NIST SPECIAL PUBLICATION 1800-8C

Securing Wireless Infusion Pumps

In Healthcare Delivery Organizations

Volume C:
How-to Guides

Gavin O'Brien
National Cybersecurity Center of Excellence
Information Technology Laboratory

Sallie Edwards
Kevin Littlefield
Neil McNab
Sue Wang
Kangmin Zheng
The MITRE Corporation
McLean, VA

May 2017

DRAFT

This publication is available free of charge from:
https://nccoe.nist.gov/projects/use-cases/medical-devices

National Institute of Standards and Technology
U.S. Department of Commerce

NCCoE
NATIONAL CYBERSECURITY CENTER OF EXCELLENCE

DISCLAIMER

Certain commercial entities, equipment, products, or materials may be identified in this document to describe an experimental procedure or concept adequately. Such identification is not intended to imply recommendation or endorsement by NIST or NCCoE, nor is it intended to imply that the entities, equipment, products, or materials are necessarily the best available for the purpose.

National Institute of Standards and Technology Special Publication 1800-8C Natl. Inst. Stand. Technol. Spec. Publ. 1800-8C, 256 pages, (May 2017), CODEN: NSPUE2

FEEDBACK

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

Comments on this publication may be submitted to: hit_nccoe@nist.gov.

Public comment period: May 8, 2017 through July 7, 2017

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

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

NATIONAL CYBERSECURITY CENTER OF EXCELLENCE

The National Cybersecurity Center of Excellence (NCCoE), a part of the National Institute of Standards and Technology (NIST), is a collaborative hub where industry organizations, government agencies, and academic institutions work together to address businesses' most pressing cybersecurity issues. This public-private partnership enables the creation of practical cybersecurity solutions for specific industries or broad, cross-sector technology challenges. Working with 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://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

Medical devices, such as infusion pumps, were once standalone instruments that interacted only with the patient or medical provider. But today's medical devices connect to a variety of health care systems, networks, and other tools within a healthcare delivery organization (HDO). Connecting devices to point-of-care medication systems and electronic health records can improve healthcare delivery processes, however, increasing connectivity capabilities also creates cybersecurity risks. Potential threats include unauthorized access to patient health information, changes to prescribed drug doses, and interference with a pump's function.

The NCCoE at NIST analyzed risk factors in and around the infusion pump ecosystem using a questionnaire-based risk assessment to develop an example implementation that demonstrates how HDOs can use standards-based, commercially available cybersecurity technologies to better protect the infusion pump ecosystem, including patient information and drug library dosing limits.

This practice guide will help HDOs implement current cybersecurity standards and best practices to reduce their cybersecurity risk, while maintaining the performance and usability of wireless infusion pumps.

KEYWORDS

authentication; authorization; digital certificates; encryption; infusion pumps; Internet of Things; IoT; medical devices; network zoning; pump servers; questionnaire-based risk assessment; segmentation; VPN; Wi-Fi; wireless medical devices

ACKNOWLEDGMENTS

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

Name	Organization
Arnab Ray	Baxter Healthcare Corporation
Pavel Slavin	Baxter Healthcare Corporation
Phillip Fisk	Baxter Healthcare Corporation
Raymond Kan	Baxter Healthcare Corporation
Tom Kowalczyk	B. Braun Medical Inc.
David Suarez	Becton, Dickinson and Company (BD)
Robert Canfield	Becton, Dickinson and Company (BD)
Rob Suarez	Becton, Dickinson and Company (BD)
Robert Skelton	Becton, Dickinson and Company (BD)
Peter Romness	Cisco
Kevin McFadden	Cisco
Rich Curtiss	Clearwater Compliance
Darin Andrew	DigiCert
Kris Singh	DigiCert
Mike Nelson	DigiCert
Chaitanya Srinivasamurthy	Hospira Inc., a Pfizer Company (ICU Medical)

Name	Organization
Joseph Sener	Hospira Inc., a Pfizer Company (ICU Medical)
Chris Edwards	Intercede
Won Jun	Intercede
Dale Nordenberg	MDISS
Jay Stevens	MDISS
Carlos Aguayo Gonzalez	PFP Cybersecurity
Thurston Brooks	PFP Cybersecurity
Colin Bowers	Ramparts
Bill Hagestad	Smiths Medical
Axel Wirth	Symantec Corporation
Bryan Jacobs	Symantec Corporation
Bill Johnson	TDi Technologies, Inc.
Barbara De Pompa Reimers	The MITRE Corporation
Sarah Kinling	The MITRE Corporation
Marilyn Kupetz	The MITRE Corporation
David Weitzel	The MITRE Corporation
Mary Yang	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
Baxter Healthcare Corporation	• Sigma Spectrum LVP, version 8 • Sigma Spectrum Wireless Battery Module, version 8 • Sigma Spectrum Master Drug Library, version 8 • CareEverywhere Gateway Server, version 14
B. Braun Medical Inc.	• Infusomat® Space Infusion System/ Large Volume Pumps • DoseTrac® Infusion Management Software/ Infusion Pump Software
Becton, Dickinson and Company (BD)	• Alaris® 8015 PC Unit v9.19.2 • Alaris® Syringe Module 8110 • Alaris® LVP Module 8100 • Alaris® Systems Manager v4.2 • Alaris® System Maintenance (ASM) v 10.19
Cisco	• Access Point (AIR-CAP1602I-A-K9) • Wireless LAN Controller 8.2.111.0 • Cisco ISE • Cisco: ASA • Catalyst 3650 Switch
Clearwater Compliance	Clearwater: IRM | Pro
DigiCert	CertCentral management account / Certificate Authority
Hospira Inc., a Pfizer Company (ICU Medical)	• Plum 360™ Infusion System, version 15.10 • LifeCare PCA™ Infusion System, version 7.02 • Hospira MedNet™, version 6.2
Intercede	MyID
MDISS	MDRAP

Technology Partner/Collaborator	Build Involvement
PFP Cybersecurity	Device Monitor
Ramparts	Risk Assessment
Smiths Medical	• Medfusion® 3500 V5 syringe infusion system • PharmGuard® Toolbox v1.5 • Medfusion 4000® Wireless Syringe Infusion Pump • CD, PHARMGUARD® TOOLBOX 2, V3.0 use with Medfusion® 4000 and 3500 V6 (US) • PharmGuard® Server Licenses, PharmGuard® Server Enterprise Edition, V1.1 • CADD®-Solis Ambulatory Infusion Pump • CADD™-Solis Medication Safety Software
Symantec Corporation	• Endpoint Protection (SEP) • Advanced Threat Protection: Network (ATP:N) • Server Advanced - DataCenter Security (DCS:SA):
TDi Technologies, Inc.	ConsoleWorks

Contents

List of Figures

List of Tables

1 Introduction

The following guidelines show IT professionals and security engineers how the NCCoE implemented this example solution. We discuss every product that we employed in this reference design. We do not, however, recreate the product manufacturers' documentation, which is widely available. Rather, these guidelines show how we integrated the products in our environment on your behalf.

Note: These guidelines are not comprehensive tutorials. Many possible service and security configurations for these products exist but 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 gives users the information they need to replicate all or parts of the example implementation that we built in our lab. This reference design is modular and can be deployed in whole or in part.

This guide contains three volumes:

- NIST SP 1800-8A: Executive Summary
- NIST SP 1800-8B: Approach, Architecture, and Security Characteristics – what we built and why
- NIST SP 1800-8C: 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 1800-8A)*, which describes the:

- challenges enterprises face in securing the wireless infusion pump ecosystem
- example solution built at the NCCoE
- benefits of adopting the example solution

Technology or security program managers who are concerned with how to identify, understand, assess, and mitigate risk will be interested in *NIST SP 1800-8B,* which describes what we did and why. The following sections will be of particular interest:

- Section 4, Risk Assessment and Mitigation, describes the risk analysis we performed
- Section 4.3, Security Characteristics and Control Mapping, maps the security characteristics of this example solution to cybersecurity standards and best practices

You might share the *Executive Summary, NIST SP 1800-8A,* with your leadership team members to help them understand the importance of adopting standards-based, commercially available technologies that can help secure the wireless infusion pump ecosystem.

IT professionals who want to implement an approach like this will find the entire practice guide useful. You can use the How-To portion of the guide, *NIST SP 1800-8C*, 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 in our environment to create an example solution.

This guide assumes that IT professionals have experience implementing security products within their enterprise. Although we have used a suite of commercial products to address this challenge, this guide does not endorse these products. Your organization can adopt this solution or one that adheres to these guidelines in part or in whole. 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. Vol B. section 4.4, 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 rather 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 hit_nccoe@nist.gov.

1.2 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 https://nccoe.nist.gov.

1.3 How-to Overview

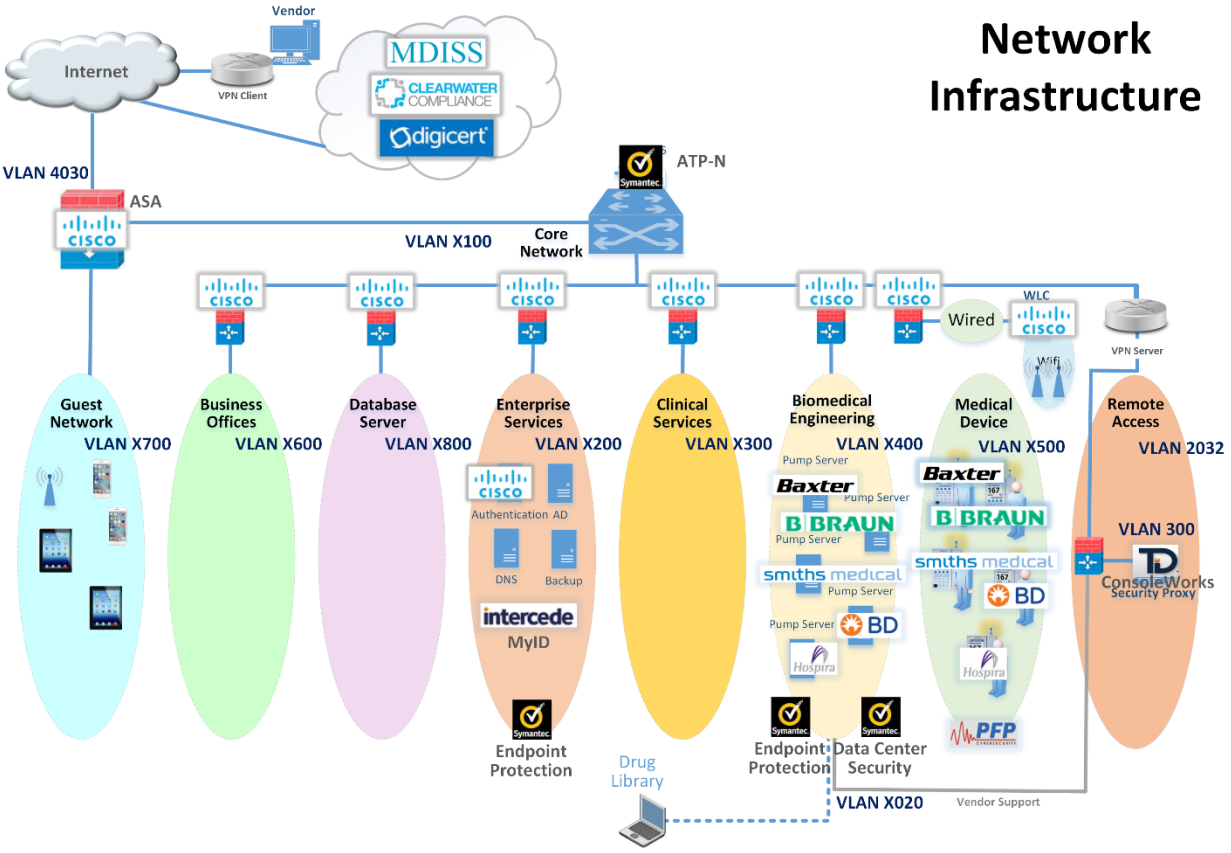
Refer to NIST SP 1800-8B: *Approach, Architecture, and Security Characteristics* for an explanation of why we used each technology.

1.4 Logical Architecture Summary

Below depicts a reference network architecture that performs groupings that would translate to network segments or zones. The rationale behind segmentation and zoning is to limit trust between

areas of the network. In considering a hospital infrastructure, NCCoE identified devices and usage, and grouped them by usage. The grouping facilitated the identification of network zones. Once zones are defined, infrastructure components may be configured such that those zones do not inherently have network access to other zones within the hospital network infrastructure. Segmenting the network in this fashion limits the overall attack surface posed to the infusion pump environment, and considers the network infrastructure configuration as part of an overall defense in depth strategy. Figure 1-1 is included from the architecture for your reference.

Figure 1-1: Logical Architecture Summary



2 Product Installation Guides

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

2.1 The Core Network

The NCCoE's example architecture implements a core network zone which is used to establish the backbone network infrastructure. The external firewall/router also has an interface connected to the core enterprise network, just like other firewall/router devices in the other zones. This zone serves as the backbone of the enterprise network and consists only of routers connected by switches. The routers automatically share internal route information with each other via authenticated Open Shortest Path First (OSPF) [1] to mitigate configuration errors as zones are added or removed.

Several functional segments may be part of this core network:

- guest network
- business office (example only)
- database server (example only)
- enterprise services
- clinical services (example only)
- biomedical engineering
- medical devices with wireless LAN
- remote access for external vendor support

The NCCoE build uses Cisco Adaptive Security Appliances (ASA) as virtual router and firewall devices within the network. Each defined zone in the hospital network we built has its own ASA, with two interfaces to protect the zone. As we considered how many ASAs to use, we opted for a tradeoff between the complexity of the configuration and the number of interfaces on a single ASA.

2.1.1 Cisco ASA Baseline Configuration

In our environment, all ASAs are virtualized and are based on Cisco's Adaptive Security Virtual Appliance (ASAv) product. In your environment, the responsible person would complete installation by following Cisco's *Adaptive Security Virtual Appliance (ASAv) Quick Start Guide, 9.6* [2].

We imported the virtual appliance called *asav-vi.ovf*, assigning the first interface to the management network, the second to the wide area network (WAN), and the third to the local area network (LAN). For an unknown reason, the '`show version`' command did not work in the console; as a workaround, we configured secure shell (SSH) [3] access and ran the command via SSH instead.

Then we configured the ASA with a baseline configuration template that allows all outbound traffic, but only related traffic inbound as allowed by the stateful firewall. Internet Control Message Protocol (ICMP) [4] enables troubleshooting with ping and traceroute tools. Authenticated OSPF automates routing tables as we added or removed ASAs in the network. In your production environment, you may wish to make different decisions in your baseline configuration. All ASAs have an additional management interface on 192.168.29.0/24. We opted to configure Simple Network Management Protocol (SNMP) [5] and SSH for management use on this interface, but not on the other interfaces. See Section A.1 for the ASA configuration for this zone.

2.1.2 External Firewall and Guest Network

We configured the build network to use network address translation (NAT) at the external firewall. This is the only point in the network where NAT is used. The upstream provider uses 10.0.0.0/8 addresses on the WAN interface. We also defined a LAN interface on 192.168.100.0/24 as the core network where other ASAs connect. Another interface is defined as *GUEST* on 192.168.170.0/24. We assigned the GUEST and LAN interfaces equal security levels higher than those for the WAN interface. When ASAs interfaces are configured with equal security levels, by default they cannot communicate with each other, but they will both have WAN access. Dynamic Host Configuration Protocol (DHCP) [6] is enabled on the GUEST interface for addressing.

See Section A.2 for the ASA configuration for this zone.

2.1.3 Enterprise Services

We defined a LAN interface on 192.168.120.0/24 as the LAN for all enterprise services. Ports are open for domain name system (DNS) from the Biomedical Engineering network to the DNS servers. Port 8114 is open for all hosts to the Symantec Endpoint Protection server. Several ports are open for any host to the Symantec Data Center Security server.

See Section A.3 for the ASA configuration for this zone.

2.1.4 Biomedical Engineering Network

This zone contains a dedicated wireless network to support the wireless infusion pumps. We defined a LAN interface on 192.168.140.0/24 for all biomedical equipment, including infusion pump servers. Each manufacturer has a custom set of ports opened to their server. These ports are only accessible from the medical device network.

Generally, the firewall is configured in this way:

All pump servers -> internet/intranet (all destinations)

All intranet -> all pump servers Ping and Traceroute (primarily for debugging)

All pumps -> *Smiths Medical Pump Server* on port 1588

All pumps -> *Carefusion Pump Server* on port 3613

All pumps -> *Baxter Pump Server* on port 51244

All pumps -> *Hospira Pump server* on ports 443, 8443, 8100,9292,11443, 11444

All pumps -> *B. Braun Pump server* on ports 443, 80, 8080, 1500, 4080

See Section A.4 for the ASA configuration for this zone.

2.1.5 Medical Devices

We defined a LAN interface on 192.168.150.0/24 as the LAN for all medical devices. The infusion pump systems are designed such that all external connections to the pumps, such as an EHR system or vendor maintenance, is completed with the associated pump server on the Biomedical Engineering network. This enables us to disallow all outbound traffic not destined for the Biomedical Engineering network. In addition, because some pump servers initiate connections to open ports on the pumps, we added vendor-specific rules to allow this. A DNS server is not useful in this case, but, if you needed one, we recommend that the ASA act as a forwarder. The DHCP server on the ASA is enabled for LAN addressing. In our lab, we discovered that at least one brand of infusion pump would not recognize network setup as complete unless at least one DNS server address was set. In this case, the DNS server address only needed to be included in the configuration; a DNS server did not actually need to be present at that address.

Generally, the firewall is configured in this way:

All pumps -> all pumps servers

All intranet -> all pumps Ping and Traceroute (primarily for debugging)

Hospira Pump Server -> All pumps ports 8100, 9292, 443, 8443

Baxter Pump Server-> All pumps port 51243

B. Braun Pump Server -> All pumps ports 80, 443, 8080, 1500

See Section A.5 for the ASA configuration for this zone.

2.1.6 Cisco Catalyst Switch Configuration

The Catalyst 3650 switch is configured with four virtual LANs (VLANs) [7]. One port is assigned to a management VLAN, with subnet 192.168.20.0/24. Wireless access points are connected to a Wi-Fi management VLAN, which also is trunked back to the virtual WLAN controller software. Additionally, the Biomedical and Device networks have some physical ports configured for testing, both of which are also trunked back to the virtualization hardware and ASAs. DHCP is enabled for the wireless access points. SNMP and SSH are enabled for management. The switch also supports Power over Ethernet (PoE), allowing for a single Ethernet cable, with both data and power for the APs.

To set up your organization's configuration, follow the instructions in Cisco's *Catalyst 3650 Switch Getting Started Guide:* http://www.cisco.com/c/en/us/td/docs/switches/lan/catalyst3650/hardware/quick/guide/cat3650_gsg.html.

See Section A.6 for the switch configuration.

2.1.7 Cisco Enterprise Wi-Fi Infrastructure

The Wi-Fi management network is different in that it does not have a firewall/router that connects directly to the core network. A completely closed network, this is used for management and communication between the Cisco Aironet wireless access points (AP) and the Cisco Wireless LAN Controller (WLC). The WLC is the central point where wireless service set identifiers (SSID), virtual LANs (VLAN), and Wi-Fi-protected access version 2 (WPA2) [8] security settings are managed for the entire enterprise. We defined two SSIDS: *IP_Dev* and *IP_Dev_Cert*. IP_Dev uses *WPA2-PSK* and *IP_Dev_Cert* uses *WPA2-Enterprise* protocols.

2.1.7.1 Installation

In our environment, the Cisco WLC is virtualized. In your environment, the responsible person would complete installation by following *Cisco's Virtual Wireless LAN Controller Deployment Guide 8.2:* http://www.cisco.com/c/en/us/td/docs/wireless/technology/mesh/8-2/b_Virtual_Wireless_LAN_Controller_Deployment_Guide_8-2.html.

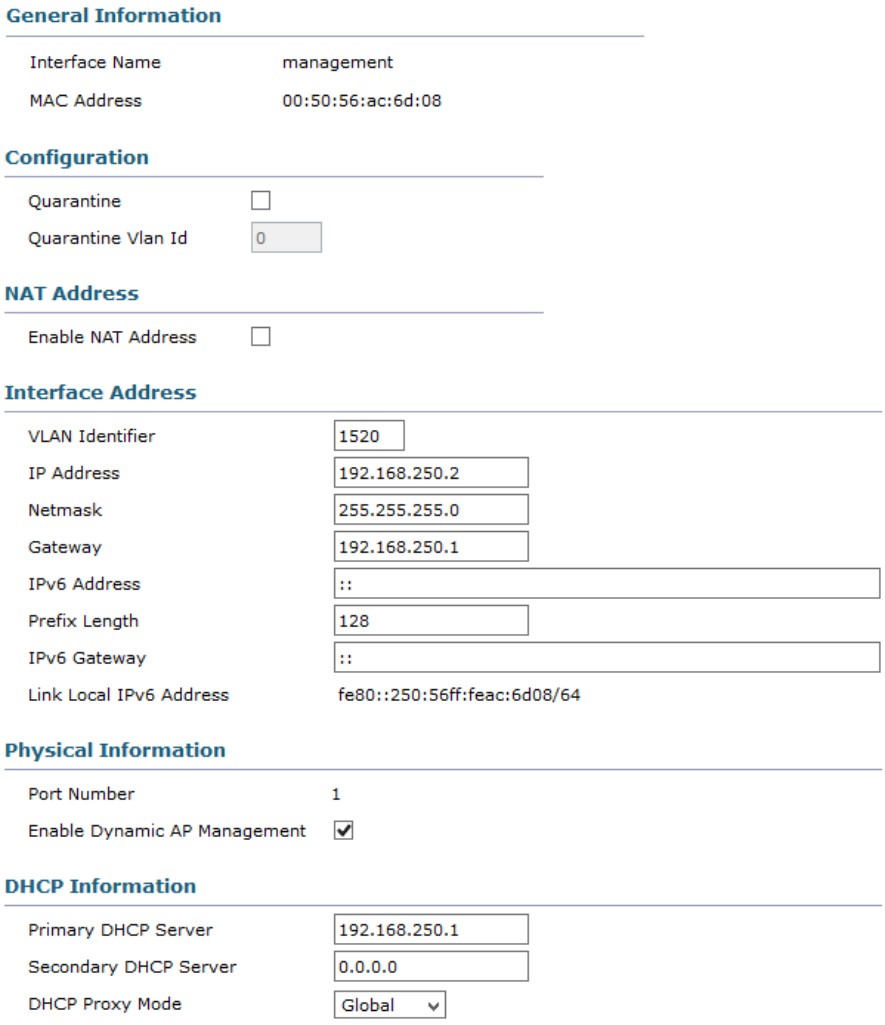
We imported the virtual appliance called *AIR_CTVM_K9_8_2_111_0.ova*, assigning the first interface to the management network, referred to as *service-port* in the web interface. The second interface is used as a trunk port, with VLAN tags for all user and Wi-Fi management traffic. In the web interface, the built-in *management* interface refers to the wireless system control traffic network that the APs are connected to.

The primary management mechanism for the WLC is the web interface. To configure an IP address for the web interface, we first needed to use the console and complete the setup wizard that sets the *service-port* address. What follows is our process, which your organization can adapt to your needs.

2.1.7.2 Controller Configuration

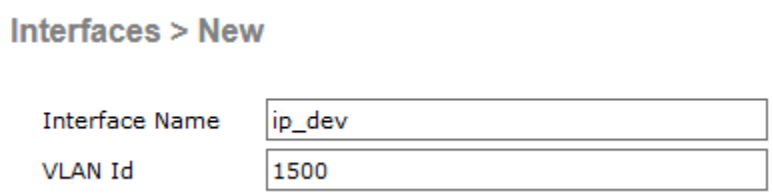
Configure Network Interfaces:

1. Configure the interface for AP management traffic at **Controller** -> **Interfaces** -> **Management**.

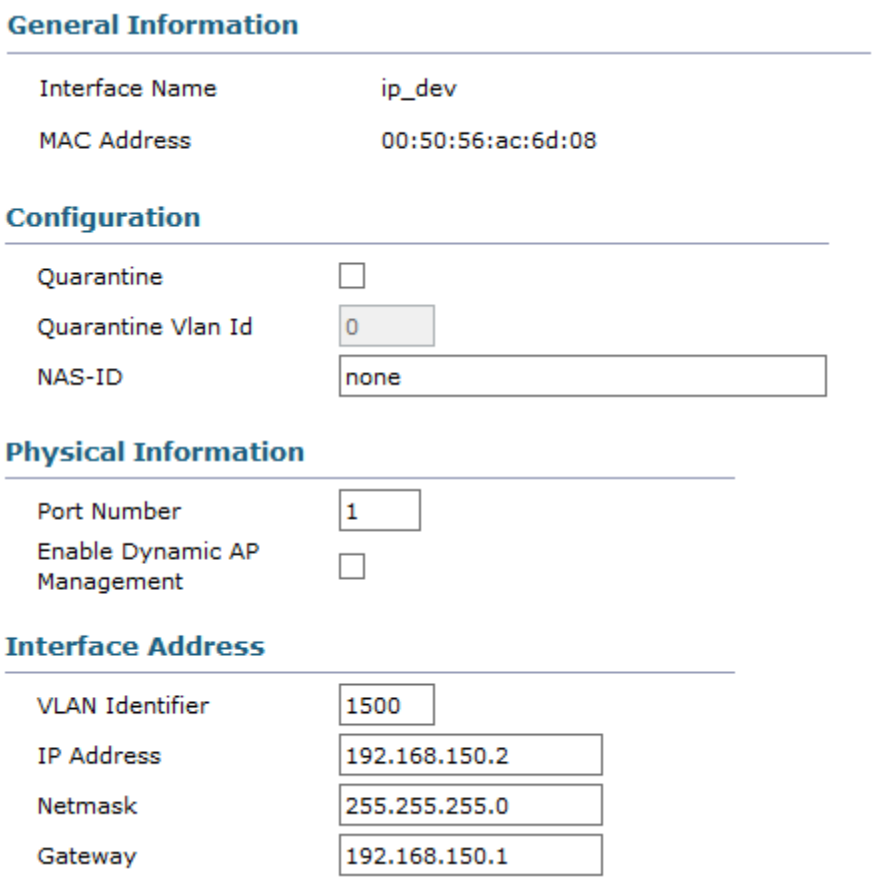


2. Configure interfaces for user Wi-Fi traffic, by first mapping the interface to an Ethernet port and setting the VLAN and IP address, and then mapping to wireless SSIDs.

Create the new interface at **Controller -> Interfaces -> New.**

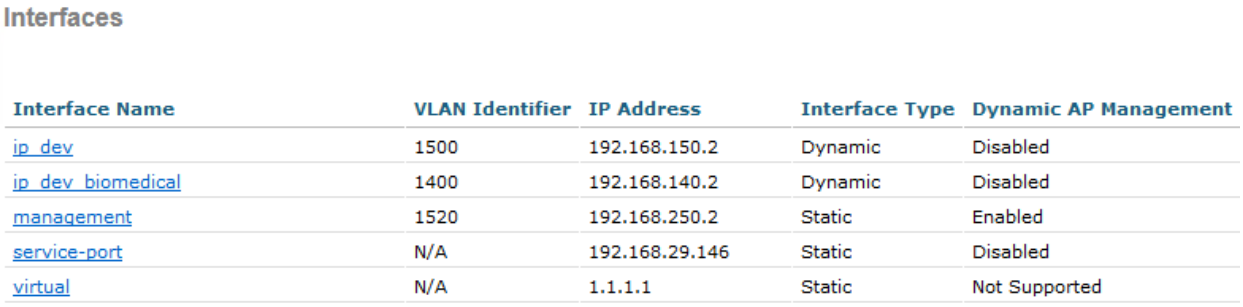


Configure the new interface by using the form below. Refer to the completed interface for the values that we used in the lab.



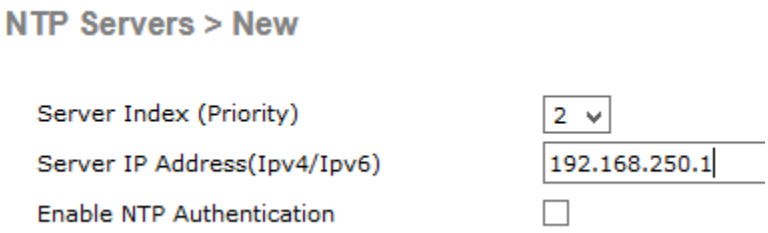
197

198 Our completed Interfaces list looks like the following:



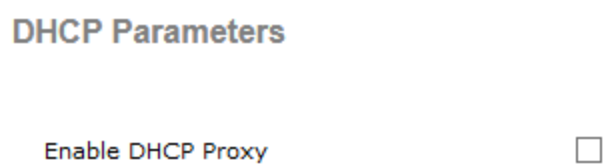
199

200 Configure NTP [9] at **Controller -> NTP -> Server -> New**:



201

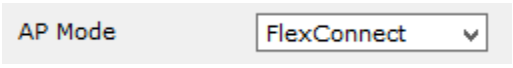
202 To configure the DHCP server, disable the DHCP Proxy at **Controller -> Advanced -> DHCP.**



2.1.7.3 Wireless AP Connection and Setup

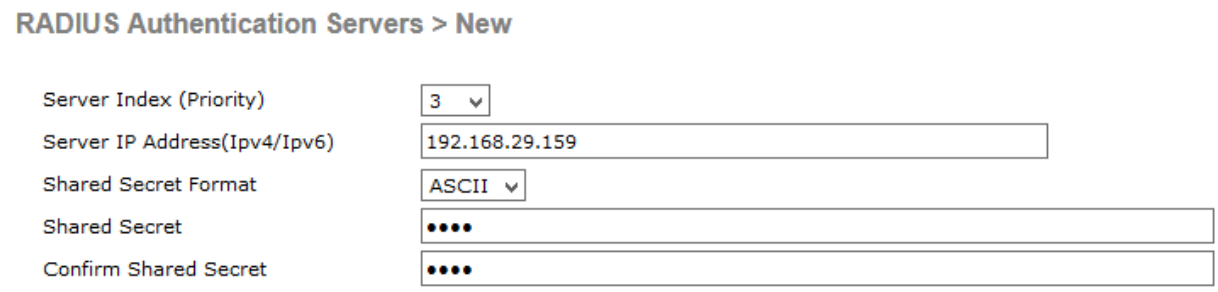
Connect the APs to the Ethernet ports configured for untagged VLAN 1520. They will obtain their addresses and the WLC address automatically via DHCP from the switch (see Cisco Catalyst Switch Configuration in Section 2.1.6). No other VLANs should to be configured for the APs because we are using a centralized switching model where Wi-Fi traffic VLANs are connected to the Enterprise network through the WLC.

As each AP is connected, it should show up in the *Wireless* tab on the WLC. For each AP, the *AP Mode* needs to be set to *FlexConnect* (see below).



2.1.7.4 Authentication Configuration

To use certificate-based authentication, the WLC must consult a RADIUS server. Configure Cisco ISE RADIUS server IP Address and Shared Secret at **Security -> RADIUS -> Authentication -> New**.



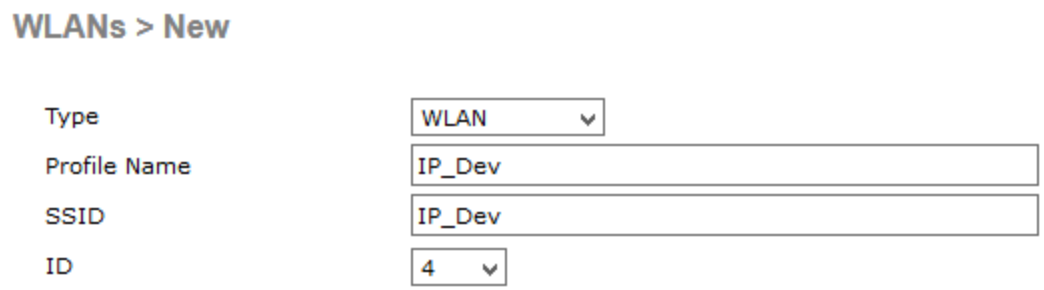
2.1.7.5 WLANs Configuration

At this point, we configured two SSIDs for medical devices: *IP_Dev* is configured for WPA2 (AES [10]) PSK, and *IP_Dev_Cert* is configured for WPA2 (AES) Enterprise. They both use the same interface and therefore connect to the same network VLAN; the only difference is the Wi-Fi security.

To create a new SSID, follow these steps:

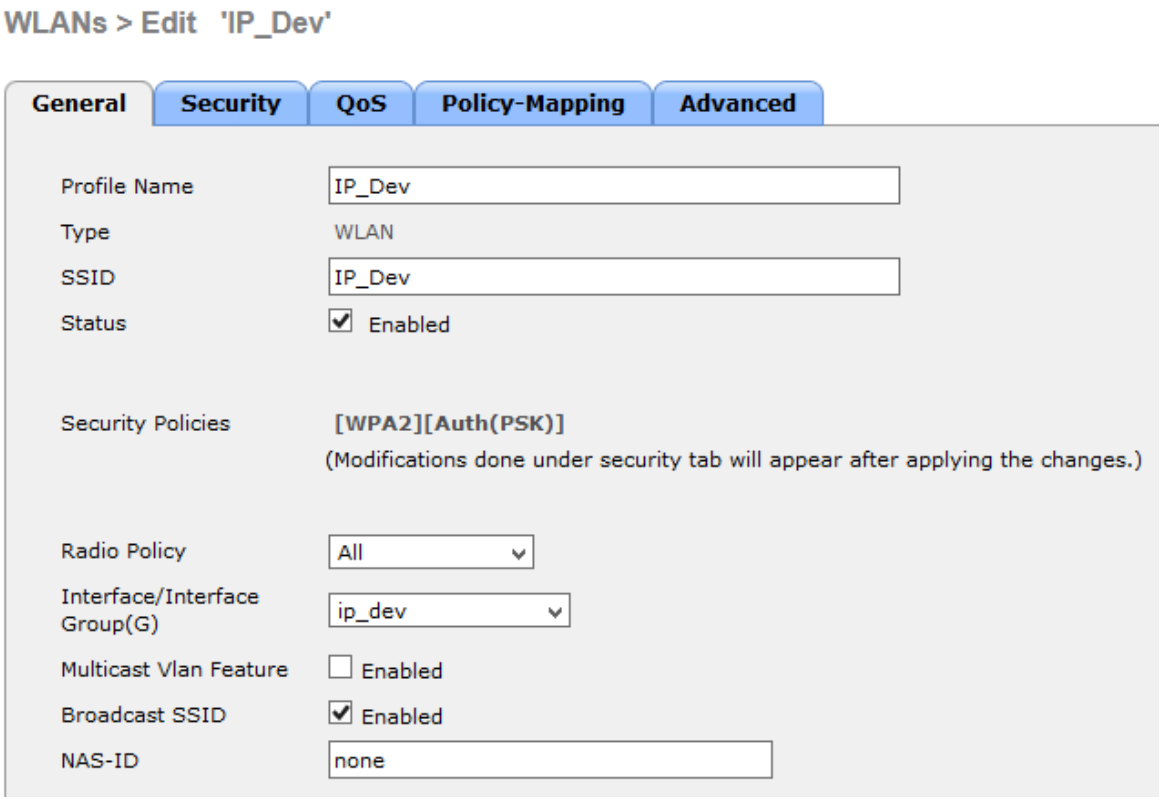
1. Use the WLAN tab.

2. Enter your new SSID information.



225

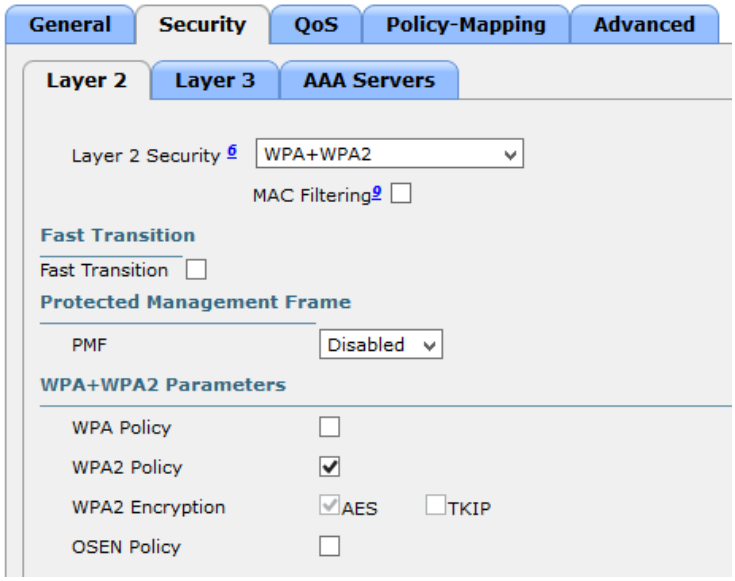
226 3. In **WLANs > WLANs -> WLANs**, select the WLAN ID number of the newly created SSID. Set *Status* to
227 *Enabled* and Interface/Interface Group(G) to *ip_dev*.



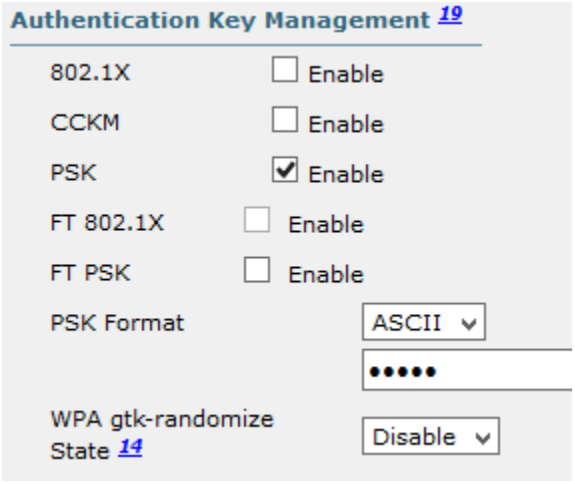
228

229 4. On the **Security tab** under **Authentication Key Management**, uncheck *802.1X*, check *PSK,* and set
230 the PSK field.

231

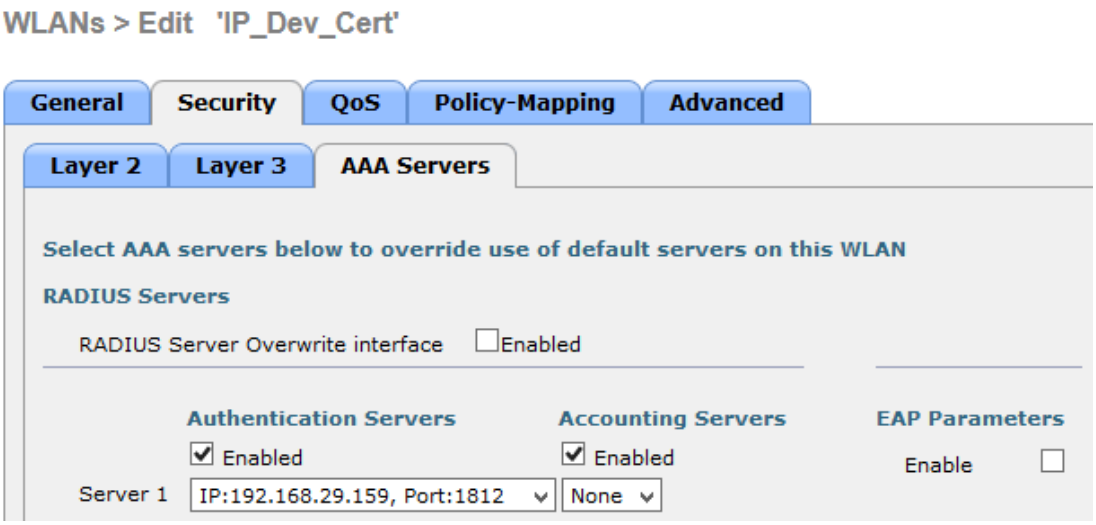


232



233 5. For the SSID *IP_Dev_Cert*, repeat the steps above, but do not change the Security Settings for
234 Authentication Key Management; leave *802.1X* checked, and leave *PSK* unchecked.

235 6. On the **Security, AAA Servers** tab, select the *RADIUS* server to authenticate with.



236

237 2.1.7.6 Monitoring

238 By using **Monitor -> Clients**, you will find the list of currently connected clients, which SSID they are
239 connected to, and the User Name used to authenticate (Common Name from Certificate).

Client MAC Addr	IP Address(Ipv4/Ipv6)	WLAN Profile	WLAN SSID	User Name
00:17:23:e1:8e:32	192.168.250.116	IP_Dev_Cert	IP_Dev_Cert	BBraun
00:17:23:f3:9f:db	192.168.250.123	IP_Dev	IP_Dev	Unknown
00:17:23:f4:f5:4e	192.168.250.118	IP_Dev_Cert	IP_Dev_Cert	Carefusion
00:18:e7:8f:cd:1f	192.168.250.126	IP_Dev	IP_Dev	Unknown
00:40:9d:96:04:0c	192.168.250.125	IP_Dev	IP_Dev	Unknown
00:40:9d:96:06:06	192.168.250.124	IP_Dev	IP_Dev	Unknown
00:80:92:68:62:26	192.168.250.117	IP_Dev_Cert	IP_Dev_Cert	Hospira
28:ed:6a:f2:4e:37	192.168.250.122	IP_Dev_Cert	IP_Dev_Cert	Baxter

240

241 2.1.7.7 Final Configuration

242 See Section A.7 for the WLC configuration, accessing details about additional configuration options at
243 *Cisco Wireless Controller Configuration Guide, Release 8.0,*
244 http://www.cisco.com/c/en/us/td/docs/wireless/controller/8-0/configuration-guide/b_cg80.html.

245 2.1.8 TDi ConsoleWorks External Remote Access

246 The NCCoE lab implemented a VendorNet using TDi ConsoleWorks, which is a browser interface that
247 enables healthcare organizations to manage, monitor, and record activities from external vendors in the
248 IT infrastructure.

249 System Environment:

250 The NCCoE lab set up a fully updated (as of 4/20/2016) CentOS 7 Operating System, with the following
251 hardware specifications:

252 - 8GB RAM
253 - 40 GB HDD
254 - 1 Network Interface

Other requirements:

- ConsoleWorks install media (we built from a CD)
- ConsoleWorksSSL-<version>.rpm
- ConsoleWorks_gui_gateway-<version>.rpm
- ConsoleWorks license keys (*TDI_Licenses.tar.gz*)
- Software installation command
- yum install uuid libbpng12 libvncserver

Installation:

As Root:

1. Place ConsoleWorks Media into the system
2. `mount` /dev/sr0 /mnt/cdrom
3. `mkdir` /tmp/consoleworks
4. `cp` /mnt/cdrom/consolew.rpm /tmp/consoleworks/consolew.rpm
5. `rpm -ivh` /tmp/consoleworks/ConsoleWorksSSL-<version>.rpm
6. `mkdir` /tmp/consoleworkskeys/
7. Copy ConsoleWorks keys to */tmp/consoleworkskeys/*
8. `cd` /tmp/consoleworkskeys/
9. `tar xzf` TDI_Licenses.tar.gz
10. `cp` /tmp/consoleworkskeys* /etc/TDI_licenses/
11. `/opt/ConsoleWorks/bin/cw_add_invo`
12. Accept the License Terms.
13. Press Enter to continue.
14. Name the instance of ConsoleWorks.
15. Press Enter to accept default port (5176).
16. Press N to deny SYSLOG listening.
17. Press Enter to accept parameters entered.
18. Press Enter to return to /opt/ConsoleWorks/bin/cw_add_invo.
19. `rpm -ivh` /tmp/consoleworks/ConsoleWorks_gui_gateway-version>.rpm
20. `/opt/gui_gateway/install_local.sh`
21. `/opt/ConsoleWorks/bin/cw_start` <invocation name created early>
22. `service gui_gatewayd start`

Usage:

1. Open a browser and navigate to *https://<ConsoleWorksIP>:5176*.
2. Log in with Username*: console_manager*, Password: *Setup.*
3. Change the default password.
4. Choose Register Now.

