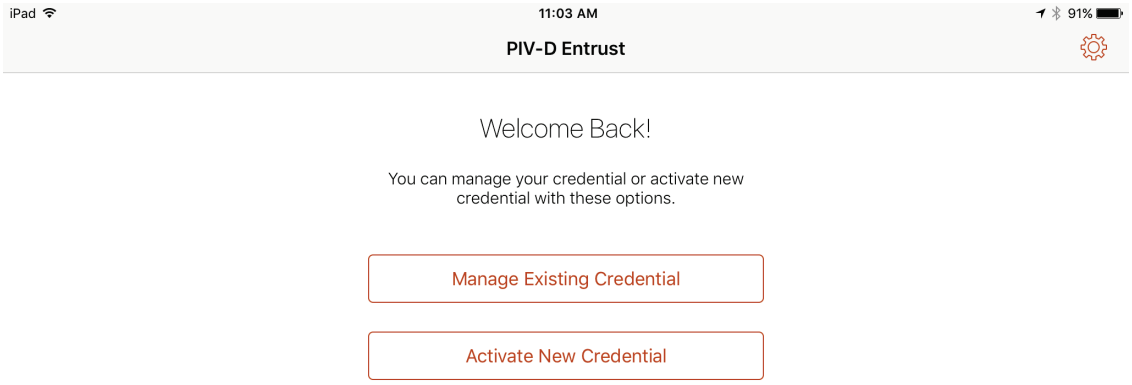
b. In the **Re-Enter your new passcode** field, re-enter the password you entered in **Step 2b**.

c. Tap **Done**.



423

424 3. Following registration with MobileIron Core and when no Derived PIV Credential is associated
425 with Mobile@Work**, PIV-D Entrust** displays a screen for managing your DPC. You will return to
426 this app in a later step.

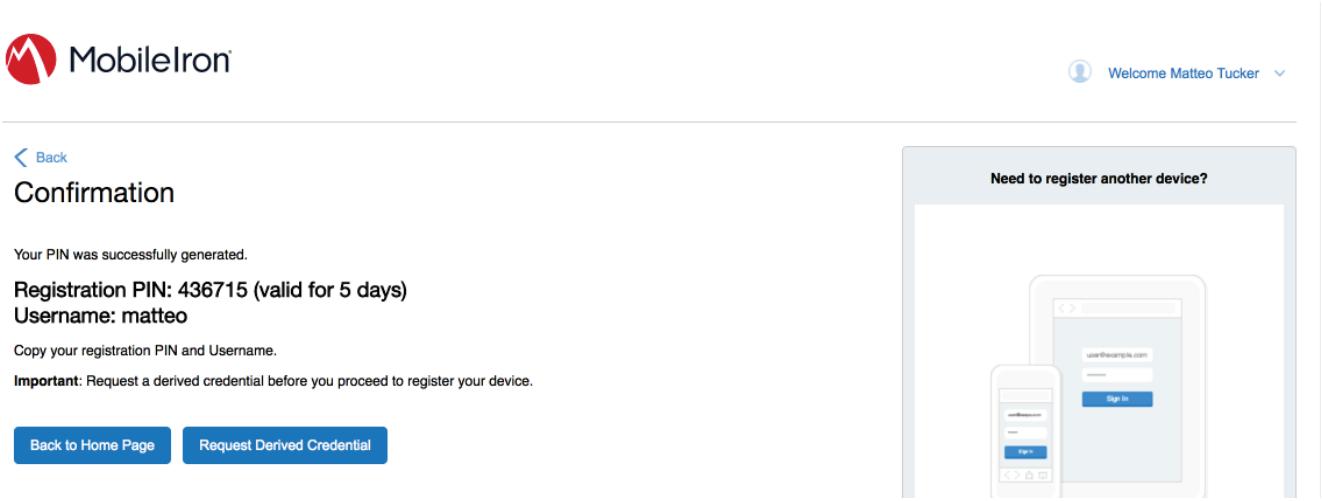


427

428 4. Insert your valid PIV Card into the reader attached to your laptop or computer workstation.

5. To request a Derived PIV Credential during the same session as registration with MobileIron:

    a. In the MobileIron Self-Service Portal **Confirmation** page (see Figure 2-2), click **Request Derived Credential**.

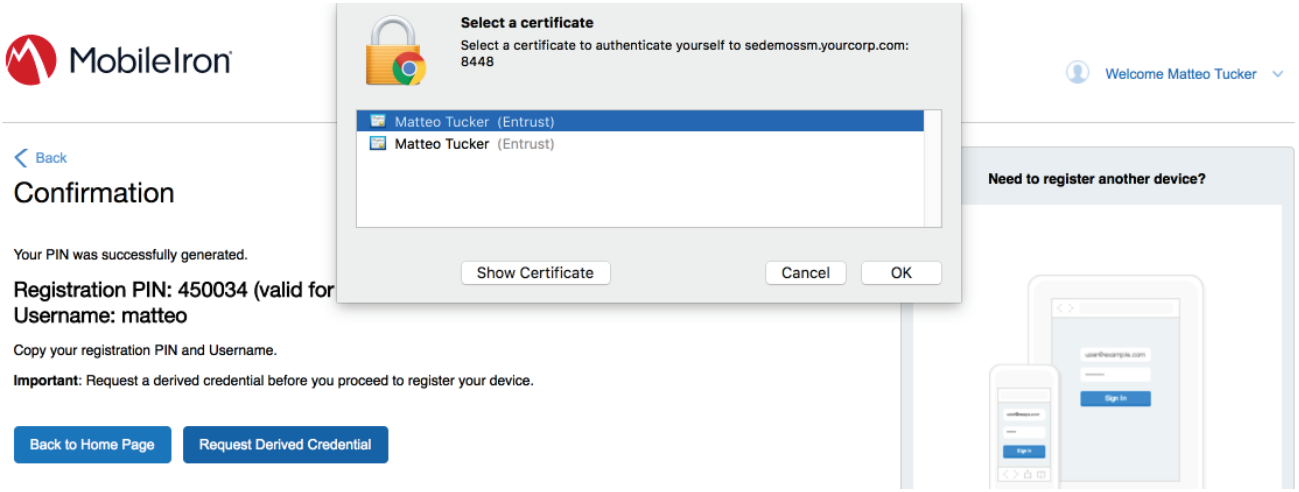


    b. In the certificate selection dialog:

        i. Select your PIV Authentication certificate from the list of available certificates. See **Step 4** of Section 2.3.1.1 for additional steps to identify this certificate, as necessary.

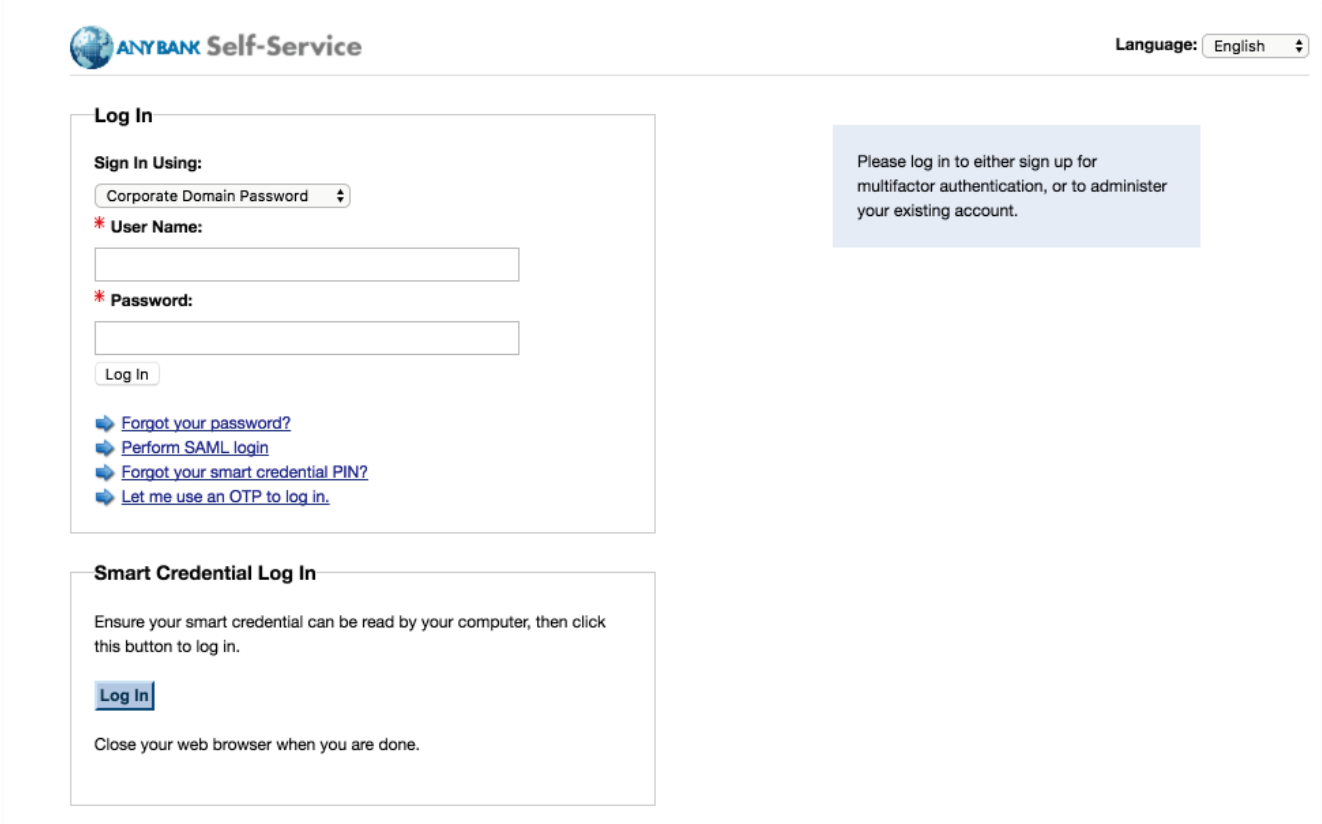
        ii. Click **OK**.

        iii. Continue with **Step 7**.



6. To request a Derived PIV Credential in a new session:
    a. Using a web browser, visit the Entrust IDG Self-Service Portal URL provided by an administrator.
    b. In the Entrust IDG Self-Service portal, under **Smart Credential Log In**, click **Log In**.