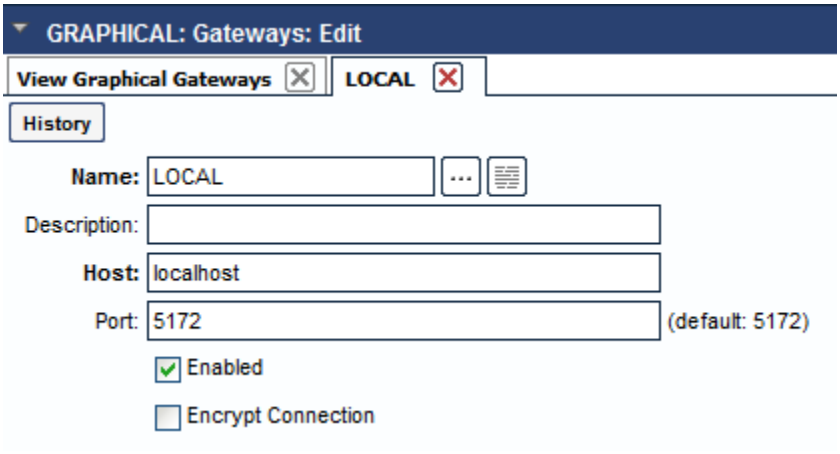
NCCoE chose ConsoleWorks to segregate and limit vendor access to our labs. Our data model groups consoles and graphical connections together into a tag. The *tag* is a collection of equipment that you need to connect to, although a vendor typically owns the equipment. This tag allows us to operate on a group of *consoles* and *graphical connections*. We group users from the same vendor into a *profile* that allows us to operate on the users. An Access Control Rule associates a profile with a tag and defines permissions for a particular component type (typically consoles or graphical connections).

Initial Configuration of Graphical Gateway

Use the menu in the sidebar to access all instructions below.

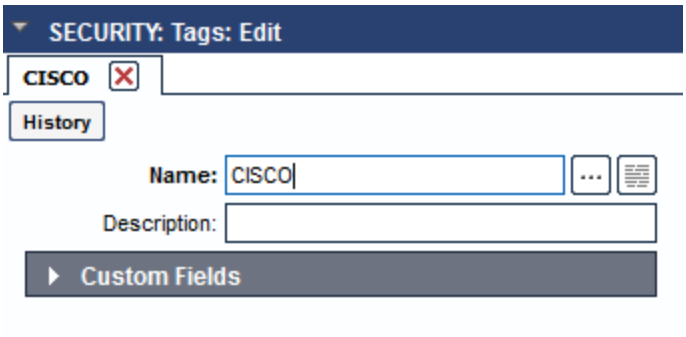
Configure Graphical Gateway (only required for graphical connections such as virtual network computing, VNC; and remote desktop protocol, RDP):

1. Click on Graphical->Gateways->Add.
2. Set a name: LOCAL, then set Host as Localhost and port as 5172.
3. Check the Enabled box and click Save.
4. Verify that it works by clicking Test in the top-left corner.



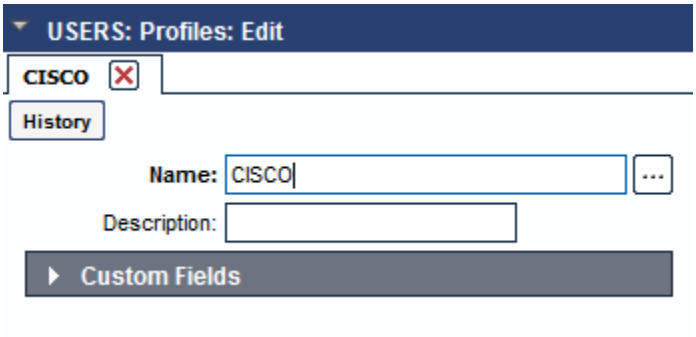
Create one tag for each vendor company:

1. Click on Security->Tags->Add.
2. Set Name*,* usually the company name.
3. Click *Save.*



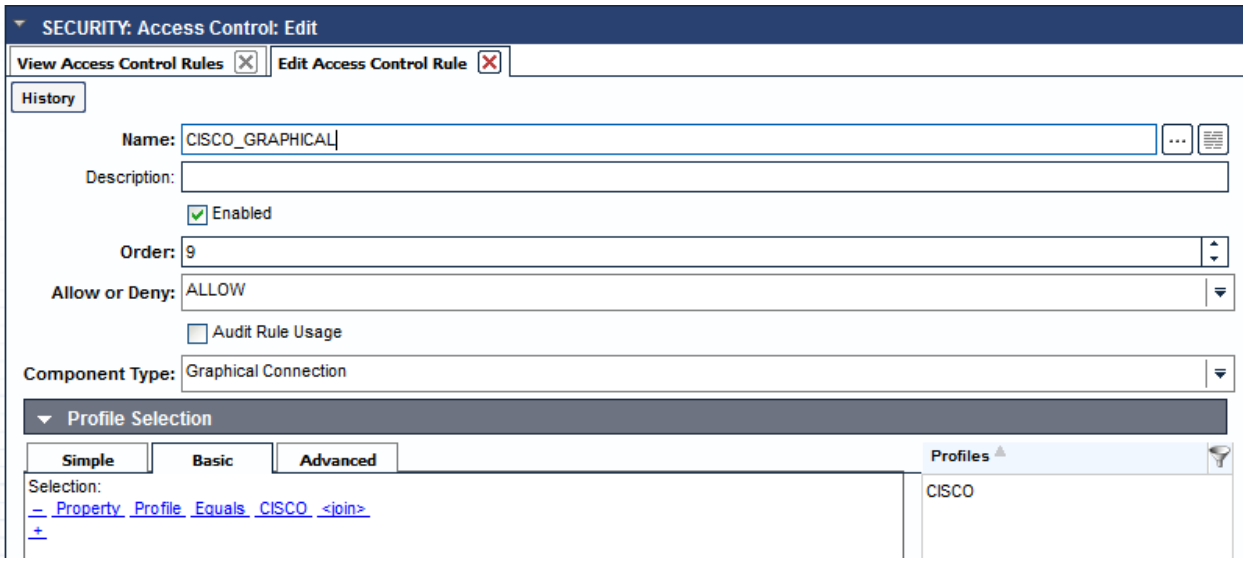
Create one profile for each vendor company.

1. Click on Users->Profiles->Add.
2. Set Name, usually the company name.
3. Click *Save.*



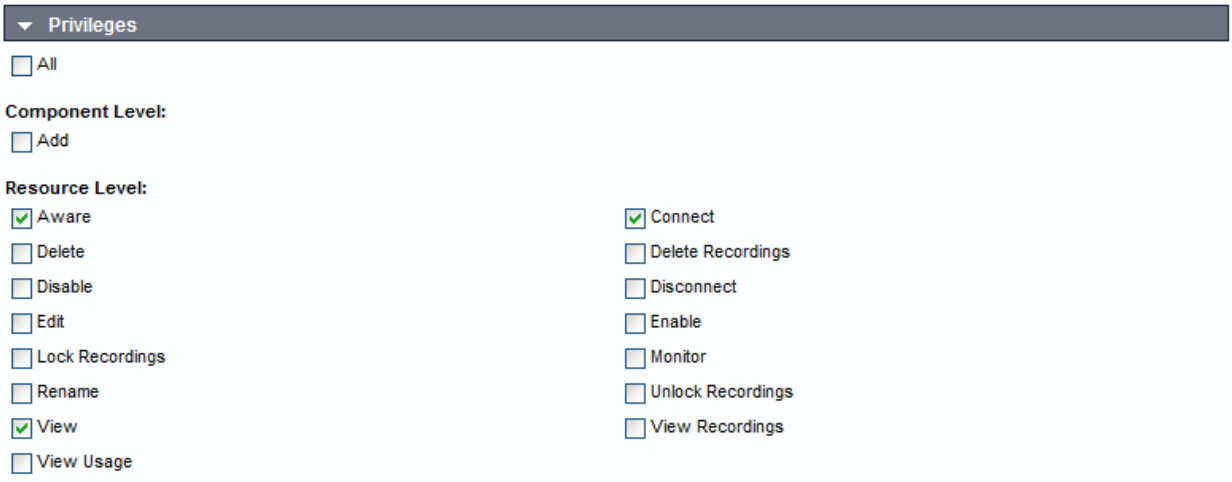
Establish graphical access controls. (Repeat this section for each vendor company.)

1. Click on Security->Access Control->Add.
2. Set Name to Vendor_Company_Graphical.
3. Check *Enabled.*
4. Set *Order.*
5. Set *Allow.*
6. Set Component Type to Graphical Connection.
7. Look under *Profile Selection*; you should see:
   - Property Profile Equals *Vendor Company Profile Name* <join>.
   - Vendor company profile should appear in the box on right.



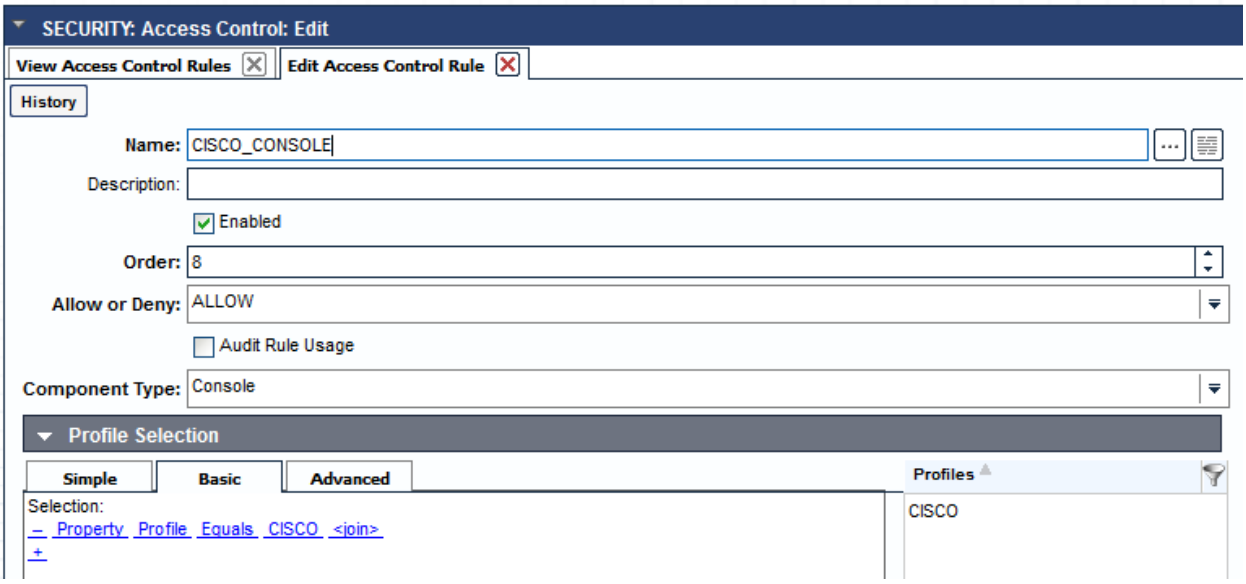
8. Look under *Resource Selection*; you should see:
   - Associated with a Tag that
   - Property Tag Equals *Vendor Company Tag name* <join>.

9. Matching Graphical Consoles should then appear in the box on right. Under Privileges, check:
   - Aware
   - View
   - Connect



Console Access Controls (repeat this section for each vendor company):

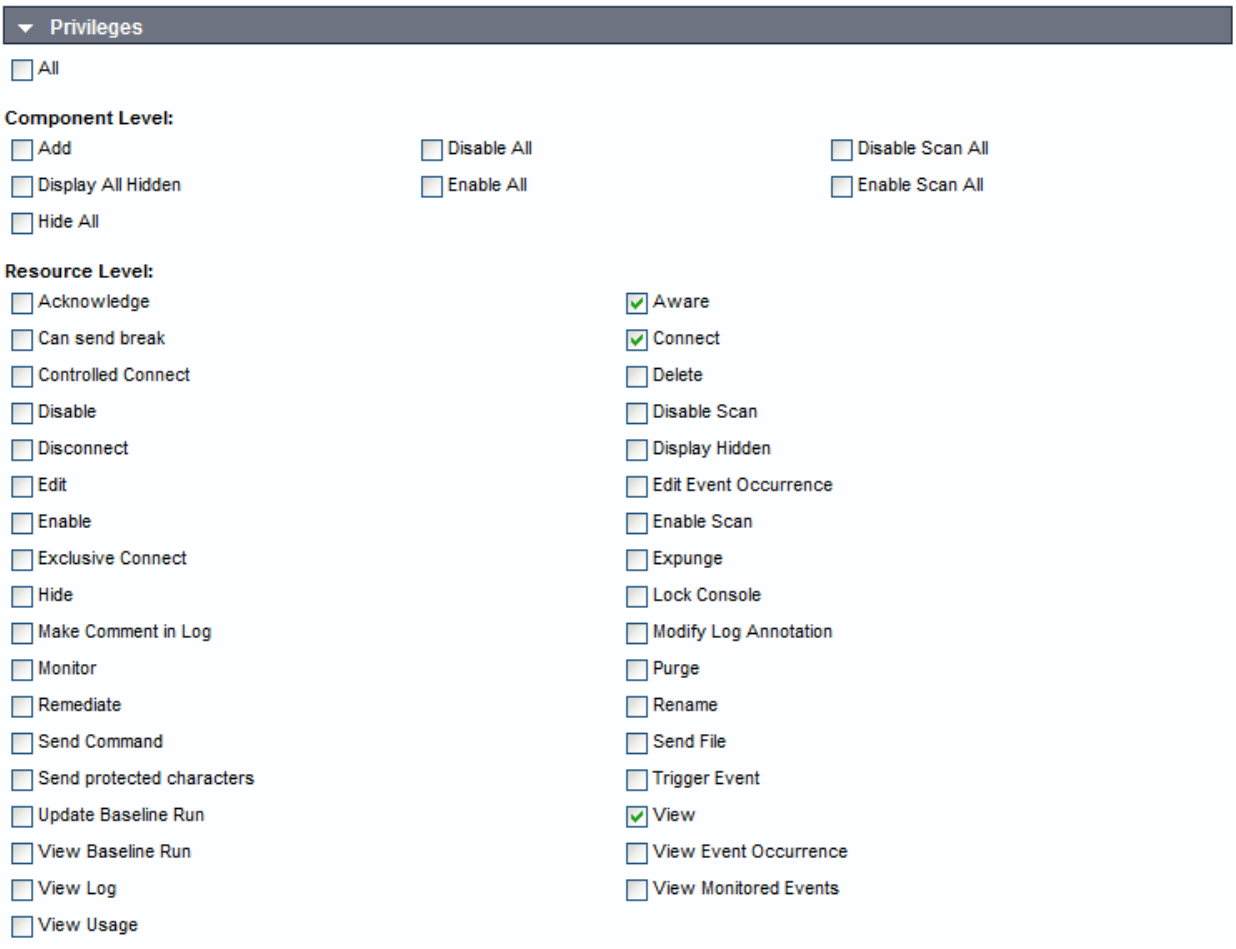
1. Security->Access Control->Add
2. Set Name to Vendor_Company_Console.
3. Check *Enabled.*
4. Set *Order.*
5. Set *Allow.*
6. Set Component Type to Console.
7. Look at *Profile Selection*. You should see:
   - Property Profile Equals **Vendor Company Profile Name** <join>.
   - Vendor company Profile should appear in the box on right.



8. Look under *Resource Selection*; you should see:
   - Associated with a Tag that
     - Property Tag Equals **Vendor Company Tag name** <join>

9. Matching consoles should appear in the box on right. Under Privileges, check:

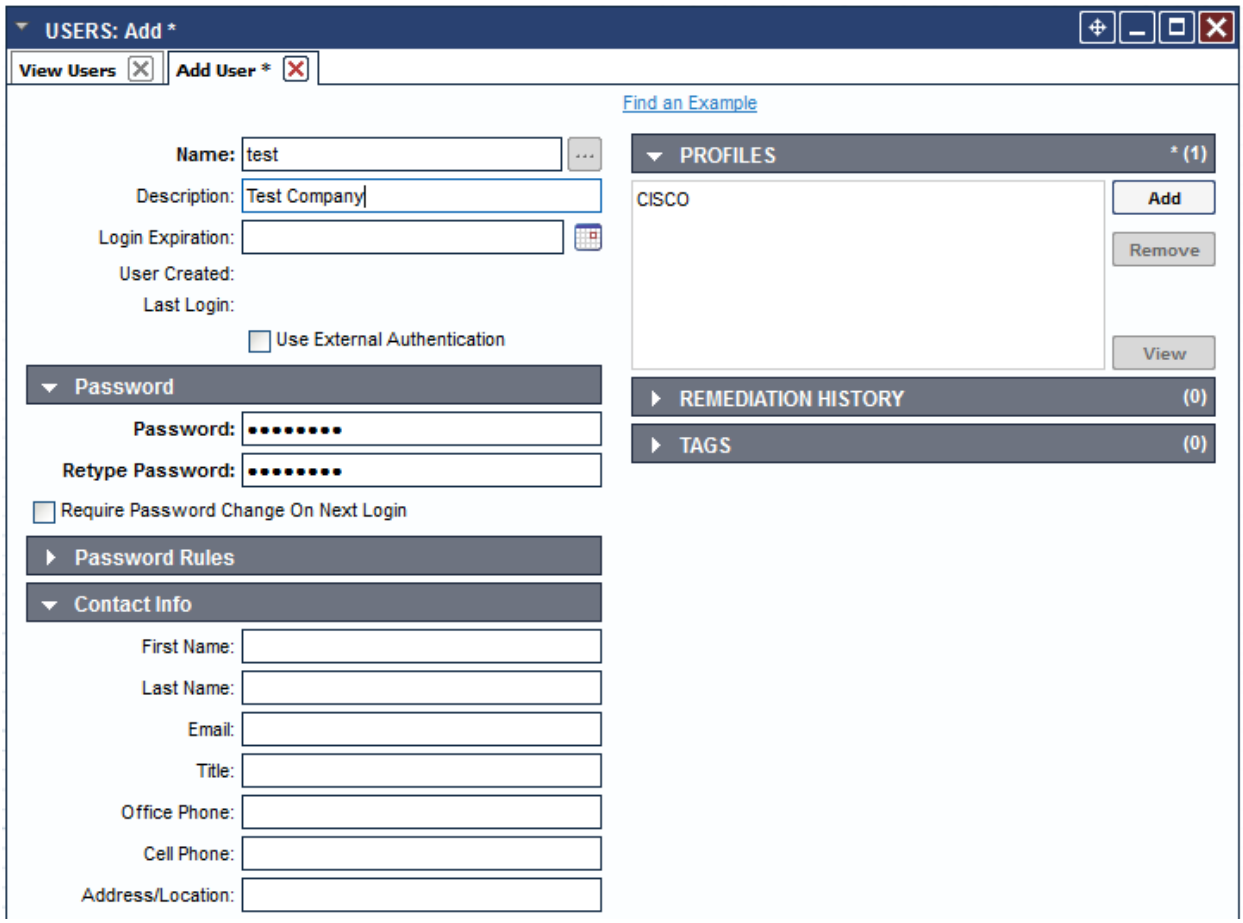
- Aware
- View
- Connect



Users:

Users->Add:

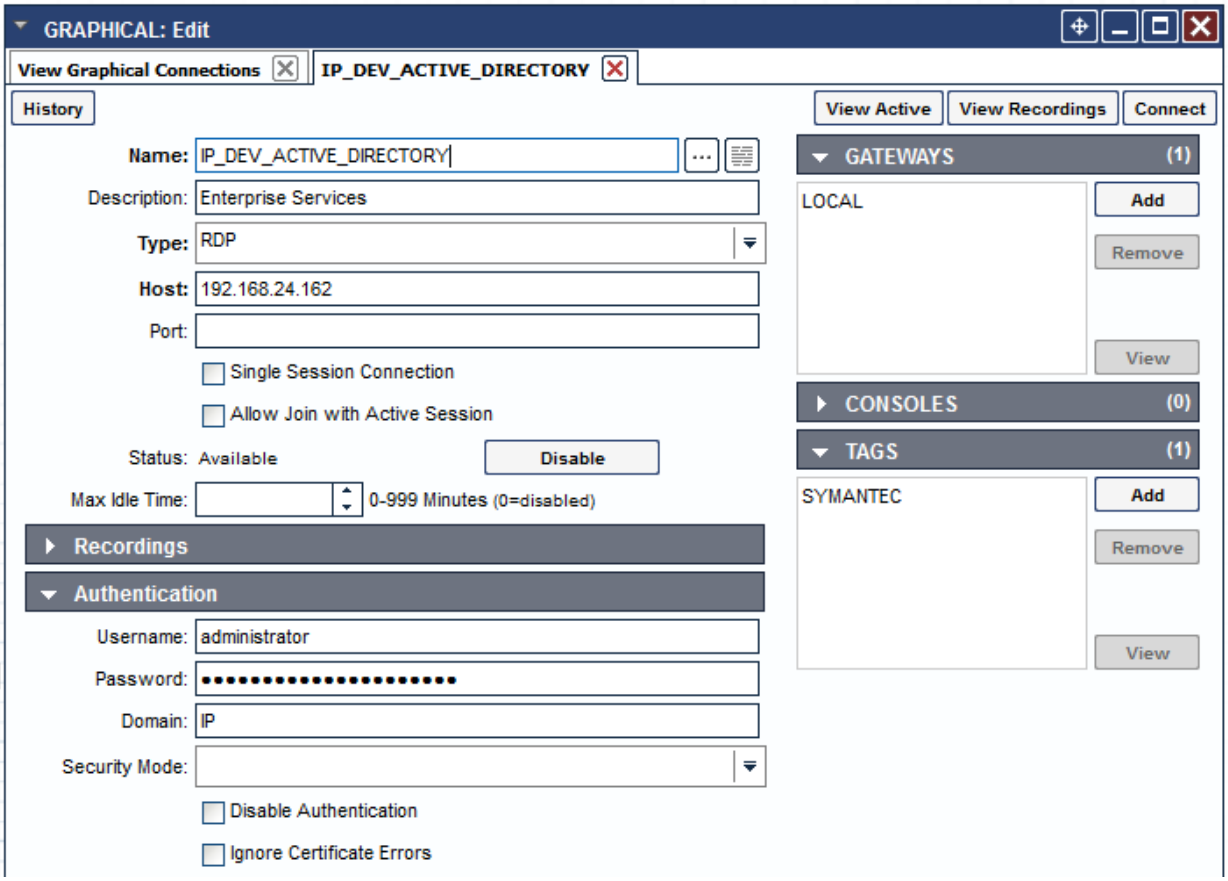
1. Set *Name.*
2. Set *Password* and retype password to confirm.
3. Fill in contact information.
4. Set *Profile* to the one defined for this user's company.
5. Click *Save.*



RDP Graphical Connections

Follow these steps to add a *RDP* graphical connection:

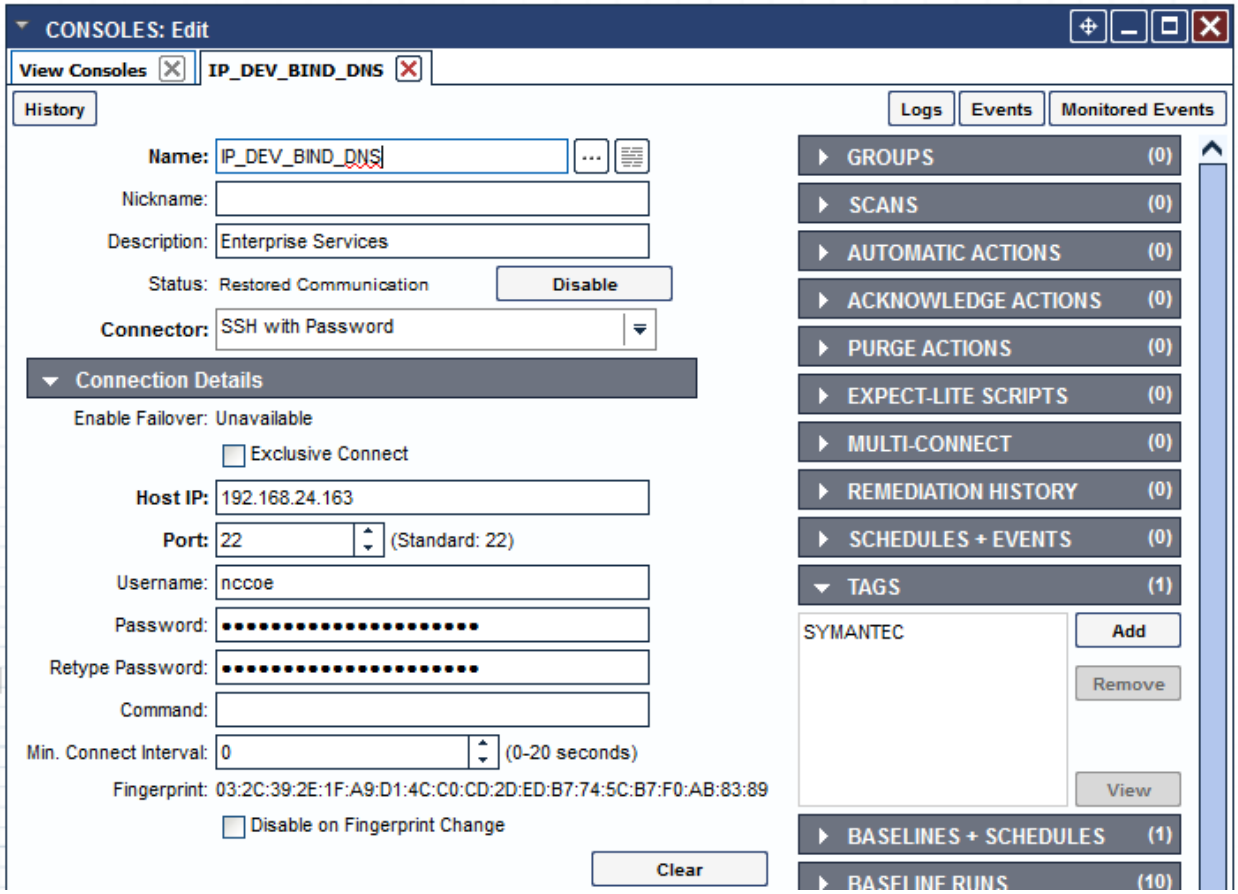
1. Graphical->Add
2. Set *Name* for the device you are connecting to.
3. Set *Type* to *RDP.*
4. Set *Hostname/IP* for the device you are connecting to.
5. Set Authentication:
   - Username
   - Password
   - *Domain* (optional).
6. Add Graphical Gateway named Local.
7. Add Tags for all vendor companies that should have access.
8. Click *Save.*



SSH Console Connections

Follow these steps to add a *SSH* console connection:

1. Consoles->Add
2. Set *Name* for the device you are connecting to.
3. Set the *Connector* to SSH Session with *Password Connection Details.*
4. Set the Host IP for the device you are connecting to by doing the following:
    a. Set Port to 22.
    b. Set Username.
    c. Set Password.
    d. Retype the password.
5. Add tags for all vendor companies that should have access.
6. Click *Save.*



2.2 Infusion Pump and Pump Server

2.2.1 Infusion Pumps

Vendors collaborating with the NCCoE in this use case donated the following pump products.

Table 2-1: Infusion Pump List

Vendor Name	Product Name	Product Type	Description
B. Braun	SpaceStation	Station for hosting individual pump	Provides centralized power and network connection for pumps stacked on the station
	Infusomat® Space large volume infusion pump	Wireless infusion pump	Designed for acute-care facilities for adults and children
	Perfusor® Space Syringe Pump	Syringe infusion pump	Can be stacked in SpaceStation and uses SpaceStation for network communication

Vendor Name	Product Name	Product Type	Description
Baxter	Baxter Sigma Spectrum	Wireless infusion pump	Provides large-volume infusion capability for patients.
BD	Alaris PC 8015	Infusion pump core system	Provides a common user interface for programming infusion, network connection, and monitoring modules. The Alaris® 8015 PC Unit is the core of the Alaris® System and provides a common user interface for programming infusion and monitoring modules.
	Alaris Syringe 8110	Syringe infusion pump	Provides syringe infusion capability for patients and it works with Alaris PC unit.
	Alaris Pump 8100	Large-volume infusion pump	Provides large-volume infusion capability for patients and it works with Alaris PC unit.
Hospira	Plum 360	Infusion system	Builds on the air management and secondary delivery features of Plum A+, while expanding its drug library and wireless capability to enable streamlined electronic medical record integration
	Hospira PCA	PCA syringe infusion system	Complements Infusion pump to manage pain
Smiths Medical	MediFusion 4000	Syringe infusion pump	Delivers medication to patients in critical care units
	CADD Solis 2000	Ambulatory infusion pump	Delivers medication to patients in hospital, home care, and alternative care facilities

2.2.1.1 Infusion Pump Setup

In our example solution, we generalized the infusion pump vendors' products and systems as infusion pump devices, infusion pump servers, and infusion pump ecosystems. Our first goal was to connect each vendor's infusion pump(s) to their corresponding pump server for performing the basic operational

events, such as registering the devices to the server; pushing/installing the new drug library to the pumps; pushing/updating the new version of software to the pumps, and keeping the log of the pump usage.

Each pump vendor has a basic setup that includes configuring the pump to connect to the network and the pump server wirelessly. We used *WPA2* security with Advanced Encryption Standard (AES) for encryption. In the case of *WPA2-PSK* mode, we assigned all infusion pumps the same access password for wireless network authentication. In the case of *WPA2-Enterprise/EAP-TLS* [11], we configured the pumps to use an individual certificate issued by DigiCert for wireless network authentication, using Cisco ISE, the enterprise authentication server.

Because each pump vendor has its own way of connecting, configuring, and setting up its pumps, we describe high-level steps in a generic way. The following table summarizes these key configuration steps. See Appendix B for the sample configuration files.

Table 2-2: Summary of Infusion Pump Configuration Methods

Vendors	Infusion Pump Model	Configuration Tool	Connection Methods
Baxter	Sigma Spectrum	Uses a PC with an IrDA interface to program multiple pumps with the same configuration Edits the network configuration file (a simple text file) on a PC and send it via the IrDA to a pump	Uses the IrDA Serial Infrared Link to a PC under the IrDA Serial Infrared Link Management Protocol v1.1
B. Braun	Space Station	Connects PC with HiBaSeD Service program to the Space Station using a B. Braun interface cable for pump configuration setting	Uses special B. Braun interface cable
	Infusomat® Space large volume infusion pump	Connects PC with HiBaSeD Service program to the Space Station using a B. Braun interface cable for pump configuration setting	Uses special B. Braun interface cable
	Perfusor® Space Syringe Pump	Connects PC with HiBaSeD Service program to the Space Station using a B. Braun interface cable for pump configuration setting	Uses special B. Braun interface cable
BD	The Alaris® 8015 PC	Uses management system to do the configuration. The Alaris® 8015 PC Unit is	Uses series cable to connect pump to a local computer.

Vendors	Infusion Pump Model	Configuration Tool	Connection Methods
		the core of the Alaris® System and provides a common user interface for programming infusion and monitoring modules.	
Hospira	Hospira PCA	Accesses Web Config utility on Pump through a web browser using the Local IP address of the pump	Uses pump's Ethernet Jack to connect to a LAN or to interface with host computer
	Plum 360	Accesses Web Config utility on Pump through a web browser using the Local IP address of the pump	Uses pump's Ethernet Jack to connect to a LAN or to interface with host computer
Smiths Medical	MediFusion 4000	Pushes configuration text file to pump using the Telnet from a PC connected to the pump with the known IP address	Connects a PC to pump using micro USB-USB cable
	CADD Solis 2000	Uses Smiths Medical Network Configuration Utility to update the pump's configuration parameters	Connects a PC to pump using micro USB-USB cable

2.2.1.2 Infusion Pump Configuration

Pre-Conditions:

- You have set up wireless AP with pre-share password SSID
- You have installed and configured infusion pump servers
- You have made available the infusion pump configuration and setup manual available

Post-Conditions:

- You have connected the infusion pumps to AP
- You have estimated the pump server to discover the pumps to the corresponding pump server

NCCoE followed the pump vendors' instructions to access to the pump in maintenance/biomedical model. We configured the pump as follows:

- For wireless properties
  - Enable wireless
  - Use DHCP

- Set SSID (IP_Dev or IP_Dev_Cert)
- For wireless security properties
  - Set Security Mode (WPA2-PSK or WPA2-Ent)
  - Set Encryption Protocol to AES/CCMP
  - Enter PSK password or install a PKI certificate
- For pump server properties
  - Set Server IP/port
  - Set Device Name or ID
  - Set Device Type
- To verify connectivity for each infusion pump and the corresponding pump server:
  - Connect pumps to AP (*IP_Dev* with PSK or *IP_Dev_Cert* with *EAP-TLS*)
  - Confirm that pump receives an IP address from the DHCP server from the AP
  - Confirm that the pump server can discover the pumps and display the pump status such connected, in use, or offline.

2.2.1.3 Infusion Pump Hardening

Hardening may include the following:

- disabling unused or unnecessary communication ports and services
- changing manufacture default administrative passwords
- securing the remote access points if there are any
- confirming the firmware version is up-to-date.

2.2.2 Infusion Pumps Server Systems

Table 2-3: Pump Servers used in this Example Implementation

Vendor Name	Product Name	Operating Platform	Description
B. Braun	DoseTrac® Infusion Management	Microsoft Windows	Drug library and infusion management system that provides real-time, infusion data reporting and analysis to add safety, efficiency and value
Baxter	Care Everywhere Infusion Pump Management System	Microsoft Windows	Provides interface capability to help hospital biomedical engineering department manage their infusion pump fleet

Vendor Name	Product Name	Operating Platform	Description
			effectively. Drug Library publishing module helps hospital pharmacy distribute and enforce medication safety rules effectively.
BD	Alaris Systems Manager	Compatible with VMWare ESX and VMWare vSphere environment	Virtual server platform that provides two-way wireless communication with Alaris PC units
Hospira	Hospira MetNet Server	Microsoft Windows	Manages drug libraries, firmware updates, and configurations of intravenous pumps
Smiths Medical	PharmGuard Server	Microsoft Windows	Manages drug libraries, firmware updates, and configurations of Hospira intravenous pumps for Smiths Medical Pumps

NCCoE installed the pump servers in the network in the VLAN 1400. To do so, we prepared a virtual machine in the VMWare with the operating system and network as specified in the vendor installation manual. Because one or more database is associated with the infusion pump server for storing the data, installation and configuration of the database is part of the pump server installation procedure. After the installation, we implemented basic configuration: the user account setup, reporting template configuration, security hardening, license installation, pump metadata installation.

We have not included the pump server setup because the vendor performs this activity.

2.3 Identity Services

2.3.1 Cisco Identity Service Engine (ISE)

The Cisco Identity Services Engine (ISE) enables your organization to:

- Centralize and unify identity and access policy management
- Have visibility and more assured device identification during certificate challenges
- Use business rules to segment access to sections of the network
- Make the user experience seamless during the challenge process, even with more assured and stronger authentication

System requirements

- Virtual Hypervisor (VH) capable of housing virtual machines (VMs)
- VM with CPU: Single Quad-core; 2.0 GHz or faster
- VM with minimum 4 GB memory
- VM with minimum 200 GB disk space

NCCoE installed the Cisco ISE 2.1 on a virtual machine using the OVA image provided by Cisco.

For your organization, follow the guidance from your VM vendor to import the OVA and start the install process. Once the system boots up, follow the console display to select one of the installation options. The configuration parameter selected for this use case is shown below:

```
! hostname
ise
!ip domain-name
nccoe.lab
! ipv6
enable
!interface
GigabitEthernet 0 ip address 192.168.29.159 255.255.255.0 ipv6 address autoconfig ipv6 enable
! interface
GigabitEthernet 1 ip address 192.168.120.159 255.255.255.0 ipv6 address autoconfig ipv6 enable
!interface
GigabitEthernet 2 shutdown ipv6 address autoconfig ipv6 enable
! interface
GigabitEthernet 3 shutdown ipv6 address autoconfig ipv6 enable
! ip name-server
8.8.8.8 8.8.4.4
! ip default-gateway
192.168.120.1
!
! clock timezone
EST
! ntp server
```

```
time.nist.gov
! username admin password hash
$5$jNPleEb4$YxDZH6oDF2Y4.02OqE/jBWxXFumRvtpe8JdNNZm1yj0 role admin
! max-ssh-sessions
5
! service sshd
enable
! password-policy
lower-case-required
upper-case-required
digit-required
no-username
no-previous-password
password-expiration-enabled
password-expiration-days 45
password-expiration-warning 30
min-password-length 4
password-lock-enabled
password-lock-timeout 15
password-lock-retry-count 3
! logging loglevel
6
! conn-limit 10
port 9060
! cdp timer
60 cdp holdtime 180 cdp run GigabitEthernet 0
! icmp echo
on
!
```

2.3.1.1 Configure ISE to Support EAP-TLS Authentication

Execute your management of the Cisco ISE with a web browser unless you intend to administer via command line. Using a web browser and the Cisco ISE host address, log on to the Cisco ISE Administration Portal. You will use the credentials (username and password) you created during the installation procedure.

2.3.1.2 Set ISE to Support RADIUS Authentication

Use the following steps to set up a communication connection from Cisco ISE to the network device (Access Point) you use as the authentication server during RADIUS [12] authentication:

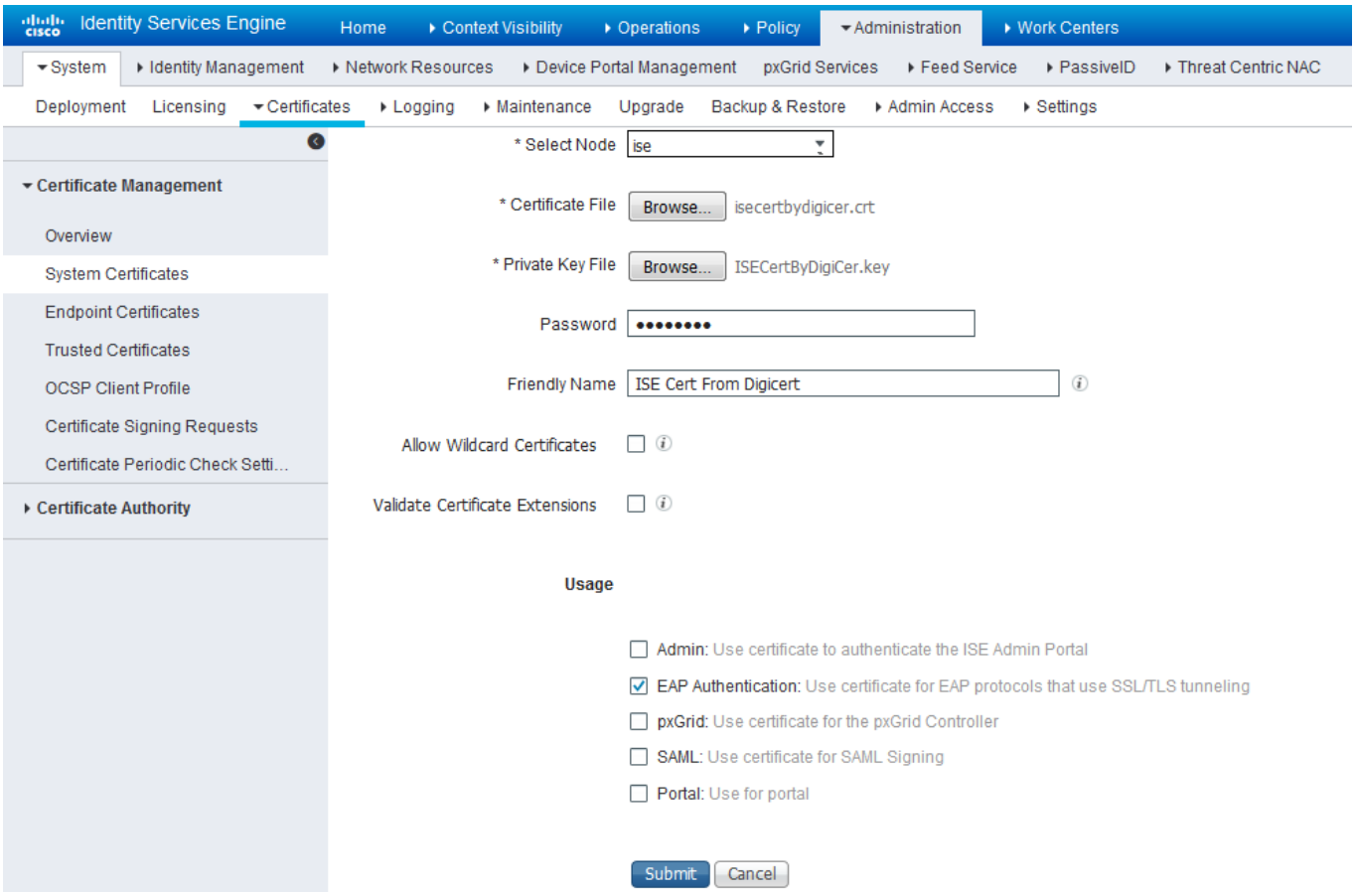
1. Add a Network Recourse

From the ISE Admin Portal, navigate to the path: ***Administration > Network Resources > Network Devices***. Then select ***Add***. Fill out the required parameters as indicated in the form:

- The name of the network device
- The IP Address of the device with its subnet mask.

2. Select the RADIUS protocol as the selected protocol, and enter the shared secret that is configured on the network device.
3. Populate the system certificate with CA-signed certificates. We replaced the Cisco ISE default self-signed certificate with the CA-signed certificate issued through DigiCert Certificate Authority. The steps for acquiring the signing certificate from DigiCert are described in the next Section 2.3.2, DigiCert Certificate Authority.
4. Once the CA-signed certificate for ISE and the Root CA are issued, use the following steps to install the certificates to the System.
5. From the ISE Administration Portal, use the navigation path **Administration > System > Certificates > System Certificate** to show the installed certificates. Then select Import to open a screen for importing Server certificate. Fill in the required information as shown in the following screen shot.

547 **Figure 2-1: Importing Server Certificate**



548

549

550 6. Check the EAP Authentication to enable the imported certificate to be used for EAP Authentication.
551 Then click the **Submit** button to complete the certificate importing.

552 7. Import the DigiCert Root CA and signing CA to ISE Trusted Certificates. From the ISE Administration
553 Portal, use the navigation path **Administration > System > Certificates > Trusted Certificate** to show
554 the installed certificates. Then select Import to open a screen for importing DigiCert Root CA and the
555 signing CA individually.