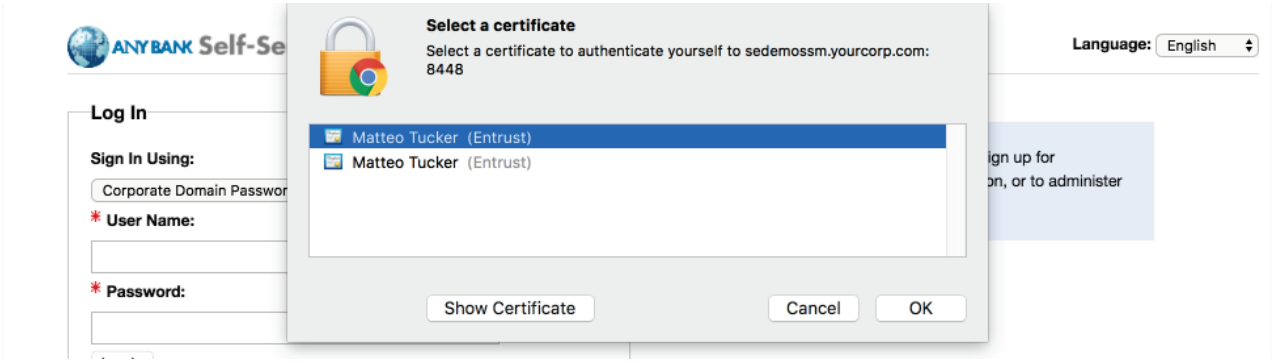
    Note: The portal used in our test environment is branded as a fictitious company, AnyBank Self-Service.



c. In the **Select a certificate** dialog:

   i. Select your PIV Authentication certificate from the list of available certificates. See **Step 4** of Section 2.1.3.1 for additional steps to identify this certificate, as necessary.

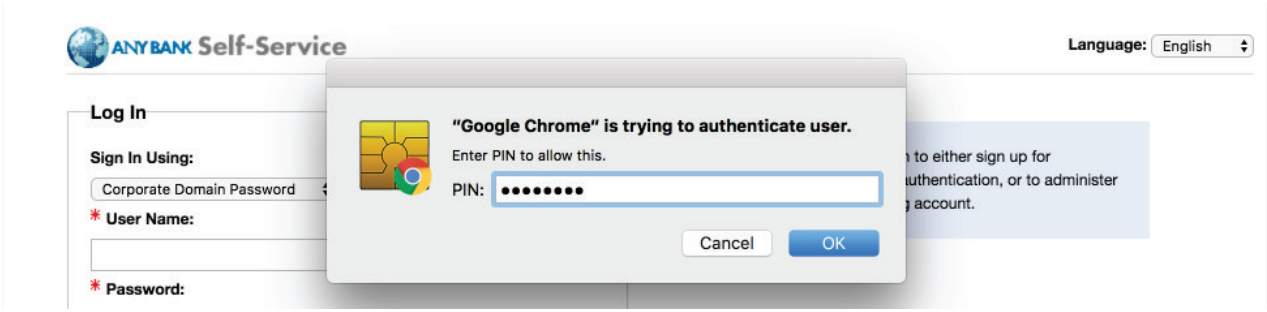
   ii. Click **OK**.



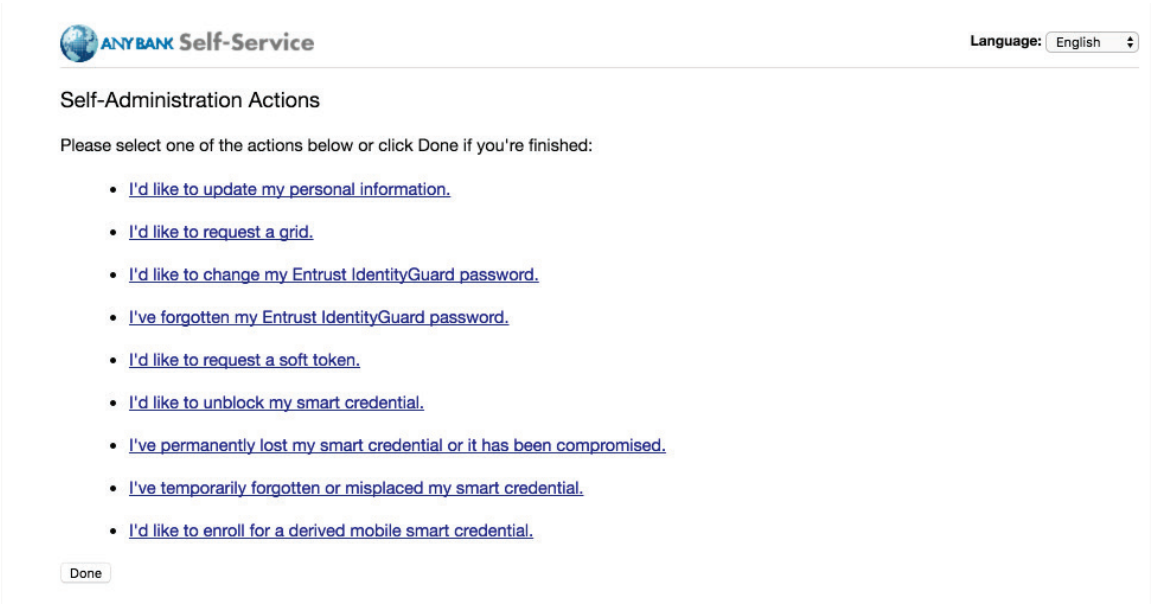
d. In the authentication dialog:

i. In the **PIN** field, enter the password to activate your PIV Card.

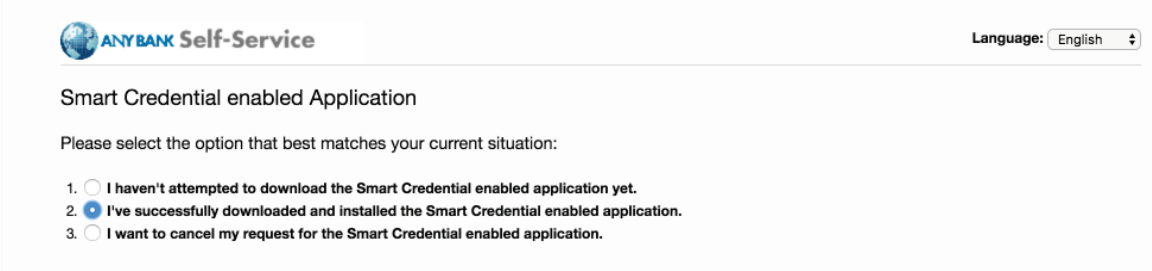
ii. Click **OK**.