556 a. After importing, make sure the certificate status is Enabled.

557 b. Establish the OCSP [13] client profile from the OCSP Client Profile page under the
558 **Administration > System > Certificates > OCSP Client Profile**.

559 c. If OCSP (Online Certificate Status Protocol) is used for Certificate Status Validation, check
560 Validate against OCSP Service and enter the OCSP service name.

561 8. Set *Identity Source for Client Certificate Authentication.* When using the trusted certificate for EAP-
562 TLS certificate-based authentication validation, set up the Certificate Authentication Profile in the
563 ISE as the external identity source. Instead of authenticating via the traditional username and
564 password, Cisco ISE compares the client certificate received from the Access Point to verify the
565 authenticity of a device, in this case, the infusion pump.

To create a Certificate Authentication Profile:

- Use the Administration Portal to navigate to the path Administration > Identity Management > External Identity Sources > Certificate Authentication Profile and click *Add.*
- Name the profile as, for example, "Cert_Auth_Profile", then fill out the form with proper parameters. Be sure to select *Subject Name* as the Principal Username X509 attribute because it is the field that will be used to validate the authenticity of the client.
- Select the *Identity Resource Sequences* tab, in the Certificate Based Authentication, check *Select Certificate Authentication Profile* and choose the *Cert_Auth_Profile* from the dropdown list.

9. Set *Authentication Protocols.* Cisco ISE uses authentication protocols to communicate with external identity sources. Cisco ISE supports many authentication protocols such as the Password Authentication Protocol (PAP), Protected Extensible Authentication Protocol (PEAP), and the Extensible Authentication Protocol-Transport Layer Security (EAP-TLS). For this build, we used the EAP-TLS protocol for user and machine authentication. To specify the allowed protocols services in Cisco ISE:
   - From the Administration Portal navigate to the path Policy >Policy Elements > Results >Authentication > Allowed Protocols > Add
   - Select the preferred protocol or list of protocols. In this build, the EAP_TLS is selected as the allowed authentication protocol.
10. Set up *Authentication Policy.* Define the authentication policy by selecting the protocols that ISE should use to communicate with the network devices, and the identity sources that it should use for authentication. To specify the authentication policy:
    - From the Administration Portal navigate to the path **Policy >Authentication Policy > Type > Rule Based**.
    - Set "if Protocol is Wireless 802.1x, use the Network Device as defined in Step 1 and the Identity Sequences as defined in Step 8.

2.3.2 DigiCert Certificate Authority

DigiCert is a cloud-based platform designed to provide a full line of SSL Certificates, tools, and platforms for optimal certificate life cycle management. After you set up an account with DigiCert, you can use a DigiCert dashboard and its built-in certificate management tools to issue PKI certificates for network authentication and encryption for data-at-rest or in-transition if needed.

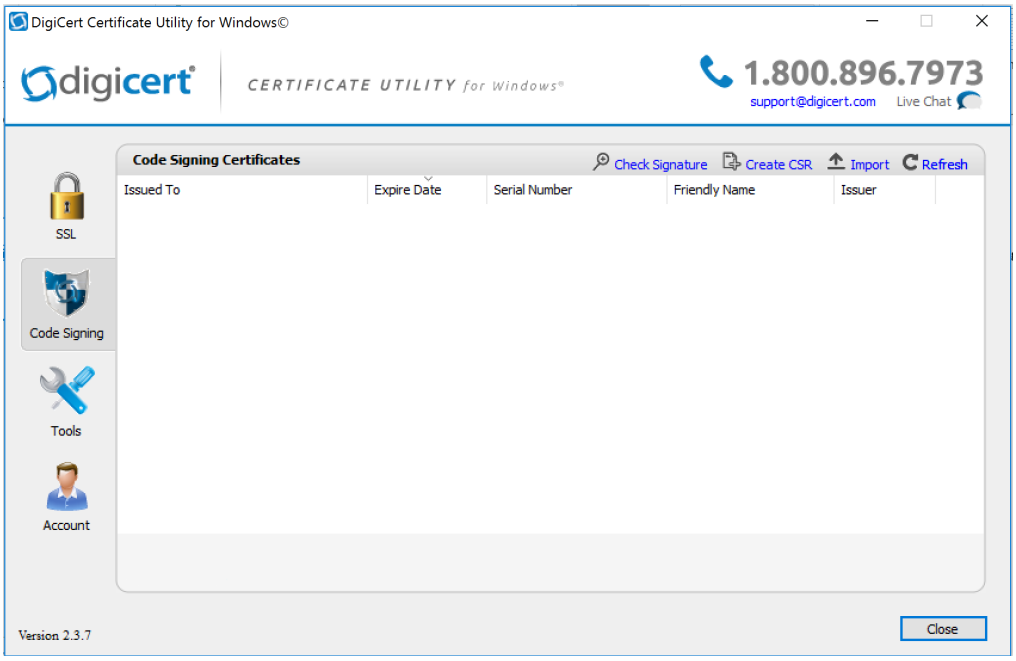
The follow instruction describes the process we used to request a PKI certificate on behalf a wireless infusion pump using the DigiCert PKI services:

2.3.2.1 Create a Certificate Signing Request (CSR)

A CSR can be represented as a Base64 encoded PKCS#10 binary format. Many tools and utilities are available to help to generate a CSR, and the key pair containing the private key and public key is generated in the same time. The CSR identifies the applicant's distinguished name, which must be digitally signed using the applicant's private key and the information for the public key chosen for the applicant. In this build, Certificate Utility for Windows (DigiCertUtil.exe) provided by DigiCert is used to generate CSRs for infusion pumps.

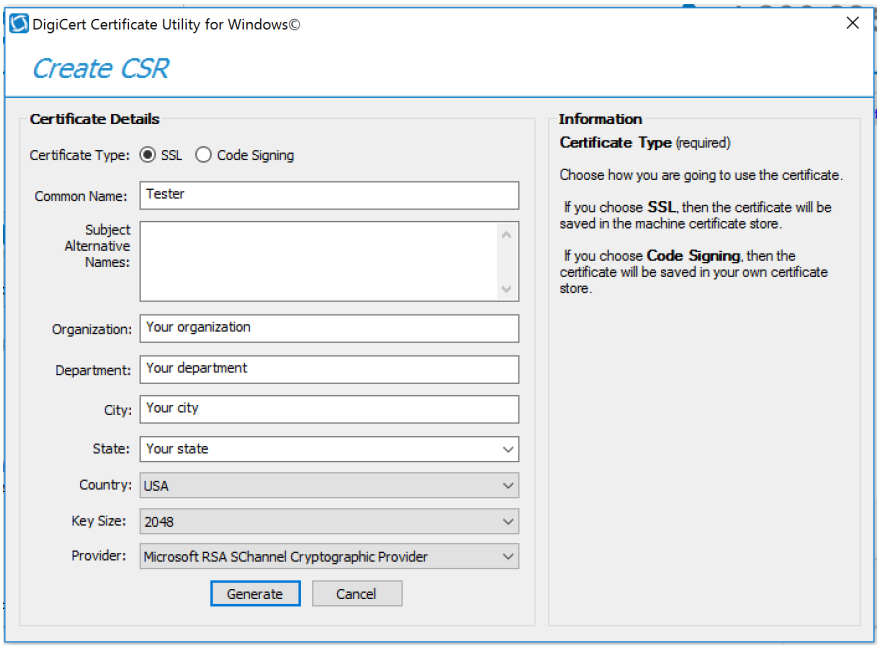
605 Download and save the DigiCertUtil.exe from https://www.digicert.com/util/csr-creation-microsoft-
606 servers-using-digicert-utility.htm.

607 1. Double-click *DigiCertUtil.exe* to start the utility:



608

609 2. Click the *Create CSR* link to open a CSR request window.



610

611 3. On the Create CSR window, fill in the key information (some is optional):

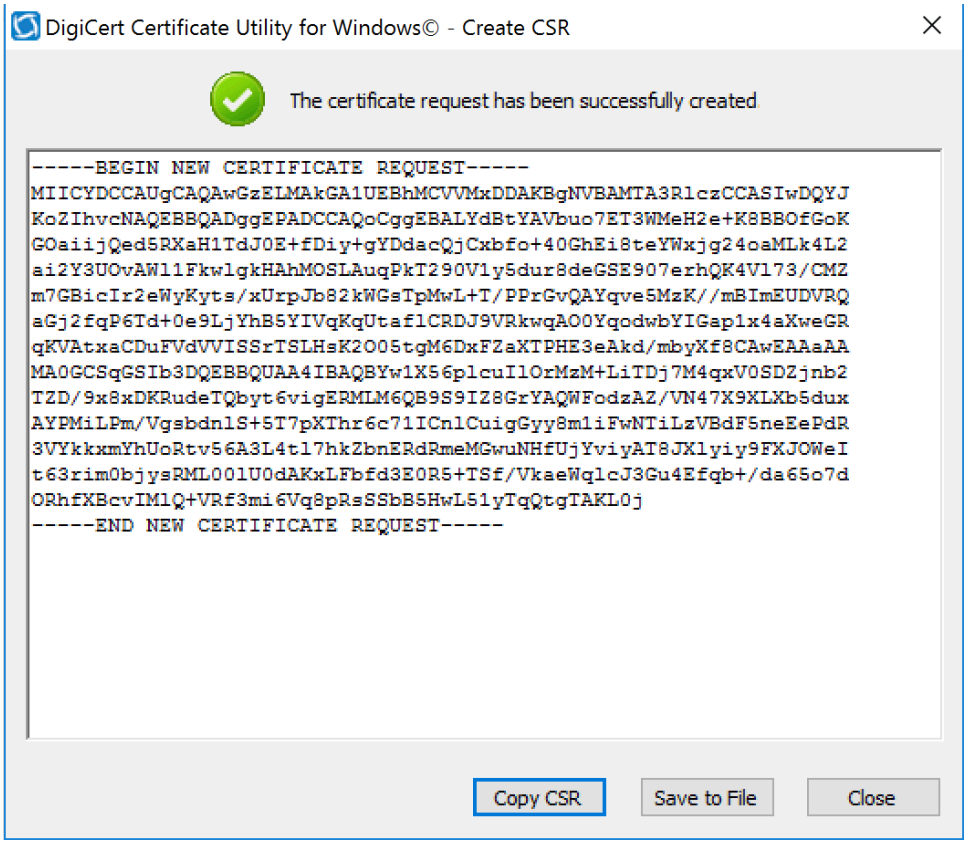
612 ▪ Certificate Type: Select *SSL*

613 ▪ Common Name: Enter the entity name

614 ▪ Organization: Enter your company's legally registered name

- City: Enter the city where your company is legally located
- State: Select the state where your company is legally located
- Country: Select the country where your company is legally located
- Key Size: In the drop-down list, select *2048*
- Provider: Select *Microsoft RSA SChannel Cryptographic Provider* (unless you have a specific cryptographic provider)

4. Click ***Generate*** to generate a CSR:



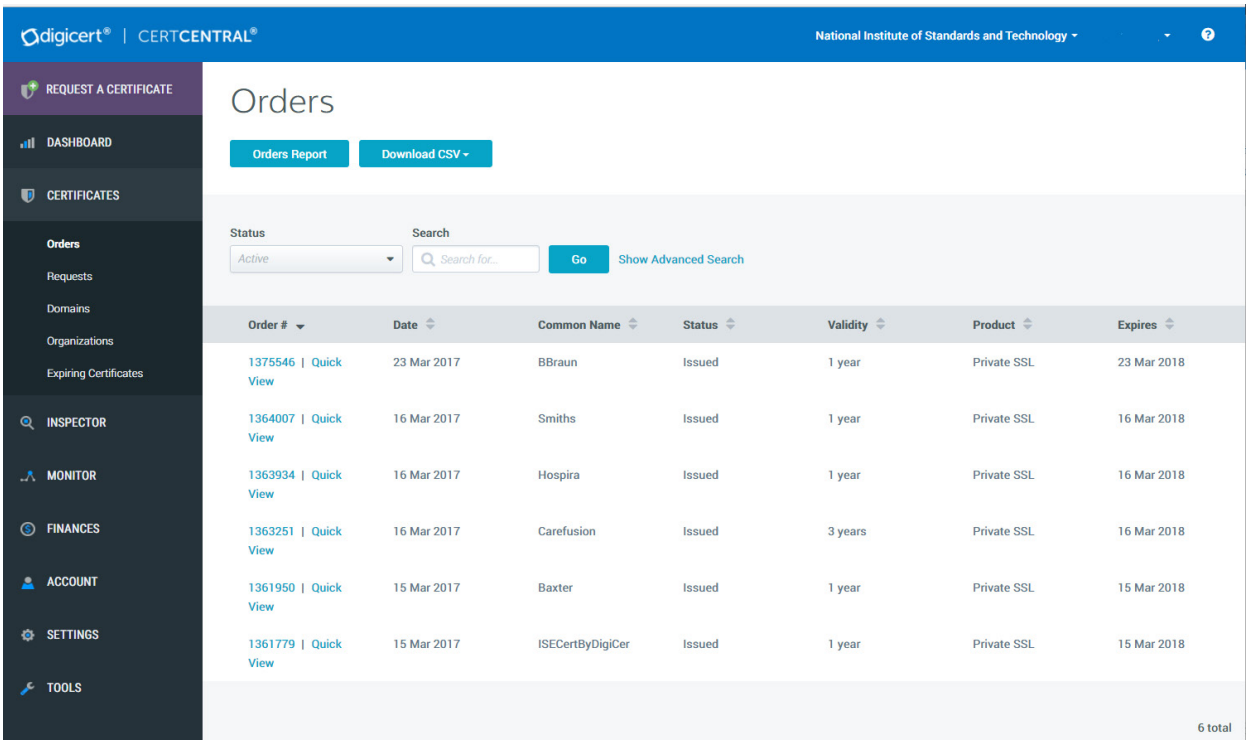
This will also generate a corresponding private key in the Windows computer from which the CSR is requested. The Certificate Enrollment Request is stored under: (*Console Root**Certificates(Local Computer)**Certificate Enrollment Requests**Certificates*).

2.3.2.2 Issue Signed Certificates

5. With a created applicant CSR, request a signed certificate using DigiCert CertCentral portal.
   - Login to a DigiCert Dashboard <https://www.digicert.com/account/login.php> with your account user name and password.
   - Once in the portal, go to **Request a Certificate**, then select ***Private SSL*** to open a certificate request form. Fill in the certificate settings in the fields shown in the form which includes pasting the CSR information to the area called *Paste your CSR.*

6. After filling in all the required information and scroll down to the bottom of the page and click on the "I agree to the Certificate Services Agreement above" check box, click the ***Submit Certificate Request*** button at the bottom of the form to submit the certificate for signing approval. The administrator of the CA authority will use the same portal with different privilege to prove the request after reviewing and verifying the submitted request information if needed.

7. To download the signed certificate, go to ***CERTIFICATES->Orders*** to list the ordered signed certificates:



8. Click a specific order number to display the certificate details with a list of actions for you to perform. Click the ***Download Certificate*** *As* to download certificates with signed CA and Root CA certificates. A variety of certificate formats can be downloaded, such as .crt, .p7b, or .PEM, etc.

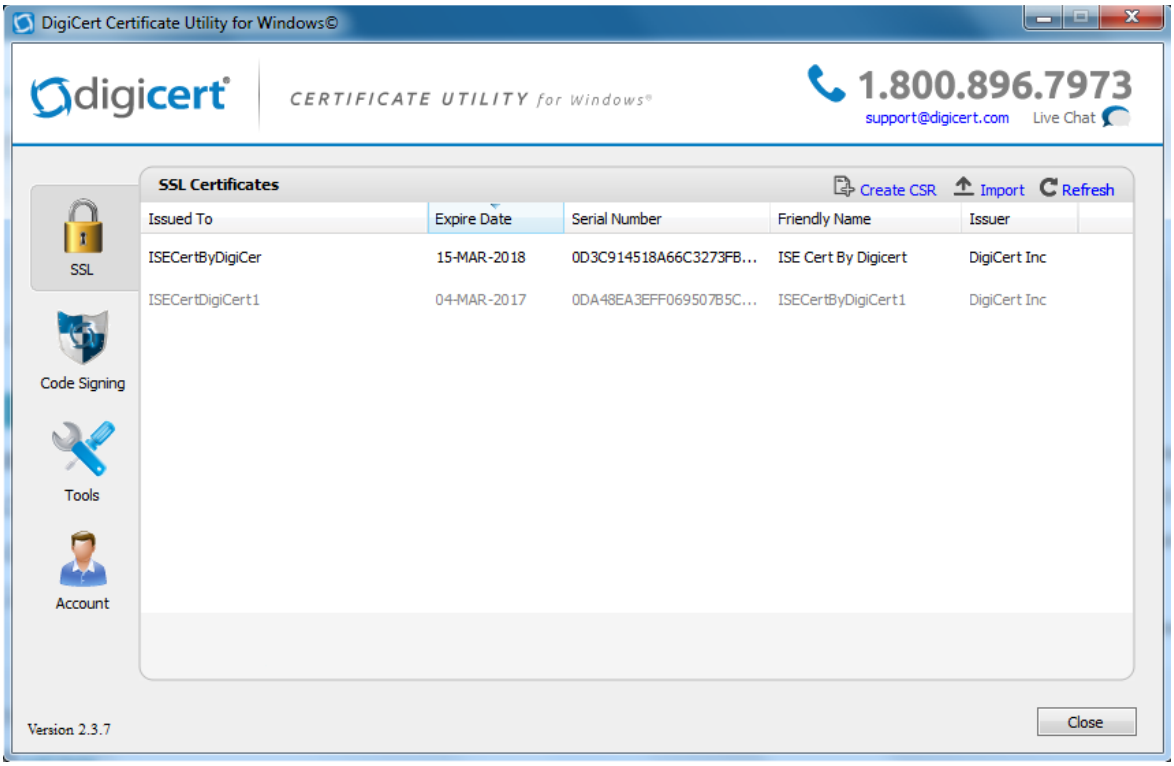
9. Save the downloaded certificate in a location where it can be used for further processing if needed.

2.3.2.3 Import and Export the Signed Certificate

Using the DigiCert Utility and OpenSSL tool, you can further manipulate the certificates to combine with the private key and export the signed certificate, or you can convert certificates or keys to the formats specified for your organization's devices.

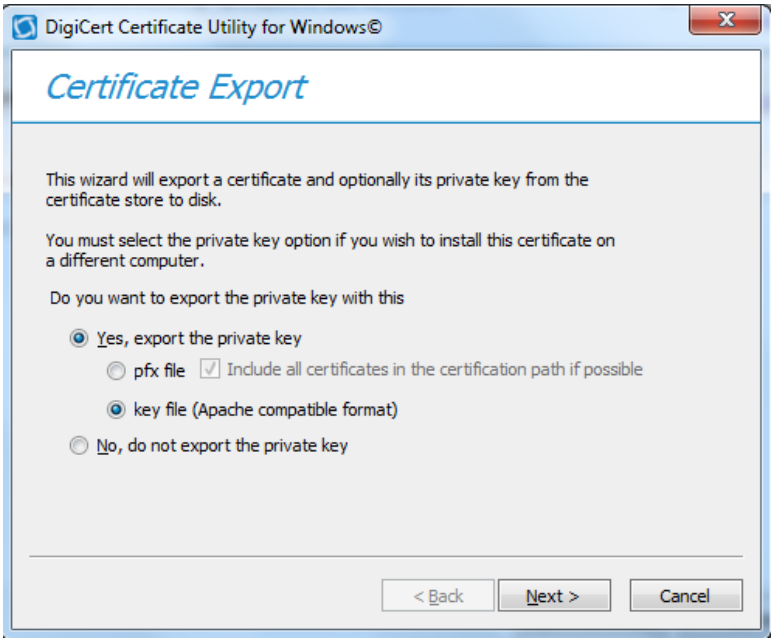
10. To import a signed certificate, use DigiCert Utility to click the *Import* button to load a downloaded file to the utility. The download file was saved in Step 9 above. Click the *Next* button to import.

11. From the DigiCert Certificate utility for Windows, click *SSL* to list all the imported files.



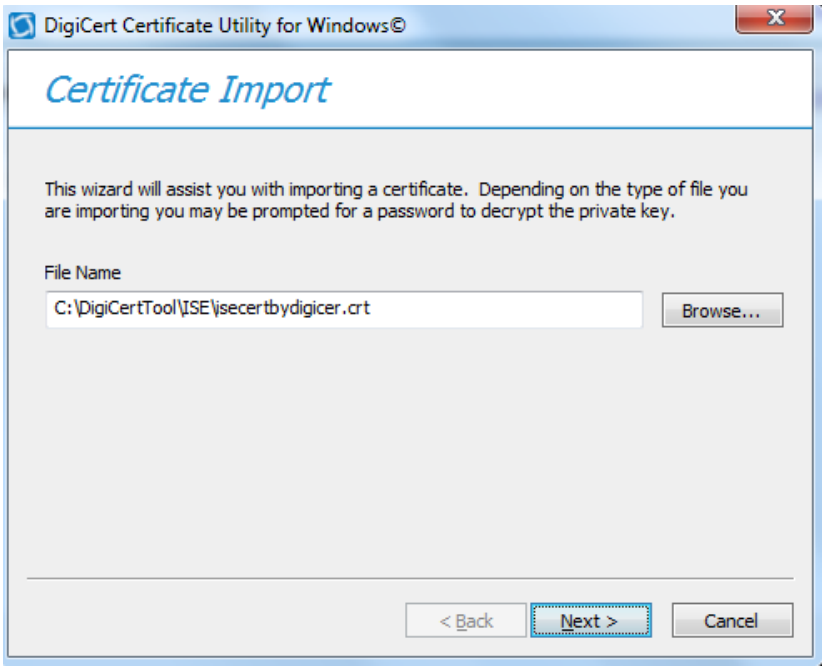
652

653 12. To export the certificate, select the certificate that you want to export as a combined certificate file
654 and key file in a *.pfx* file or separated as a certificate file and key file, and then click *Export*
655 *Certificate.*



656

657 13. Click the *Next* button and follow the wizard instruction to save the certificate file and private key file
658 to a location you desire.



2.3.2.4 Certificate and Key File Format Conversion

PKI certificates and key files can be in different formats. When PKI certificates are used in medical devices, device manufacturer user guides specify which formats are acceptable in their devices. Fortunately, many tools can perform format conversion. One utility tool that NCCoE used is the OpenSSL for Windows. It is open source and can be downloaded from https://www.openssl.org/community/binaries.html. Here are some of the useful convert commands:

- To convert .crt to .pem:
  - **openssl** *x509* **-in** mycert.crt **-outform** *PEM* **-out** mycert.pem.
- To convert a private key into PEM format:
  - **openssl rsa -in** yourdomain.key **-outform** *PEM* **-out** yourdomain_pem.key.
- Separate a pfx file into two different .key/.crt files:
  - For a key file: **openssl pkcs12 -in** *yourfile*.pfx **-nocerts -out** keyfile-*encrypted*.key.
  - For cert file: **openssl pkcs12 -in** [*yourfile*.pfx] **-clcerts -nokeys -out** [*certificate*.crt].
- To convert a Cert PEM file to DER:
  - **openssl x509 -outform der -inform** *DEM* **-in** *certificate.pem* **-out** *certificate.der.*
- To convert a key PEM file to DER:
  - **openssl rsa -inform** *DEM* **-in** infile.key **-out** outfile.der-**outform** *DER.*

2.4 Symantec Endpoint Protection and Intrusion Detection

NCCoE protected the pump server application in the notional Biomedical Engineering network by using three Symantec cybersecurity products on an enterprise network, with a specific focus on wireless infusion pumps:

- Symantec Data Center Security- Server Advanced
- Symantec Endpoint Protection Manager Server
- Symantec Advanced Threat Protection Server.

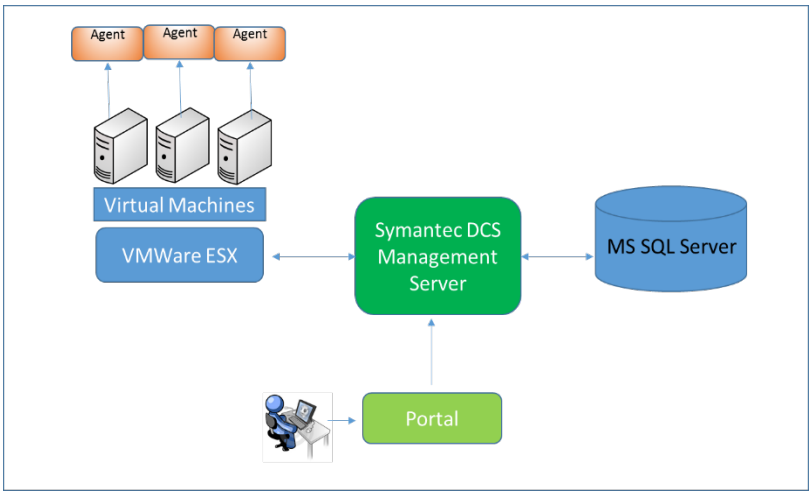
Each product protects components in the enterprise systems at different levels.

2.4.1 Symantec Data Center Security: Server Advanced

For data center security, Server Advanced provides a policy-based approach to endpoint security and compliance. It includes the management server, the agents, the unified management console, the database, and DCS Security Virtual Appliance (SVA). The agent components working with the server management provide intrusion prevention and detection on endpoint devices; the database is used for storing the policies, agent information, and real time actionable events; and the SVA provides agentless anti-malware protection for VMWare guest VMs running Windows.

The management server and the console can be installed on one system, and the agents are generally deployed to every supported host or endpoint devices. Figure 2-2 displays the Data Center Security: Server Advanced Environment.

Figure 2-2: Data Center Security: Server Advanced Environment



2.4.1.1 *Installing Data Center Security: Server Advanced Manager*

Minimum Hardware Requirement: Server Advanced includes hardware support x86, EM64T, and AMD64 with 60 GB free disk space (all platforms) 8 GB RAM 4 CPUs.

Minimum Software Requirement: Windows Installer 2.0 or higher, Microsoft SQL Server 2008, .NET Framework 4.0 or 4.5.1, PowerShell 2.0, and Windows 2008 or later.

Operating the Symantec Data Center Security: Server Advanced installation requires to link to an instance of SQL Server locally or remotely. All installations allocate approximately 60 GB of space for the database on SQL Server Enterprise edition. We first installed a new instance of SQL Server that conforms to the Symantec installation requirements. The SQL Server was installed on the same machine as that for the Data Center Security: Server Advanced Manager.

Follow these steps to install the SQL Server software.

1. Use *SCSP* as the default instance name
2. Set authentication configuration to Mixed Mode (Windows authentication and SQL Server authentication)
3. Set the "*sa*" with a password when you set Mixed Mode authentication. You will need this password when you install Data Center.
4. After installing the instance of SQL Server, select to authenticate using SQL Server credentials.
5. Register the instance. Registering the instance also starts the instance.

Follow these steps to install Data Center Security: Server Advanced:

1. Double click *server.exe*, then in the Welcome panel, click *Next* and accept the license agreement
2. In the Installation Type panel, click Evaluation Installation, then click Use an Existing MSSQL Instance, and then click Next.
3. Follow the instructions and select the parameters suitable for your organization to complete the installation.

See *Symantec™ Data Center Security: Server, Monitoring Edition, and Server Advanced 6.7 MP1 Planning and Deployment Guide* for further details:
https://symwisedownload.symantec.com//resources/sites/SYMWISE/content/live/DOCUMENTATION/9000/DOC9394/en_US/DCSSA_Planning_Deployment_Guide.pdf?__gda__=1494398285_572b0ff349979359e0cc9342b337f3bb

2.4.1.2 Configuration of Data Center Security: Server Advanced Manager

After you install the Management Server, the Server Configuration Wizard lets you configure various parameters of the installation.

One purpose of these configuration settings is to use the policy-based least privilege access control provided by DCS to lock down the configuration settings, files, and file systems in the pump for restricting application and operating system behavior and protecting the files and systems from tampering.

To enable a policy in DCS Management Server, follow these steps:

1. Login to the DCS console.
2. Create a policy folder.
3. In the Java console, click *Policies.*
4. Under the *Policies* tab, click *Prevention* or *Detection.*
5. On the Policies page, in the *Workspace Folders*, select the *Workspace* folder and then right-click *Add Folder.* Look for a new policy folder with the name *New Folder.* Rename this folder as *Pump Server*.
6. Copy an existing policy to the Pump Server folder.
7. From the default Symantec folder, find a proper policy example and copy it to the Pump Server.
8. Using the *Move To* command. In the *Workspace* pane, select a policy (e.g., "windows-baseline-detection" policy in *Symantec folder* for *Detection*), and then right-click *Move To.* In the *MoveFolder* dialog box, select *Pump Server* to receive the policy, and then click *MoveTo.*

9. To edit a policy, right-click a policy, and then click *Edit Policy.* Configure the setting based on your security protection needs.

DCS Advanced Server provides a variety of configurable protection from application data protection, application protection to network protection. For example, the Windows prevention policies have a Protected Whitelisting strategy that lets you specify an application to which you always want to allow access or give permission to run. When you whitelist a process or an application, all the other processes and applications that are not included in the list are denied access.

To allow a program to run by using the Protected Whitelisting strategy, follow these steps:

10. In the management console, click the *Policies* tab and then click *Prevention.*
11. In the *Policies* workspace, click *Add.*
12. In the Select a Prevention Policy Builder wizard, in the New Policy Builder section, click Launch.
13. In the *Policy Name* panel, from the *Policy Pack* drop-down list, select the policy pack that you want to use as the baseline for the new custom policy.
14. In the *Name* text box, enter a name for the policy that you create. In this build, we use "Windows Prevention Policy 6.0 Reference 31 Protected Whitelisting strategy."
15. Check Create a custom prevention policy, and then click Next.
16. In the *Protection Strategy* panel, use the slider to select *Protected Whitelisting.*
17. In the *Trusted Updaters* panel, click *Add,* and then in the *Select Type* dialog box, select the type of updater that you want to add. The Trusted Updaters list is populated through the agent data retriever. You can edit or delete an updater that you have already added to the list.
18. Click *Next.*
19. In the *Application Rules* panel, click *Add,* and then in the *Select Type* dialog box, select the type of rules that you want to add. You can edit or delete a rule that you have already added to the list.
20. In the *Global Policy Options* panel, click *Configure* to configure the global policy settings, and then click *Next.*
21. In the *Summary* panel, click *Save.*

2.4.1.3 Installing Data Center Security: Server Advanced Agent

Use agent.exe to install the agent software on computers that run supported Windows operating systems. To install the Windows agent software, follow these steps:

1. On the installation package, double-click *agent.exe.*
2. In the *Welcome* panel, click *Next.*
3. In the License Agreement panel, select I accept the terms in the license agreement, and then click Next.
4. In the *Destination Folder* panel, change the folders if necessary, and then click Next.
5. In the *Agent Configuration* panel, accept or change the default settings, and then click *Next.* Ensure that *Enable Intrusion Prevention* is checked.

6. In the *Management Server Configuration* panel, in the Primary Management Server box, type the fully qualified host name or IP address of the primary server that is used to manage this agent. If you changed the Agent Port setting during management server installation, in the Agent Port box, type a port number that matches.
7. (Optional) In the *Management Server Configuration* panel, in the Alternate Management Servers box, type the fully qualified host name or IP address of the alternate servers that are used for failover for this agent. Type the servers in a comma-separated list.
8. In the *Management Server Configuration* panel, accept the directory for the SSL certificate *Agent-cert.ssl*, or click *Browse* to browse to and locate *Agent-cert.ssl*. Access to a copy of the SSL certificate *Agent-cert.ssl* is required to connect to the management server. All primary and alternate management servers must use the same certificate.
9. In the Management Server Configuration panel, click Next.
10. (Optional) In the *Agent Group Configuration* panel, in the group boxes, type the group names that you created with the Java console. You may add multiple detection policy group names separated with commas. You may include the name of an existing detection policy domain in the group path/name.
11. In the *Agent Group Configuration* panel, click *Next.*
12. In the *Service User Configuration* panel, accept the default Local System account, and then click *Next.*
13. In the *Ready to Install the Program* panel, confirm the installation parameters, and then click Install.
14. When the installation completes, click *Finish.*

Agent installation configures the appropriate networking for the environment. The agent installation configuration includes which Data Center Security: Server Advanced Management Servers to communicate with, which ports to use, and how often to poll for changes. The initial Data Center Security: Server Advanced installation also determines whether key product features are enabled or not. Particular key agent features can be installed, and each provides different protection:

- Enabling the intrusion prevention feature
- Enabling the real-time file integrity monitoring feature in intrusion detection
- Enabling the real-time file integrity monitoring feature in intrusion detection
- Creating agent registration groups.

See the Symantec Data Center Security: Server, Monitoring Edition, and Server Advanced 6.7 MP1 Planning and Deployment Guide for details: http://help.symantec.com/cs/DCS6.7/DCS6_7/v118490468_v110163010/Installing-Data-Center-Security:-Server-Advanced-6.7-or-6.7-MP1/?locale=EN_US.

2.4.2 Symantec Endpoint Protection Manager

Minimum Hardware Requirement: 2 GB RAM as minimum; 8 GB or more available recommended. Hard drive should be 40 GB as minimum (200 GB recommended) for the management server and database with a remote SQL Server database.

Minimum Software Requirement: Windows Installer 2.0 or higher, Microsoft SQL Server 2008, .NET Framework 4.0 or 4.5.1, PowerShell 2.0, and Windows 2008 Server or later. Intel Pentium Dual-Core or equivalent minimum, 8-core or greater is recommended.

The Symantec Endpoint Protection Manager includes an embedded database. You may instead choose to use a database from one of the following versions of Microsoft SQL Server: SQL Server 2008, SP4 up to SQL Server 2016.

2.4.2.1 Installing Symantec Endpoint Manager

1. Download the product, extract the entire installation file to a physical disk, such as a hard disk. Run *Setup.exe.* The installation should start automatically.
2. Follow the screen instruction and accept the license agreement.
3. Continue the installation until it is finished. After the initial installation completes, configure the server and database.
4. Click *Next.* The Management Server Configuration Wizard starts.
5. Select *Default Configuration,* and then click *Next.*
6. Enter company name, a password for the default administrator admin, and an email address.
7. If you run *LiveUpdate* as part of a new installation, content is more readily available for the clients you deploy.
8. If you want Symantec to receive anonymous data, click *Next* to begin the database creation.
9. When the database creation completes, click *Finish* to complete the Symantec Endpoint Protection Manager configuration.

2.4.2.2 Installing the Client

After installing Symantec Endpoint Protection Manager, install the Symantec Endpoint Protection client to the endpoint host with the Client Deployment Wizard. Of the several installation methods, we recommend using the *Save* package. This installation option creates an executable installation package that you save on the management server and then distribute to the client computers. Follow these steps:

1. Make your configuration selections as you install the Symantec Endpoint Protection Manager and then create the client installation packages.
2. Save the installation package to a folder on the computer that runs Symantec Endpoint Protection Manager.
3. Copy this package to a client machine where you have an administrator privilege.
4. The installation package comprises one setup.exe file. Click the executable file to start the installation. Follow the wizards to complete the installation.

2.4.3 Symantec Advanced Threat Protection: Advanced Threat Protection: Network

With Advanced Threat Protection: Network (ATP:N) installed on the network, it can provide Network-based protection of medical device subnets via monitor internal inbound and outbound internet traffic.

We integrate Symantec Advanced Threat Protection (ATP) with Symantec Endpoint Protection, it will allow ATP to monitor and manage all network traffic from the endpoints and provide threat assessment for dangerous activity to secure the medical devices on an enterprise network.

Minimum Hardware Requirement: 32 GB RAM; 4 CPUs. Hard drive should be at least 500 GB.

Minimum Software Requirement: ESXi 5.5 and 6.0, ATP virtual appliance includes an Integrated Dell Remote Access Controller (iDRAC). The iDRAC console requires the latest version of the Java Runtime Environment (JRE) installed on the administrative client.

2.4.3.1 ATP-N Installation

The installation of the ATP-N involves the deployment of the OVA template on the VMware ESXi Server. A sample installation steps are shown below:

1. Deploy the OVA. During the Deploying procedure, the Deploy OVA Template wizard prompts you to map the Source Network adapters, which are built into the APT OVA with Destination Networks that you already configured on your network.
2. In VMware vSphere Client, start the newly-created virtual appliance.
3. Open a console to the appliance and logon with the user name admin and the proper password to start the bootstrap.
4. From a computer that is on the same subnet as the appliance management port, use a browser to connect to the APT Manager using the ATP IP address. The user name is setup and the password is *Symantec*.

2.4.3.2 Integrating APT with Symantec Endpoint Protection

To integrate the Symantec Advanced Threat Protection (ATP) with Symantec Endpoint Protection allows us to Correlation of event data from Symantec Endpoint Protection Manager to ATP. To do the integration, follow these steps:

1. On Symantec Endpoint Protection Manager, prepare the database for log collection to allow ATP to access the database using DB administrator (sa) credentials.
2. Enable Symantec Endpoint Protection Correlation option by checking in the Settings > Global > Synapse area of ATP Manager.
3. In ATP Manager, configure the connection to Symantec Endpoint Protection Manager instances.
4. In Symantec Endpoint Protection Manager, configure host integrity and quarantine firewall policies, if not already enabled.
5. In Symantec Endpoint Protection Manager, configure endpoints to send information to the ATP management node.
6. In ATP Manager, add SSL certificates for secure communication between endpoints and ATP, if needed.

More detail about integrating ATP and Symantec Endpoint Protection can be found from the following reference: http://help.symantec.com/cs/ATP_2.2/ATP/v102658999_v117970559/About-integrating-ATP-with-Symantec-Endpoint-Protection?locale=EN_US.

2.5 Risk Assessment Tools

2.5.1 Clearwater IRM|Analysis™ Software

We used Clearwater IRM|Analysis™ Software-as-a-Service (SaaS) application, a control-based risk tool for conducting a risk assessment with a focus on the Healthcare Delivery Organization (HDO) enterprise. In our environment, we built the enterprise network to simulate a typical HDO environment. Clearwater Compliance created an account for NCCoE under their cloud based tool, IRM|Analysis™. The software is based on the construct of an "Information Asset" which creates, maintains, receives or transmits electronically Protected Health Information (ePHI.) This can be a software application, information system, medical device system, etc.

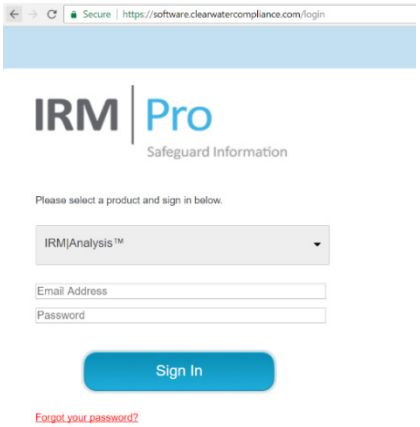
This section does not show you how to conduct a risk assessment. Instead, we present some basic steps for using the IRM|Analysis™ tool to conduct the risk assessment:

1. Login to IRM|Analysis™.
2. Import Inventory of Information Assets or enter the data through the Asset Inventory Form.
3. Establish conformance with the NIST-based Security Controls.
4. Determine the Risk Rating predicated on a 5x5 matrix of likelihood x impact.
5. Identify those risks that are exceed the established "risk threshold."
6. Document "Risk Response" and associated tasks necessary to mitigate, transfer, avoid or accept the risk in the IRM|Analysis™ software.
7. Leverage Dashboard and Reporting functionality to provide documentation and evidence of a credible and bona fide risk analysis.

2.5.1.1 Login to IRM|Analysis™

1. From a browser, type https://software.clearwatercompliance.com/login.
2. On the Login page (see Figure 2-3), enter the appropriate email and password.
3. Click on Sign In.

Figure 2-3: IRM|Analysis™ Login Page



2.5.1.2 Enter Asset Inventory

We used the *New Asset* page to add the assets to the system and the *Edit Asset* page to update the record. After all assets are entered, an analysis is conducted to determine if media (i.e., devices) associated with different assets can be grouped together based on a similar risk profile. For instance: all servers are virtual machines using the same Storage Area Network and identical Operating Systems. If you have 10 assets that have server selected and they are all the same, they can be grouped and evaluated as one. The Media/Asset Group is the logic group for organizing media into classes to reduce the number of identical security control assessments.

To add a new asset:

1. On the IRM|Analysis™ tool, expand *Assets* on the left menu bar.
2. Under Assets, click on Asset Inventory List.
3. On the *Asset Inventory List* page (see Figure 2-4), click on the *New* button.
4. On the *New Asset* form (see Figure 2-5), enter the required information and click on the *Save* button.