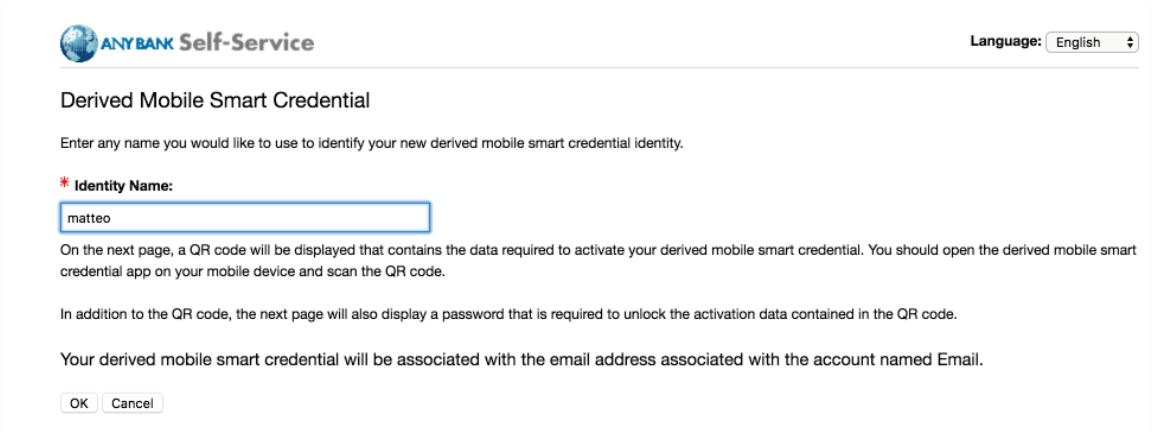
7. On the **Self-Administration Actions** page, follow the **I'd like to enroll for a derived mobile smart credential** link (displayed below as the last item; this may vary based on which self-administration actions your Entrust IDG administrator enabled).



8. On the **Smart Credential enabled Application** page, select **Option 2: I've successfully downloaded and installed the Smart Credential enabled application**.



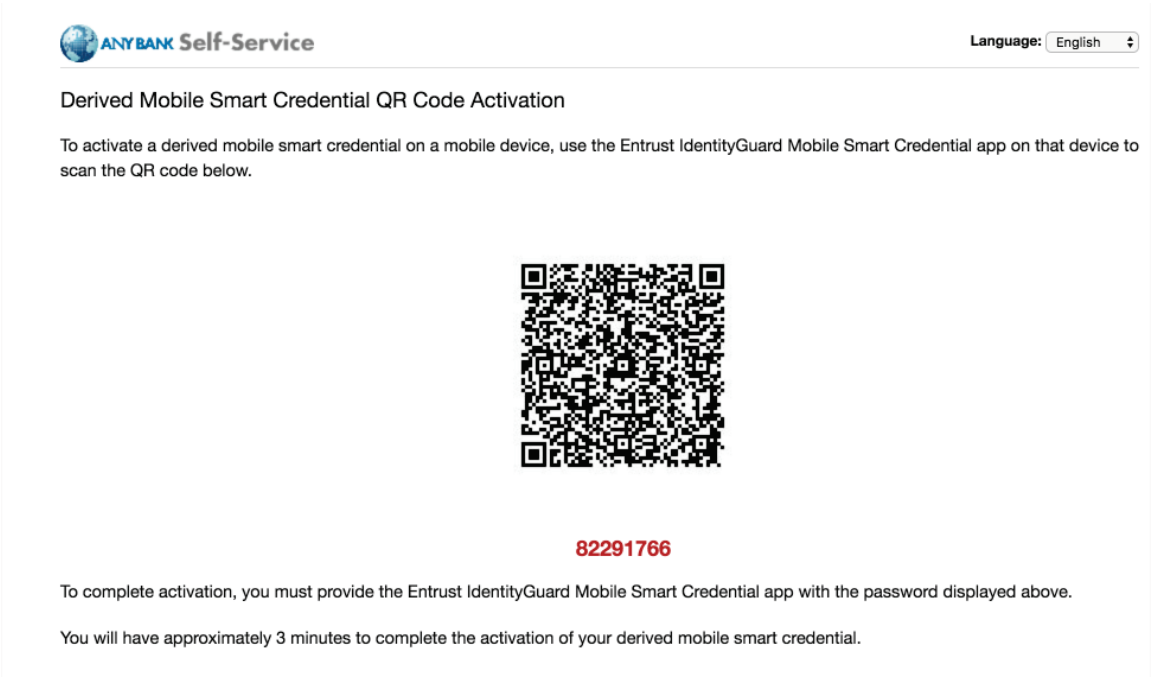
9. On the **Derived Mobile Smart Credential** page:
    a. In the **Identity Name** field, enter your LDAP or MobileIron user ID.
    b. Click **OK**.



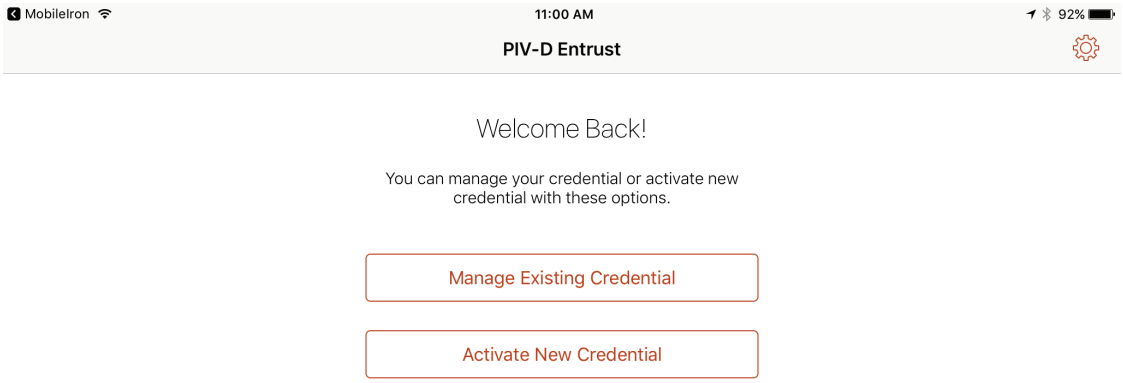
10. The **Derived Mobile Smart Credential QR Code Activation** page displays information used in future steps; keep this page displayed. The workflow resumes using the MobileIron PIV-D Entrust app open on the target mobile device.

    Note: **Steps 11-13** must be completed using the target mobile device within approximately three minutes or **Steps 7-10** must be repeated to generate new activation codes.

Figure 2-3 Derived Mobile Smart Credential QR Code Activation Page

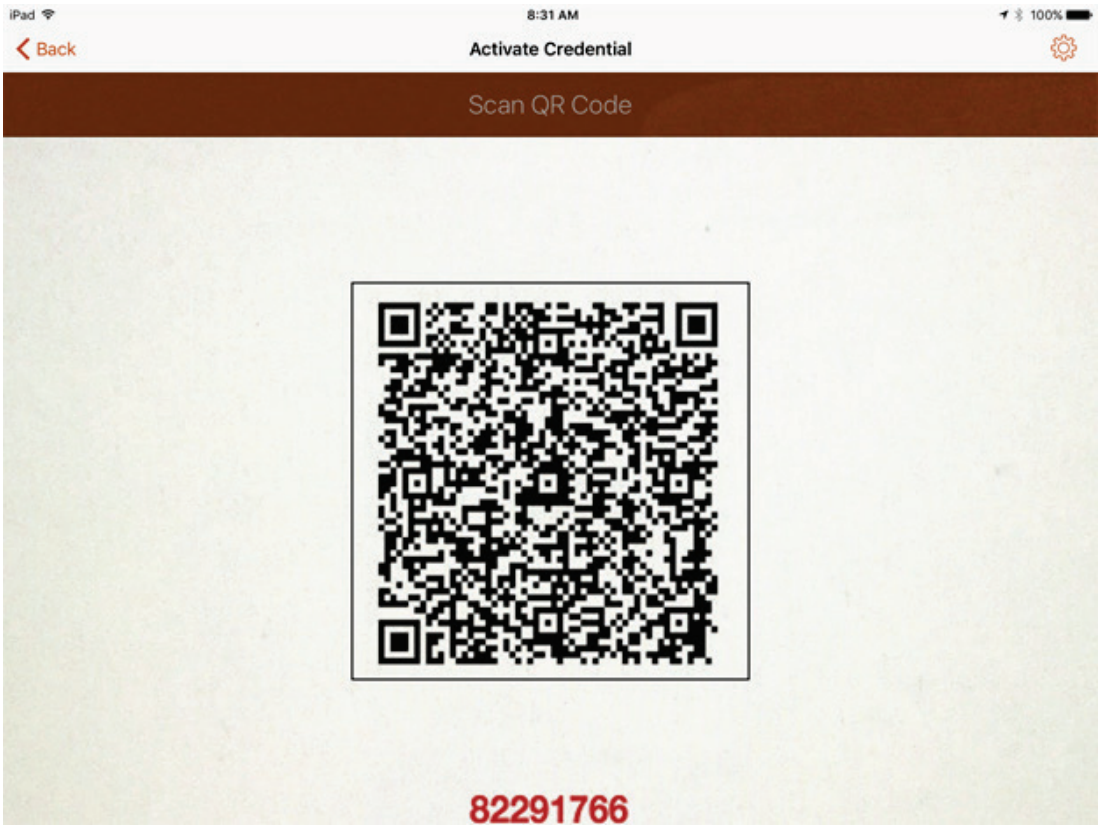


11. In the **PIV-D Entrust** app running on the target mobile device, tap **Activate New Credential**.



470

471 12. Use the device camera to capture the QR code displayed on the **Derived Mobile Smart Creden-**
472 **tial QR Code Activation** page as represented in Figure 2-3.