Figure 2-4: Asset Inventory List

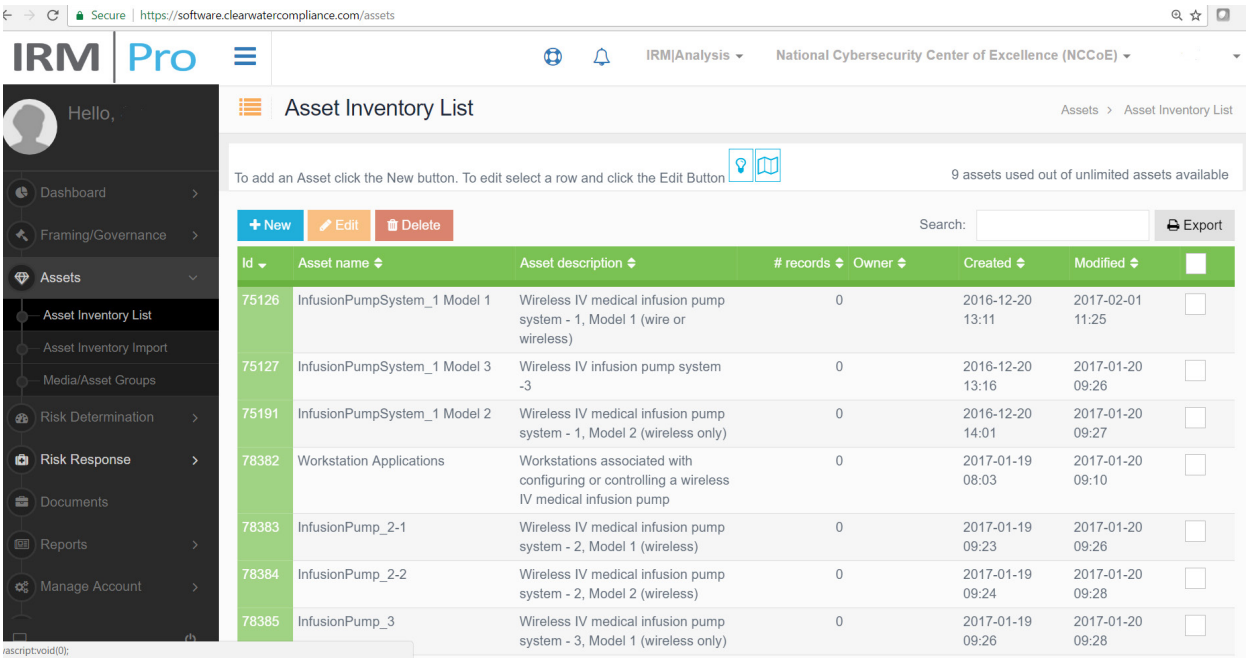
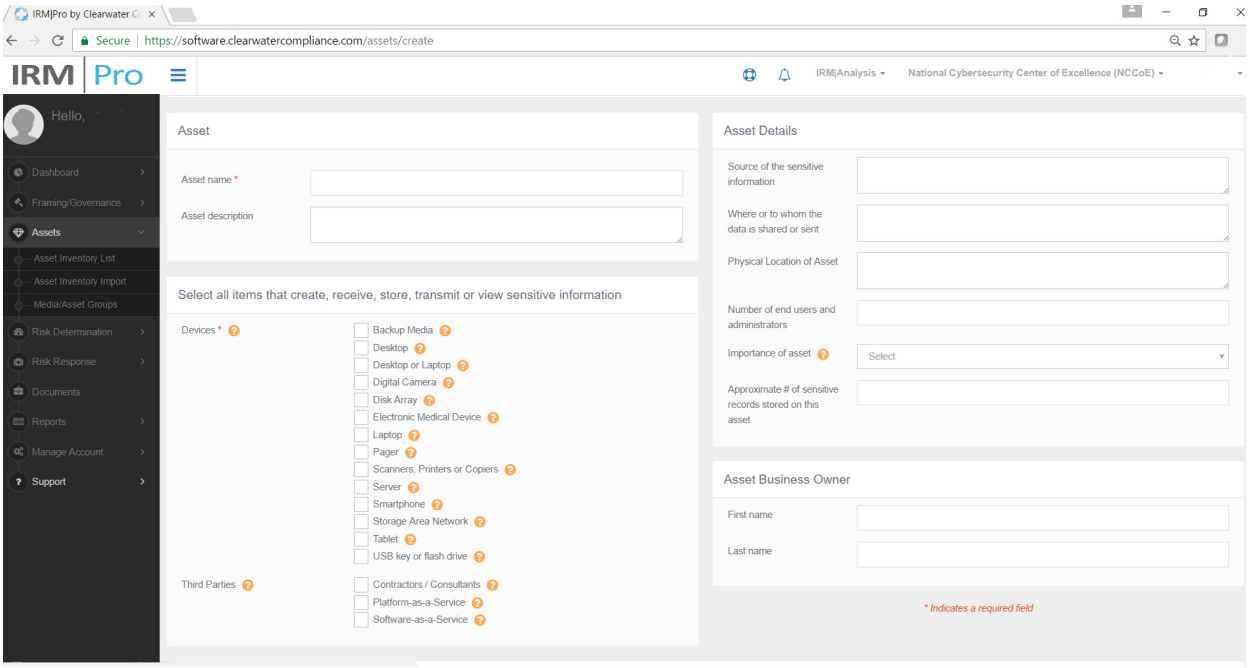


Figure 2-5: New Asset



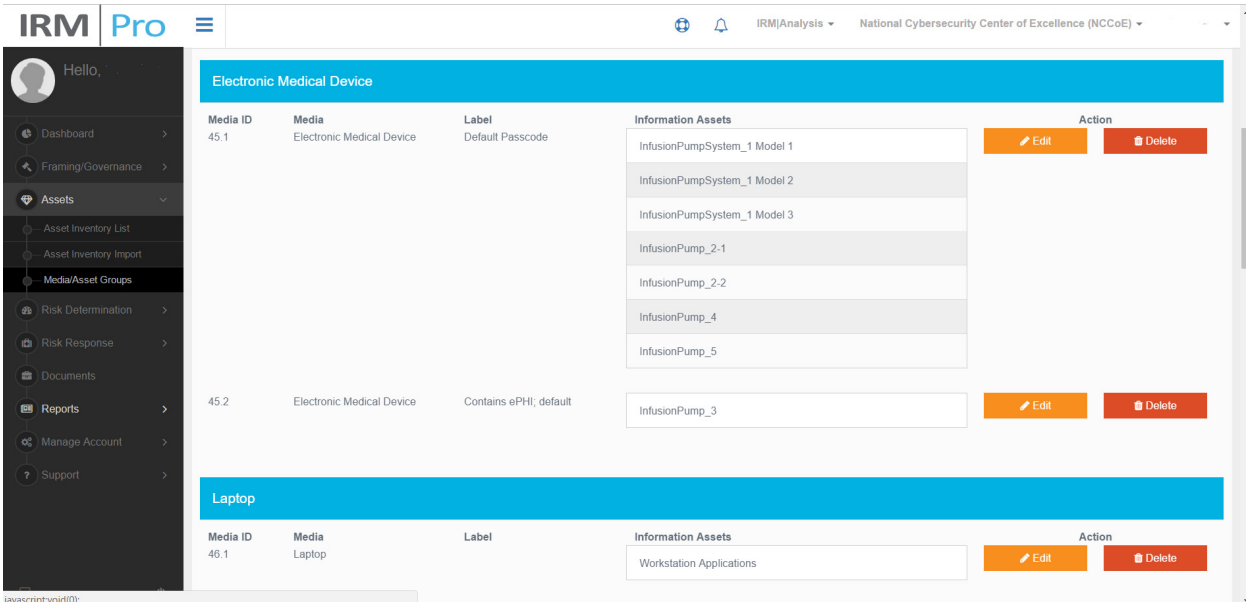
To update an asset:

1. On the IRM|Analysis™ tool, expand *Assets* on the left menu bar.
2. Under Assets, click on *Asset Inventory List*.
3. On the *Asset Inventory List* page (see Figure 2-4), select the asset you want to edit, then click on the *Edit* button.
4. On the *Edit Media/Asset Groups* page (see Figure 2-7), enter the necessary information and click on the *Save* button.

To view and manage media/asset groups:

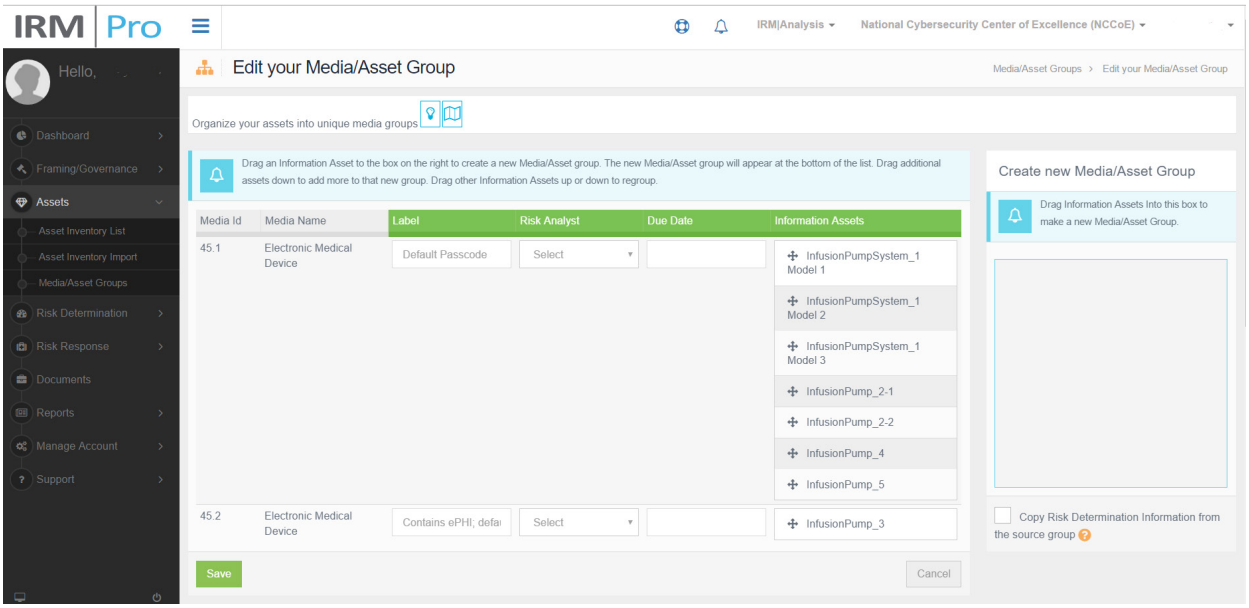
1. On the IRM|Analysis™ tool, expend *Assets* on the left menu bar.
2. Under Assets, click on Media/Asset Groups.
3. On the *Media/Asset Groups* (see Figure 2-6), scroll up and down to view the groups and select a group by clicking on the *Edit* button.
4. On the *Edit Media/Asset Groups page* (see Figure 2-7), enter the necessary information and click on the *Save* button.

950 **Figure 2-6: Media/Asset Groups**



951

952 **Figure 2-7: Edit Media/Asset Group**



953

954 ### *2.5.1.3 Risk Determination*

955 The IRM|Analysis™ tool uses different methods to determine risk. In this section, we show two ways to
956 use the tool: Controls – Global/Media screen to document the status of a control; and the Risk
957 Questionnaire List to select a given Media/Asset group.

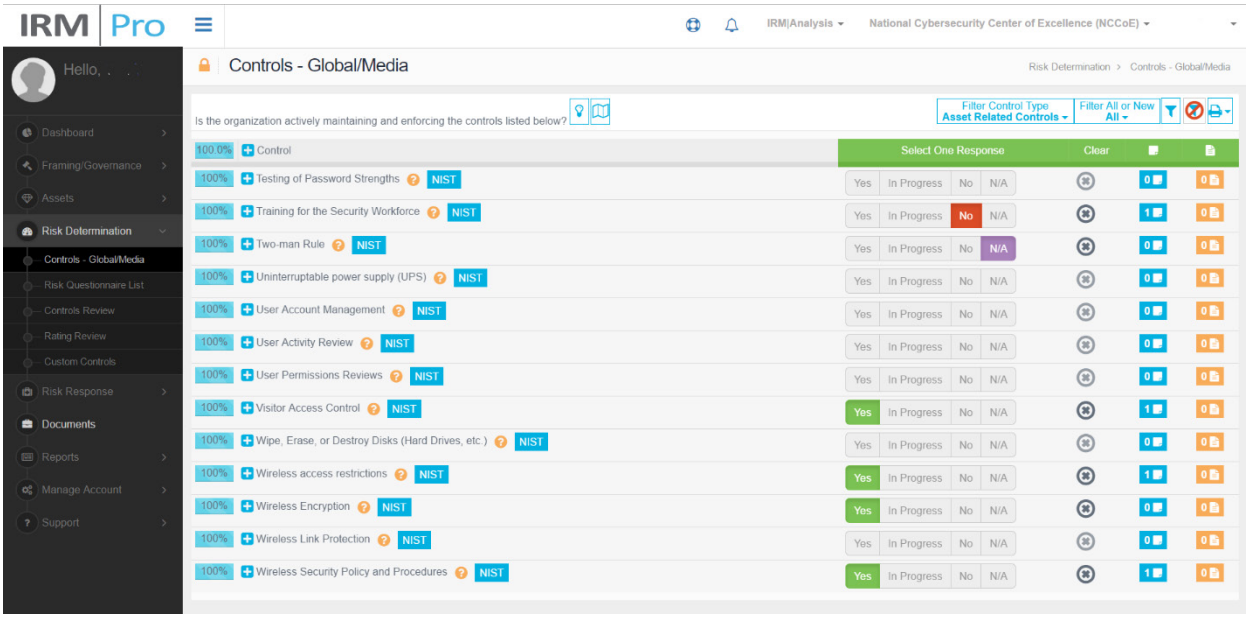
958 To use the Risk Determination at Global/Media level:

959 1. On the IRM|Analysis™ tool, expand *Risk Determination* on the left menu bar.

960 2. Under Risk Determination, click on Controls – Global/Media.

3. On the *Controls – Global/Media* page (see Figure 2-8), scroll up and down to view the controls. For each control, select one of the responses (i.e., Yes, In Progress, No, and N/A) to indicate the response status.

Figure 2-8: Controls - Global/Media



To use the Risk Determination at the Asset/Media group level:

1. On the IRM|Analysis™ tool, expand *Risk Determination* on the left menu bar.
2. Under Risk Determination, click on Risk Questionnaire List.
3. On the *Risk Questionnaire List* page (see Figure 2-9), scroll up and down to view the media/asset groups.
4. For each relevant media/asset group, select the *Risk Analyst*, fill in the *Due Date* and click on the *Continue* button to get in the Risk Questionnaire Form (see Figure 2-10 – part 1 and Figure 2-11 – part 2).
5. For each control, select one of the responses (i.e., *Yes*, *In Progress*, *No*, and *N/A*) to indicate the response status (example shown in part 1), if it was already noted on the Controls Global/Media page.
6. Controls can be set globally or for individual Media/Asset Groups. The plus sign will expand the control to reveal the Media/Asset Groups so the control can be set individually. To illustrate, a global control can be set for Training for the Security Workforce but an individual control would be set for each of the Media/Asset groups associated with the User Activity Review since only a subset of assets may undergo a User Activity Review.
7. Then determine and select the Risk Likelihood and Risk Impact for the selected risk scenario (example shown in part 2) to populate the Risk Rating.
8. You may select the question mark for more information on the control and the NIST symbol for a quick reference to NIST SP800-53.

Figure 2-9: Risk Questionnaire List

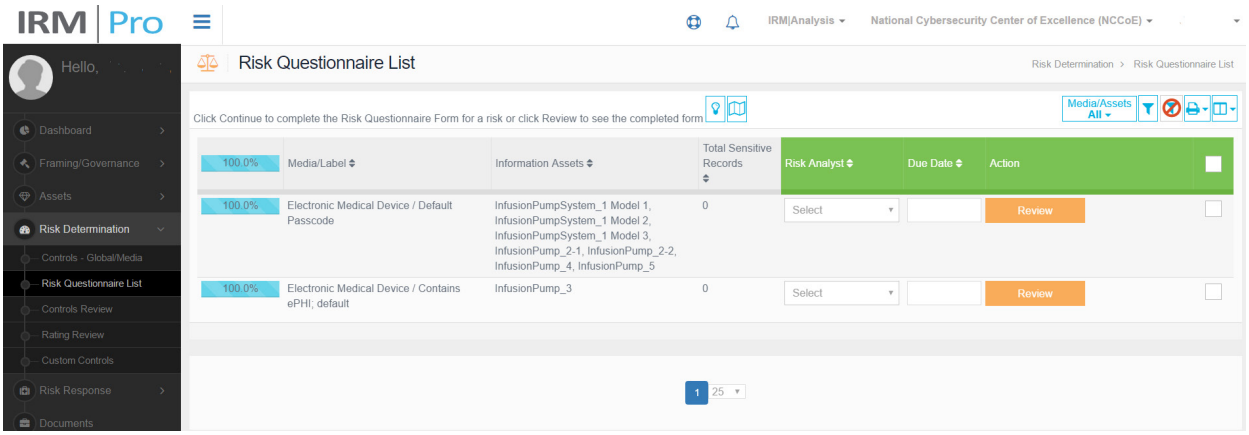
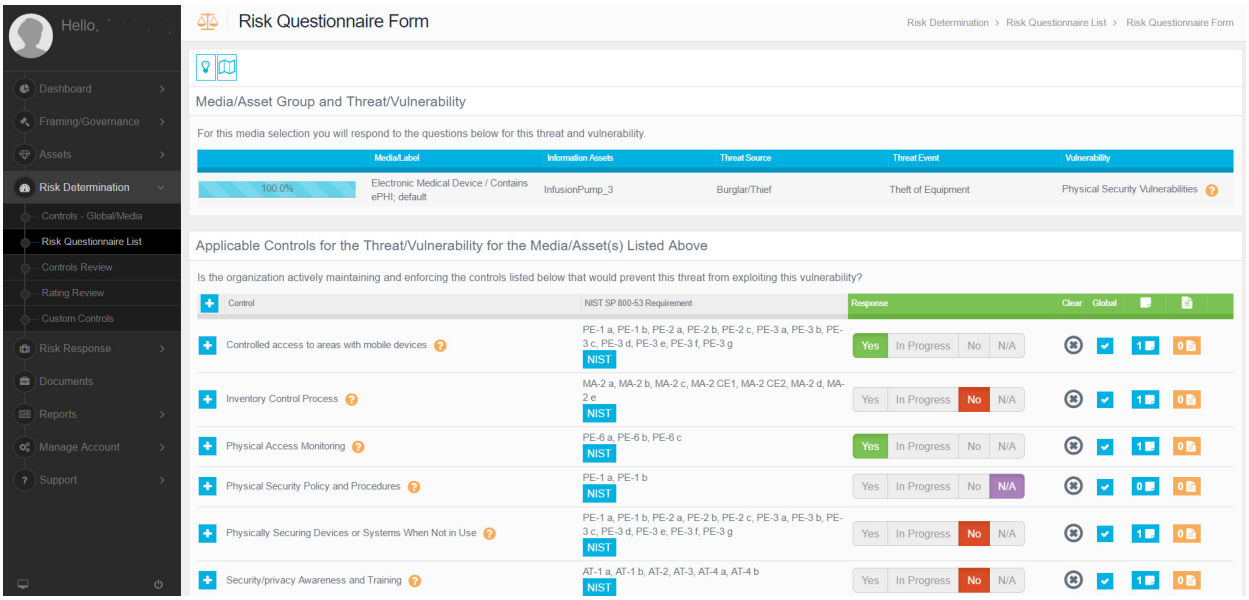
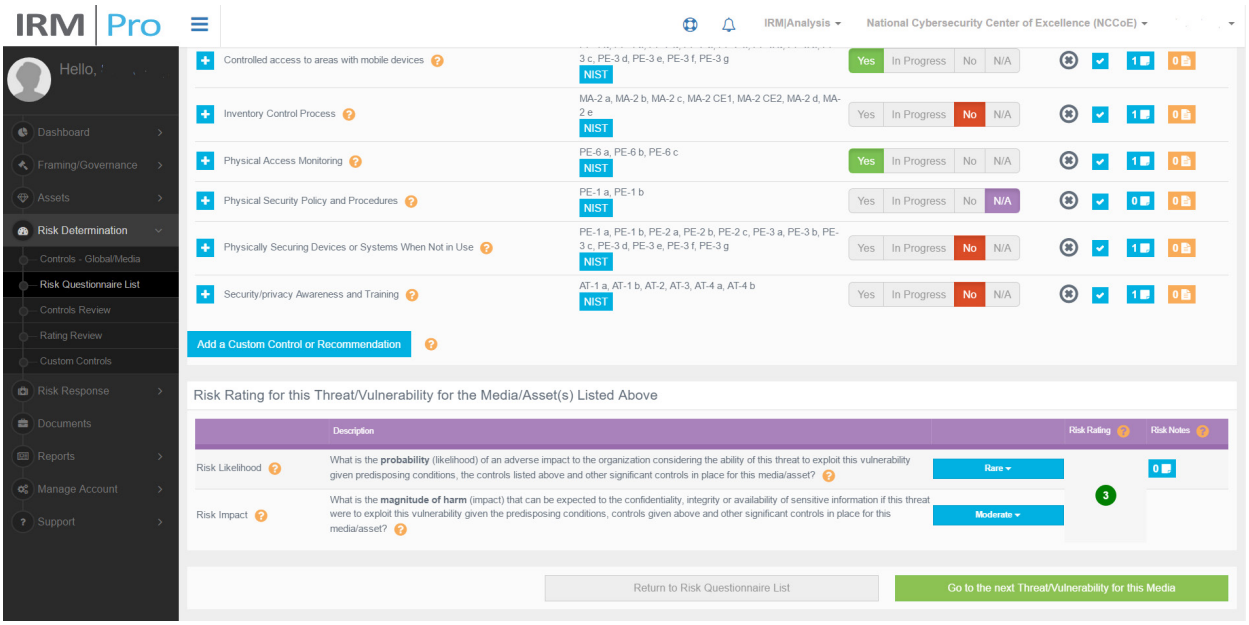


Figure 2-10: Risk Questionnaire Form (part 1)



990 **Figure 2-11: Risk Questionnaire Form (part 2)**



991

992 ### *2.5.1.4 Risk Response*

993 The IRM|Analysis™ tool enables users to try different methods of reviewing risk scenarios, acquiring a
994 risk rating, and seeing progress in a risk response workflow. The basics of using the tool follow.

995 Consider following these risk response steps:

996 1. In the IRM|Analysis™ tool, expand *Risk Response* in the left menu bar.

997 2. Under Risk Response, click on Risk Response List.

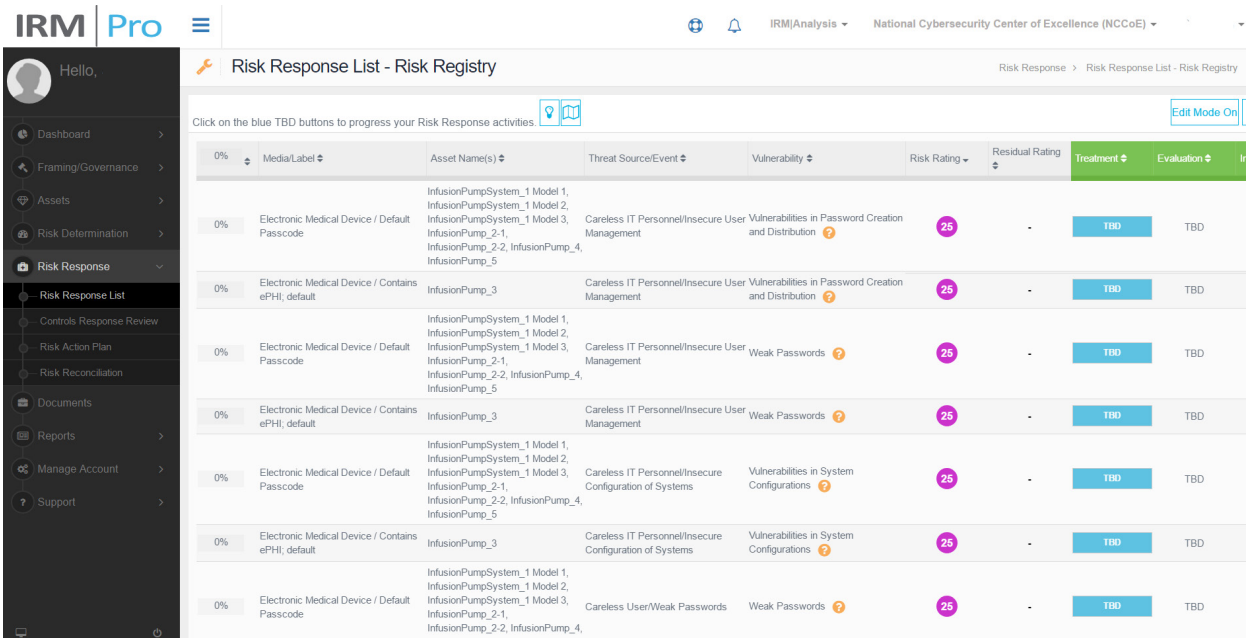
998 3. Only those risks which exceed the risk threshold established under *Framing/Governance* in the left
999 menu bar will move to the Risk Response portion of the software.

1000 4. On the *Risk Response List* page (see Figure 2-12), scroll up and down to view the Medial/Asset
1001 Groups along with the associated threat source, vulnerability, and risk rating.

1002 5. For each relevant risk response, click on the button under the Treatment column to enter the *Risk*
1003 *Treat and Evaluate Form* page of that risk (see Figure 2-13).

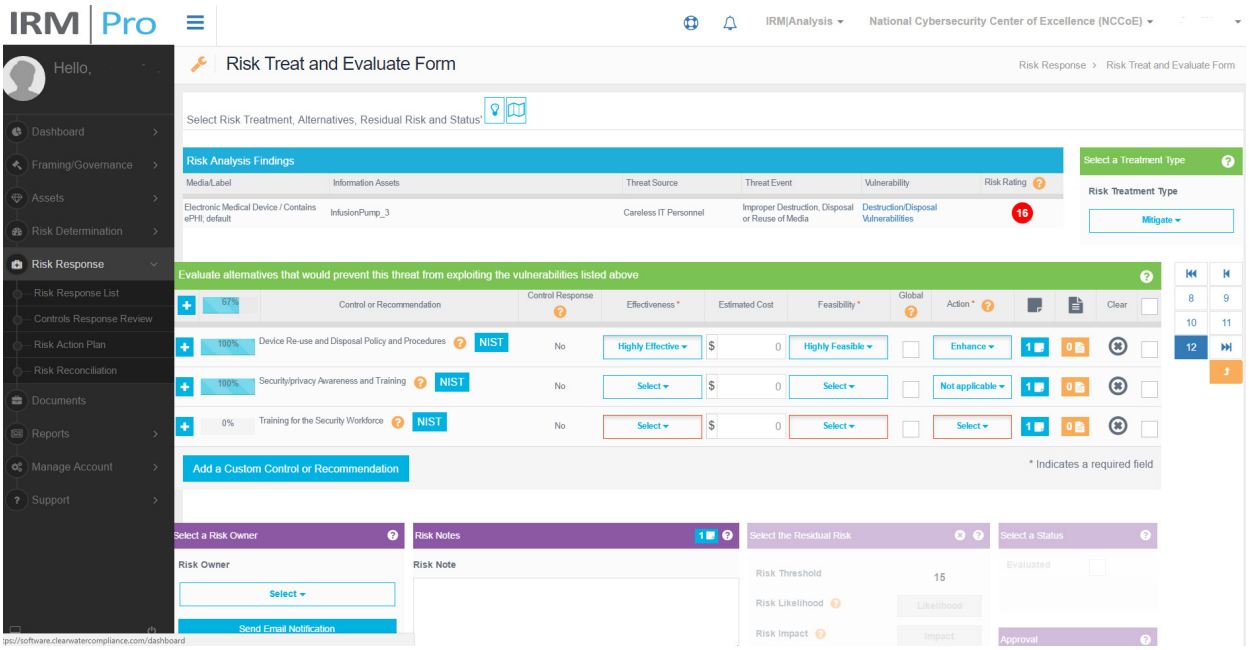
1004 6. On the *Risk Treat and Evaluate Form* page, perform the risk response analysis by selecting the risk
1005 treatment type; evaluate the control or recommendation; select risk owner; put risk notes, and so
1006 on.

1007 **Figure 2-12: Risk Response List - Risk Registry**



1008

1009 **Figure 2-13: Risk Treat and Evaluate Form**



1010

1011 *2.5.1.5 Dashboard and Report*

1012 The IRM|Analysis™ tool enables users to review their risk analyses with a dashboard or report format.
1013 To access the dashboard views, follow these steps:

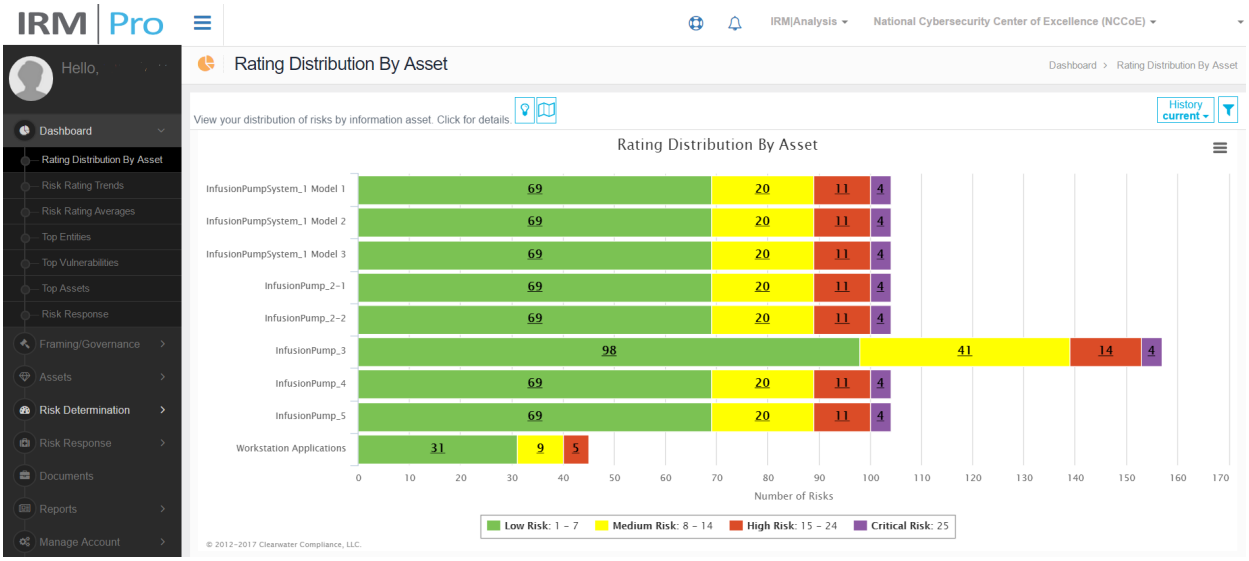
1014 1. On the IRM|Analysis™ tool, expand *Dashboard* on the left menu bar

1015 2. Under Dashboard, click on Rating Distribution by Asset

3. Example Dashboard: Rating Distribution by Asset page (see Figure 2-14 below)

You can also view other types of dashboards, such as *Risk Rating Trends* and *Risk Rating Averages*.

Figure 2-14: Dashboard Example

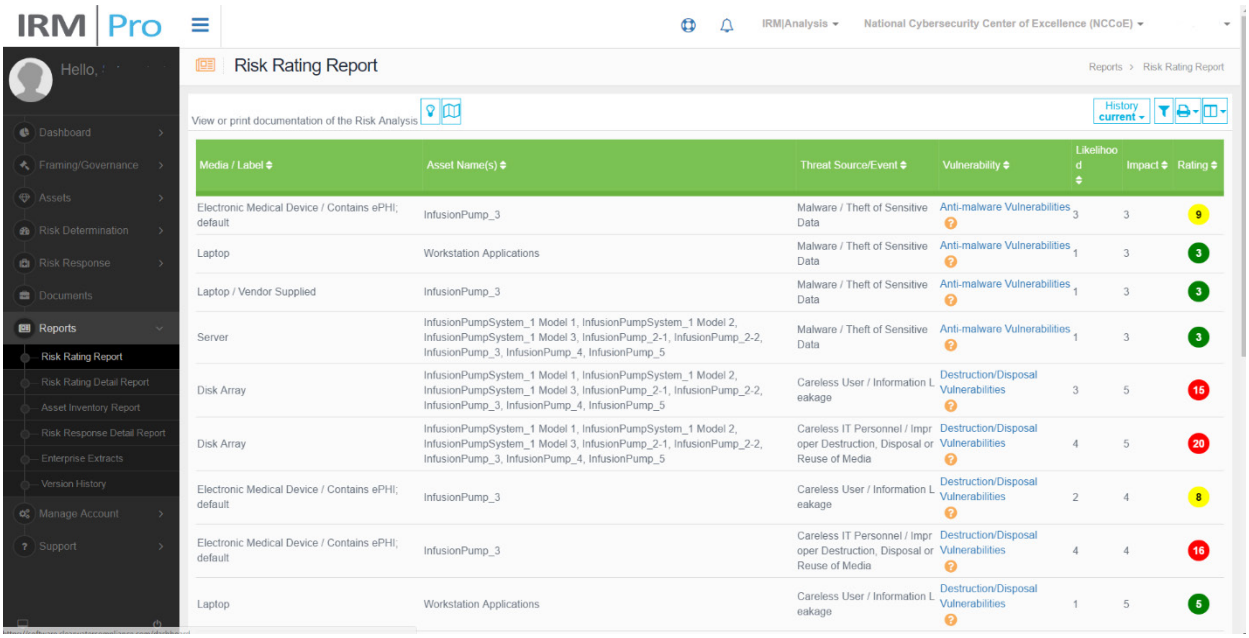


For report views, follow these steps:

1. On the IRM|Analysis™ tool, expand *Reports* on the left menu bar
2. Under Reports, click on Risk Rating Report
3. Example Report: *Risk Rating Report* page is showing (see Figure 2-15 below)

You can also view other types of dashboards, such as *Risk Rating Trends* and *Risk Rating Averages*.

1026 **Figure 2-15: Report Example**



1027

1028 2.5.2 MDISS MDRAP

1029 We used MDISS's cloud-based Medical Device Risk Assessment Platform (MDRAP), a questionnaire-
1030 based risk assessment tool to conduct the assessment on the medical devices. In our environment, we
1031 set up and configured wireless infusion pump systems from five manufactures and built the enterprise
1032 network to simulate a typical HDO environment.

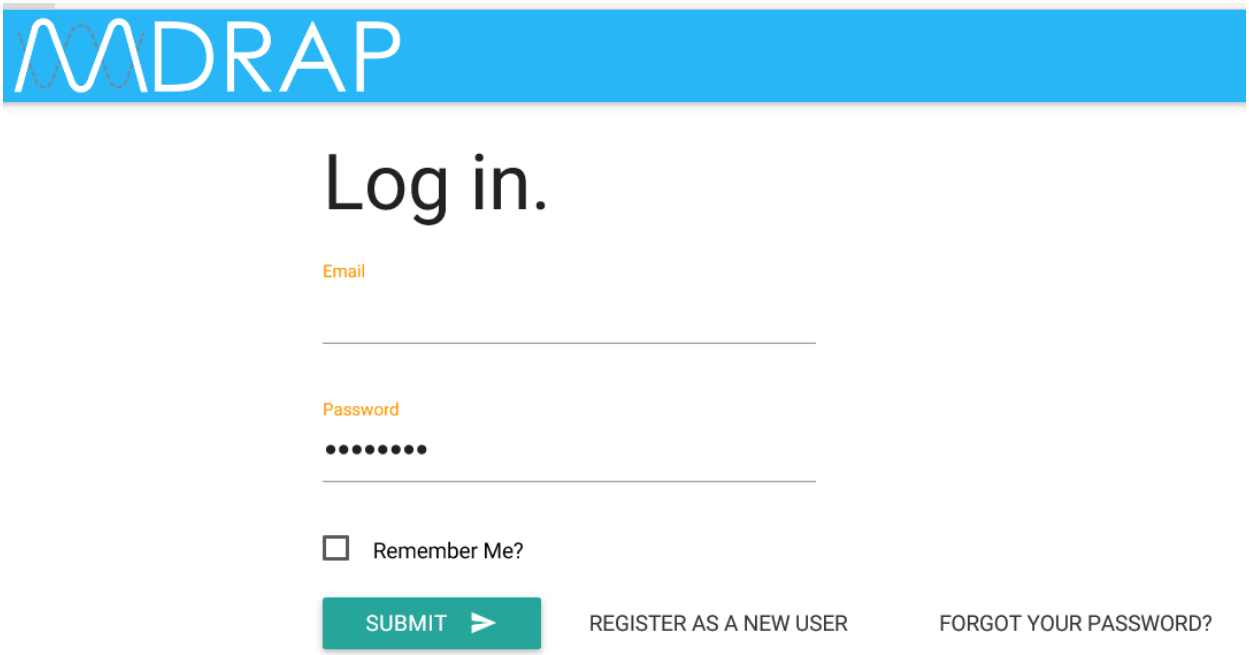
1033 Please note, this section does not show you how to conduct a risk assessment. Instead, we show these
1034 basic steps for using the MDRAP tool:

1035 - Login to MDRAP
1036 - Conduct Device Inventory
1037 - Risk Assessment
1038 - Dashboard and Reports.

1039 *2.5.2.1 Login to MDRAP*

1040 1. Within a browser, type https://mdrap.mdiss.org/ and click on *Log In*
1041 2. On the Login page (see Figure 2-16), enter the appropriate email and password
1042 3. Click on *Submit.*

1043 **Figure 2-16: MDRAP Login Page**



1044

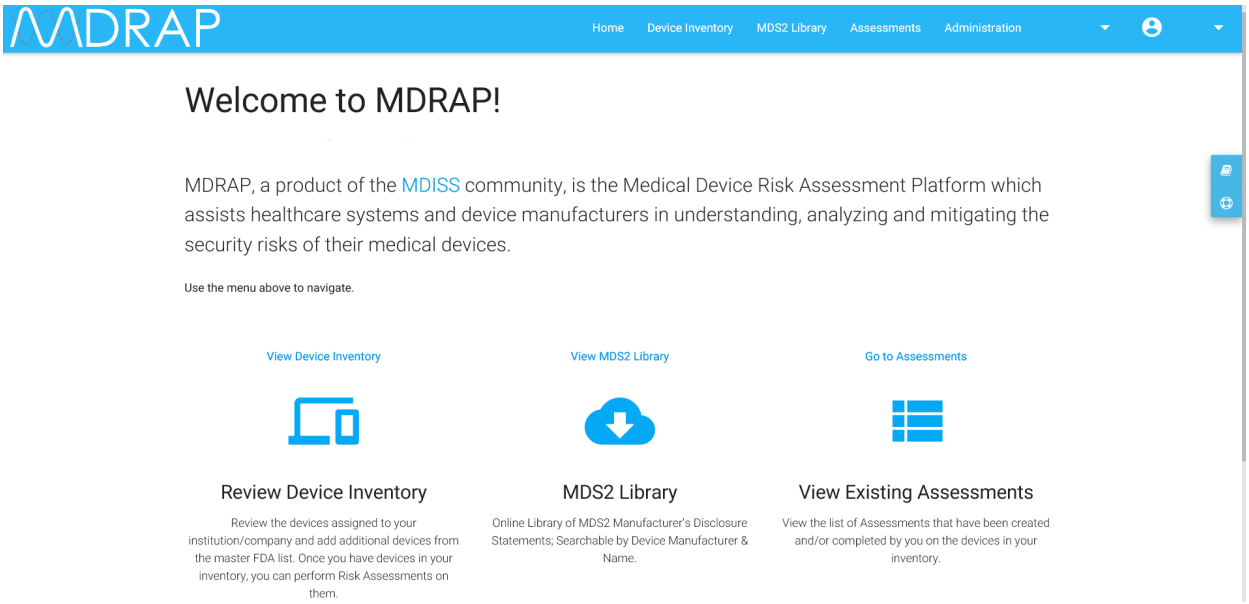
1045 ### *2.5.2.2 Conduct Device Inventory*

1046 We use the Device Inventory module of MDRAP to keep track all the infusion pumps and servers in our
1047 sample implementation. Add Device, per its name, enables us to add individual devices, while Bulk
1048 Import enables us to add a group of devices. Steps for using both methods follow.

1049 1. On the Welcome to MDRAP page (see Figure 2-17), click on Device Inventory on the menu bar or
1050 on the View Device Inventory link on the page.

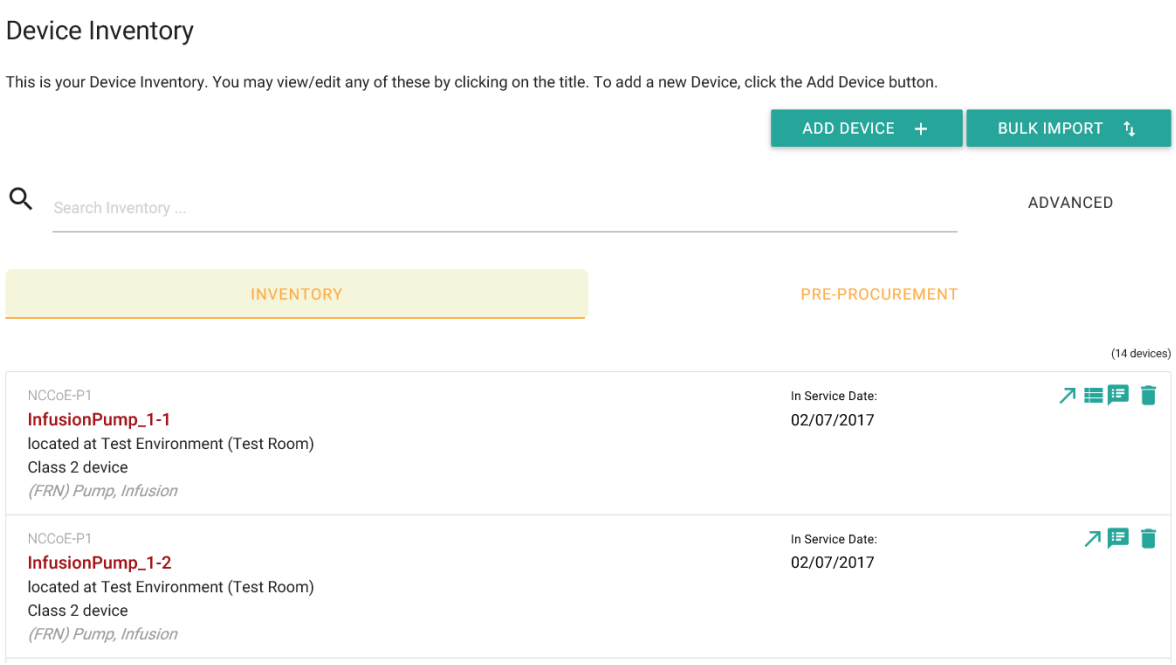
1051 2. On the Device Inventory page (Figure 2-18), add an individual device, or edit a device, or bulk import
1052 a group of devices.

1053 **Figure 2-17: MDRAP Welcome page**



1054

1055 **Figure 2-18: Device Inventory List**



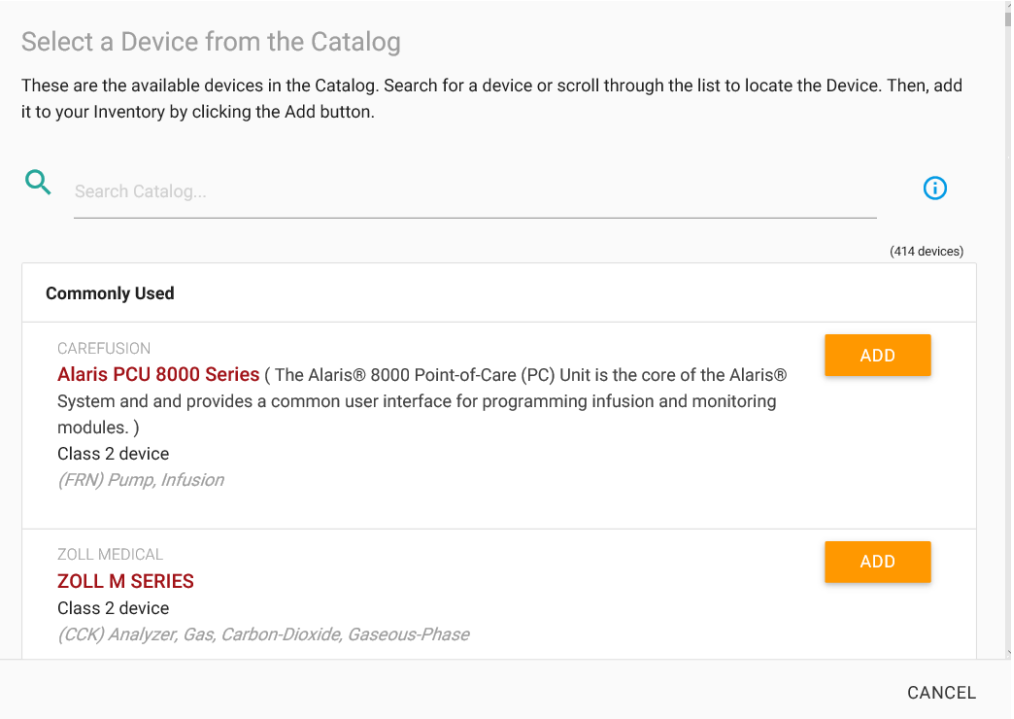
1056

1057 Add device:

1058 1. On the Device Inventory page (see Figure 2-18 above), click on ADD DEVICE.

1059 2. On Add Device page (see Figure 2-19 below), locate the device from the Category List, then click on
1060 ADD.