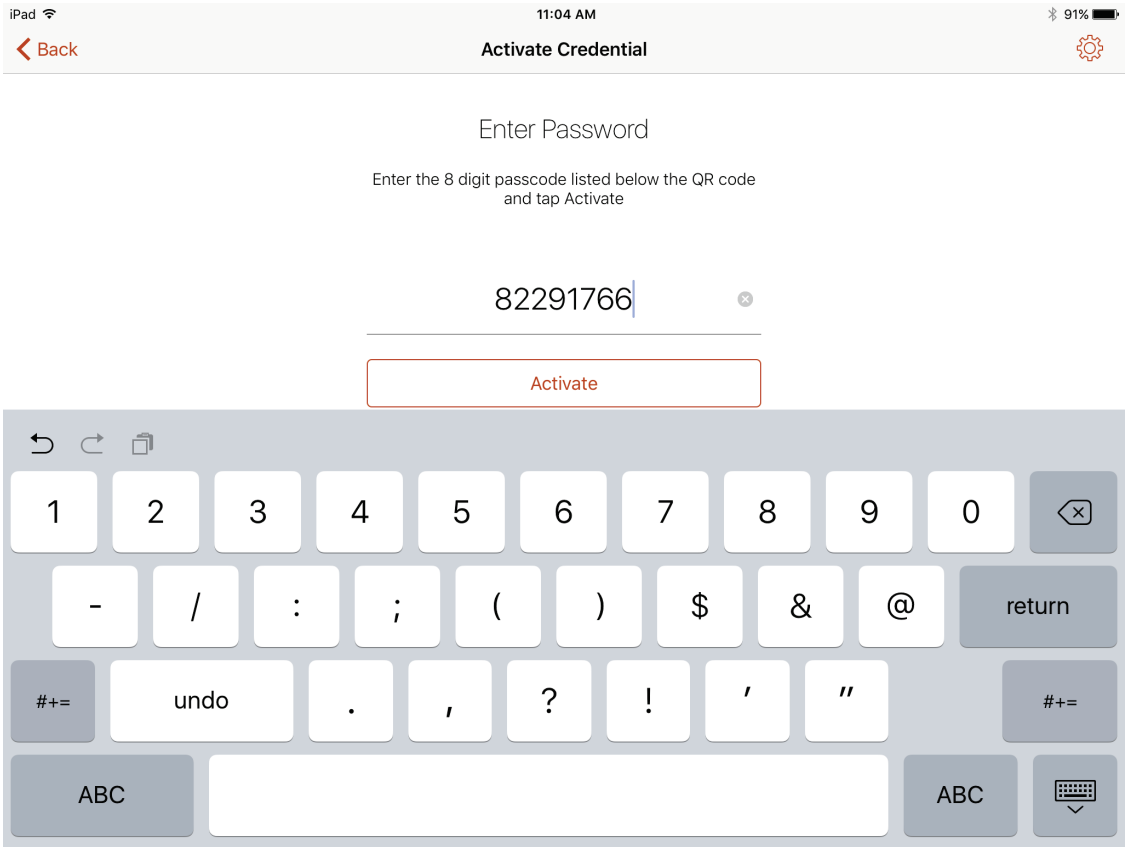


473

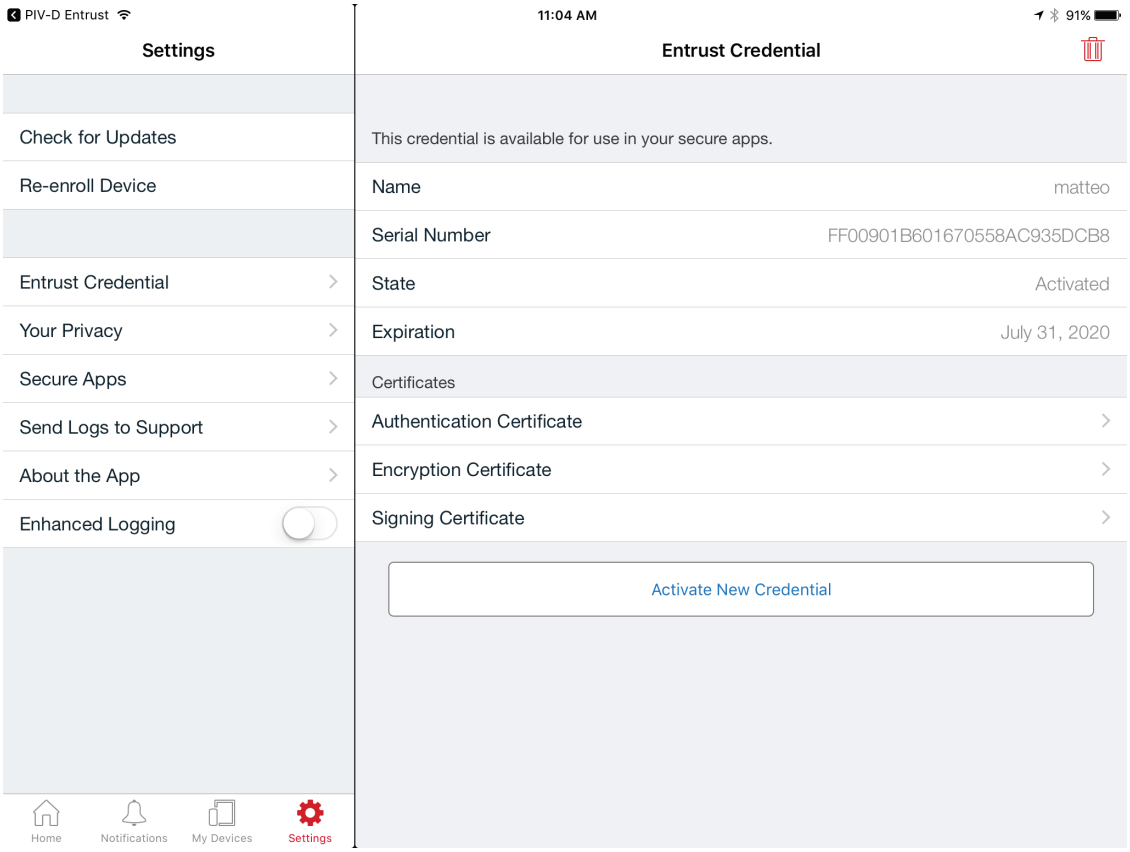
13. On the **Activate Credential** screen:

    a. Enter the **password** below the QR code displayed on the **Derived Mobile Smart Credential QR Code Activation** page (displayed by the same device used to perform **Steps 4-10**) as represented in Figure 2-3.

    b. Tap **Activate**.



14. If issuance was successful, the PIV-D Entrust app should automatically launch MobileIron. Go to **Mobile@Work > Settings > Entrust Credential** to view its details.