1061 **Figure 2-19: Add Device**



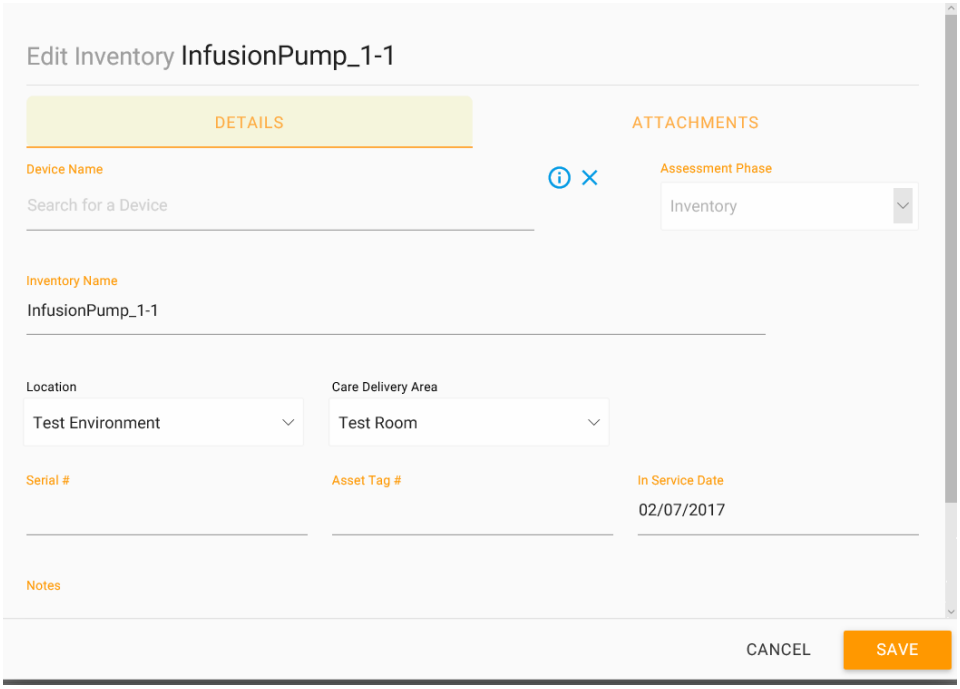
1062

1063 Edit a device:

1064 1. On the Device Inventory page (see Figure 2-18 above), locate the device from the list, click on the
1065 product name link or the Edit icon.

1066 2. On the Edit Inventory page (see Figure 2-20 below), update the data and click on Save.

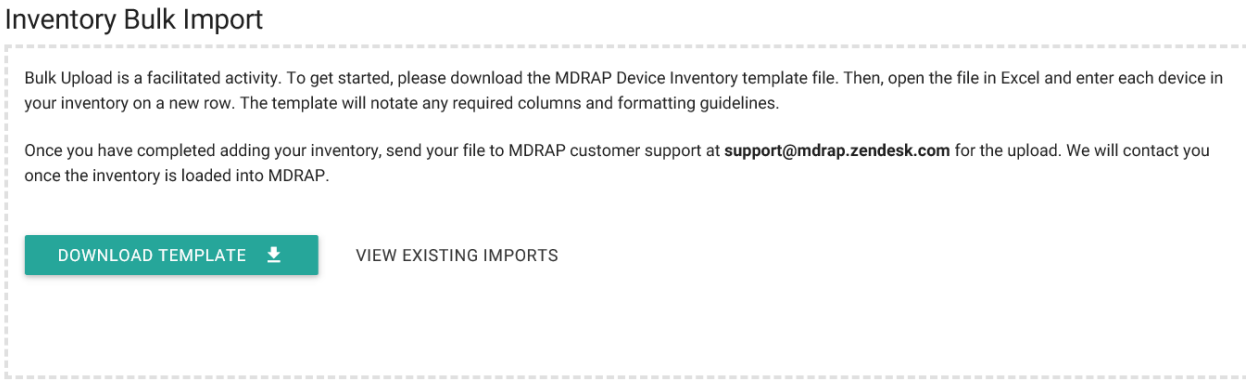
Figure 2-20: Edit Device



Bulk Import a group of devices:

1. On the Device Inventory page (see Figure 2-18: Device Inventory List above), click on BULK IMPORT button.
2. On Inventory Bulk Import page (see Figure 2-21 below), download the template, fill-in the data into the template.
3. Follow the instruction to upload and import the devices by using the template (see Figure 2-22).

Figure 2-21: Inventory Bulk Import



1078 **Figure 2-22: Device inventory Template Sample**

MDRAP Device Inventory Template

version 1.0.0
last updated 6/29/2016

** Required*
*** Enter a custom name as you refer to the device in your Organization; otherwise, leave it blank and it will default to the Device Name*

Device Name *	Manufacturer *	Location *	Department / Care Area *	Custom Name **	Serial #	Asset Tag	In Service On	Notes
InfusionPump_1-1	NCCoE-P1	NCCoE	Health Lab	CoE User				
PumpServer_1	NCCoE-P1	NCCoE	Health Lab	NCCoE User				
InfusionPump_1-2	NCCoE-P1	NCCoE	Health Lab	NCCoE User				
NetworkSetup_1	NCCoE-P1	NCCoE	Health Lab	NCCoE User				
InfusionPump_2-1	NCCoE-P2	NCCoE	Health Lab	NCCoE User				
InfusionPump_2-2	NCCoE-P2	NCCoE	Health Lab	NCCoE User				
PumpServer_2	NCCoE-P2	NCCoE	Health Lab	NCCoE User				
InfusionPump_3	NCCoE-P3	NCCoE	Health Lab	NCCoE User				
PumpServer_3	NCCoE-P3	NCCoE	Health Lab	NCCoE User				
NetworkSetup_3	NCCoE-P3	NCCoE	Health Lab	NCCoE User				
InfusionPump_4	NCCoE-P4	NCCoE	Health Lab	NCCoE User				
PumpServer_4	NCCoE-P4	NCCoE	Health Lab	NCCoE User				
InfusionPump_5	NCCoE-P5	NCCoE	Health Lab	NCCoE User				
PumpServer_5	NCCoE-P5	NCCoE	Health Lab	NCCoE User				

Inventory | Locations | Departments

1079

1080 ### *2.5.2.3 Risk Assessment*

1081 We created a risk assessment for each device by responding to the MDRAP's built-in questionnaire. The
1082 basic steps of creating a risk assessment for a given device follow:

1083 1. Create assessment

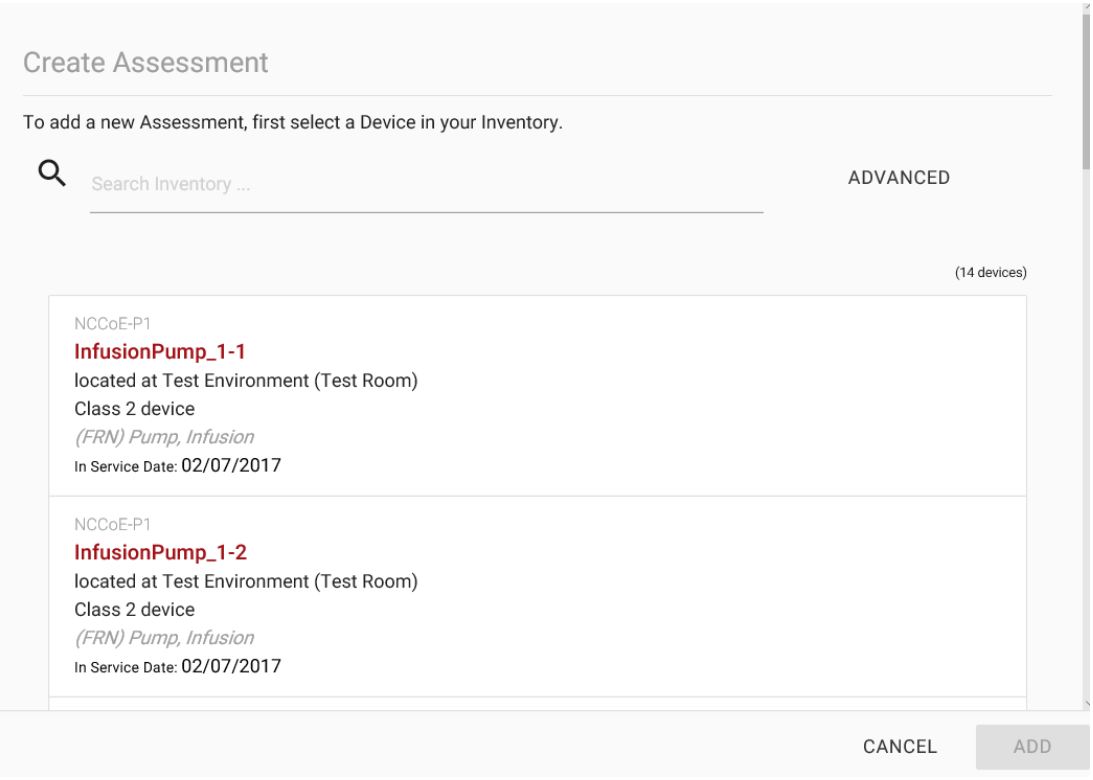
1084 d. On the *Welcome to MDRAP* page (see Figure 2-17 above), click on *Assessments* on the menu
1085 bar or *Go to Assessments* link on the page.

1086 e. On *Create Assessment* page 1(see Figure 2-23), select a device.

1087 f. On Create Assessment page 2 (see Figure 2-24), select Questionnaire type (i.e., MDISS
1088 Questionnaire).

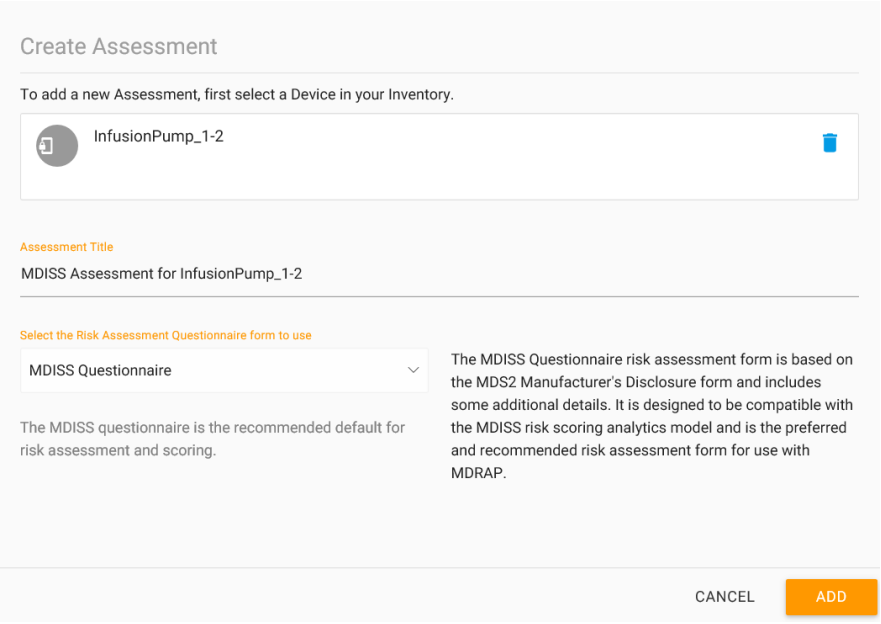
1089 g. Answer the questions and then click *Next* button (see example questionnaire pages in Figure
1090 2-25 and Figure 2-26).

1091 **Figure 2-23: Create Assessment (part 1)**



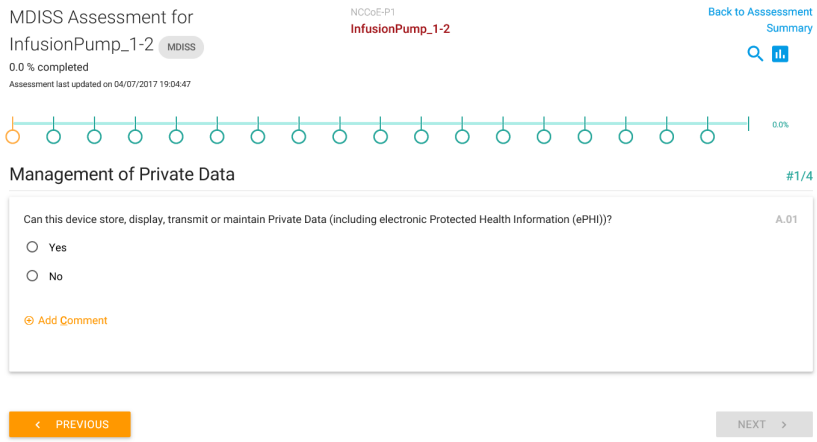
1092

1093 **Figure 2-24: Create Assessment (part 2)**



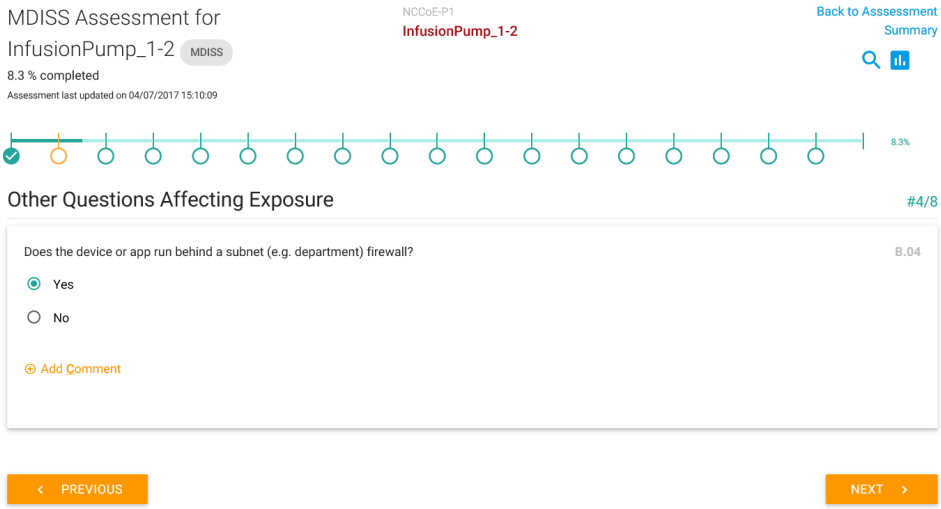
1094

1095 **Figure 2-25: Assessment Step (example 1)**



1096

1097 **Figure 2-26: Assessment Step (example 2)**

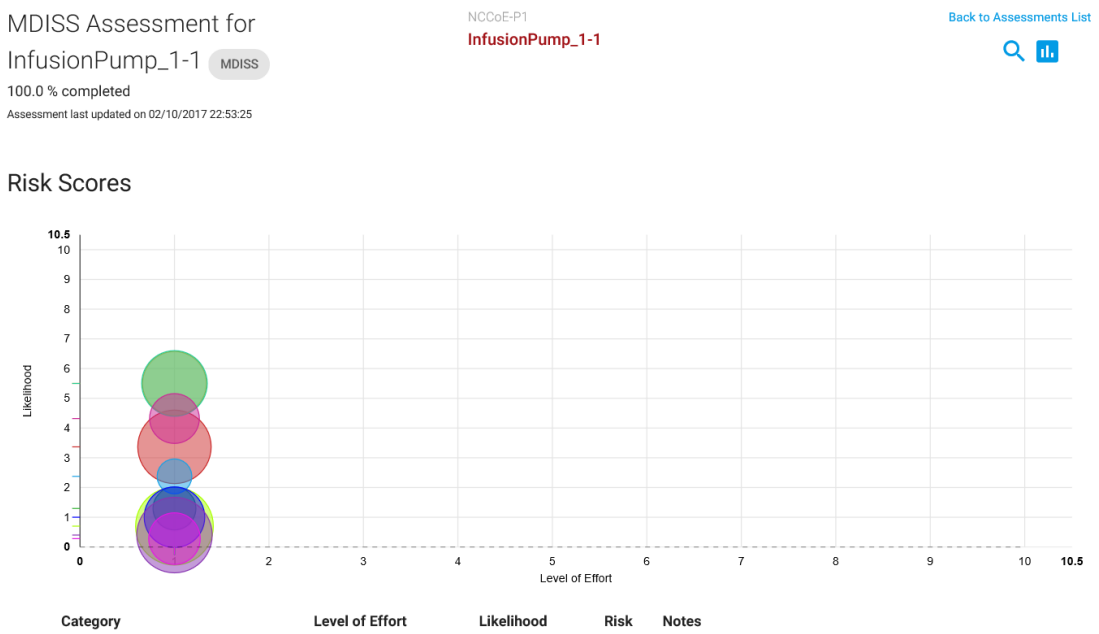


1098

1099 *2.5.2.4 Dashboard and Reports*

1100 MDRAP computes assessment results based on the responses to the questionnaires. For a given
1101 assessment (complete or partially complete), the assessment result is available for view as a dashboard
1102 (see Figure 2-27) or report (see Figure 2-28).

1103 **Figure 2-27: Assessment Result (dashboard example)**



1104

1105 **Figure 2-28: Assessment Result (report example)**

	Category	Level of Effort	Likelihood	Risk	Notes
	Audit Controls	1	3.367	5.25	* Patient identity not captured.
	Authorization	1	5.5	3.75	* Authorization can be bypassed using an API. * Operator can acquire root-level privilege. * Root-level privilege is the only authorization mode.
	Automatic Logoff	1	0.7	6	
	Cyber Security Product Upgrades	1	1.295	1.175	* Device OS is not supported by the OS manufacturer.
	Malware Detection / Protection	1	5.5	4	* No Virus Protection
	Other Scoreable MDS2 Security Categories	1	2.375	0.453	* No encrypption of data at rest. * No Fuzz-testing performed * Some device storage components not physically secured.
	Other Security Considerations - Remote Access	1	1	3.275	* Maintenance users require root privilege.
	Person Authentication	1	0.4	5.6	* Device does not store, display, transmit, or maintain ePHI. * Passwords cannot be set to expire. * Person authentication is not supported.
	System and Application Hardening	1	4.32	1.907	* Device transmits data in the clear on shared networks. * System does not alllow file-level access controls. * Unnecessary services active.
	Transmission Confidentiality &	1	0.28	2.118	

1106

Appendix A Baseline Configuration File

A.1 Baseline Configuration File

```
ASA Version 9.6(1)
!
interface Management0/0
 ip address 192.168.29.149 255.255.255.0
!
! optional, SSH, version is important as v1 is insecure and on by default, also set your own password!
username cisco password XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
aaa authentication ssh console LOCAL
! set to network and interface you want to manage from, can be WAN
ssh 192.168.29.0 255.255.255.0 management
ssh version 2
!
hostname internal-kmcfadde
!
! Configure network interfaces
interface GigabitEthernet0/0
 nameif WAN
 security-level 50
 ip address 192.168.100.149 255.255.255.0
 no shutdown
! optional, authenticated OSPF for excellence
 ospf authentication-key [L}N]@Uv
 ospf authentication message-digest
!
interface GigabitEthernet0/1
 nameif LAN
 security-level 100
 ip address 192.168.150.1 255.255.255.0
```

```
 no shutdown
!
! optional, DHCP Server
dhcpd address 192.168.150.220-192.168.150.250 LAN
dhcpd dns 8.8.8.8 8.8.4.4
dhcpd option 3 ip 192.168.150.1
dhcpd enable LAN
!
! optional, OSPFv2
router ospf 1
 network 192.168.100.0 255.255.255.0 area 0
 redistribute connected subnets
 redistribute static subnets
!
! Configure DNS resolution here, required for license activation
dns domain-lookup WAN
dns server-group DefaultDNS
 name-server 8.8.8.8
 name-server 8.8.4.4
!
license smart
 feature tier standard
 throughput level 1G
names
!
! optional, Configure time zone and NTP here
clock timezone EST -5
clock summer-time EDT recurring
ntp server 10.97.74.8
!
```

```
! Allow ping through LAN to WAN
policy-map global_policy
 class inspection_default
  inspect icmp
  inspect icmp error
!
! Show up in traceroute
policy-map global_policy
 class class-default
  set connection decrement-ttl
!
! Make ICMP/UDP traceroute work from LAN to WAN
object-group icmp-type PING-REPLIES
 icmp-object echo-reply
object-group icmp-type TRACEROUTE-REPLIES
 icmp-object time-exceeded
 icmp-object unreachable
 group-object PING-REPLIES
access-list 101 extended permit icmp any any object-group TRACEROUTE-REPLIES
access-list 101 extended permit icmp any any object-group PING-REPLIES
!
! Allow ICMP ping/traceroute from WAN to LAN
object-group icmp-type PING
 icmp-object echo
access-list 101 extended permit icmp any any object-group PING
!
! Allow UDP traceroute from WAN to LAN
object-group service TRACEROUTEUDP
 service-object udp destination gt 33434
access-list 101 extended permit object-group TRACEROUTEUDP any any
```

```
!
! example, allow a specific port on a host
! access-list 101 extended permit tcp any host 192.168.140.XXX eq www
!
! Add firewall rules we created to WAN interface
access-group 101 in interface WAN
!
! Example, set a static route
! route WAN 192.168.140.0 255.255.255.0 192.168.100.111
!
! SNMP
object network SNMPHOSTS
 subnet 192.168.29.0 255.255.255.0
snmp-server enable
snmp-server community public
snmp-server host-group management SNMPHOSTS
```

A.2 External Firewall and Guest Network ASA Configuration File

```
: Saved
:
: Serial Number: 9AK64JT2D2M
: Hardware:   ASAv, 2048 MB RAM, CPU Xeon E5 series 2200 MHz
:
ASA Version 9.6(1)
!
hostname border-kmcfadde
enable password 8Ry2YjIyt7RRXU24 encrypted
xlate per-session deny tcp any4 any4
xlate per-session deny tcp any4 any6
xlate per-session deny tcp any6 any4
xlate per-session deny tcp any6 any6
xlate per-session deny udp any4 any4 eq domain
xlate per-session deny udp any4 any6 eq domain
xlate per-session deny udp any6 any4 eq domain
xlate per-session deny udp any6 any6 eq domain
!
license smart
 feature tier standard
 throughput level 1G
names

!
interface GigabitEthernet0/0
 nameif WAN
 security-level 0
 ip address 10.32.3.10 255.255.255.0
!
```

```
interface GigabitEthernet0/1
 nameif LAN
 security-level 100
 ip address 192.168.100.101 255.255.255.0
 ospf authentication-key *****
 ospf authentication message-digest
!
interface GigabitEthernet0/2
 nameif GUEST
 security-level 100
 ip address 192.168.170.1 255.255.255.0
!
interface GigabitEthernet0/3
 shutdown
 no nameif
 no security-level
 no ip address
!
interface GigabitEthernet0/4
 shutdown
 no nameif
 no security-level
 no ip address
!
interface GigabitEthernet0/5
 shutdown
 no nameif
 no security-level
 no ip address
!
```

```
interface GigabitEthernet0/6
 shutdown
 no nameif
 no security-level
 no ip address
!
interface GigabitEthernet0/7
 shutdown
 no nameif
 no security-level
 no ip address
!
interface GigabitEthernet0/8
 shutdown
 no nameif
 no security-level
 no ip address
!
interface Management0/0
 management-only
 nameif management
 security-level 0
 ip address 192.168.29.147 255.255.255.0
!
ftp mode passive
clock timezone EST -5
clock summer-time EDT recurring
dns domain-lookup WAN
dns server-group DefaultDNS
 name-server 8.8.8.8
```

```
 name-server 8.8.4.4
object network LAN-SUBNETS
 subnet 192.168.0.0 255.255.0.0
object network SNMPHOSTS
 subnet 192.168.29.0 255.255.255.0
object-group icmp-type PING-REPLIES
 icmp-object echo-reply
object-group icmp-type TRACEROUTE-REPLIES
 icmp-object time-exceeded
 icmp-object unreachable
 group-object PING-REPLIES
object-group icmp-type PING
 icmp-object echo
object-group service TRACEROUTEUDP
 service-object udp destination gt 33434
access-list 101 extended permit icmp any any object-group TRACEROUTE-REPLIES
pager lines 23
mtu WAN 1500
mtu LAN 1500
mtu management 1500
mtu GUEST 1500
no failover
no monitor-interface service-module
icmp unreachable rate-limit 1 burst-size 1
no asdm history enable
arp timeout 14400
no arp permit-nonconnected
!
object network LAN-SUBNETS
 nat (LAN,WAN) dynamic interface
```

```
access-group 101 in interface WAN
!
route-map DEFAULT permit 10
 match interface WAN

!
router ospf 1
 network 192.168.100.0 255.255.255.0 area 0
 log-adj-changes
 redistribute connected subnets
 redistribute static subnets
 default-information originate
!
route WAN 0.0.0.0 0.0.0.0 10.32.3.1 1
timeout xlate 3:00:00
timeout pat-xlate 0:00:30
timeout conn 1:00:00 half-closed 0:10:00 udp 0:02:00 sctp 0:02:00 icmp 0:00:02
timeout sunrpc 0:10:00 h323 0:05:00 h225 1:00:00 mgcp 0:05:00 mgcp-pat 0:05:00
timeout sip 0:30:00 sip_media 0:02:00 sip-invite 0:03:00 sip-disconnect 0:02:00
timeout sip-provisional-media 0:02:00 uauth 0:05:00 absolute
timeout tcp-proxy-reassembly 0:01:00
timeout floating-conn 0:00:00
user-identity default-domain LOCAL
aaa authentication ssh console LOCAL
snmp-server host-group management SNMPHOSTS poll community *****
no snmp-server location
no snmp-server contact
snmp-server community *****
crypto ipsec security-association pmtu-aging infinite
crypto ca trustpoint _SmartCallHome_ServerCA
```

```
 no validation-usage
 crl configure
crypto ca trustpool policy
 auto-import
crypto ca certificate chain _SmartCallHome_ServerCA
 certificate ca 6ecc7aa5a7032009b8cebcf4e952d491
    308205ec 308204d4 a0030201 0202106e cc7aa5a7 032009b8 cebcf4e9 52d49130
    0d06092a 864886f7 0d010105 05003081 ca310b30 09060355 04061302 55533117
    30150603 55040a13 0e566572 69536967 6e2c2049 6e632e31 1f301d06 0355040b
    13165665 72695369 676e2054 72757374 204e6574 776f726b 313a3038 06035504
    0b133128 63292032 30303620 56657269 5369676e 2c20496e 632e202d 20466f72
    20617574 686f7269 7a656420 75736520 6f6e6c79 31453043 06035504 03133c56
    65726953 69676e20 436c6173 73203320 5075626c 69632050 72696d61 72792043
    65727469 66696361 74696f6e 20417574 686f7269 7479202d 20473530 1e170d31
    30303230 38303030 3030305a 170d3230 30323037 32333539 35395a30 81b5310b
    30090603 55040613 02555331 17301506 0355040a 130e5665 72695369 676e2c20
    496e632e 311f301d 06035504 0b131656 65726953 69676e20 54727573 74204e65
    74776f72 6b313b30 39060355 040b1332 5465726d 73206f66 20757365 20617420
    68747470 733a2f2f 7777772e 76657269 7369676e 2e636f6d 2f727061 20286329
    3130312f 302d0603 55040313 26566572 69536967 6e20436c 61737320 33205365
    63757265 20536572 76657220 4341202d 20473330 82012230 0d06092a 864886f7
    0d010101 05000382 010f0030 82010a02 82010100 b187841f c20c45f5 bcab2597
    a7ada23e 9cbaf6c1 39b88bca c2ac56c6 e5bb658e 444f4dce 6fed094a d4af4e10
    9c688b2e 957b899b 13cae234 34c1f35b f3497b62 83488174 d188786c 0253f9bc
    7f432657 5833833b 330a17b0 d04e9124 ad867d64 12dc744a 34a11d0a ea961d0b
    15fca34b 3bce6388 d0f82d0c 948610ca b69a3dca eb379c00 48358629 5078e845
    63cd1941 4ff595ec 7b98d4c4 71b350be 28b38fa0 b9539cf5 ca2c23a9 fd1406e8
    18b49ae8 3c6e81fd e4cd3536 b351d369 ec12ba56 6e6f9b57 c58b14e7 0ec79ced
    4a546ac9 4dc5bf11 b1ae1c67 81cb4455 33997f24 9b3f5345 7f861af3 3cfa6d7f
    81f5b84a d3f58537 1cb5a6d0 09e4187b 384efa0f 02030100 01a38201 df308201
```

```
    db303406 082b0601 05050701 01042830 26302406 082b0601 05050730 01861868
    7474703a 2f2f6f63 73702e76 65726973 69676e2e 636f6d30 12060355 1d130101
    ff040830 060101ff 02010030 70060355 1d200469 30673065 060b6086 480186f8
    45010717 03305630 2806082b 06010505 07020116 1c687474 70733a2f 2f777777
    2e766572 69736967 6e2e636f 6d2f6370 73302a06 082b0601 05050702 02301e1a
    1c687474 70733a2f 2f777777 2e766572 69736967 6e2e636f 6d2f7270 61303406
    03551d1f 042d302b 3029a027 a0258623 68747470 3a2f2f63 726c2e76 65726973
    69676e2e 636f6d2f 70636133 2d67352e 63726c30 0e060355 1d0f0101 ff040403
    02010630 6d06082b 06010505 07010c04 61305fa1 5da05b30 59305730 55160969
    6d616765 2f676966 3021301f 30070605 2b0e0302 1a04148f e5d31a86 ac8d8e6b
    c3cf806a d448182c 7b192e30 25162368 7474703a 2f2f6c6f 676f2e76 65726973
    69676e2e 636f6d2f 76736c6f 676f2e67 69663028 0603551d 11042130 1fa41d30
    1b311930 17060355 04031310 56657269 5369676e 4d504b49 2d322d36 301d0603
    551d0e04 1604140d 445c1653 44c1827e 1d20ab25 f40163d8 be79a530 1f060355
    1d230418 30168014 7fd365a7 c2ddecbb f03009f3 4339fa02 af333133 300d0609
    2a864886 f70d0101 05050003 82010100 0c8324ef ddc30cd9 589cfe36 b6eb8a80
    4bd1a3f7 9df3cc53 ef829ea3 a1e697c1 589d756c e01d1b4c fad1c12d 05c0ea6e
    b2227055 d9203340 3307c265 83fa8f43 379bea0e 9a6c70ee f69c803b d937f47a
    6decd018 7d494aca 99c71928 a2bed877 24f78526 866d8705 404167d1 273aeddc
    481d22cd 0b0b8bbc f4b17bfd b499a8e9 762ae11a 2d876e74 d388dd1e 22c6df16
    b62b8214 0a945cf2 50ecafce ff62370d ad65d306 4153ed02 14c8b558 28a1ace0
    5becb37f 954afb03 c8ad26db e6667812 4ad99f42 fbe198e6 42839b8f 8f6724e8
    6119b5dd cdb50b26 058ec36e c4c875b8 46cfe218 065ea9ae a8819a47 16de0c28
    6c2527b9 deb78458 c61f381e a4c4cb66
  quit
telnet timeout 5
ssh stricthostkeycheck
ssh 192.168.29.0 255.255.255.0 management
ssh timeout 5
ssh version 2
```

```
ssh key-exchange group dh-group1-sha1
console timeout 0
dhcpd dns 8.8.8.8 8.8.4.4
dhcpd option 3 ip 192.168.170.1
!
dhcpd address 192.168.170.220-192.168.170.250 GUEST
dhcpd enable GUEST
!
dynamic-access-policy-record DfltAccessPolicy
username cisco password YBYvHe595lIMVg7Y encrypted
!
class-map inspection_default
 match default-inspection-traffic
!
!
policy-map type inspect dns migrated_dns_map_1
 parameters
  message-length maximum client auto
  message-length maximum 512
policy-map global_policy
 class inspection_default
  inspect dns migrated_dns_map_1
  inspect ftp
  inspect h323 h225
  inspect h323 ras
  inspect ip-options
  inspect netbios
  inspect rsh
  inspect rtsp
  inspect skinny
```

```
  inspect esmtp
  inspect sqlnet
  inspect sunrpc
  inspect tftp
  inspect sip
  inspect xdmcp
  inspect icmp
  inspect icmp error
 class class-default
  set connection decrement-ttl
!
service-policy global_policy global
prompt hostname context
no call-home reporting anonymous
call-home
 profile CiscoTAC-1
  no active
  destination address http https://tools.cisco.com/its/service/oddce/services/DDCEService
  destination address email callhome@cisco.com
  destination transport-method http
  subscribe-to-alert-group diagnostic
  subscribe-to-alert-group environment
  subscribe-to-alert-group inventory periodic monthly
  subscribe-to-alert-group configuration periodic monthly
  subscribe-to-alert-group telemetry periodic daily
 profile License
  destination address http https://tools.cisco.com/its/service/oddce/services/DDCEService
  destination transport-method http
Cryptochecksum:9ffa4947d875e0c501e036c54e80ee93
: end
```

A.3 Enterprise Services ASA Configuration File

```
: Saved
:
: Serial Number: 9AEHKLC171M
: Hardware:   ASAv, 2048 MB RAM, CPU Xeon E5 series 2200 MHz
:
ASA Version 9.6(1)
!
hostname enterprise-services-kmcfadde
enable password 8Ry2YjIyt7RRXU24 encrypted
xlate per-session deny tcp any4 any4
xlate per-session deny tcp any4 any6
xlate per-session deny tcp any6 any4
xlate per-session deny tcp any6 any6
xlate per-session deny udp any4 any4 eq domain
xlate per-session deny udp any4 any6 eq domain
xlate per-session deny udp any6 any4 eq domain
xlate per-session deny udp any6 any6 eq domain
!
license smart
 feature tier standard
 throughput level 1G
names
!
interface GigabitEthernet0/0
 nameif WAN
 security-level 50
 ip address 192.168.100.154 255.255.255.0
 ospf authentication-key *****
 ospf authentication message-digest
```

```
!
interface GigabitEthernet0/1
 nameif LAN
 security-level 100
 ip address 192.168.120.1 255.255.255.0
!
interface GigabitEthernet0/2
 shutdown
 no nameif
 no security-level
 no ip address
!
interface GigabitEthernet0/3
 shutdown
 no nameif
 no security-level
 no ip address
!
interface GigabitEthernet0/4
 shutdown
 no nameif
 no security-level
 no ip address
!
interface GigabitEthernet0/5
 shutdown
 no nameif
 no security-level
 no ip address
!
```

```
interface GigabitEthernet0/6
 shutdown
 no nameif
 no security-level
 no ip address
!
interface GigabitEthernet0/7
 shutdown
 no nameif
 no security-level
 no ip address
!
interface GigabitEthernet0/8
 shutdown
 no nameif
 no security-level
 no ip address
!
interface Management0/0
 management-only
 nameif management
 security-level 0
 ip address 192.168.29.154 255.255.255.0
!
ftp mode passive
clock timezone EST -5
clock summer-time EDT recurring
dns domain-lookup WAN
dns server-group DefaultDNS
 name-server 8.8.8.8
```

```
 name-server 8.8.4.4
object network SNMPHOSTS
 subnet 192.168.29.0 255.255.255.0
object-group service DNS
 service-object tcp-udp destination eq domain
object-group service SYMANTEC-DCS
 service-object tcp destination eq 4443
 service-object tcp destination eq https
 service-object tcp destination eq 8443
 service-object tcp destination eq 2222
access-list 101 extended permit icmp any any time-exceeded
access-list 101 extended permit icmp any any unreachable
access-list 101 extended permit icmp any any echo-reply
access-list 101 extended permit icmp any any echo
access-list 101 extended permit udp any any gt 33434
access-list 101 extended permit object-group DNS 192.168.140.0 255.255.255.0 host 192.168.120.162
access-list 101 extended permit object-group DNS 192.168.140.0 255.255.255.0 host 192.168.120.163
access-list 101 extended permit tcp any host 192.168.120.166 eq 8114
access-list 101 extended permit object-group SYMANTEC-DCS any host 192.168.120.167
pager lines 23
mtu management 1500
mtu WAN 1500
mtu LAN 1500
no failover
icmp unreachable rate-limit 1 burst-size 1
no asdm history enable
arp timeout 14400
no arp permit-nonconnected
access-group 101 in interface WAN
router ospf 1
```

```
 network 192.168.100.0 255.255.255.0 area 0
 log-adj-changes
 redistribute connected subnets
 redistribute static subnets
!
timeout xlate 3:00:00
timeout pat-xlate 0:00:30
timeout conn 1:00:00 half-closed 0:10:00 udp 0:02:00 sctp 0:02:00 icmp 0:00:02
timeout sunrpc 0:10:00 h323 0:05:00 h225 1:00:00 mgcp 0:05:00 mgcp-pat 0:05:00
timeout sip 0:30:00 sip_media 0:02:00 sip-invite 0:03:00 sip-disconnect 0:02:00
timeout sip-provisional-media 0:02:00 uauth 0:05:00 absolute
timeout tcp-proxy-reassembly 0:01:00
timeout floating-conn 0:00:00
user-identity default-domain LOCAL
aaa authentication ssh console LOCAL
snmp-server host-group management SNMPHOSTS poll community *****
no snmp-server location
no snmp-server contact
snmp-server community *****
crypto ipsec security-association pmtu-aging infinite
crypto ca trustpoint _SmartCallHome_ServerCA
 no validation-usage
 crl configure
crypto ca trustpool policy
 auto-import
crypto ca certificate chain _SmartCallHome_ServerCA
 certificate ca 6ecc7aa5a7032009b8cebcf4e952d491
    308205ec 308204d4 a0030201 0202106e cc7aa5a7 032009b8 cebcf4e9 52d49130
    0d06092a 864886f7 0d010105 05003081 ca310b30 09060355 04061302 55533117
    30150603 55040a13 0e566572 69536967 6e2c2049 6e632e31 1f301d06 0355040b
```

13165665 72695369 676e2054 72757374 204e6574 776f726b 313a3038 06035504
0b133128 63292032 30303620 56657269 5369676e 2c20496e 632e202d 20466f72
20617574 686f7269 7a656420 75736520 6f6e6c79 31453043 06035504 03133c56
65726953 69676e20 436c6173 73203320 5075626c 69632050 72696d61 72792043
65727469 66696361 74696f6e 20417574 686f7269 7479202d 20473530 1e170d31
30303230 38303030 3030305a 170d3230 30323037 32333539 35395a30 81b5310b
30090603 55040613 02555331 17301506 0355040a 130e5665 72695369 676e2c20
496e632e 311f301d 06035504 0b131656 65726953 69676e20 54727573 74204e65
74776f72 6b313b30 39060355 040b1332 5465726d 73206f66 20757365 20617420
68747470 733a2f2f 7777772e 76657269 7369676e 2e636f6d 2f727061 20286329
3130312f 302d0603 55040313 26566572 69536967 6e20436c 61737320 33205365
63757265 20536572 76657220 4341202d 20473330 82012230 0d06092a 864886f7
0d010101 05000382 010f0030 82010a02 82010100 b187841f c20c45f5 bcab2597
a7ada23e 9cbaf6c1 39b88bca c2ac56c6 e5bb658e 444f4dce 6fed094a d4af4e10
9c688b2e 957b899b 13cae234 34c1f35b f3497b62 83488174 d188786c 0253f9bc
7f432657 5833833b 330a17b0 d04e9124 ad867d64 12dc744a 34a11d0a ea961d0b
15fca34b 3bce6388 d0f82d0c 948610ca b69a3dca eb379c00 48358629 5078e845
63cd1941 4ff595ec 7b98d4c4 71b350be 28b38fa0 b9539cf5 ca2c23a9 fd1406e8
18b49ae8 3c6e81fd e4cd3536 b351d369 ec12ba56 6e6f9b57 c58b14e7 0ec79ced
4a546ac9 4dc5bf11 b1ae1c67 81cb4455 33997f24 9b3f5345 7f861af3 3cfa6d7f
81f5b84a d3f58537 1cb5a6d0 09e4187b 384efa0f 02030100 01a38201 df308201
db303406 082b0601 05050701 01042830 26302406 082b0601 05050730 01861868
7474703a 2f2f6f63 73702e76 65726973 69676e2e 636f6d30 12060355 1d130101
ff040830 060101ff 02010030 70060355 1d200469 30673065 060b6086 480186f8
45010717 03305630 2806082b 06010505 07020116 1c687474 70733a2f 2f777777
2e766572 69736967 6e2e636f 6d2f6370 73302a06 082b0601 05050702 02301e1a
1c687474 70733a2f 2f777777 2e766572 69736967 6e2e636f 6d2f7270 61303406
03551d1f 042d302b 3029a027 a0258623 68747470 3a2f2f63 726c2e76 65726973
69676e2e 636f6d2f 70636133 2d67352e 63726c30 0e060355 1d0f0101 ff040403
02010630 6d06082b 06010505 07010c04 61305fa1 5da05b30 59305730 55160969

```
    6d616765 2f676966 3021301f 30070605 2b0e0302 1a04148f e5d31a86 ac8d8e6b
    c3cf806a d448182c 7b192e30 25162368 7474703a 2f2f6c6f 676f2e76 65726973
    69676e2e 636f6d2f 76736c6f 676f2e67 69663028 0603551d 11042130 1fa41d30
    1b311930 17060355 04031310 56657269 5369676e 4d504b49 2d322d36 301d0603
    551d0e04 1604140d 445c1653 44c1827e 1d20ab25 f40163d8 be79a530 1f060355
    1d230418 30168014 7fd365a7 c2ddecbb f03009f3 4339fa02 af333133 300d0609
    2a864886 f70d0101 05050003 82010100 0c8324ef ddc30cd9 589cfe36 b6eb8a80
    4bd1a3f7 9df3cc53 ef829ea3 a1e697c1 589d756c e01d1b4c fad1c12d 05c0ea6e
    b2227055 d9203340 3307c265 83fa8f43 379bea0e 9a6c70ee f69c803b d937f47a
    6decd018 7d494aca 99c71928 a2bed877 24f78526 866d8705 404167d1 273aeddc
    481d22cd 0b0b8bbc f4b17bfd b499a8e9 762ae11a 2d876e74 d388dd1e 22c6df16
    b62b8214 0a945cf2 50ecafce ff62370d ad65d306 4153ed02 14c8b558 28a1ace0
    5becb37f 954afb03 c8ad26db e6667812 4ad99f42 fbe198e6 42839b8f 8f6724e8
    6119b5dd cdb50b26 058ec36e c4c875b8 46cfe218 065ea9ae a8819a47 16de0c28
    6c2527b9 deb78458 c61f381e a4c4cb66
  quit
telnet timeout 5
ssh stricthostkeycheck
ssh 192.168.29.0 255.255.255.0 management
ssh timeout 5
ssh version 2
ssh key-exchange group dh-group1-sha1
console timeout 0
dynamic-access-policy-record DfltAccessPolicy
username cisco password YBYvHe595lIMVg7Y encrypted
!
class-map inspection_default
 match default-inspection-traffic
!
!
```

```
policy-map type inspect dns migrated_dns_map_1
 parameters
  message-length maximum client auto
  message-length maximum 512
policy-map global_policy
 class inspection_default
  inspect dns migrated_dns_map_1
  inspect ftp
  inspect h323 h225
  inspect h323 ras
  inspect ip-options
  inspect netbios
  inspect rsh
  inspect rtsp
  inspect skinny
  inspect esmtp
  inspect sqlnet
  inspect sunrpc
  inspect tftp
  inspect sip
  inspect xdmcp
  inspect icmp
  inspect icmp error
 class class-default
  set connection decrement-ttl
!
service-policy global_policy global
prompt hostname context
no call-home reporting anonymous
call-home
```

```
 profile License
  destination address http https://tools.cisco.com/its/service/oddce/services/DDCEService
  destination transport-method http
 profile CiscoTAC-1
  no active
  destination address http https://tools.cisco.com/its/service/oddce/services/DDCEService
  destination address email callhome@cisco.com
  destination transport-method http
  subscribe-to-alert-group diagnostic
  subscribe-to-alert-group environment
  subscribe-to-alert-group inventory periodic monthly
  subscribe-to-alert-group configuration periodic monthly
  subscribe-to-alert-group telemetry periodic daily
Cryptochecksum:e57e00145eb4fd26d97b4b0109308140
: end
```

A.4 Biomedical Engineering

```
: Saved
:
: Serial Number: 9A3RHJVFPQS
: Hardware:   ASAv, 2048 MB RAM, CPU Xeon E5 series 2200 MHz
:
ASA Version 9.6(1)
!
hostname biomedical-kmcfadde
enable password 8Ry2YjIyt7RRXU24 encrypted
xlate per-session deny tcp any4 any4
xlate per-session deny tcp any4 any6
xlate per-session deny tcp any6 any4
xlate per-session deny tcp any6 any6
xlate per-session deny udp any4 any4 eq domain
xlate per-session deny udp any4 any6 eq domain
xlate per-session deny udp any6 any4 eq domain
xlate per-session deny udp any6 any6 eq domain
!
license smart
 feature tier standard
 throughput level 1G
names
!
interface GigabitEthernet0/0
 nameif WAN
 security-level 50
 ip address 192.168.100.152 255.255.255.0
 ospf authentication-key *****
 ospf authentication message-digest
```

```
!
interface GigabitEthernet0/1
 nameif LAN
 security-level 100
 ip address 192.168.140.1 255.255.255.0
!
interface GigabitEthernet0/2
 shutdown
 no nameif
 no security-level
 no ip address
!
interface GigabitEthernet0/3
 shutdown
 no nameif
 no security-level
 no ip address
!
interface GigabitEthernet0/4
 shutdown
 no nameif
 no security-level
 no ip address
!
interface GigabitEthernet0/5
 shutdown
 no nameif
 no security-level
 no ip address
!
```

```
interface GigabitEthernet0/6
 shutdown
 no nameif
 no security-level
 no ip address
!
interface GigabitEthernet0/7
 shutdown
 no nameif
 no security-level
 no ip address
!
interface GigabitEthernet0/8
 shutdown
 no nameif
 no security-level
 no ip address
!
interface Management0/0
 management-only
 nameif management
 security-level 0
 ip address 192.168.29.152 255.255.255.0
!
ftp mode passive
clock timezone EST -5
clock summer-time EDT recurring
dns domain-lookup WAN
dns server-group DefaultDNS
 name-server 8.8.8.8
```

```
 name-server 8.8.4.4
object network SNMPHOSTS
 subnet 192.168.29.0 255.255.255.0
object network PUMPS
 subnet 192.168.150.0 255.255.255.0
object-group icmp-type PING-REPLIES
 icmp-object echo-reply
object-group icmp-type TRACEROUTE-REPLIES
 icmp-object time-exceeded
 icmp-object unreachable
 group-object PING-REPLIES
object-group icmp-type PING
 icmp-object echo
object-group service TRACEROUTEUDP
 service-object udp destination gt 33434
object-group service BAXTERPORTS
 service-object tcp-udp destination eq 51244
object-group service SMITHSPORTS
 service-object tcp destination eq 1588
object-group service CAREFUSIONPORTS
 service-object tcp destination eq 3613
object-group service PCAPORTS
 service-object tcp destination eq https
 service-object tcp destination eq 11443
 service-object tcp destination eq 11444
object-group service PLUM360PORTS
 service-object tcp destination eq 8100
 service-object tcp destination eq 9292
object-group service HOSPIRAPUMPSIMPORTS
 service-object tcp destination eq https
```

```
 service-object tcp destination eq 8443
object-group service BBRAUNPORTS
 service-object tcp destination eq www
 service-object tcp destination eq https
 service-object tcp destination eq 8080
 service-object tcp destination eq 1500
 service-object tcp destination eq 4080
access-list 101 extended permit icmp any any object-group TRACEROUTE-REPLIES
access-list 101 extended permit object-group TRACEROUTEUDP any any
access-list 101 extended permit icmp any any object-group PING
access-list 101 extended permit icmp any any object-group PING-REPLIES
access-list 101 extended permit object-group SMITHSPORTS object PUMPS host 192.168.140.150
access-list 101 extended permit object-group CAREFUSIONPORTS object PUMPS host 192.168.140.158
access-list 101 extended permit object-group PCAPORTS object PUMPS host 192.168.140.160
access-list 101 extended permit object-group PLUM360PORTS object PUMPS host 192.168.140.160
access-list 101 extended permit object-group HOSPIRAPUMPSIMPORTS object PUMPS host
192.168.140.160
access-list 101 extended permit object-group BAXTERPORTS object PUMPS host 192.168.140.165
access-list 101 extended permit object-group BBRAUNPORTS object PUMPS host 192.168.140.169
pager lines 23
mtu WAN 1500
mtu LAN 1500
mtu management 1500
no failover
no monitor-interface service-module
icmp unreachable rate-limit 1 burst-size 1
no asdm history enable
arp timeout 14400
no arp permit-nonconnected
access-group 101 in interface WAN
```

```
router ospf 1
 network 192.168.100.0 255.255.255.0 area 0
 log-adj-changes
 redistribute connected subnets
 redistribute static subnets
!
timeout xlate 3:00:00
timeout pat-xlate 0:00:30
timeout conn 1:00:00 half-closed 0:10:00 udp 0:02:00 sctp 0:02:00 icmp 0:00:02
timeout sunrpc 0:10:00 h323 0:05:00 h225 1:00:00 mgcp 0:05:00 mgcp-pat 0:05:00
timeout sip 0:30:00 sip_media 0:02:00 sip-invite 0:03:00 sip-disconnect 0:02:00
timeout sip-provisional-media 0:02:00 uauth 0:05:00 absolute
timeout tcp-proxy-reassembly 0:01:00
timeout floating-conn 0:00:00
user-identity default-domain LOCAL
aaa authentication ssh console LOCAL
snmp-server host-group management SNMPHOSTS poll community *****
no snmp-server location
no snmp-server contact
snmp-server community *****
crypto ipsec security-association pmtu-aging infinite
crypto ca trustpoint _SmartCallHome_ServerCA
 no validation-usage
 crl configure
crypto ca trustpool policy
 auto-import
crypto ca certificate chain _SmartCallHome_ServerCA
 certificate ca 6ecc7aa5a7032009b8cebcf4e952d491
    308205ec 308204d4 a0030201 0202106e cc7aa5a7 032009b8 cebcf4e9 52d49130
    0d06092a 864886f7 0d010105 05003081 ca310b30 09060355 04061302 55533117
```

30150603 55040a13 0e566572 69536967 6e2c2049 6e632e31 1f301d06 0355040b
13165665 72695369 676e2054 72757374 204e6574 776f726b 313a3038 06035504
0b133128 63292032 30303620 56657269 5369676e 2c20496e 632e202d 20466f72
20617574 686f7269 7a656420 75736520 6f6e6c79 31453043 06035504 03133c56
65726953 69676e20 436c6173 73203320 5075626c 69632050 72696d61 72792043
65727469 66696361 74696f6e 20417574 686f7269 7479202d 20473530 1e170d31
30303230 38303030 3030305a 170d3230 30323037 32333539 35395a30 81b5310b
30090603 55040613 02555331 17301506 0355040a 130e5665 72695369 676e2c20
496e632e 311f301d 06035504 0b131656 65726953 69676e20 54727573 74204e65
74776f72 6b313b30 39060355 040b1332 5465726d 73206f66 20757365 20617420
68747470 733a2f2f 7777772e 76657269 7369676e 2e636f6d 2f727061 20286329
3130312f 302d0603 55040313 26566572 69536967 6e20436c 61737320 33205365
63757265 20536572 76657220 4341202d 20473330 82012230 0d06092a 864886f7
0d010101 05000382 010f0030 82010a02 82010100 b187841f c20c45f5 bcab2597
a7ada23e 9cbaf6c1 39b88bca c2ac56c6 e5bb658e 444f4dce 6fed094a d4af4e10
9c688b2e 957b899b 13cae234 34c1f35b f3497b62 83488174 d188786c 0253f9bc
7f432657 5833833b 330a17b0 d04e9124 ad867d64 12dc744a 34a11d0a ea961d0b
15fca34b 3bce6388 d0f82d0c 948610ca b69a3dca eb379c00 48358629 5078e845
63cd1941 4ff595ec 7b98d4c4 71b350be 28b38fa0 b9539cf5 ca2c23a9 fd1406e8
18b49ae8 3c6e81fd e4cd3536 b351d369 ec12ba56 6e6f9b57 c58b14e7 0ec79ced
4a546ac9 4dc5bf11 b1ae1c67 81cb4455 33997f24 9b3f5345 7f861af3 3cfa6d7f
81f5b84a d3f58537 1cb5a6d0 09e4187b 384efa0f 02030100 01a38201 df308201
db303406 082b0601 05050701 01042830 26302406 082b0601 05050730 01861868
7474703a 2f2f6f63 73702e76 65726973 69676e2e 636f6d30 12060355 1d130101
ff040830 060101ff 02010030 70060355 1d200469 30673065 060b6086 480186f8
45010717 03305630 2806082b 06010505 07020116 1c687474 70733a2f 2f777777
2e766572 69736967 6e2e636f 6d2f6370 73302a06 082b0601 05050702 02301e1a
1c687474 70733a2f 2f777777 2e766572 69736967 6e2e636f 6d2f7270 61303406
03551d1f 042d302b 3029a027 a0258623 68747470 3a2f2f63 726c2e76 65726973
69676e2e 636f6d2f 70636133 2d67352e 63726c30 0e060355 1d0f0101 ff040403

02010630 6d06082b 06010505 07010c04 61305fa1 5da05b30 59305730 55160969
6d616765 2f676966 3021301f 30070605 2b0e0302 1a04148f e5d31a86 ac8d8e6b
c3cf806a d448182c 7b192e30 25162368 7474703a 2f2f6c6f 676f2e76 65726973
69676e2e 636f6d2f 76736c6f 676f2e67 69663028 0603551d 11042130 1fa41d30
1b311930 17060355 04031310 56657269 5369676e 4d504b49 2d322d36 301d0603
551d0e04 1604140d 445c1653 44c1827e 1d20ab25 f40163d8 be79a530 1f060355
1d230418 30168014 7fd365a7 c2ddecbb f03009f3 4339fa02 af333133 300d0609
2a864886 f70d0101 05050003 82010100 0c8324ef ddc30cd9 589cfe36 b6eb8a80
4bd1a3f7 9df3cc53 ef829ea3 a1e697c1 589d756c e01d1b4c fad1c12d 05c0ea6e
b2227055 d9203340 3307c265 83fa8f43 379bea0e 9a6c70ee f69c803b d937f47a
6decd018 7d494aca 99c71928 a2bed877 24f78526 866d8705 404167d1 273aeddc
481d22cd 0b0b8bbc f4b17bfd b499a8e9 762ae11a 2d876e74 d388dd1e 22c6df16
b62b8214 0a945cf2 50ecafce ff62370d ad65d306 4153ed02 14c8b558 28a1ace0
5becb37f 954afb03 c8ad26db e6667812 4ad99f42 fbe198e6 42839b8f 8f6724e8
6119b5dd cdb50b26 058ec36e c4c875b8 46cfe218 065ea9ae a8819a47 16de0c28
6c2527b9 deb78458 c61f381e a4c4cb66

quit

telnet timeout 5

ssh stricthostkeycheck

ssh 192.168.29.0 255.255.255.0 management

ssh timeout 5

ssh version 2

ssh key-exchange group dh-group1-sha1

console timeout 0

dhcpd dns 192.168.120.163 192.168.120.162

dhcpd option 3 ip 192.168.140.1

!

dhcpd address 192.168.140.220-192.168.140.250 LAN

dhcpd enable LAN

!

```
dynamic-access-policy-record DfltAccessPolicy
username cisco password YBYvHe595lIMVg7Y encrypted
!
class-map inspection_default
 match default-inspection-traffic
!
!
policy-map type inspect dns migrated_dns_map_1
 parameters
  message-length maximum client auto
  message-length maximum 512
policy-map global_policy
 class inspection_default
  inspect dns migrated_dns_map_1
  inspect ftp
  inspect h323 h225
  inspect h323 ras
  inspect ip-options
  inspect netbios
  inspect rsh
  inspect rtsp
  inspect skinny
  inspect esmtp
  inspect sqlnet
  inspect sunrpc
  inspect tftp
  inspect sip
  inspect xdmcp
  inspect icmp
  inspect icmp error
```

```
 class class-default
  set connection decrement-ttl
!
service-policy global_policy global
prompt hostname context
no call-home reporting anonymous
call-home
 profile CiscoTAC-1
  no active
  destination address http https://tools.cisco.com/its/service/oddce/services/DDCEService
  destination address email callhome@cisco.com
  destination transport-method http
  subscribe-to-alert-group diagnostic
  subscribe-to-alert-group environment
  subscribe-to-alert-group inventory periodic monthly
  subscribe-to-alert-group configuration periodic monthly
  subscribe-to-alert-group telemetry periodic daily
 profile License
  destination address http https://tools.cisco.com/its/service/oddce/services/DDCEService
  destination transport-method http
Cryptochecksum:627e549de0a7dd97cd1379bbf37bc168
: end
```

A.5 Medical Devices Zone ASA Configuration File

```
: Saved

:
: Serial Number: 9AEWS2E5JRA
: Hardware:   ASAv, 2048 MB RAM, CPU Xeon E5 series 2200 MHz
:
ASA Version 9.6(1)
!
hostname medical-devices-kmcfadde
enable password 8Ry2YjIyt7RRXU24 encrypted
xlate per-session deny tcp any4 any4
xlate per-session deny tcp any4 any6
xlate per-session deny tcp any6 any4
xlate per-session deny tcp any6 any6
xlate per-session deny udp any4 any4 eq domain
xlate per-session deny udp any4 any6 eq domain
xlate per-session deny udp any6 any4 eq domain
xlate per-session deny udp any6 any6 eq domain
!
license smart
 feature tier standard
 throughput level 1G
names

!
interface GigabitEthernet0/0
 nameif WAN
 security-level 50
 ip address 192.168.100.149 255.255.255.0
 ospf authentication-key *****
 ospf authentication message-digest
!
interface GigabitEthernet0/1
 nameif LAN
 security-level 100
 ip address 192.168.150.1 255.255.255.0
!
interface GigabitEthernet0/2
 shutdown
 no nameif
 no security-level
 no ip address
!
interface GigabitEthernet0/3
 shutdown
 no nameif
```

```
 no security-level
 no ip address
!
interface GigabitEthernet0/4
 shutdown
 no nameif
 no security-level
 no ip address
!
interface GigabitEthernet0/5
 shutdown
 no nameif
 no security-level
 no ip address
!
interface GigabitEthernet0/6
 shutdown
 no nameif
 no security-level
 no ip address
!
interface GigabitEthernet0/7
 shutdown
 no nameif
 no security-level
 no ip address
!
interface GigabitEthernet0/8
 shutdown
 no nameif
 no security-level
 no ip address
!
interface Management0/0
 management-only
 nameif management
 security-level 0
 ip address 192.168.29.149 255.255.255.0
!
ftp mode passive
clock timezone EST -5
clock summer-time EDT recurring
dns domain-lookup WAN
dns server-group DefaultDNS
 name-server 8.8.8.8
 name-server 8.8.4.4
object network SNMPHOSTS
 subnet 192.168.29.0 255.255.255.0
```

```
object network PUMPSERVERS
 subnet 192.168.140.0 255.255.255.0
object network PUMPS
 subnet 192.168.150.0 255.255.255.0
object-group icmp-type PING-REPLIES
 icmp-object echo-reply
object-group service PCAPORTS
 service-object tcp destination eq https
 service-object tcp destination eq 11444
 service-object tcp destination eq 11443
 service-object tcp destination eq 8443
object-group icmp-type TRACEROUTE-REPLIES
 icmp-object time-exceeded
 icmp-object unreachable
 group-object PING-REPLIES
object-group icmp-type PING
 icmp-object echo
object-group service TRACEROUTEUDP
 service-object udp destination gt 33434
object-group service PLUM360PORTS
 service-object tcp destination eq 8100
 service-object tcp destination eq 9292
object-group service HOSPIRAPUMPSIMPORTS
 service-object tcp destination eq https
 service-object tcp destination eq 8443
object-group service BAXTERPUMPPORTS
 service-object tcp-udp destination eq 51243
object-group service BBRAUNPORTS
 service-object tcp destination eq www
 service-object tcp destination eq https
 service-object tcp destination eq 8080
 service-object tcp destination eq 1500
access-list LAN2WAN extended permit ip object PUMPS object PUMPSERVERS
access-list WAN2LAN extended permit object-group PCAPORTS host 192.168.140.160 o
bject PUMPS
access-list WAN2LAN extended permit icmp any any object-group PING
access-list WAN2LAN extended permit object-group TRACEROUTEUDP any any
access-list WAN2LAN extended permit icmp any any object-group TRACEROUTE-REPLIES
access-list WAN2LAN extended permit icmp any any object-group PING-REPLIES
access-list WAN2LAN extended permit object-group PLUM360PORTS host 192.168.140.1
60 object PUMPS
access-list WAN2LAN extended permit object-group HOSPIRAPUMPSIMPORTS host 192.16
8.140.160 object PUMPS
access-list WAN2LAN extended permit object-group BAXTERPUMPPORTS host 192.168.14
0.165 object PUMPS
access-list WAN2LAN extended permit object-group BBRAUNPORTS host 192.168.140.16
9 object PUMPS
pager lines 23
```

```
mtu WAN 1500
mtu LAN 1500
mtu management 1500
no failover
no monitor-interface service-module
icmp unreachable rate-limit 1 burst-size 1
no asdm history enable
arp timeout 14400
no arp permit-nonconnected
access-group WAN2LAN in interface WAN
access-group LAN2WAN in interface LAN
router ospf 1
 network 192.168.100.0 255.255.255.0 area 0
 log-adj-changes
 redistribute connected subnets
 redistribute static subnets
!
timeout xlate 3:00:00
timeout pat-xlate 0:00:30
timeout conn 1:00:00 half-closed 0:10:00 udp 0:02:00 sctp 0:02:00 icmp 0:00:02
timeout sunrpc 0:10:00 h323 0:05:00 h225 1:00:00 mgcp 0:05:00 mgcp-pat 0:05:00
timeout sip 0:30:00 sip_media 0:02:00 sip-invite 0:03:00 sip-disconnect 0:02:00
timeout sip-provisional-media 0:02:00 uauth 0:05:00 absolute
timeout tcp-proxy-reassembly 0:01:00
timeout floating-conn 0:00:00
user-identity default-domain LOCAL
aaa authentication ssh console LOCAL
snmp-server host-group management SNMPHOSTS poll community *****
no snmp-server location
no snmp-server contact
snmp-server community *****
crypto ipsec security-association pmtu-aging infinite
crypto ca trustpoint _SmartCallHome_ServerCA
 no validation-usage
 crl configure
crypto ca trustpool policy
 auto-import
crypto ca certificate chain _SmartCallHome_ServerCA
 certificate ca 6ecc7aa5a7032009b8cebcf4e952d491
    308205ec 308204d4 a0030201 0202106e cc7aa5a7 032009b8 cebcf4e9 52d49130
    0d06092a 864886f7 0d010105 05003081 ca310b30 09060355 04061302 55533117
    30150603 55040a13 0e566572 69536967 6e2c2049 6e632e31 1f301d06 0355040b
    13165665 72695369 676e2054 72757374 204e6574 776f726b 313a3038 06035504
    0b133128 63292032 30303620 56657269 5369676e 2c20496e 632e202d 20466f72
    20617574 686f7269 7a656420 75736520 6f6e6c79 31453043 06035504 03133c56
    65726953 69676e20 436c6173 73203320 5075626c 69632050 72696d61 72792043
    65727469 66696361 74696f6e 20417574 686f7269 7479202d 20473530 1e170d31
    30303230 38303030 3030305a 170d3230 30323037 32333539 35395a30 81b5310b
```

```
    30090603 55040613 02555331 17301506 0355040a 130e5665 72695369 676e2c20
    496e632e 311f301d 06035504 0b131656 65726953 69676e20 54727573 74204e65
    74776f72 6b313b30 39060355 040b1332 5465726d 73206f66 20757365 20617420
    68747470 733a2f2f 7777772e 76657269 7369676e 2e636f6d 2f727061 20286329
    3130312f 302d0603 55040313 26566572 69536967 6e20436c 61737320 33205365
    63757265 20536572 76657220 4341202d 20473330 82012230 0d06092a 864886f7
    0d010101 05000382 010f0030 82010a02 82010100 b187841f c20c45f5 bcab2597
    a7ada23e 9cbaf6c1 39b88bca c2ac56c6 e5bb658e 444f4dce 6fed094a d4af4e10
    9c688b2e 957b899b 13cae234 34c1f35b f3497b62 83488174 d188786c 0253f9bc
    7f432657 5833833b 330a17b0 d04e9124 ad867d64 12dc744a 34a11d0a ea961d0b
    15fca34b 3bce6388 d0f82d0c 948610ca b69a3dca eb379c00 48358629 5078e845
    63cd1941 4ff595ec 7b98d4c4 71b350be 28b38fa0 b9539cf5 ca2c23a9 fd1406e8
    18b49ae8 3c6e81fd e4cd3536 b351d369 ec12ba56 6e6f9b57 c58b14e7 0ec79ced
    4a546ac9 4dc5bf11 b1ae1c67 81cb4455 33997f24 9b3f5345 7f861af3 3cfa6d7f
    81f5b84a d3f58537 1cb5a6d0 09e4187b 384efa0f 02030100 01a38201 df308201
    db303406 082b0601 05050701 01042830 26302406 082b0601 05050730 01861868
    7474703a 2f2f6f63 73702e76 65726973 69676e2e 636f6d30 12060355 1d130101
    ff040830 060101ff 02010030 70060355 1d200469 30673065 060b6086 480186f8
    45010717 03305630 2806082b 06010505 07020116 1c687474 70733a2f 2f777777
    2e766572 69736967 6e2e636f 6d2f6370 73302a06 082b0601 05050702 02301e1a
    1c687474 70733a2f 2f777777 2e766572 69736967 6e2e636f 6d2f7270 61303406
    03551d1f 042d302b 3029a027 a0258623 68747470 3a2f2f63 726c2e76 65726973
    69676e2e 636f6d2f 70636133 2d67352e 63726c30 0e060355 1d0f0101 ff040403
    02010630 6d06082b 06010505 07010c04 61305fa1 5da05b30 59305730 55160969
    6d616765 2f676966 3021301f 30070605 2b0e0302 1a04148f e5d31a86 ac8d8e6b
    c3cf806a d448182c 7b192e30 25162368 7474703a 2f2f6c6f 676f2e76 65726973
    69676e2e 636f6d2f 76736c6f 676f2e67 69663028 0603551d 11042130 1fa41d30
    1b311930 17060355 04031310 56657269 5369676e 4d504b49 2d322d36 301d0603
    551d0e04 1604140d 445c1653 44c1827e 1d20ab25 f40163d8 be79a530 1f060355
    1d230418 30168014 7fd365a7 c2ddecbb f03009f3 4339fa02 af333133 300d0609
    2a864886 f70d0101 05050003 82010100 0c8324ef ddc30cd9 589cfe36 b6eb8a80
    4bd1a3f7 9df3cc53 ef829ea3 a1e697c1 589d756c e01d1b4c fad1c12d 05c0ea6e
    b2227055 d9203340 3307c265 83fa8f43 379bea0e 9a6c70ee f69c803b d937f47a
    6decd018 7d494aca 99c71928 a2bed877 24f78526 866d8705 404167d1 273aeddc
    481d22cd 0b0b8bbc f4b17bfd b499a8e9 762ae11a 2d876e74 d388dd1e 22c6df16
    b62b8214 0a945cf2 50ecafce ff62370d ad65d306 4153ed02 14c8b558 28a1ace0
    5becb37f 954afb03 c8ad26db e6667812 4ad99f42 fbe198e6 42839b8f 8f6724e8
    6119b5dd cdb50b26 058ec36e c4c875b8 46cfe218 065ea9ae a8819a47 16de0c28
    6c2527b9 deb78458 c61f381e a4c4cb66
  quit
telnet timeout 5
ssh stricthostkeycheck
ssh 192.168.29.0 255.255.255.0 management
ssh timeout 5
ssh version 2
ssh key-exchange group dh-group1-sha1
console timeout 0
dhcpd dns 192.168.150.1
```

```
dhcpd option 3 ip 192.168.150.1
!
dhcpd address 192.168.150.220-192.168.150.250 LAN
dhcpd enable LAN
!
dynamic-access-policy-record DfltAccessPolicy
username cisco password YBYvHe595lIMVg7Y encrypted
!
class-map inspection_default
 match default-inspection-traffic
!
!
policy-map type inspect dns migrated_dns_map_1
 parameters
  message-length maximum client auto
  message-length maximum 512
policy-map global_policy
 class inspection_default
  inspect dns migrated_dns_map_1
  inspect ftp
  inspect h323 h225
  inspect h323 ras
  inspect ip-options
  inspect netbios
  inspect rsh
  inspect rtsp
  inspect skinny
  inspect esmtp
  inspect sqlnet
  inspect sunrpc
  inspect tftp
  inspect sip
  inspect xdmcp
  inspect icmp
  inspect icmp error
 class class-default
  set connection decrement-ttl
!
service-policy global_policy global
prompt hostname context
no call-home reporting anonymous
call-home
 profile CiscoTAC-1
  no active
  destination address http https://tools.cisco.com/its/service/oddce/services/DD
CEService
  destination address email callhome@cisco.com
  destination transport-method http
```

```
  subscribe-to-alert-group diagnostic
  subscribe-to-alert-group environment
  subscribe-to-alert-group inventory periodic monthly
  subscribe-to-alert-group configuration periodic monthly
  subscribe-to-alert-group telemetry periodic daily
 profile License
  destination address http https://tools.cisco.com/its/service/oddce/services/DD
CEService
  destination transport-method http
Cryptochecksum:b2e10eb9d982ddbe5330e964af80d2d3

: end
```

A.6 Switch Configuration File

```
!
! Last configuration change at 22:21:08 UTC Wed Feb 22 2017 by cisco
! NVRAM config last updated at 23:22:47 UTC Wed Feb 22 2017 by cisco
!
version 15.0
no service pad
service timestamps debug datetime msec
service timestamps log datetime msec
service password-encryption
service compress-config
!
hostname Cisco3650-01
!
boot-start-marker
boot-end-marker
!
!
vrf definition Mgmt-vrf
 !
 address-family ipv4
 exit-address-family
 !
 address-family ipv6
 exit-address-family
!
logging console emergencies
enable secret 5 $1$FraY$.34n8ay7c.I7qwJttjHas0
enable password 7 023624481811003348
!
username admin privilege 15 password 7 04734A125E75606E0B4A
user-name cisco
 creation-time 1469560730
 privilege 15
 password 7 0523471B701862291B56
 type mgmt-user
no aaa new-model
switch 1 provision ws-c3650-48ps
!
ip domain-name nist.gov
ip device tracking
ip dhcp excluded-address 192.168.250.1 192.168.250.9
!
ip dhcp pool WLAN
 network 192.168.250.0 255.255.255.0
 default-router 192.168.250.1
 option 43 hex c0a8.fa02
```

```
!
!
vtp mode transparent
!
crypto pki trustpoint TP-self-signed-2035642131
 enrollment selfsigned
 subject-name cn=IOS-Self-Signed-Certificate-2035642131
 revocation-check none
 rsakeypair TP-self-signed-2035642131
!
!
crypto pki certificate chain TP-self-signed-2035642131
 certificate self-signed 01
  3082024D 308201B6 A0030201 02020101 300D0609 2A864886 F70D0101 04050030
  31312F30 2D060355 04031326 494F532D 53656C66 2D536967 6E65642D 43657274
  69666963 6174652D 32303335 36343231 3331301E 170D3136 30373236 32303436
  32355A17 0D323030 31303130 30303030 305A3031 312F302D 06035504 03132649
  4F532D53 656C662D 5369676E 65642D43 65727469 66696361 74652D32 30333536
  34323133 3130819F 300D0609 2A864886 F70D0101 01050003 818D0030 81890281
  8100F1C4 010AE138 9BD9BBCC 2E563180 698979B5 51F7B46B D122595E E7033DCA
  D80C9432 0728E47F 8CAC2629 40CEC617 5CDFFBD9 19744025 CB62CA75 8F6F0A9A
  34F790DD 07DA9D60 737196C1 FDD9E764 6D22EDA3 8D9E7DF5 6CD934E3 D89FA9D5
  C165F3EE E9E0EA9F 37742B00 2C4CFA0B C262E61B 95565B42 302B23E7 A1C85D9F
  5FDB0203 010001A3 75307330 0F060355 1D130101 FF040530 030101FF 30200603
  551D1104 19301782 15436973 636F3336 35302D30 312E6E69 73742E67 6F76301F
  0603551D 23041830 1680148F 3A1CDEB7 502DACB7 DF4E96E4 EA1470F1 CFD1F730
  1D060355 1D0E0416 04148F3A 1CDEB750 2DACB7DF 4E96E4EA 1470F1CF D1F7300D
  06092A86 4886F70D 01010405 00038181 004FE025 9B72B4D2 5391B847 F443B481
  4493F8BD 69D2FF3A 3C2E6D96 D7D83B92 91DBB84D DD47E242 9B2F45AC CA7C7CBC
  D7CB9660 2B07AE9B 0376D5A1 15CBA04B B326AADE AB213EB1 D625FBFF B2F54CCD
  40B1EB91 C6DD5E33 DEA8EEB3 20ECDE96 F42527D6 AD1F6A5D A261D394 FE358B8F
  317FAFD0 E853785D 777E1E1D 6F561A2A 07
      quit
!
!
!
!
!
diagnostic bootup level minimal
spanning-tree mode pvst
spanning-tree extend system-id
!
redundancy
 mode sso
!
!
vlan 20
!
```

```
vlan 1400
 name IP_DEV_BIOMEDICAL
!
vlan 1500
 name IP_DEV
!
vlan 1520
 name WIFI_MGMT
!
ip ssh version 2
!
class-map match-any non-client-nrt-class
  match non-client-nrt
!
policy-map port_child_policy
 class non-client-nrt-class
    bandwidth remaining ratio 10
!
!
!
!
!
!
interface GigabitEthernet0/0
 vrf forwarding Mgmt-vrf
 ip address 192.168.20.13 255.255.255.0
 negotiation auto
!
interface GigabitEthernet1/0/1
 switchport access vlan 1520
 switchport mode access
 spanning-tree portfast
!
interface GigabitEthernet1/0/2
 switchport access vlan 1520
 switchport mode access
 spanning-tree portfast
!
interface GigabitEthernet1/0/3
 switchport access vlan 1520
 switchport mode access
 spanning-tree portfast
!
interface GigabitEthernet1/0/4
 switchport access vlan 1520
 switchport mode access
 spanning-tree portfast
!
```

```
interface GigabitEthernet1/0/5
 spanning-tree portfast
!
interface GigabitEthernet1/0/6
 spanning-tree portfast
!
interface GigabitEthernet1/0/7
 spanning-tree portfast
!
interface GigabitEthernet1/0/8
 spanning-tree portfast
!
interface GigabitEthernet1/0/9
 spanning-tree portfast
!
interface GigabitEthernet1/0/10
 spanning-tree portfast
!
interface GigabitEthernet1/0/11
 spanning-tree portfast
!
interface GigabitEthernet1/0/12
 spanning-tree portfast
!
interface GigabitEthernet1/0/13
 spanning-tree portfast
!
interface GigabitEthernet1/0/14
 spanning-tree portfast
!
interface GigabitEthernet1/0/15
 spanning-tree portfast
!
interface GigabitEthernet1/0/16
 spanning-tree portfast
!
interface GigabitEthernet1/0/17
 spanning-tree portfast
!
interface GigabitEthernet1/0/18
 spanning-tree portfast
!
interface GigabitEthernet1/0/19
 spanning-tree portfast
!
interface GigabitEthernet1/0/20
 spanning-tree portfast
!
```

```
interface GigabitEthernet1/0/21
 spanning-tree portfast
!
interface GigabitEthernet1/0/22
 spanning-tree portfast
!
interface GigabitEthernet1/0/23
 spanning-tree portfast
!
interface GigabitEthernet1/0/24
 spanning-tree portfast
!
interface GigabitEthernet1/0/25
 spanning-tree portfast
!
interface GigabitEthernet1/0/26
 spanning-tree portfast
!
interface GigabitEthernet1/0/27
 spanning-tree portfast
!
interface GigabitEthernet1/0/28
 spanning-tree portfast
!
interface GigabitEthernet1/0/29
 spanning-tree portfast
!
interface GigabitEthernet1/0/30
 spanning-tree portfast
!
interface GigabitEthernet1/0/31
 spanning-tree portfast
!
interface GigabitEthernet1/0/32
 spanning-tree portfast
!
interface GigabitEthernet1/0/33
 spanning-tree portfast
!
interface GigabitEthernet1/0/34
 spanning-tree portfast
!
interface GigabitEthernet1/0/35
 spanning-tree portfast
!
interface GigabitEthernet1/0/36
 spanning-tree portfast
!
```

```
interface GigabitEthernet1/0/37
 spanning-tree portfast
!
interface GigabitEthernet1/0/38
 spanning-tree portfast
!
interface GigabitEthernet1/0/39
 spanning-tree portfast
!
interface GigabitEthernet1/0/40
 spanning-tree portfast
!
interface GigabitEthernet1/0/41
 switchport access vlan 1400
 spanning-tree portfast
!
interface GigabitEthernet1/0/42
 switchport access vlan 1400
 spanning-tree portfast
!
interface GigabitEthernet1/0/43
 switchport access vlan 1400
 spanning-tree portfast
!
interface GigabitEthernet1/0/44
 switchport access vlan 1400
 spanning-tree portfast
!
interface GigabitEthernet1/0/45
 description Set to 10/Half for Hospira
 switchport access vlan 1500
 speed 10
 duplex half
 spanning-tree portfast
!
interface GigabitEthernet1/0/46
 switchport access vlan 1500
 spanning-tree portfast
!
interface GigabitEthernet1/0/47
 description VLAN trunk
 switchport trunk allowed vlan 1400,1500,1520
 switchport mode trunk
 spanning-tree portfast
!
interface GigabitEthernet1/0/48
 description management connection on VL20
 switchport access vlan 20
```

```
 spanning-tree portfast
!
interface GigabitEthernet1/1/1
!
interface GigabitEthernet1/1/2
!
interface GigabitEthernet1/1/3
!
interface GigabitEthernet1/1/4
!
interface Vlan1
 no ip address
 shutdown
!
interface Vlan20
 ip address 192.168.20.13 255.255.255.0
!
interface Vlan1520
 description Wireless-MGMT
 ip address 192.168.250.1 255.255.255.0
!
no ip http server
no ip http secure-server
ip route 0.0.0.0 0.0.0.0 192.168.20.254
!
ip access-list extended SSH-Access
 permit tcp 192.168.20.0 0.0.0.255 any eq 22
 deny   ip any any log
!
access-list 10 permit 192.168.20.0 0.0.0.255
!
snmp-server community public RO 10
snmp-server location NCCoE
snmp-server contact nccoe_healthcare_dev@nist.gov
!
!
line con 0
 exec-timeout 0 0
 stopbits 1
line aux 0
 stopbits 1
line vty 0 4
 access-class SSH-Access in
 exec-timeout 300 0
 password 7 022E454F5A5223014E1D
 login local
 transport input ssh
line vty 5 15
```

```
 access-class SSH-Access in
 exec-timeout 300 0
 password 7 022E454F5A5223014E1D
 login local
 transport input ssh
!
ntp server 10.97.74.8
wsma agent exec
 profile httplistener
 profile httpslistener
wsma agent config
 profile httplistener
 profile httpslistener
wsma agent filesys
 profile httplistener
 profile httpslistener
wsma agent notify
 profile httplistener
 profile httpslistener
!
wsma profile listener httplistener
 transport http
!
wsma profile listener httpslistener
 transport https
ap group default-group
end
```

A.7 Wireless Configuration

System Inventory

NAME: "Chassis" , DESCR: "Cisco Wireless Controller"

PID: AIR-CTVM-K9, VID: V01, SN: 96NTPERK0A6

Burned-in MAC Address..... 00:50:56:AC:6D:08

Maximum number of APs supported..... 200

System Information

Manufacturer's Name..... Cisco Systems Inc.

Product Name..... Cisco Controller

Product Version..... 8.2.111.0

RTOS Version..... 8.2.111.0

Bootloader Version..... 8.2.111.0

Emergency Image Version..... 8.2.111.0

Build Type..... DATA + WPS

System Name..... wlc

System Location.....

System Contact.....

System ObjectID..... 1.3.6.1.4.1.9.1.1631

IP Address..... 192.168.250.2

IPv6 Address..... ::

System Up Time..... 6 days 3 hrs 48 mins 20 secs

System Timezone Location.....

System Stats Realtime Interval..... 5

System Stats Normal Interval..... 180

Configured Country..... US - United States

State of 802.11b Network..... Enabled

State of 802.11a Network..... Enabled

Number of WLANs..... 2

Number of Active Clients..... 2

Burned-in MAC Address..... 00:50:56:AC:6D:08

Maximum number of APs supported..... 200

System Nas-Id.....

WLC MIC Certificate Types..... SHA1

Licensing Type..... RTU

vWLC config..... Small

Backup Controller Configuration

AP primary Backup Controller .....

AP secondary Backup Controller .....

System Time Information:

Time..... Thu Aug 18 20:05:16 2016

Timezone delta..... 0:0

Timezone location.....

NTP Servers

NTP Polling Interval..... 3600

Index	NTP Key Index	NTP Server	Status	NTP Msg Auth Status
1	0	192.168.250.1	Not Synched	AUTH DISABLED

Redundancy Information

Redundancy Mode ..... SSO DISABLED

Local State..... ACTIVE

Peer State..... N/A

Unit..... Primary

Unit ID..... 00:50:56:AC:6D:08

Redunadancy State..... N/A

Mobility MAC..... 00:50:56:AC:6D:08

Redundancy Management IP Address..... 0.0.0.0

Peer Redundancy Management IP Address..... 0.0.0.0

Redundancy Port IP Address..... 0.0.0.0

Peer Redundancy Port IP Address..... 169.254.0.0

AP Bundle Information

Primary AP Image	Size
ap1g1	12660
ap1g2	11748
ap1g3	13672
ap1g4	19256
ap3g1	9736
ap3g2	13480
ap3g3	18696
ap801	8064
ap802	9536

c1140 8636

c1520 7344

c1550 10628

c1570 11536

c602i 3864

version.info 4

Secondary AP Image Size

---------- ----

ap1g1 12660

ap1g2 11748

ap1g3 13672

ap1g4 19256

ap3g1 9736

ap3g2 13480

ap3g3 18696

ap801 8064

ap802 9536

c1140 8636

c1520 7344

c1550 10628

c1570 11536

c602i 3864

version.info 4

Switch Configuration

802.3x Flow Control Mode..... Disable

FIPS prerequisite features..... Disabled

WLANCC prerequisite features..... Disabled

UCAPL prerequisite features..... Disabled

secret obfuscation..... Enabled

Strong Password Check Features

case-check..... Enabled

consecutive-check..... Enabled

default-check..... Enabled

username-check..... Enabled

position-check..... Disabled

case-digit-check..... Disabled

Min. Password length..... 3

Min. Upper case chars..... 0

Min. Lower case chars..... 0

Min. Digits chars..... 0

Min. Special chars..... 0

Mgmt User

Password Lifetime [days]..... 0

Password Lockout..... Disabled

Lockout Attempts..... 3

Lockout Timeout [mins]..... 5

SNMPv3 User

Password Lifetime [days]..... 0

Password Lockout..... Disabled

Lockout Attempts..... 3

Lockout Timeout [mins]..... 5

Network Information

RF-Network Name..... WLAN

DNS Server IP.....

Web Mode..... Disable

Secure Web Mode..... Enable

Secure Web Mode Cipher-Option High..... Disable

Secure Web Mode Cipher-Option SSLv2..... Disable

Secure Web Mode RC4 Cipher Preference..... Disable

Secure Web Mode SSL Protocol..... Disable

OCSP..... Disabled

OCSP responder URL.....

Secure Shell (ssh)..... Enable

Secure Shell (ssh) Cipher-Option High..... Disable

Telnet..... Disable

Ethernet Multicast Forwarding..... Disable

Ethernet Broadcast Forwarding..... Disable

IPv4 AP Multicast/Broadcast Mode..... Unicast

IPv6 AP Multicast/Broadcast Mode..... Unicast

IGMP snooping..... Disabled

IGMP timeout..... 60 seconds

IGMP Query Interval..... 20 seconds

MLD snooping..... Disabled

MLD timeout..... 60 seconds

MLD query interval..... 20 seconds

User Idle Timeout..... 300 seconds

ARP Idle Timeout..... 300 seconds

Cisco AP Default Master..... Disable

AP Join Priority..... Disable

Mgmt Via Wireless Interface..... Disable

Mgmt Via Dynamic Interface..... Disable

Bridge MAC filter Config..... Enable

Bridge Security Mode..... EAP

Mesh Full Sector DFS..... Enable

Mesh Backhaul RRM..... Disable

AP Fallback ..... Enable

Web Auth CMCC Support ..... Disabled

Web Auth Redirect Ports 80

Web Auth Proxy Redirect ..... Disable

Web Auth Captive-Bypass ..... Disable

Web Auth Secure Web ..... Enable

Web Auth Secure Redirection ..... Disable

Fast SSID Change ..... Disabled

AP Discovery - NAT IP Only ..... Enabled

IP/MAC Addr Binding Check ..... Enabled

Link Local Bridging Status ..... Disabled

CCX-lite status ..... Disable

oeap-600 dual-rlan-ports ..... Disable

oeap-600 local-network ..... Enable

oeap-600 Split Tunneling (Printers)..... Disable

WebPortal Online Client 0

WebPortal NTF_LOGOUT Client 0

mDNS snooping..... Disabled

mDNS Query Interval..... 15 minutes

Web Color Theme..... Default

Capwap Prefer Mode..... IPv4

Network Profile..... Disabled

Client ip conflict detection (DHCP) ..... Disabled

Mesh BH RRM ..... Disable

Mesh Aggressive DCA..... Disable

Mesh Auto RF..... Disable

HTTP Profiling Port..... 80

Port Summary

Pr	Type	STP Stat	Admin Mode	Physical Mode	Physical Status	Link Status	Link Trap	POE
--	-------	----	-------	----------	----------	------	-------	---------

1 Normal Forw Enable Auto 1000 Full Up Enable N/A

AP Summary

Number of APs..... 2

Global AP User Name..... Not Configured

Global AP Dot1x User Name..... Not Configured

AP Name Slots AP Model Ethernet MAC Location Country IP Address Clients DSE Location

---------- ----- ---------- ---------- ---------- ---------- ---------- -------- ----------

AP78da.6ee0.08ec 2 AIR-CAP1602I-A-K9 78:da:6e:e0:08:ec default location US 192.168.250.10 0 [0 ,0 ,0]

AP24e9.b34b.f1ed 2 AIR-CAP1602I-A-K9 24:e9:b3:4b:f1:ed default location US 192.168.250.11 1 [0 ,0 ,0]

AP Tcp-Mss-Adjust Info

AP Name TCP State MSS Size

---------- -------- -------

AP78da.6ee0.08ec disabled -

AP24e9.b34b.f1ed disabled -

AP Location

Total Number of AP Groups..... 1

Site Name..... default-group

Site Description..... <none>

NAS-identifier..... none

Client Traffic QinQ Enable..... FALSE

DHCPv4 QinQ Enable..... FALSE

AP Operating Class..... Not-configured

Capwap Prefer Mode..... Not-configured

RF Profile

2.4 GHz band..... <none>

5 GHz band..... <none>

WLAN ID	Interface	Network Admission Control	Radio Policy
1	ip_dev	Disabled	None
2	ip_dev	Disabled	None

*AP3600 with 802.11ac Module will only advertise first 8 WLANs on 5GHz radios.