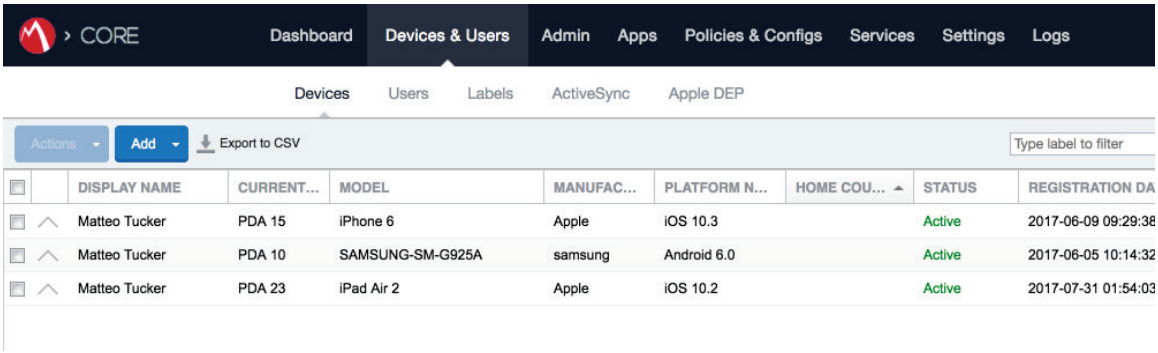
2.3.2 DPC Maintenance

Changes to a DPC Subscriber's PIV Card that result in a re-key or reissuance (e.g., official name change) require the subscriber to repeat the initial issuance workflow as described in the previous section. The issued DPC will replace any existing DPC in the MobileIron Apps@Work container.

2.3.3 DPC Termination

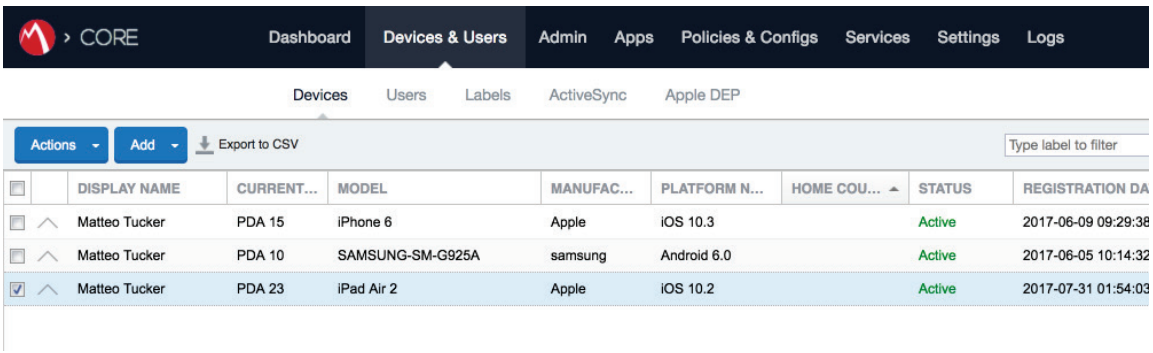
Termination of a DPC can be initiated from the MobileIron Admin Console. Upon completion of this workflow, the DPC stored in the MobileIron Apps@Work container will be cryptographically wiped (destroyed). These steps are performed by a MobileIron Core administrator.

1. In the MobileIron Admin Console, navigate to **Devices & Users > Devices**.



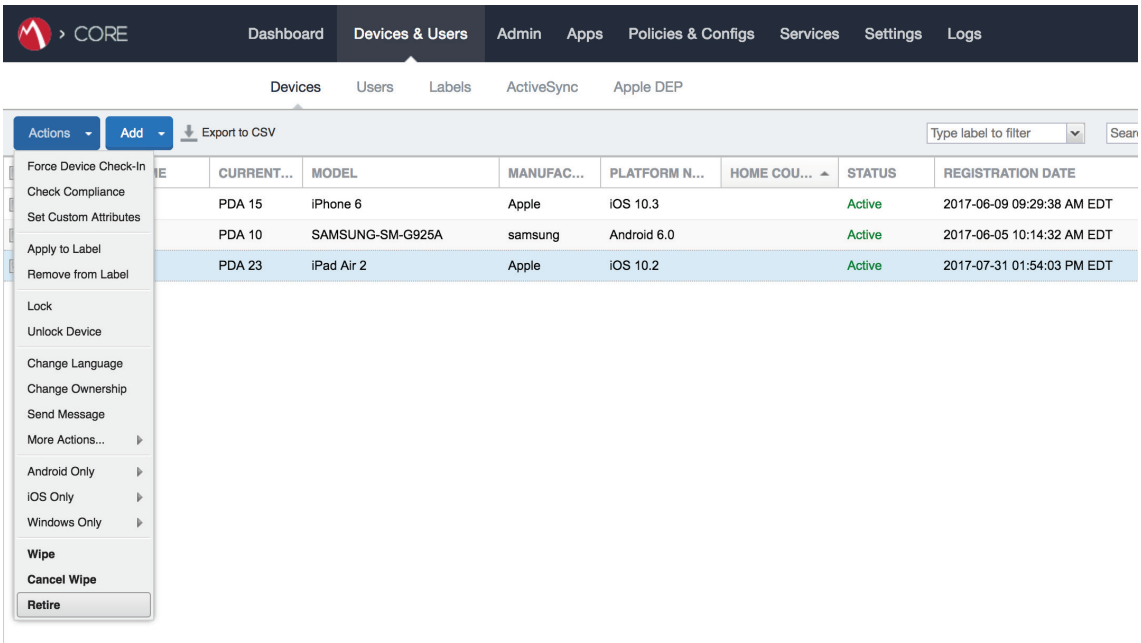
492

493 2. Select the **checkbox** in the row identifying the mobile device to be retired.



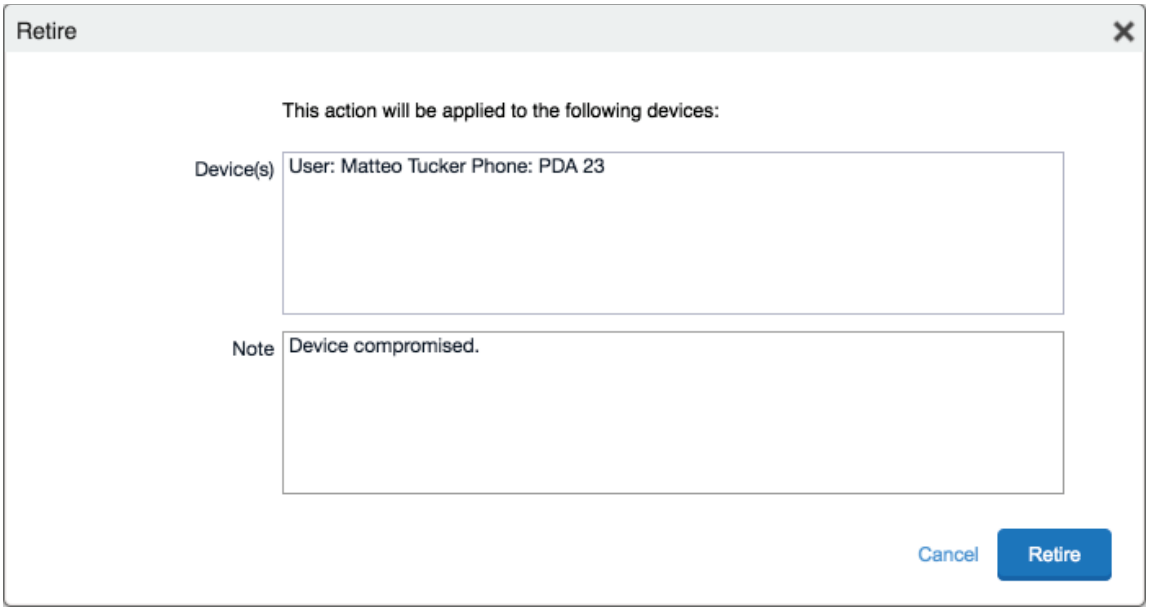
494

495 3. Select **Actions > Retire**.

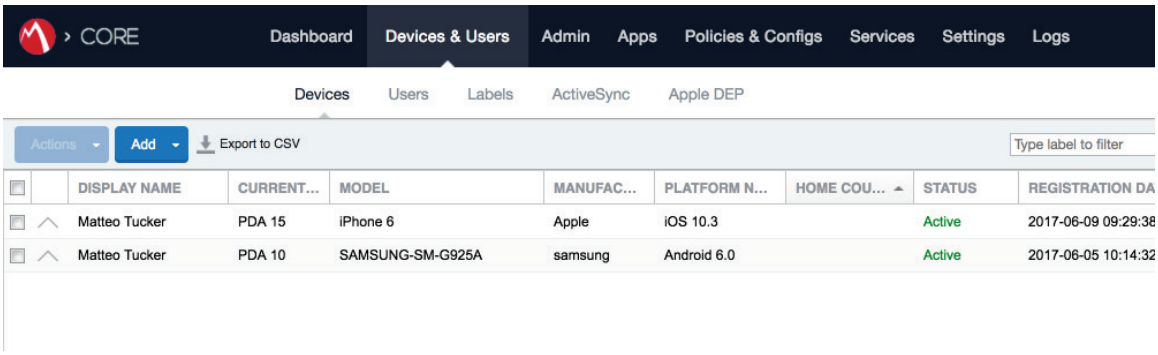


496

4. In the **Retire** dialog that appears:
    a. In the **Note** textbox, enter the reason(s) the device is being retired from MobileIron.
    b. Select **Retire**.



5. The **Devices** tab no longer displays the retired mobile device in the list of the devices.



The MobileIron PIV-D Entrust app now no longer reflects management by MobileIron. As a result, the Derived PIV Credential has been cryptographically wiped (destroyed) and its recovery is computationally infeasible.

Appendix A List of Acronyms

AD	Active Directory
API	Application Programming Interface
CA	Certificate Authority
CAPI	Cryptographic Application Programming Interface
CMS	Credential Management System
CRADA	Cooperative Research and Development Agreement
DMZ	Demilitarized Zone
DN	Distinguished Name
DPC	Derived PIV Credential
EEM	Enterprise Mobility Management
FASC-N	Federal Agency Smart Card Number
FIPS	Federal Information Processing Standards
IDG	Identity Guard
IT	Information Technology
JCE	Java Cryptography Extension
JTK	Java Tool Kit
LDAP	Lightweight Directory Access Protocol
NCCoE	National Cybersecurity Center of Excellence
NIST	National Institute of Standards and Technology
OU	Organizational Unit
PFX	Personal Exchange Format
PIN	Personal Identification Number
PIV	Personal Identity Verification
PKI	Public Key Infrastructure
QR	Quick Response [code]
RSA	Rivest-Shamir-Adleman
SCEP	Simple Certificate Enrollment Protocol
SP	Special Publication
SQL	Structured Query Language
SSM	Self-Service Module
TLS	Transport Layer Security

UPN	User Principal Name
URL	Universal Resource Locator
UUID	Universal Unique Identifier
VLAN	Virtual Local Area Network