Lan Port configs

LAN	Status	POE	RLAN
1	Disabled	Disabled	None
2	Disabled		None
3	Disabled		None

External 3G/4G module configs

LAN	Status	POE	RLAN
1	Disabled		None

AP Name	Slots	AP Model	Ethernet MAC	Location	Port	Country	Priority

---------- ----- ---------- ---------- ---------- ---- ------- --------

AP78da.6ee0.08ec 2 AIR-CAP1602I-A-K9 78:da:6e:e0:08:ec default location 1 US 1

AP24e9.b34b.f1ed 2 AIR-CAP1602I-A-K9 24:e9:b3:4b:f1:ed default location 1 US 1

RF Profile

Number of RF Profiles..... 6

Out Of Box State..... Disabled

Out Of Box Persistence..... Disabled

RF Profile Name	Band	Description	11n-client-only	Applied
High-Client-Density-802.11a	5 GHz	<none>	disable	No
High-Client-Density-802.11bg	2.4 GHz	<none>	disable	No
Low-Client-Density-802.11a	5 GHz	<none>	disable	No
Low-Client-Density-802.11bg	2.4 GHz	<none>	disable	No
Typical-Client-Density-802.11a	5 GHz	<none>	disable	No
Typical-Client-Density-802.11bg	2.4 GHz	<none>	disable	No

RF Profile name..... High-Client-Density-802.11a

Description..... <none>

AP Group Name..... <none>

Radio policy..... 5 GHz

11n-client-only..... disabled

Transmit Power Threshold v1..... -65 dBm

Transmit Power Threshold v2..... -67 dBm

Min Transmit Power..... 7 dBm

Max Transmit Power..... 30 dBm

802.11a Operational Rates

802.11a 6M Rate..... Disabled

802.11a 9M Rate..... Disabled

802.11a 12M Rate..... Mandatory

802.11a 18M Rate..... Supported

802.11a 24M Rate..... Mandatory

802.11a 36M Rate..... Supported

802.11a 48M Rate..... Supported

802.11a 54M Rate..... Supported

Max Clients..... 200

WLAN ID	Max Clients
1	600
2	600

Trap Threshold

Clients..... 12 clients

Interference..... 10 %

Noise..... -70 dBm

Utilization..... 80 %

Multicast Data Rate..... 0

Rx Sop Threshold..... -78 dBm

Cca Threshold..... 0 dBm

Slot Admin State:..... Enabled

Band Select

Probe Response..... Disabled

Cycle Count..... 2 cycles

Cycle Threshold..... 200 milliseconds

Expire Suppression..... 20 seconds

Expire Dual Band..... 60 seconds

Client Rssi..... -80 dBm

Client Mid Rssi..... -80 dBm

Load Balancing

Denial..... 3 count

Window..... 5 clients

Coverage Data

Data..... -80 dBm

Voice..... -80 dBm

Minimum Client Level..... 3 clients

Exception Level..... 25 %

DCA Channel List..... 36,40,44,48,52,56,60,64,100,
104,108,112,116,120,124,128,
132,136,140,144,149,153,157,
161

DCA Bandwidth..... 20

DCA Foreign AP Contribution..... enabled

802.11n MCS Rates

MCS-00 Rate..... enabled

MCS-01 Rate..... enabled

MCS-02 Rate..... enabled

MCS-03 Rate..... enabled

MCS-04 Rate..... enabled

MCS-05 Rate..... enabled

MCS-06 Rate..... enabled

MCS-07 Rate..... enabled

MCS-08 Rate..... enabled

MCS-09 Rate..... enabled

MCS-10 Rate..... enabled

MCS-11 Rate..... enabled

MCS-12 Rate..... enabled

MCS-13 Rate..... enabled

MCS-14 Rate..... enabled

MCS-15 Rate..... enabled

MCS-16 Rate..... enabled

MCS-17 Rate..... enabled

MCS-18 Rate..... enabled

MCS-19 Rate..... enabled

MCS-20 Rate..... enabled

MCS-21 Rate..... enabled

MCS-22 Rate..... enabled

MCS-23 Rate..... enabled

MCS-24 Rate..... enabled

MCS-25 Rate..... enabled

MCS-26 Rate..... enabled

MCS-27 Rate..... enabled

MCS-28 Rate..... enabled

MCS-29 Rate..... enabled

MCS-30 Rate..... enabled

MCS-31 Rate..... enabled

Client Network Preference..... default

RF Profile name..... High-Client-Density-802.11bg

Description..... <none>

AP Group Name..... <none>

Radio policy..... 2.4 GHz

11n-client-only..... disabled

Transmit Power Threshold v1..... -70 dBm

Transmit Power Threshold v2..... -67 dBm

Min Transmit Power..... 7 dBm

Max Transmit Power..... 30 dBm

802.11b/g Operational Rates

802.11b/g 1M Rate..... Disabled

802.11b/g 2M Rate..... Disabled

802.11b/g 5.5M Rate..... Disabled

802.11b/g 11M Rate..... Disabled

802.11g 6M Rate..... Disabled

802.11g 9M Rate..... Supported

802.11g 12M Rate..... Mandatory

802.11g 18M Rate..... Supported

802.11g 24M Rate..... Supported

802.11g 36M Rate..... Supported

802.11g 48M Rate..... Supported

802.11g 54M Rate..... Supported

Max Clients..... 200

WLAN ID	Max Clients
1	600
2	600

Trap Threshold

Clients..... 12 clients

Interference..... 10 %

Noise..... -70 dBm

Utilization..... 80 %

Multicast Data Rate..... 0

Rx Sop Threshold..... -82 dBm

Cca Threshold..... 0 dBm

Slot Admin State:..... Enabled

Band Select

Probe Response..... Disabled

Cycle Count..... 2 cycles

Cycle Threshold..... 200 milliseconds

Expire Suppression..... 20 seconds

Expire Dual Band..... 60 seconds

Client Rssi..... -80 dBm

Client Mid Rssi..... -80 dBm

Load Balancing

Denial..... 3 count

Window..... 5 clients

Coverage Data

Data..... -80 dBm

Voice..... -80 dBm

Minimum Client Level..... 3 clients

Exception Level..... 25 %

DCA Channel List..... 1,6,11

DCA Bandwidth..... 20

DCA Foreign AP Contribution..... enabled

802.11n MCS Rates

MCS-00 Rate..... enabled

MCS-01 Rate..... enabled

MCS-02 Rate..... enabled

MCS-03 Rate..... enabled

MCS-04 Rate..... enabled

MCS-05 Rate..... enabled

MCS-06 Rate..... enabled

MCS-07 Rate..... enabled

MCS-08 Rate..... enabled

MCS-09 Rate..... enabled

MCS-10 Rate..... enabled

MCS-11 Rate..... enabled

MCS-12 Rate..... enabled

MCS-13 Rate..... enabled

MCS-14 Rate..... enabled

MCS-15 Rate..... enabled

MCS-16 Rate..... enabled

MCS-17 Rate..... enabled

MCS-18 Rate..... enabled

MCS-19 Rate..... enabled

MCS-20 Rate..... enabled

MCS-21 Rate..... enabled

MCS-22 Rate..... enabled

MCS-23 Rate..... enabled

MCS-24 Rate..... enabled

MCS-25 Rate..... enabled

MCS-26 Rate..... enabled

MCS-27 Rate..... enabled

MCS-28 Rate..... enabled

MCS-29 Rate..... enabled

MCS-30 Rate..... enabled

MCS-31 Rate..... enabled

Client Network Preference..... default

RF Profile name..... Low-Client-Density-802.11a

Description..... <none>

AP Group Name..... <none>

Radio policy..... 5 GHz

11n-client-only..... disabled

Transmit Power Threshold v1..... -60 dBm

Transmit Power Threshold v2..... -67 dBm

Min Transmit Power..... -10 dBm

Max Transmit Power..... 30 dBm

802.11a Operational Rates

802.11a 6M Rate..... Mandatory

802.11a 9M Rate..... Supported

802.11a 12M Rate..... Mandatory

802.11a 18M Rate..... Supported

802.11a 24M Rate..... Mandatory

802.11a 36M Rate..... Supported

802.11a 48M Rate..... Supported

802.11a 54M Rate..... Supported

Max Clients..... 200

WLAN ID	Max Clients
1	600
2	600

Trap Threshold

Clients..... 12 clients

Interference..... 10 %

Noise..... -70 dBm

Utilization..... 80 %

Multicast Data Rate..... 0

Rx Sop Threshold..... -80 dBm

Cca Threshold..... 0 dBm

Slot Admin State:..... Enabled

Band Select

Probe Response..... Disabled

Cycle Count..... 2 cycles

Cycle Threshold..... 200 milliseconds

Expire Suppression..... 20 seconds

Expire Dual Band..... 60 seconds

Client Rssi..... -80 dBm

Client Mid Rssi..... -80 dBm

Load Balancing

Denial..... 3 count

Window..... 5 clients

Coverage Data

Data..... -90 dBm

Voice..... -90 dBm

Minimum Client Level..... 2 clients

Exception Level..... 25 %

DCA Channel List..... 36,40,44,48,52,56,60,64,100,
104,108,112,116,120,124,128,
132,136,140,144,149,153,157,
161

DCA Bandwidth..... 20

DCA Foreign AP Contribution..... enabled

802.11n MCS Rates

MCS-00 Rate..... enabled

MCS-01 Rate..... enabled

MCS-02 Rate..... enabled

MCS-03 Rate..... enabled

MCS-04 Rate..... enabled

MCS-05 Rate..... enabled

MCS-06 Rate..... enabled

MCS-07 Rate..... enabled

MCS-08 Rate..... enabled

MCS-09 Rate..... enabled

MCS-10 Rate..... enabled

MCS-11 Rate..... enabled

MCS-12 Rate..... enabled

MCS-13 Rate..... enabled

MCS-14 Rate..... enabled

MCS-15 Rate..... enabled

MCS-16 Rate..... enabled

MCS-17 Rate..... enabled

MCS-18 Rate..... enabled

MCS-19 Rate..... enabled

MCS-20 Rate..... enabled

MCS-21 Rate..... enabled

MCS-22 Rate..... enabled

MCS-23 Rate..... enabled

MCS-24 Rate..... enabled

MCS-25 Rate..... enabled

MCS-26 Rate..... enabled

MCS-27 Rate..... enabled

MCS-28 Rate..... enabled

MCS-29 Rate..... enabled

MCS-30 Rate..... enabled

MCS-31 Rate..... enabled

Client Network Preference..... default

RF Profile name..... Low-Client-Density-802.11bg

Description..... <none>

AP Group Name..... <none>

Radio policy..... 2.4 GHz

11n-client-only..... disabled

Transmit Power Threshold v1..... -65 dBm

Transmit Power Threshold v2..... -67 dBm

Min Transmit Power..... -10 dBm

Max Transmit Power..... 30 dBm

802.11b/g Operational Rates

802.11b/g 1M Rate..... Mandatory

802.11b/g 2M Rate..... Mandatory

802.11b/g 5.5M Rate..... Mandatory

802.11b/g 11M Rate..... Mandatory

802.11g 6M Rate..... Supported

802.11g 9M Rate..... Supported

802.11g 12M Rate..... Supported

802.11g 18M Rate..... Supported

802.11g 24M Rate..... Supported

802.11g 36M Rate..... Supported

802.11g 48M Rate..... Supported

802.11g 54M Rate..... Supported

Max Clients..... 200

WLAN ID	Max Clients
1	600
2	600

Trap Threshold

Clients..... 12 clients

Interference..... 10 %

Noise..... -70 dBm

Utilization..... 80 %

Multicast Data Rate..... 0

Rx Sop Threshold..... -85 dBm

Cca Threshold..... 0 dBm

Slot Admin State:..... Enabled

Band Select

Probe Response..... Disabled

Cycle Count..... 2 cycles

Cycle Threshold..... 200 milliseconds

Expire Suppression..... 20 seconds

Expire Dual Band..... 60 seconds

Client Rssi..... -80 dBm

Client Mid Rssi..... -80 dBm

Load Balancing

Denial..... 3 count

Window..... 5 clients

Coverage Data

Data..... -90 dBm

Voice..... -90 dBm

Minimum Client Level..... 2 clients

Exception Level..... 25 %

DCA Channel List..... 1,6,11

DCA Bandwidth..... 20

DCA Foreign AP Contribution..... enabled

802.11n MCS Rates

MCS-00 Rate..... enabled

MCS-01 Rate..... enabled

MCS-02 Rate..... enabled

MCS-03 Rate..... enabled

MCS-04 Rate..... enabled

MCS-05 Rate..... enabled

MCS-06 Rate..... enabled

MCS-07 Rate..... enabled

MCS-08 Rate..... enabled

MCS-09 Rate..... enabled

MCS-10 Rate..... enabled

MCS-11 Rate..... enabled

MCS-12 Rate..... enabled

MCS-13 Rate..... enabled

MCS-14 Rate..... enabled

MCS-15 Rate..... enabled

MCS-16 Rate..... enabled

MCS-17 Rate..... enabled

MCS-18 Rate..... enabled

MCS-19 Rate..... enabled

MCS-20 Rate..... enabled

MCS-21 Rate..... enabled

MCS-22 Rate..... enabled

MCS-23 Rate..... enabled

MCS-24 Rate..... enabled

MCS-25 Rate..... enabled

MCS-26 Rate..... enabled

MCS-27 Rate..... enabled

MCS-28 Rate..... enabled

MCS-29 Rate..... enabled

MCS-30 Rate..... enabled

MCS-31 Rate..... enabled

Client Network Preference..... default

RF Profile name..... Typical-Client-Density-802.11a

Description..... <none>

AP Group Name..... <none>

Radio policy..... 5 GHz

11n-client-only..... disabled

Transmit Power Threshold v1..... -70 dBm

Transmit Power Threshold v2..... -67 dBm

Min Transmit Power..... -10 dBm

Max Transmit Power..... 30 dBm

802.11a Operational Rates

802.11a 6M Rate..... Mandatory

802.11a 9M Rate..... Supported

802.11a 12M Rate..... Mandatory

802.11a 18M Rate..... Supported

802.11a 24M Rate..... Mandatory

802.11a 36M Rate..... Supported

802.11a 48M Rate..... Supported

802.11a 54M Rate..... Supported

Max Clients..... 200

WLAN ID	Max Clients
1	600
2	600

Trap Threshold

Clients..... 12 clients

Interference..... 10 %

Noise..... -70 dBm

Utilization..... 80 %

Multicast Data Rate..... 0

Rx Sop Threshold..... AUTO

Cca Threshold..... 0 dBm

Slot Admin State:..... Enabled

Band Select

Probe Response..... Disabled

Cycle Count..... 2 cycles

Cycle Threshold..... 200 milliseconds

Expire Suppression..... 20 seconds

Expire Dual Band..... 60 seconds

Client Rssi..... -80 dBm

Client Mid Rssi..... -80 dBm

Load Balancing

Denial..... 3 count

Window..... 5 clients

Coverage Data

Data..... -80 dBm

Voice..... -80 dBm

Minimum Client Level..... 3 clients

Exception Level..... 25 %

DCA Channel List..... 36,40,44,48,52,56,60,64,100,
104,108,112,116,120,124,128,
132,136,140,144,149,153,157,
161

DCA Bandwidth..... 20

DCA Foreign AP Contribution..... enabled

802.11n MCS Rates

MCS-00 Rate..... enabled

MCS-01 Rate..... enabled

MCS-02 Rate..... enabled

MCS-03 Rate..... enabled

MCS-04 Rate..... enabled

MCS-05 Rate..... enabled

MCS-06 Rate..... enabled

MCS-07 Rate..... enabled

MCS-08 Rate..... enabled

MCS-09 Rate..... enabled

MCS-10 Rate..... enabled

MCS-11 Rate..... enabled

MCS-12 Rate..... enabled

MCS-13 Rate..... enabled

MCS-14 Rate..... enabled

MCS-15 Rate..... enabled

MCS-16 Rate..... enabled

MCS-17 Rate..... enabled

MCS-18 Rate..... enabled

MCS-19 Rate..... enabled

MCS-20 Rate..... enabled

MCS-21 Rate..... enabled

MCS-22 Rate..... enabled

MCS-23 Rate..... enabled

MCS-24 Rate..... enabled

MCS-25 Rate..... enabled

MCS-26 Rate..... enabled

MCS-27 Rate..... enabled

MCS-28 Rate..... enabled

MCS-29 Rate..... enabled

MCS-30 Rate..... enabled

MCS-31 Rate..... enabled

Client Network Preference..... default

RF Profile name..... Typical-Client-Density-802.11bg

Description..... <none>

AP Group Name..... <none>

Radio policy..... 2.4 GHz

11n-client-only..... disabled

Transmit Power Threshold v1..... -70 dBm

Transmit Power Threshold v2..... -67 dBm

Min Transmit Power..... -10 dBm

Max Transmit Power..... 30 dBm

802.11b/g Operational Rates

802.11b/g 1M Rate..... Disabled

802.11b/g 2M Rate..... Disabled

802.11b/g 5.5M Rate..... Disabled

802.11b/g 11M Rate..... Disabled

802.11g 6M Rate..... Disabled

802.11g 9M Rate..... Supported

802.11g 12M Rate..... Mandatory

802.11g 18M Rate..... Supported

802.11g 24M Rate..... Supported

802.11g 36M Rate..... Supported

802.11g 48M Rate..... Supported

802.11g 54M Rate..... Supported

Max Clients..... 200

WLAN ID	Max Clients
1	600
2	600

Trap Threshold

Clients..... 12 clients

Interference..... 10 %

Noise..... -70 dBm

Utilization..... 80 %

Multicast Data Rate..... 0

Rx Sop Threshold..... AUTO

Cca Threshold..... 0 dBm

Slot Admin State:..... Enabled

Band Select

Probe Response..... Disabled

Cycle Count..... 2 cycles

Cycle Threshold..... 200 milliseconds

Expire Suppression..... 20 seconds

Expire Dual Band..... 60 seconds

Client Rssi..... -80 dBm

Client Mid Rssi..... -80 dBm

Load Balancing

Denial..... 3 count

Window..... 5 clients

Coverage Data

Data..... -80 dBm

Voice..... -80 dBm

Minimum Client Level..... 3 clients

Exception Level..... 25 %

DCA Channel List..... 1,6,11

DCA Bandwidth..... 20

DCA Foreign AP Contribution..... enabled

802.11n MCS Rates

MCS-00 Rate..... enabled

MCS-01 Rate..... enabled

MCS-02 Rate..... enabled

MCS-03 Rate..... enabled

MCS-04 Rate..... enabled

MCS-05 Rate..... enabled

MCS-06 Rate..... enabled

MCS-07 Rate..... enabled

MCS-08 Rate..... enabled

MCS-09 Rate..... enabled

MCS-10 Rate..... enabled

MCS-11 Rate..... enabled

MCS-12 Rate..... enabled

MCS-13 Rate..... enabled

MCS-14 Rate..... enabled

MCS-15 Rate..... enabled

MCS-16 Rate..... enabled

MCS-17 Rate..... enabled

MCS-18 Rate..... enabled

MCS-19 Rate..... enabled

MCS-20 Rate..... enabled

MCS-21 Rate..... enabled

MCS-22 Rate..... enabled

MCS-23 Rate..... enabled

MCS-24 Rate..... enabled

MCS-25 Rate..... enabled

MCS-26 Rate..... enabled

MCS-27 Rate..... enabled

MCS-28 Rate..... enabled

MCS-29 Rate..... enabled

MCS-30 Rate..... enabled

MCS-31 Rate..... enabled

Client Network Preference..... default

AP Config

Cisco AP Identifier..... 3

Cisco AP Name..... AP78da.6ee0.08ec

Country code..... US - United States

Regulatory Domain allowed by Country..... 802.11bg:-A 802.11a:-AB

AP Country code..... US - United States

AP Regulatory Domain..... -A

Switch Port Number 1

MAC Address..... 78:da:6e:e0:08:ec

IP Address Configuration..... DHCP

IP Address..... 192.168.250.10

IP NetMask..... 255.255.255.0

Gateway IP Addr..... 192.168.250.1

NAT External IP Address..... None

CAPWAP Path MTU..... 1485

DHCP Release Override..... Disabled

Telnet State..... Globally Disabled

Ssh State..... Globally Disabled

Cisco AP Location..... default location

Cisco AP Floor Label..... 0

Cisco AP Group Name..... default-group

Primary Cisco Switch Name.....

Primary Cisco Switch IP Address..... Not Configured

Secondary Cisco Switch Name.....

Secondary Cisco Switch IP Address..... Not Configured

Tertiary Cisco Switch Name.....

Tertiary Cisco Switch IP Address..... Not Configured

Administrative State ..... ADMIN_ENABLED

Operation State ..... REGISTERED

Mirroring Mode ..... Disabled

AP Mode ..... FlexConnect

Public Safety ..... Disabled

ATF Mode: ..... Disable

AP SubMode ..... Not Configured

Rogue Detection ..... Enabled

AP Vlan Trunking ..... Disabled

Remote AP Debug ..... Disabled

Logging trap severity level ..... informational

Logging syslog facility ..... kern

S/W Version 8.2.111.0

Boot Version 15.2.2.0

Mini IOS Version 7.5.1.73

Stats Reporting Period 180

Stats Collection Mode ..... normal

LED State..... Enabled

PoE Pre-Standard Switch..... Disabled

PoE Power Injector MAC Addr..... Disabled

Power Type/Mode..... PoE/Full Power

Number Of Slots..... 2

AP Model..... AIR-CAP1602I-A-K9

AP Image..... C1600-K9W8-M

IOS Version..... 15.3(3)JC2$

Reset Button..... Enabled

AP Serial Number..... FGL1748W52Y

AP Certificate Type..... Manufacture Installed

AP Lag Status ..... Disable

Native Vlan Inheritance: ..... AP

FlexConnect Vlan mode :..... Disabled

FlexConnect Group..... Not a member of any group

Group VLAN ACL Mappings

Group VLAN Name to Id Mappings

Template in Modified State - apply it to see mappings

AP-Specific FlexConnect Policy ACLs :

L2Acl Configuration ..... Not Available

FlexConnect Local-Split ACLs :

WLAN ID	PROFILE NAME	ACL	TYPE

Flexconnect Central-Dhcp Values :

WLAN ID	PROFILE NAME	Central-Dhcp	DNS Override	Nat-Pat	Type
1	IP_Dev No Encryption	False	False	False	Wlan

Flex AVC visibility Configurations.....

WlanId	PROFILE NAME	Inherit-level Visibility	Flex Avc-profile
1	IP_Dev No Encryption	wlan-spec	disable none

FlexConnect Backup Auth Radius Servers :

Primary Radius Server..... Disabled

Secondary Radius Server..... Disabled

AP User Mode..... AUTOMATIC

AP User Name..... Cisco

AP Dot1x User Mode..... Not Configured

AP Dot1x User Name..... Not Configured

Cisco AP system logging host..... 255.255.255.255

AP Core Dump Config..... Disabled

AP Up Time..... 2 days, 22 h 22 m 20 s

AP LWAPP Up Time..... 2 days, 22 h 18 m 20 s

Join Date and Time..... Mon Aug 15 21:47:06 2016

Join Taken Time..... 0 days, 00 h 03 m 59 s

Attributes for Slot 0

Radio Type..... RADIO_TYPE_80211n-2.4

Administrative State ..... ADMIN_ENABLED

Operation State ..... UP

Mesh Radio Role ..... ACCESS

Radio Role ..... Client Serving (Remote)

CellId 0

Station Configuration

Configuration ..... AUTOMATIC

Number Of WLANs 1

Medium Occupancy Limit 100

CFP Period 4

CFP MaxDuration 60

BSSID 5c:a4:8a:be:ca:90

Operation Rate Set

1000 Kilo Bits..... MANDATORY

2000 Kilo Bits..... MANDATORY

5500 Kilo Bits..... MANDATORY

11000 Kilo Bits..... MANDATORY

6000 Kilo Bits..... SUPPORTED

9000 Kilo Bits..... SUPPORTED

12000 Kilo Bits..... SUPPORTED

18000 Kilo Bits..... SUPPORTED

24000 Kilo Bits..... SUPPORTED

36000 Kilo Bits..... SUPPORTED

48000 Kilo Bits..... SUPPORTED

54000 Kilo Bits..... SUPPORTED

MCS Set

MCS 0..... SUPPORTED

MCS 1..... SUPPORTED

MCS 2..... SUPPORTED

MCS 3..... SUPPORTED

MCS 4..... SUPPORTED

MCS 5..... SUPPORTED

MCS 6..... SUPPORTED

MCS 7..... SUPPORTED

MCS 8..... SUPPORTED

MCS 9..... SUPPORTED

MCS 10..... SUPPORTED

MCS 11..... SUPPORTED

MCS 12..... SUPPORTED

MCS 13..... SUPPORTED

MCS 14..... SUPPORTED

MCS 15..... SUPPORTED

MCS 16..... DISABLED

MCS 17..... DISABLED

MCS 18..... DISABLED

MCS 19..... DISABLED

MCS 20..... DISABLED

MCS 21..... DISABLED

MCS 22..... DISABLED

MCS 23..... DISABLED

MCS 24..... DISABLED

MCS 25..... DISABLED

MCS 26..... DISABLED

MCS 27..... DISABLED

MCS 28..... DISABLED

MCS 29..... DISABLED

MCS 30..... DISABLED

MCS 31..... DISABLED

Beacon Period 100

Fragmentation Threshold 2346

Multi Domain Capability Implemented ..... TRUE

Multi Domain Capability Enabled ..... TRUE

Country String ..... US

Multi Domain Capability

Configuration ..... AUTOMATIC

First Chan Num 1

Number Of Channels 11

MAC Operation Parameters

Configuration ..... AUTOMATIC

Fragmentation Threshold 2346

Packet Retry Limit 64

Tx Power

Num Of Supported Power Levels 6

Tx Power Level 1 ..... 22 dBm

Tx Power Level 2 ..... 19 dBm

Tx Power Level 3 ..... 16 dBm

Tx Power Level 4 ..... 13 dBm

Tx Power Level 5 ..... 10 dBm

Tx Power Level 6 ..... 7 dBm

Tx Power Configuration ..... AUTOMATIC

Current Tx Power Level 1

Tx Power Assigned By ..... DTPC

Phy OFDM parameters

Configuration ..... AUTOMATIC

Current Channel 11

Channel Assigned By ..... DCA

Extension Channel ..... NONE

Channel Width..... 20 Mhz

Allowed Channel List..... 1,2,3,4,5,6,7,8,9,10,11

TI Threshold ..... -50

DCA Channel List..... Global

Legacy Tx Beamforming Configuration ..... CUSTOMIZED

Legacy Tx Beamforming ..... ENABLED

Antenna Type..... INTERNAL_ANTENNA

Internal Antenna Gain (in .5 dBi units).... 8

Diversity..... DIVERSITY_ENABLED

802.11n Antennas

A..... ENABLED

B..... ENABLED

C..... ENABLED

Performance Profile Parameters

Configuration ..... AUTOMATIC

Interference threshold..... 10 %

Noise threshold..... -70 dBm

RF utilization threshold..... 80 %

Data-rate threshold..... 1000000 bps

Client threshold..... 12 clients

Coverage SNR threshold..... 12 dB

Coverage exception level..... 25 %

Client minimum exception level..... 3 clients

Rogue Containment Information

Containment Count..... 0

CleanAir Management Information

CleanAir Capable..... Yes

CleanAir Management Administration St.... Enabled

CleanAir Management Operation State..... Down

Rapid Update Mode..... Off

Spectrum Expert connection..... Enabled

CleanAir NSI Key..... C44B365F4CFF338BE94B85633D98944B

Spectrum Expert Connections counter.... 0

CleanAir Sensor State..... Configured

Radio Extended Configurations

Beacon period..... 100 milliseconds

Beacon range..... AUTO

Multicast buffer..... AUTO

Multicast data-rate..... AUTO

RX SOP threshold..... AUTO

CCA threshold..... AUTO

Attributes for Slot 1

Radio Type..... RADIO_TYPE_80211n-5

Radio Subband..... RADIO_SUBBAND_ALL

Administrative State ..... ADMIN_ENABLED

Operation State ..... UP

Mesh Radio Role ..... ACCESS

Radio Role ..... Client Serving (Remote)

CellId 0

Station Configuration

Configuration ..... AUTOMATIC

Number Of WLANs 1

Medium Occupancy Limit 100

CFP Period 4

CFP MaxDuration 60

BSSID 5c:a4:8a:be:ca:90

Operation Rate Set

6000 Kilo Bits..... MANDATORY

9000 Kilo Bits..... SUPPORTED

12000 Kilo Bits..... MANDATORY

18000 Kilo Bits..... SUPPORTED

24000 Kilo Bits..... MANDATORY

36000 Kilo Bits..... SUPPORTED

48000 Kilo Bits..... SUPPORTED

54000 Kilo Bits..... SUPPORTED

MCS Set

MCS 0..... SUPPORTED

MCS 1..... SUPPORTED

MCS 2..... SUPPORTED

MCS 3..... SUPPORTED

MCS 4..... SUPPORTED

MCS 5..... SUPPORTED

MCS 6..... SUPPORTED

MCS 7..... SUPPORTED

MCS 8..... SUPPORTED

MCS 9..... SUPPORTED

MCS 10..... SUPPORTED

MCS 11..... SUPPORTED

MCS 12..... SUPPORTED

MCS 13..... SUPPORTED

MCS 14..... SUPPORTED

MCS 15..... SUPPORTED

MCS 16..... DISABLED

MCS 17..... DISABLED

MCS 18..... DISABLED

MCS 19..... DISABLED

MCS 20..... DISABLED

MCS 21..... DISABLED

MCS 22..... DISABLED

MCS 23..... DISABLED

MCS 24..... DISABLED

MCS 25..... DISABLED

MCS 26..... DISABLED

MCS 27..... DISABLED

MCS 28..... DISABLED

MCS 29..... DISABLED

MCS 30..... DISABLED

MCS 31..... DISABLED

Beacon Period 100

Fragmentation Threshold 2346

Multi Domain Capability Implemented ..... TRUE

Multi Domain Capability Enabled ..... TRUE

Country String ..... US

Multi Domain Capability

Configuration ..... AUTOMATIC

First Chan Num 36

Number Of Channels 21

MAC Operation Parameters

Configuration ..... AUTOMATIC

Fragmentation Threshold 2346

Packet Retry Limit 64

Tx Power

Num Of Supported Power Levels 6

Tx Power Level 1 ..... 22 dBm

Tx Power Level 2 ..... 19 dBm

Tx Power Level 3 ..... 16 dBm

Tx Power Level 4 ..... 13 dBm

Tx Power Level 5 ..... 10 dBm

Tx Power Level 6 ..... 7 dBm

Tx Power Configuration ..... AUTOMATIC

Current Tx Power Level 1

Tx Power Assigned By ..... DTPC

Phy OFDM parameters

Configuration ..... AUTOMATIC

Current Channel 149

Channel Assigned By ..... DCA

Extension Channel ..... NONE

Channel Width..... 20 Mhz

Allowed Channel List..... 36,40,44,48,52,56,60,64,100,

..... 104,108,112,116,132,136,140,

..... 149,153,157,161,165

TI Threshold ..... -50

DCA Channel List..... Global

Legacy Tx Beamforming Configuration ..... CUSTOMIZED

Legacy Tx Beamforming ..... ENABLED

Antenna Type..... INTERNAL_ANTENNA

Internal Antenna Gain (in .5 dBi units).... 8

Diversity..... DIVERSITY_ENABLED

802.11n Antennas

A..... ENABLED

B..... ENABLED

C..... ENABLED

Performance Profile Parameters

Configuration ..... AUTOMATIC

Interference threshold..... 10 %

Noise threshold..... -70 dBm

RF utilization threshold..... 80 %

Data-rate threshold..... 1000000 bps

Client threshold..... 12 clients

Coverage SNR threshold..... 16 dB

Coverage exception level..... 25 %

Client minimum exception level..... 3 clients

Rogue Containment Information

Containment Count..... 0

CleanAir Management Information

CleanAir Capable..... Yes

CleanAir Management Administration St.... Enabled

CleanAir Management Operation State..... Down

Rapid Update Mode..... Off

Spectrum Expert connection..... Enabled

CleanAir NSI Key..... C44B365F4CFF338BE94B85633D98944B

Spectrum Expert Connections counter.... 0

CleanAir Sensor State..... Configured

Radio Extended Configurations

Beacon period..... 100 milliseconds

Beacon range..... AUTO

Multicast buffer..... AUTO

Multicast data-rate..... AUTO

RX SOP threshold..... AUTO

CCA threshold..... AUTO

Cisco AP Identifier..... 4

Cisco AP Name..... AP24e9.b34b.f1ed

Country code..... US - United States

Regulatory Domain allowed by Country..... 802.11bg:-A 802.11a:-AB

AP Country code..... US - United States

AP Regulatory Domain..... -A

Switch Port Number 1

MAC Address..... 24:e9:b3:4b:f1:ed

IP Address Configuration..... DHCP

IP Address..... 192.168.250.11

IP NetMask..... 255.255.255.0

Gateway IP Addr..... 192.168.250.1

NAT External IP Address..... None

CAPWAP Path MTU..... 1485

DHCP Release Override..... Disabled

Telnet State..... Globally Disabled

Ssh State..... Globally Disabled

Cisco AP Location..... default location

Cisco AP Floor Label..... 0

Cisco AP Group Name..... default-group

Primary Cisco Switch Name.....

Primary Cisco Switch IP Address..... Not Configured

Secondary Cisco Switch Name.....

Secondary Cisco Switch IP Address..... Not Configured

Tertiary Cisco Switch Name.....

Tertiary Cisco Switch IP Address..... Not Configured

Administrative State ..... ADMIN_ENABLED

Operation State ..... REGISTERED

Mirroring Mode ..... Disabled

AP Mode ..... FlexConnect

Public Safety ..... Disabled

ATF Mode: ..... Disable

AP SubMode ..... Not Configured

Rogue Detection ..... Enabled

AP Vlan Trunking ..... Disabled

Remote AP Debug ..... Disabled

Logging trap severity level ..... emergencies

Logging syslog facility ..... system

S/W Version 8.2.111.0

Boot Version 15.2.2.0

Mini IOS Version 7.5.1.73

Stats Reporting Period 180

Stats Collection Mode ..... normal

LED State..... Enabled

PoE Pre-Standard Switch..... Disabled

PoE Power Injector MAC Addr..... Disabled

Power Type/Mode..... PoE/Full Power

Number Of Slots..... 2

AP Model..... AIR-CAP1602I-A-K9

AP Image..... C1600-K9W8-M

IOS Version..... 15.3(3)JC2$

Reset Button..... Enabled

AP Serial Number..... FGL1748W52S

AP Certificate Type..... Manufacture Installed

AP Lag Status ..... Disable

Native Vlan Inheritance: ..... Group

FlexConnect Vlan mode :..... Disabled

FlexConnect Group..... Not a member of any group

Group VLAN ACL Mappings

Group VLAN Name to Id Mappings

Template in Modified State - apply it to see mappings

AP-Specific FlexConnect Policy ACLs :

L2Acl Configuration ..... Not Available

FlexConnect Local-Split ACLs :

WLAN ID	PROFILE NAME	ACL	TYPE

Flexconnect Central-Dhcp Values :

WLAN ID	PROFILE NAME	Central-Dhcp	DNS Override	Nat-Pat	Type
1	IP_Dev No Encryption	False	False	False	Wlan

Flex AVC visibility Configurations.....

WlanId	PROFILE NAME	Inherit-level Visibility	Flex Avc-profile
1	IP_Dev No Encryption	wlan-spec	disable none

FlexConnect Backup Auth Radius Servers :

Primary Radius Server..... Disabled

Secondary Radius Server..... Disabled

AP User Mode..... AUTOMATIC

AP User Name..... Cisco

AP Dot1x User Mode..... Not Configured

AP Dot1x User Name..... Not Configured

Cisco AP system logging host..... 255.255.255.255

AP Core Dump Config..... Disabled

AP Up Time..... 2 days, 22 h 22 m 16 s

AP LWAPP Up Time..... 2 days, 22 h 18 m 14 s

Join Date and Time..... Mon Aug 15 21:47:12 2016

Join Taken Time..... 0 days, 00 h 04 m 01 s

Attributes for Slot 0

Radio Type..... RADIO_TYPE_80211n-2.4

Administrative State ..... ADMIN_ENABLED

Operation State ..... UP

Mesh Radio Role ..... ACCESS

Radio Role ..... Client Serving (Remote)

CellId 0

Station Configuration

Configuration ..... AUTOMATIC

Number Of WLANs 1

Medium Occupancy Limit 100

CFP Period 4

CFP MaxDuration 60

BSSID 1c:1d:86:31:e5:50

Operation Rate Set

1000 Kilo Bits..... MANDATORY

2000 Kilo Bits..... MANDATORY

5500 Kilo Bits..... MANDATORY

11000 Kilo Bits..... MANDATORY

6000 Kilo Bits..... SUPPORTED

9000 Kilo Bits..... SUPPORTED

12000 Kilo Bits..... SUPPORTED

18000 Kilo Bits..... SUPPORTED

24000 Kilo Bits..... SUPPORTED

36000 Kilo Bits..... SUPPORTED

48000 Kilo Bits..... SUPPORTED

54000 Kilo Bits..... SUPPORTED

MCS Set

MCS 0..... SUPPORTED

MCS 1..... SUPPORTED

MCS 2..... SUPPORTED

MCS 3..... SUPPORTED

MCS 4..... SUPPORTED

MCS 5..... SUPPORTED

MCS 6..... SUPPORTED

MCS 7..... SUPPORTED

MCS 8..... SUPPORTED

MCS 9..... SUPPORTED

MCS 10..... SUPPORTED

MCS 11..... SUPPORTED

MCS 12..... SUPPORTED

MCS 13..... SUPPORTED

MCS 14..... SUPPORTED

MCS 15..... SUPPORTED

MCS 16..... DISABLED

MCS 17..... DISABLED

MCS 18..... DISABLED

MCS 19..... DISABLED

MCS 20..... DISABLED

MCS 21..... DISABLED

MCS 22..... DISABLED

MCS 23..... DISABLED

MCS 24..... DISABLED

MCS 25..... DISABLED

MCS 26..... DISABLED

MCS 27..... DISABLED

MCS 28..... DISABLED

MCS 29..... DISABLED

MCS 30..... DISABLED

MCS 31..... DISABLED

Beacon Period 100

Fragmentation Threshold 2346

Multi Domain Capability Implemented ..... TRUE

Multi Domain Capability Enabled ..... TRUE

Country String ..... US

Multi Domain Capability

Configuration ..... AUTOMATIC

First Chan Num 1

Number Of Channels 11

MAC Operation Parameters

Configuration ..... AUTOMATIC

Fragmentation Threshold 2346

Packet Retry Limit 64

Tx Power

Num Of Supported Power Levels 6

Tx Power Level 1 ..... 22 dBm

Tx Power Level 2 ..... 19 dBm

Tx Power Level 3 ..... 16 dBm

Tx Power Level 4 ..... 13 dBm

Tx Power Level 5 ..... 10 dBm

Tx Power Level 6 ..... 7 dBm

Tx Power Configuration ..... AUTOMATIC

Current Tx Power Level 1

Tx Power Assigned By ..... DTPC

Phy OFDM parameters

Configuration ..... AUTOMATIC

Current Channel 11

Channel Assigned By ..... DCA

Extension Channel ..... NONE

Channel Width..... 20 Mhz

Allowed Channel List..... 1,2,3,4,5,6,7,8,9,10,11

TI Threshold ..... -50

DCA Channel List..... Global

Legacy Tx Beamforming Configuration ..... CUSTOMIZED

Legacy Tx Beamforming ..... ENABLED

Antenna Type..... INTERNAL_ANTENNA

Internal Antenna Gain (in .5 dBi units).... 8

Diversity..... DIVERSITY_ENABLED

802.11n Antennas

A..... ENABLED

B..... ENABLED

C..... ENABLED

Performance Profile Parameters

Configuration ..... AUTOMATIC

Interference threshold..... 10 %

Noise threshold..... -70 dBm

RF utilization threshold..... 80 %

Data-rate threshold..... 1000000 bps

Client threshold..... 12 clients

Coverage SNR threshold..... 12 dB

Coverage exception level..... 25 %

Client minimum exception level..... 3 clients

Rogue Containment Information

Containment Count..... 0

CleanAir Management Information

CleanAir Capable..... Yes

CleanAir Management Administration St.... Disabled

CleanAir Management Operation State..... Down

Rapid Update Mode..... Off

Spectrum Expert connection..... Enabled

CleanAir NSI Key..... 8994C2313910BF9588C6693603B8F970

Spectrum Expert Connections counter.... 0

CleanAir Sensor State..... Configured

Radio Extended Configurations

Beacon period..... 100 milliseconds

Beacon range..... AUTO

Multicast buffer..... AUTO

Multicast data-rate..... AUTO

RX SOP threshold..... AUTO

CCA threshold..... AUTO

Attributes for Slot 1

Radio Type..... RADIO_TYPE_80211n-5

Radio Subband..... RADIO_SUBBAND_ALL

Administrative State ..... ADMIN_ENABLED

Operation State ..... UP

Mesh Radio Role ..... ACCESS

Radio Role ..... Client Serving (Remote)

CellId 0

Station Configuration

Configuration ..... AUTOMATIC

Number Of WLANs 1

Medium Occupancy Limit 100

CFP Period 4

CFP MaxDuration 60

BSSID 1c:1d:86:31:e5:50

Operation Rate Set

6000 Kilo Bits..... MANDATORY

9000 Kilo Bits..... SUPPORTED

12000 Kilo Bits..... MANDATORY

18000 Kilo Bits..... SUPPORTED

24000 Kilo Bits..... MANDATORY

36000 Kilo Bits..... SUPPORTED

48000 Kilo Bits..... SUPPORTED

54000 Kilo Bits..... SUPPORTED

MCS Set

MCS 0..... SUPPORTED

MCS 1..... SUPPORTED

MCS 2..... SUPPORTED

MCS 3..... SUPPORTED

MCS 4..... SUPPORTED

MCS 5..... SUPPORTED

MCS 6..... SUPPORTED

MCS 7..... SUPPORTED

MCS 8..... SUPPORTED

MCS 9..... SUPPORTED

MCS 10..... SUPPORTED

MCS 11..... SUPPORTED

MCS 12..... SUPPORTED

MCS 13..... SUPPORTED

MCS 14..... SUPPORTED

MCS 15..... SUPPORTED

MCS 16..... DISABLED

MCS 17..... DISABLED

MCS 18..... DISABLED

MCS 19..... DISABLED

MCS 20..... DISABLED

MCS 21..... DISABLED

MCS 22..... DISABLED

MCS 23..... DISABLED

MCS 24..... DISABLED

MCS 25..... DISABLED

MCS 26..... DISABLED

MCS 27..... DISABLED

MCS 28..... DISABLED

MCS 29..... DISABLED

MCS 30..... DISABLED

MCS 31..... DISABLED

Beacon Period 100

Fragmentation Threshold 2346

Multi Domain Capability Implemented ..... TRUE

Multi Domain Capability Enabled ..... TRUE

Country String ..... US

Multi Domain Capability

Configuration ..... AUTOMATIC

First Chan Num 36

Number Of Channels 21

MAC Operation Parameters

Configuration ..... AUTOMATIC

Fragmentation Threshold 2346

Packet Retry Limit 64

Tx Power

Num Of Supported Power Levels 6

Tx Power Level 1 ..... 22 dBm

Tx Power Level 2 ..... 19 dBm

Tx Power Level 3 ..... 16 dBm

Tx Power Level 4 ..... 13 dBm

Tx Power Level 5 ..... 10 dBm

Tx Power Level 6 ..... 7 dBm

Tx Power Configuration ..... AUTOMATIC

Current Tx Power Level 1

Tx Power Assigned By ..... DTPC

Phy OFDM parameters

Configuration ..... AUTOMATIC

Current Channel 48

Channel Assigned By ..... DCA

Extension Channel ..... NONE

Channel Width..... 20 Mhz

Allowed Channel List..... 36,40,44,48,52,56,60,64,100,

..... 104,108,112,116,132,136,140,

..... 149,153,157,161,165

TI Threshold ..... -50

DCA Channel List..... Global

Legacy Tx Beamforming Configuration ..... CUSTOMIZED

Legacy Tx Beamforming ..... ENABLED

Antenna Type..... INTERNAL_ANTENNA

Internal Antenna Gain (in .5 dBi units).... 8

Diversity..... DIVERSITY_ENABLED

802.11n Antennas

A..... ENABLED

B..... ENABLED

C..... ENABLED

Performance Profile Parameters

Configuration ..... AUTOMATIC

Interference threshold..... 10 %

Noise threshold..... -70 dBm

RF utilization threshold..... 80 %

Data-rate threshold..... 1000000 bps

Client threshold..... 12 clients

Coverage SNR threshold..... 16 dB

Coverage exception level..... 25 %

Client minimum exception level..... 3 clients

Rogue Containment Information

Containment Count..... 0

CleanAir Management Information

CleanAir Capable..... Yes

CleanAir Management Administration St.... Disabled

CleanAir Management Operation State..... Down

Rapid Update Mode..... Off

Spectrum Expert connection..... Enabled

CleanAir NSI Key..... 8994C2313910BF9588C6693603B8F970

Spectrum Expert Connections counter.... 0

CleanAir Sensor State..... Configured

Radio Extended Configurations

Beacon period..... 100 milliseconds

Beacon range..... AUTO

Multicast buffer..... AUTO

Multicast data-rate..... AUTO

RX SOP threshold..... AUTO

CCA threshold..... AUTO

AP Airewave Director Configuration

AP does not have the 802.11-abgn radio.

Number Of Slots..... 2

AP Name..... AP78da.6ee0.08ec

MAC Address..... 78:da:6e:e0:08:ec

Slot ID..... 0

Radio Type..... RADIO_TYPE_80211b/g

Sub-band Type..... All

Noise Information

Noise Profile..... PASSED

Interference Information

Interference Profile..... PASSED

Rogue Histogram (20)

.....

Load Information

Load Profile..... PASSED

Receive Utilization..... 0 %

Transmit Utilization..... 0 %

Channel Utilization..... 38 %

Attached Clients..... 0 clients

Coverage Information

Coverage Profile..... PASSED

Failed Clients..... 0 clients

Client Signal Strengths

RSSI -100 dbm..... 0 clients

RSSI -92 dbm..... 0 clients

RSSI -84 dbm..... 0 clients

RSSI -76 dbm..... 0 clients

RSSI -68 dbm..... 0 clients

RSSI -60 dbm..... 0 clients

RSSI -52 dbm..... 0 clients

Client Signal To Noise Ratios

SNR 0 dB..... 0 clients

SNR 5 dB..... 0 clients

SNR 10 dB..... 0 clients

SNR 15 dB..... 0 clients

SNR 20 dB..... 0 clients

SNR 25 dB..... 0 clients

SNR 30 dB..... 0 clients

SNR 35 dB..... 0 clients

SNR 40 dB..... 0 clients

SNR 45 dB..... 0 clients

Nearby APs

Radar Information

Channel Assignment Information

Current Channel Average Energy..... -127 dBm

Previous Channel Average Energy..... -127 dBm

Channel Change Count..... 415

Last Channel Change Time..... Thu Aug 18 20:01:53 2016

Recommended Best Channel..... 11

RF Parameter Recommendations

Power Level..... 1

RTS/CTS Threshold..... 2347

Fragmentation Threshold..... 2346

Antenna Pattern..... 0

Persistent Interference Devices

Class Type Channel DC (%%) RSSI (dBm) Last Update Time

Number Of Slots..... 2

AP Name..... AP78da.6ee0.08ec

MAC Address..... 78:da:6e:e0:08:ec

Slot ID..... 1

Radio Type..... RADIO_TYPE_80211a

Sub-band Type..... All

Noise Information

Noise Profile..... PASSED

Interference Information

Interference Profile..... PASSED

Rogue Histogram (20/40/80/160)

.....

Load Information

Load Profile..... PASSED

Receive Utilization..... 0 %

Transmit Utilization..... 0 %

Channel Utilization..... 1 %

Attached Clients..... 0 clients

Coverage Information

Coverage Profile..... PASSED

Failed Clients..... 0 clients

Client Signal Strengths

RSSI -100 dbm..... 0 clients

RSSI -92 dbm..... 0 clients

RSSI -84 dbm..... 0 clients

RSSI -76 dbm..... 0 clients

RSSI -68 dbm..... 0 clients

RSSI -60 dbm..... 0 clients

RSSI -52 dbm..... 0 clients

Client Signal To Noise Ratios

SNR 0 dB..... 0 clients

SNR 5 dB..... 0 clients

SNR 10 dB..... 0 clients

SNR 15 dB..... 0 clients

SNR 20 dB..... 0 clients

SNR 25 dB..... 0 clients

SNR 30 dB..... 0 clients

SNR 35 dB..... 0 clients

SNR 40 dB..... 0 clients

SNR 45 dB..... 0 clients

Nearby APs

Radar Information

Channel Assignment Information

Current Channel Average Energy..... -127 dBm

Previous Channel Average Energy..... -127 dBm

Channel Change Count..... 417

Last Channel Change Time..... Thu Aug 18 20:05:14 2016

Recommended Best Channel..... 149

RF Parameter Recommendations

Power Level..... 1

RTS/CTS Threshold..... 2347

Fragmentation Threshold..... 2346

Antenna Pattern..... 0

Persistent Interference Devices

Class Type Channel DC (%%) RSSI (dBm) Last Update Time

---------- ------- ------ ---------- ----------

All third party trademarks are the property of their respective owners.

AP does not have the 802.11-abgn radio.

Number Of Slots..... 2

AP Name..... AP24e9.b34b.f1ed

MAC Address..... 24:e9:b3:4b:f1:ed

Slot ID..... 0

Radio Type..... RADIO_TYPE_80211b/g

Sub-band Type..... All

Noise Information

Noise Profile..... PASSED

Interference Information

Interference Profile..... PASSED

Rogue Histogram (20)

.....

Load Information

Load Profile..... PASSED

Receive Utilization..... 0 %

Transmit Utilization..... 0 %

Channel Utilization..... 34 %

Attached Clients..... 1 clients

Coverage Information

Coverage Profile..... PASSED

Failed Clients..... 0 clients

Client Signal Strengths

RSSI -100 dbm..... 0 clients

RSSI -92 dbm..... 0 clients

RSSI -84 dbm..... 0 clients

RSSI -76 dbm..... 0 clients

RSSI -68 dbm..... 0 clients

RSSI -60 dbm..... 0 clients

RSSI -52 dbm..... 1 clients

Client Signal To Noise Ratios

SNR 0 dB..... 0 clients

SNR 5 dB..... 0 clients

SNR 10 dB..... 0 clients

SNR 15 dB..... 0 clients

SNR 20 dB..... 0 clients

SNR 25 dB..... 0 clients

SNR 30 dB..... 0 clients

SNR 35 dB..... 0 clients

SNR 40 dB..... 0 clients

SNR 45 dB..... 1 clients

Nearby APs

Radar Information

Channel Assignment Information

Current Channel Average Energy..... -127 dBm

Previous Channel Average Energy..... -127 dBm

Channel Change Count..... 415

Last Channel Change Time..... Thu Aug 18 20:01:53 2016

Recommended Best Channel..... 11

RF Parameter Recommendations

Power Level..... 1

RTS/CTS Threshold..... 2347

Fragmentation Threshold..... 2346

Antenna Pattern..... 0

Persistent Interference Devices

Class Type Channel DC (%%) RSSI (dBm) Last Update Time

---------- ------- ------ ---------- ----------

Number Of Slots..... 2

AP Name..... AP24e9.b34b.f1ed

MAC Address..... 24:e9:b3:4b:f1:ed

Slot ID..... 1

Radio Type..... RADIO_TYPE_80211a

Sub-band Type..... All

Noise Information

Noise Profile..... PASSED

Interference Information

Interference Profile..... PASSED

Rogue Histogram (20/40/80/160)

.....

Load Information

Load Profile..... PASSED

Receive Utilization..... 0 %

Transmit Utilization..... 0 %

Channel Utilization..... 0 %

Attached Clients..... 0 clients

Coverage Information

Coverage Profile..... PASSED

Failed Clients..... 0 clients

Client Signal Strengths

RSSI -100 dbm..... 0 clients

RSSI -92 dbm..... 0 clients

RSSI -84 dbm..... 0 clients

RSSI -76 dbm..... 0 clients

RSSI -68 dbm..... 0 clients

RSSI -60 dbm..... 0 clients

RSSI -52 dbm..... 0 clients

Client Signal To Noise Ratios

SNR 0 dB..... 0 clients

SNR 5 dB..... 0 clients

SNR 10 dB..... 0 clients

SNR 15 dB..... 0 clients

SNR 20 dB..... 0 clients

SNR 25 dB..... 0 clients

SNR 30 dB..... 0 clients

SNR 35 dB..... 0 clients

SNR 40 dB..... 0 clients

SNR 45 dB..... 0 clients

Nearby APs

Radar Information

Channel Assignment Information

Current Channel Average Energy..... -127 dBm

Previous Channel Average Energy..... -127 dBm

Channel Change Count..... 417

Last Channel Change Time..... Thu Aug 18 20:05:14 2016

Recommended Best Channel..... 48

RF Parameter Recommendations

Power Level..... 1

RTS/CTS Threshold..... 2347

Fragmentation Threshold..... 2346

Antenna Pattern..... 0

Persistent Interference Devices

Class Type	Channel	DC (%%)	RSSI (dBm)	Last Update Time

802.11a Configuration

802.11a Network..... Enabled

11acSupport..... Enabled

11nSupport..... Enabled

802.11a Low Band..... Enabled

802.11a Mid Band..... Enabled

802.11a High Band..... Enabled

802.11a Operational Rates

802.11a 6M Rate..... Mandatory

802.11a 9M Rate..... Supported

802.11a 12M Rate..... Mandatory

802.11a 18M Rate..... Supported

802.11a 24M Rate..... Mandatory

802.11a 36M Rate..... Supported

802.11a 48M Rate..... Supported

802.11a 54M Rate..... Supported

802.11n MCS Settings:

MCS 0..... Supported

MCS 1..... Supported

MCS 2..... Supported

MCS 3..... Supported

MCS 4..... Supported

MCS 5..... Supported

MCS 6..... Supported

MCS 7..... Supported

MCS 8..... Supported

MCS 9..... Supported

MCS 10..... Supported

MCS 11..... Supported

MCS 12..... Supported

MCS 13..... Supported

MCS 14..... Supported

MCS 15..... Supported

MCS 16..... Supported

MCS 17..... Supported

MCS 18..... Supported

MCS 19..... Supported

MCS 20..... Supported

MCS 21..... Supported

MCS 22..... Supported

MCS 23..... Supported

MCS 24..... Supported

MCS 25..... Supported

MCS 26..... Supported

MCS 27..... Supported

MCS 28..... Supported

MCS 29..... Supported

MCS 30..... Supported

MCS 31..... Supported

802.11ac MCS Settings:

Nss=1: MCS 0-9 ..... Supported

Nss=2: MCS 0-9 ..... Supported

Nss=3: MCS 0-9 ..... Supported

Nss=4: MCS 0-7 ..... Supported

802.11n Status:

A-MPDU Tx:

Priority 0..... Enabled

Priority 1..... Enabled

Priority 2..... Enabled

Priority 3..... Enabled

Priority 4..... Enabled

Priority 5..... Enabled

Priority 6..... Disabled

Priority 7..... Disabled

Aggregation scheduler..... Enabled

Frame Burst..... Automatic

Realtime Timeout..... 10

Non Realtime Timeout..... 200

A-MSDU Tx:

Priority 0..... Enabled

Priority 1..... Enabled

Priority 2..... Enabled

Priority 3..... Enabled

Priority 4..... Enabled

Priority 5..... Enabled

Priority 6..... Disabled

Priority 7..... Disabled

A-MSDU Max Subframes 3

A-MSDU MAX Length 8k

Rifs Rx ..... Enabled

Guard Interval ..... Any

Beacon Interval..... 100

CF Pollable mandatory..... Disabled

CF Poll Request mandatory..... Disabled

CFP Period..... 4

CFP Maximum Duration..... 60

Default Channel..... 36

Default Tx Power Level..... 0

DTPC Status..... Enabled

Fragmentation Threshold..... 2346

RSSI Low Check..... Disabled

RSSI Threshold..... -80

TI Threshold..... -50

Legacy Tx Beamforming setting..... Disabled

Traffic Stream Metrics Status..... Disabled

Expedited BW Request Status..... Disabled

World Mode..... Enabled

dfs-peakdetect..... Enabled

EDCA profile type..... default-wmm

Voice MAC optimization status..... Disabled

Call Admission Control (CAC) configuration

Voice AC:

```
  Voice AC - Admission control (ACM)..... Disabled
  Voice Stream-Size..... 84000
  Voice Max-Streams..... 2
  Voice max RF bandwidth..... 75
  Voice reserved roaming bandwidth..... 6
  Voice CAC Method ..... Load-Based
  Voice tspec inactivity timeout..... Disabled
 CAC SIP-Voice configuration
  SIP based CAC ..... Disabled
  SIP Codec Type ..... CODEC_TYPE_G711
  SIP call bandwidth ..... 64
  SIP call bandwith sample-size ..... 20
Video AC:
  Video AC - Admission control (ACM)..... Disabled
  Video max RF bandwidth..... Infinite
  Video reserved roaming bandwidth..... 0
  Video load-based CAC mode..... Disabled
  Video CAC Method ..... Static
 CAC SIP-Video Configuration
  SIP based CAC ..... Disabled
  Best-effort AC - Admission control (ACM)..... Disabled
  Background AC - Admission control (ACM)..... Disabled
Maximum Number of Clients per AP Radio..... 200

802.11a Advanced Configuration
Member RRM Information
AP Name                MAC Address      Slot Admin   Oper      Channel        TxPower
------------------------------ ----------------- ---- -------- ----------- ------------------ -------------
AP78da.6ee0.08ec       5c:a4:8a:be:ca:90  1   ENABLED  UP       149*           *1/6 (22 dBm)
AP24e9.b34b.f1ed       1c:1d:86:31:e5:50  1   ENABLED  UP       48*            *1/6 (22 dBm)
```

802.11a Airewave Director Configuration

RF Event and Performance Logging

Channel Update Logging..... Off

Coverage Profile Logging..... Off

Foreign Profile Logging..... Off

Load Profile Logging..... Off

Noise Profile Logging..... Off

Performance Profile Logging..... Off

TxPower Update Logging..... Off

Default 802.11a AP performance profiles

802.11a Global Interference threshold..... 10 %

802.11a Global noise threshold..... -70 dBm

802.11a Global RF utilization threshold..... 80 %

802.11a Global throughput threshold..... 1000000 bps

802.11a Global clients threshold..... 12 clients

Default 802.11a AP monitoring

802.11a Monitor Mode..... enable

802.11a Monitor Mode for Mesh AP Backhaul..... disable

802.11a Monitor Channels..... Country channels

802.11a RRM Neighbor Discover Type..... Transparent

802.11a RRM Neighbor RSSI Normalization..... Enabled

802.11a AP Coverage Interval..... 90 seconds

802.11a AP Load Interval..... 60 seconds

802.11a AP Monitor Measurement Interval..... 180 seconds

802.11a AP Neighbor Timeout Factor..... 5

802.11a AP Report Measurement Interval..... 180 seconds

Leader Automatic Transmit Power Assignment

Transmit Power Assignment Mode..... AUTO

Transmit Power Update Interval..... 600 seconds

Transmit Power Threshold..... -70 dBm

Transmit Power Neighbor Count..... 3 APs

Min Transmit Power..... -10 dBm

Max Transmit Power..... 30 dBm

Update Contribution

Noise..... Enable

Interference..... Enable

Load..... Disable

Device Aware..... Disable

Transmit Power Assignment Leader..... wlc (192.168.250.2) (::)

Last Run..... 21 seconds ago

Last Run Time..... 0 seconds

TPC Mode..... Version 1

TPCv2 Target RSSI..... -67 dBm

TPCv2 VoWLAN Guide RSSI..... -67.0 dBm

TPCv2 SOP..... -85.0 dBm

TPCv2 Default Client Ant Gain..... 0.0 dBi

TPCv2 Path Loss Decay Factor..... 3.6

TPCv2 Search Intensity..... 10 Iterations

AP Name	Channel	TxPower	Allowed Power Levels
AP78da.6ee0.08ec	149*	*1/6 (22 dBm)	[22/19/16/13/10/7/7/7]
AP24e9.b34b.f1ed	48*	*1/6 (22 dBm)	[22/19/16/13/10/7/7/7]

Coverage Hole Detection

802.11a Coverage Hole Detection Mode..... Enabled

802.11a Coverage Voice Packet Count..... 100 packets

802.11a Coverage Voice Packet Percentage..... 50%

802.11a Coverage Voice RSSI Threshold..... -80 dBm

802.11a Coverage Data Packet Count..... 50 packets

802.11a Coverage Data Packet Percentage..... 50%

802.11a Coverage Data RSSI Threshold..... -80 dBm

802.11a Global coverage exception level..... 25 %

802.11a Global client minimum exception lev.... 3 clients

OptimizedRoaming

802.11a OptimizedRoaming Mode..... Disabled

802.11a OptimizedRoaming Reporting Interval.... 90 seconds

802.11a OptimizedRoaming Rate Threshold..... disabled

802.11a OptimizedRoaming Hysteresis..... 6 dB

OptimizedRoaming Stats

802.11a OptimizedRoaming Disassociations..... 0

802.11a OptimizedRoaming Rejections..... 0

Leader Automatic Channel Assignment

Channel Assignment Mode..... AUTO

Channel Update Interval..... 600 seconds

Anchor time (Hour of the day)..... 0

Update Contribution

Noise..... Enable

Interference..... Enable

Load..... Disable

Device Aware..... Disable

CleanAir Event-driven RRM option..... Disabled

Channel Assignment Leader..... wlc (192.168.250.2) (::)

Last Run..... 21 seconds ago

Last Run Time..... 0 seconds

DCA Sensitivity Level..... MEDIUM (15 dB)

DCA 802.11n/ac Channel Width..... 20 MHz

DCA Minimum Energy Limit..... -95 dBm

Channel Energy Levels

```
    Minimum..... -127 dBm
    Average..... -127 dBm
    Maximum..... -127 dBm
  Channel Dwell Times
    Minimum..... 0 days, 00 h 00 m 19 s
    Average..... 0 days, 00 h 00 m 19 s
    Maximum..... 0 days, 00 h 00 m 19 s
  802.11a 5 GHz Auto-RF Channel List
    Allowed Channel List..... 36,40,44,48,52,56,60,64,100,
                              104,108,112,116,120,124,128,
                              132,136,140,144,149,153,157,
                              161
    Unused Channel List..... 165
  802.11a 4.9 GHz Auto-RF Channel List
    Allowed Channel List.....
    Unused Channel List..... 1,2,3,4,5,6,7,8,9,10,11,12,
                              13,14,15,16,17,18,19,20,21,
                              22,23,24,25,26
  DCA Outdoor AP option..... Disabled
802.11a Radio RF Grouping
  RF Group Name..... WLAN
  RF Protocol Version(MIN)..... 101(30)
  RF Packet Header Version..... 2
  Group Role(Mode)..... LEADER(AUTO)
  Group State..... Idle
  Group Update Interval..... 600 seconds
  Group Leader..... wlc (192.168.250.2) (::)
  Group Member
          ..... wlc (192.168.250.2)
  Maximum/Current number of Group Member..... 20/1
```

Maximum/Current number of AP..... 500/2

Last Run..... 21 seconds ago

802.11a CleanAir Configuration

Clean Air Solution..... Disabled

Air Quality Settings:

Air Quality Reporting..... Enabled

Air Quality Reporting Period (min)..... 15

Air Quality Alarms..... Enabled

Air Quality Alarm Threshold..... 35

Unclassified Interference..... Disabled

Unclassified Severity Threshold..... 20

Interference Device Settings:

Interference Device Reporting..... Enabled

Interference Device Types:

TDD Transmitter..... Enabled

Jammer..... Enabled

Continuous Transmitter..... Enabled

DECT-like Phone..... Enabled

Video Camera..... Enabled

WiFi Inverted..... Enabled

WiFi Invalid Channel..... Enabled

SuperAG..... Enabled

Canopy..... Enabled

WiMax Mobile..... Enabled

WiMax Fixed..... Enabled

Interference Device Alarms..... Enabled

Interference Device Types Triggering Alarms:

TDD Transmitter..... Disabled

Jammer..... Enabled

Continuous Transmitter..... Disabled

DECT-like Phone..... Disabled

Video Camera..... Disabled

WiFi Inverted..... Enabled

WiFi Invalid Channel..... Enabled

SuperAG..... Disabled

Canopy..... Disabled

WiMax Mobile..... Disabled

WiMax Fixed..... Disabled

Additional Clean Air Settings:

CleanAir ED-RRM State..... Disabled

CleanAir ED-RRM Sensitivity..... Medium

CleanAir ED-RRM Custom Threshold..... 50

CleanAir Rogue Contribution..... Disabled

CleanAir Rogue Duty-Cycle Threshold..... 80

CleanAir Persistent Devices state..... Disabled

CleanAir Persistent Device Propagation..... Disabled

802.11a CleanAir AirQuality Summary

AQ = Air Quality

DFS = Dynamic Frequency Selection

AP Name Channel Avg AQ Min AQ Interferers DFS

---------- ------- ------ ------ ---------- ---

802.11b Configuration

802.11b Network..... Enabled

11gSupport..... Enabled

11nSupport..... Enabled

802.11b/g Operational Rates

802.11b/g 1M Rate..... Mandatory

802.11b/g 2M Rate..... Mandatory

802.11b/g 5.5M Rate..... Mandatory

802.11b/g 11M Rate..... Mandatory

802.11g 6M Rate..... Supported

802.11g 9M Rate..... Supported

802.11g 12M Rate..... Supported

802.11g 18M Rate..... Supported

802.11g 24M Rate..... Supported

802.11g 36M Rate..... Supported

802.11g 48M Rate..... Supported

802.11g 54M Rate..... Supported

802.11n MCS Settings:

MCS 0..... Supported

MCS 1..... Supported

MCS 2..... Supported

MCS 3..... Supported

MCS 4..... Supported

MCS 5..... Supported

MCS 6..... Supported

MCS 7..... Supported

MCS 8..... Supported

MCS 9..... Supported

MCS 10..... Supported

MCS 11..... Supported

MCS 12..... Supported

MCS 13..... Supported

MCS 14..... Supported

MCS 15..... Supported

MCS 16..... Supported

MCS 17..... Supported

MCS 18..... Supported

MCS 19..... Supported

MCS 20..... Supported

MCS 21..... Supported

MCS 22..... Supported

MCS 23..... Supported

MCS 24..... Supported

MCS 25..... Supported

MCS 26..... Supported

MCS 27..... Supported

MCS 28..... Supported

MCS 29..... Supported

MCS 30..... Supported

MCS 31..... Supported

802.11n Status:

A-MPDU Tx:

Priority 0..... Enabled

Priority 1..... Enabled

Priority 2..... Enabled

Priority 3..... Enabled

Priority 4..... Enabled

Priority 5..... Enabled

Priority 6..... Disabled

Priority 7..... Disabled

Aggregation scheduler..... Enabled

Realtime Timeout..... 10

Non Realtime Timeout..... 200

A-MSDU Tx:

Priority 0..... Enabled

Priority 1..... Enabled

Priority 2..... Enabled

Priority 3..... Enabled

Priority 4..... Enabled

Priority 5..... Enabled

Priority 6..... Disabled

Priority 7..... Disabled

A-MSDU Max Subframes 3

A-MSDU MAX Length 8k

Rifs Rx ..... Enabled

Guard Interval ..... Any

Beacon Interval..... 100

CF Pollable mode..... Disabled

CF Poll Request mandatory..... Disabled

CFP Period..... 4

CFP Maximum Duration..... 60

Default Channel..... 1

Default Tx Power Level..... 0

DTPC Status..... Enabled

RSSI Low Check..... Disabled

RSSI Threshold..... -80

Call Admission Limit 105

G711 CU Quantum 15

ED Threshold..... -50

Fragmentation Threshold..... 2346

PBCC mandatory..... Disabled

RTS Threshold..... 2347

Short Preamble mandatory..... Enabled

Short Retry Limit..... 7

Legacy Tx Beamforming setting..... Disabled

Traffic Stream Metrics Status..... Disabled

Expedited BW Request Status..... Disabled

World Mode..... Enabled

Faster Carrier Tracking Loop..... Disabled

EDCA profile type..... default-wmm

Voice MAC optimization status..... Disabled

Call Admission Control (CAC) configuration

Voice AC - Admission control (ACM)..... Disabled

Voice Stream-Size..... 84000

Voice Max-Streams..... 2

Voice max RF bandwidth..... 75

Voice reserved roaming bandwidth..... 6

Voice CAC Method..... Load-Based

Voice tspec inactivity timeout..... Disabled

CAC SIP-Voice configuration

SIP based CAC ..... Disabled

SIP Codec Type ..... CODEC_TYPE_G711

SIP call bandwidth: 64

SIP call bandwidth sample-size 20

Video AC - Admission control (ACM)..... Disabled

Video max RF bandwidth..... Infinite

Video reserved roaming bandwidth..... 0

Video load-based CAC mode..... Disabled

Video CAC Method ..... Static

CAC SIP-Video configuration

SIP based CAC ..... Disabled

Best-effort AC - Admission control (ACM)..... Disabled

Background AC - Admission control (ACM)..... Disabled

Maximum Number of Clients per AP..... 200

802.11b Advanced Configuration

Member RRM Information

AP Name	MAC Address	Admin	Oper	Channel	TxPower
AP78da.6ee0.08ec	5c:a4:8a:be:ca:90	ENABLED	UP	11*	*1/6 (22 dBm)
AP24e9.b34b.f1ed	1c:1d:86:31:e5:50	ENABLED	UP	11*	*1/6 (22 dBm)

802.11b Airewave Director Configuration

RF Event and Performance Logging

Channel Update Logging..... Off

Coverage Profile Logging..... Off

Foreign Profile Logging..... Off

Load Profile Logging..... Off

Noise Profile Logging..... Off

Performance Profile Logging..... Off

Transmit Power Update Logging..... Off

Default 802.11b AP performance profiles

802.11b Global Interference threshold..... 10 %

802.11b Global noise threshold..... -70 dBm

802.11b Global RF utilization threshold..... 80 %

802.11b Global throughput threshold..... 1000000 bps

802.11b Global clients threshold..... 12 clients

Default 802.11b AP monitoring

802.11b Monitor Mode..... enable

802.11b Monitor Channels..... Country channels

802.11b RRM Neighbor Discovery Type..... Transparent

802.11b RRM Neighbor RSSI Normalization..... Enabled

802.11b AP Coverage Interval..... 90 seconds

802.11b AP Load Interval..... 60 seconds

802.11b AP Monitor Measurement Interval..... 180 seconds

802.11b AP Neighbor Timeout Factor..... 5

802.11b AP Report Measurement Interval..... 180 seconds

Leader Automatic Transmit Power Assignment

Transmit Power Assignment Mode..... AUTO

Transmit Power Update Interval..... 600 seconds

Transmit Power Threshold..... -70 dBm

Transmit Power Neighbor Count..... 3 APs

Min Transmit Power..... -10 dBm

Max Transmit Power..... 30 dBm

Update Contribution

Noise..... Enable

Interference..... Enable

Load..... Disable

Device Aware..... Disable

Transmit Power Assignment Leader..... wlc (192.168.250.2) (::)

Last Run..... 225 seconds ago

Last Run Time..... 0 seconds

TPC Mode..... Version 1

TPCv2 Target RSSI..... -67 dBm

TPCv2 VoWLAN Guide RSSI..... -67.0 dBm

TPCv2 SOP..... -85.0 dBm

TPCv2 Default Client Ant Gain..... 0.0 dBi

TPCv2 Path Loss Decay Factor..... 3.6

TPCv2 Search Intensity..... 10 Iterations

```
AP Name                 Channel   TxPower      Allowed Power Levels
-------------------------------- ---------- ------------ ------------------------
AP78da.6ee0.08ec          *11       *1/6 (22 dBm) [22/19/16/13/10/7/7/7]
AP24e9.b34b.f1ed          *11       *1/6 (22 dBm) [22/19/16/13/10/7/7/7]
Coverage Hole Detection
  802.11b Coverage Hole Detection Mode..... Enabled
  802.11b Coverage Voice Packet Count..... 100 packets
  802.11b Coverage Voice Packet Percentage..... 50%
  802.11b Coverage Voice RSSI Threshold..... -80 dBm
  802.11b Coverage Data Packet Count..... 50 packets
  802.11b Coverage Data Packet Percentage..... 50%
  802.11b Coverage Data RSSI Threshold..... -80 dBm
  802.11b Global coverage exception level..... 25 %
  802.11b Global client minimum exception lev.... 3 clients
OptimizedRoaming
  802.11b OptimizedRoaming Mode..... Disabled
  802.11b OptimizedRoaming Reporting Interval.... 90 seconds
  802.11b OptimizedRoaming Rate Threshold..... disabled
  802.11b OptimizedRoaming Hysteresis..... 6 dB
OptimizedRoaming Stats
  802.11b OptimizedRoaming Disassociations..... 0
  802.11b OptimizedRoaming Rejections..... 0
Leader Automatic Channel Assignment
  Channel Assignment Mode..... AUTO
  Channel Update Interval..... 600 seconds
  Anchor time (Hour of the day)..... 0
  Update Contribution
    Noise..... Enable
    Interference..... Enable
```

Load..... Disable

Device Aware..... Disable

CleanAir Event-driven RRM option..... Disabled

Channel Assignment Leader..... wlc (192.168.250.2) (::)

Last Run..... 225 seconds ago

Last Run Time..... 0 seconds

DCA Sensitivity Level: ..... MEDIUM (10 dB)

DCA Minimum Energy Limit..... -95 dBm

Channel Energy Levels

Minimum..... -127 dBm

Average..... -127 dBm

Maximum..... -127 dBm

Channel Dwell Times

Minimum..... 0 days, 00 h 03 m 43 s

Average..... 0 days, 00 h 03 m 43 s

Maximum..... 0 days, 00 h 03 m 43 s

802.11b Auto-RF Allowed Channel List..... 1,6,11

Auto-RF Unused Channel List..... 2,3,4,5,7,8,9,10

802.11b Radio RF Grouping

RF Group Name..... WLAN

RF Protocol Version(MIN)..... 101(30)

RF Packet Header Version..... 2

Group Role(Mode)..... LEADER(AUTO)

Group State..... Idle

Group Update Interval..... 600 seconds

Group Leader..... wlc (192.168.250.2) (::)

Group Member

..... wlc (192.168.250.2)

Maximum/Current number of Group Member..... 20/1

Maximum/Current number of AP..... 500/2

Last Run..... 225 seconds ago

802.11b CleanAir Configuration

Clean Air Solution..... Disabled

Air Quality Settings:

Air Quality Reporting..... Enabled

Air Quality Reporting Period (min)..... 15

Air Quality Alarms..... Enabled

Air Quality Alarm Threshold..... 35

Unclassified Interference..... Disabled

Unclassified Severity Threshold..... 20

Interference Device Settings:

Interference Device Reporting..... Enabled

Interference Device Types:

Bluetooth Link..... Enabled

Microwave Oven..... Enabled

802.11 FH..... Enabled

Bluetooth Discovery..... Enabled

TDD Transmitter..... Enabled

Jammer..... Enabled

Continuous Transmitter..... Enabled

DECT-like Phone..... Enabled

Video Camera..... Enabled

802.15.4..... Enabled

WiFi Inverted..... Enabled

WiFi Invalid Channel..... Enabled

SuperAG..... Enabled

Canopy..... Enabled

Microsoft Device..... Enabled

WiMax Mobile..... Enabled

WiMax Fixed..... Enabled

BLE Beacon..... Enabled

Interference Device Alarms..... Enabled

Interference Device Types Triggering Alarms:

Bluetooth Link..... Disabled

Microwave Oven..... Disabled

802.11 FH..... Disabled

Bluetooth Discovery..... Disabled

TDD Transmitter..... Disabled

Jammer..... Enabled

Continuous Transmitter..... Disabled

DECT-like Phone..... Disabled

Video Camera..... Disabled

802.15.4..... Disabled

WiFi Inverted..... Enabled

WiFi Invalid Channel..... Enabled

SuperAG..... Disabled

Canopy..... Disabled

Microsoft Device..... Disabled

WiMax Mobile..... Disabled

WiMax Fixed..... Disabled

BLE Beacon..... Disabled

Additional Clean Air Settings:

CleanAir ED-RRM State..... Disabled

CleanAir ED-RRM Sensitivity..... Medium

CleanAir ED-RRM Custom Threshold..... 50

CleanAir Rogue Contribution..... Disabled

CleanAir Rogue Duty-Cycle Threshold..... 80

CleanAir Persistent Devices state..... Disabled

CleanAir Persistent Device Propagation..... Disabled

802.11a CleanAir AirQuality Summary

AQ = Air Quality

DFS = Dynamic Frequency Selection

AP Name	Channel	Avg AQ	Min AQ	Interferers	DFS

RF Density Optimization Configurations

FRA State..... Disabled

FRA Sensitivity..... low (100)

FAR Interval..... 1 Hour(s)

Last Run..... 2703 seconds ago

Last Run Time..... 0 seconds

AP Name	MAC Address	Slot	Current Band	COF %	Suggested Mode

COF : Coverage Overlap Factor

RF Client Steering Configurations

Client Steering Configuration Information

Macro to micro transition threshold..... -55 dBm

micro to Macro transition threshold..... -65 dBm

micro-Macro transition minimum client count.... 3

micro-Macro transition client balancing win.... 3

Probe suppression mode..... disabled

Probe suppression validity window..... 100 s

Probe suppression aggregate window..... 200 ms

Probe suppression transition aggressiveness.... 3

Probe suppression hysteresis..... -6 dBm

Mobility Configuration

Mobility Protocol Port..... 16666

Default Mobility Domain..... WLAN

Multicast Mode ..... Disabled

Mobility Domain ID for 802.11r..... 0xf6a2

Mobility Keepalive Interval..... 10

Mobility Keepalive Count..... 3

Mobility Group Members Configured..... 1

Mobility Control Message DSCP Value..... 0

Controllers configured in the Mobility Group

MAC Address	IP Address	Group Name	Multicast IP	Status
00:50:56:ac:6d:08	192.168.250.2	WLAN	0.0.0.0	Up

Mobility Hash Configuration

Default Mobility Domain..... WLAN

IP Address Hash Key

192.168.250.2 7a9b864fa2922672949cf9a66fd012a0ce8cc7b0

Self Signed Certificate details

SSC Hash validation..... Enabled.

SSC Device Certificate details:

Subject Name :

C=US, ST=California, L=San Jose, O=Cisco Virtual Wireless LAN Controller,

CN=DEVICE-vWLC-AIR-CTVM-K9-005056AC6338, emailAddress=support@vwlc.com

Validity :

Start : Jul 26 20:52:54 2016 GMT

End : Jun 4 20:52:54 2026 GMT

Hash key : 7a9b864fa2922672949cf9a66fd012a0ce8cc7b0

Mobility Foreign Map Configuration

WLAN ID	Foreign Mac Address	Interface

Advanced Configuration

Probe request filtering..... Enabled

Probes fwd to controller per client per radio.... 2

Probe request rate-limiting interval..... 500 msec

Aggregate Probe request interval..... 500 msec

Increased backoff parameters for probe respon.... Disabled

EAP-Identity-Request Timeout (seconds)..... 30

EAP-Identity-Request Max Retries..... 2

EAP Key-Index for Dynamic WEP..... 0

EAP Max-Login Ignore Identity Response..... enable

EAP-Request Timeout (seconds)..... 30

EAP-Request Max Retries..... 2

EAPOL-Key Timeout (milliseconds)..... 1000

EAPOL-Key Max Retries..... 2

EAP-Broadcast Key Interval..... 3600

dot11-padding..... Disabled

padding-size..... 0

Advanced Hotspot Commands

ANQP 4-way state..... Disabled

GARP Broadcast state: ..... Enabled

GAS request rate limit ..... Disabled

ANQP comeback delay in TUs(TU=1024usec)..... 1 TUs (=1mSec)

Location Configuration

RFID Tag data Collection..... Enabled

RFID timeout..... 1200 seconds

RFID mobility.....

Interface Configuration

Interface Name..... ip_dev

MAC Address..... 00:50:56:ac:6d:08

IP Address..... 192.168.150.2

IP Netmask..... 255.255.255.0

IP Gateway..... 192.168.150.1

External NAT IP State..... Disabled

External NAT IP Address..... 0.0.0.0

VLAN..... 1500

Quarantine-vlan..... 0

NAS-Identifier..... none

Physical Port..... 1

DHCP Proxy Mode..... Global

Primary DHCP Server..... Unconfigured

Secondary DHCP Server..... Unconfigured

DHCP Option 82..... Disabled

DHCP Option 82 bridge mode insertion..... Disabled

IPv4 ACL..... Unconfigured

mDNS Profile Name..... Unconfigured

AP Manager..... No

Guest Interface..... N/A

3G VLAN..... Disabled

L2 Multicast..... Enabled

Interface Name..... management

MAC Address..... 00:50:56:ac:6d:08

IP Address..... 192.168.250.2

IP Netmask..... 255.255.255.0

IP Gateway..... 192.168.250.1

External NAT IP State..... Disabled

External NAT IP Address..... 0.0.0.0

Link Local IPv6 Address..... fe80::250:56ff:feac:6d08/64

STATE ..... REACHABLE

Primary IPv6 Address..... ::/128

STATE ..... NONE

Primary IPv6 Gateway..... ::

Primary IPv6 Gateway Mac Address..... 00:00:00:00:00:00

STATE ..... INCOMPLETE

VLAN..... 1520

Quarantine-vlan..... 0

Physical Port..... 1

DHCP Proxy Mode..... Global

Primary DHCP Server..... 192.168.250.1

Secondary DHCP Server..... Unconfigured

DHCP Option 82..... Disabled

DHCP Option 82 bridge mode insertion..... Disabled

IPv4 ACL..... Unconfigured

IPv6 ACL..... Unconfigured

mDNS Profile Name..... Unconfigured

AP Manager..... Yes

Guest Interface..... N/A

L2 Multicast..... Enabled

Interface Name..... service-port

MAC Address..... 00:50:56:ac:63:38

IP Address..... 192.168.29.146

IP Netmask..... 255.255.255.0

Link Local IPv6 Address..... fe80::250:56ff:feac:6338/64

STATE ..... NONE

IPv6 Address..... ::/128

STATE ..... NONE

SLAAC..... Disabled

DHCP Protocol..... Disabled

AP Manager..... No

Guest Interface..... N/A

Speed 1Gbps

Duplex ..... Full

Auto Negotiation ..... Enabled

Link Status..... Up

Port specific Information:

inet addr:192.168.29.146 Bcast:192.168.29.255 Mask:255.255.255.0

inet6 addr: fe80::250:56ff:feac:6338/64 Scope:Link

UP BROADCAST RUNNING MULTICAST MTU:1430 Metric:1

RX packets:258830 errors:0 dropped:298 overruns:0 frame:0

TX packets:95115 errors:0 dropped:0 overruns:0 carrier:0

collisions:0 txqueuelen:1000

RX bytes:25069479 (23.9 MiB) TX bytes:55852901 (53.2 MiB)

Interface Name..... virtual

MAC Address..... 00:50:56:ac:6d:08

IP Address..... 1.1.1.1

Virtual DNS Host Name..... Disabled

AP Manager..... No

Guest Interface..... N/A

Interface Group Configuration

WLAN Configuration

WLAN Identifier..... 1

Profile Name..... IP_Dev No Encryption

Network Name (SSID)..... IP_Dev

Status..... Disabled

MAC Filtering..... Disabled

Broadcast SSID..... Enabled

AAA Policy Override..... Disabled

Network Admission Control

Client Profiling Status

Radius Profiling ..... Disabled

DHCP ..... Disabled

HTTP ..... Disabled

Local Profiling ..... Disabled

DHCP ..... Disabled

HTTP ..... Disabled

Radius-NAC State..... Disabled

SNMP-NAC State..... Disabled

Quarantine VLAN..... 0

Maximum number of Associated Clients..... 0

Maximum number of Clients per AP Radio..... 200

ATF Policy..... 0

Number of Active Clients..... 0

Exclusionlist Timeout..... 60 seconds

Session Timeout..... 86400 seconds

User Idle Timeout..... Disabled

Sleep Client..... disable

Sleep Client Timeout..... 720 minutes

User Idle Threshold..... 0 Bytes

NAS-identifier..... none

CHD per WLAN..... Enabled

Webauth DHCP exclusion..... Disabled

Interface..... ip_dev

Multicast Interface..... Not Configured

WLAN IPv4 ACL..... unconfigured

WLAN IPv6 ACL..... unconfigured

WLAN Layer2 ACL..... unconfigured

mDNS Status..... Disabled

mDNS Profile Name..... unconfigured

DHCP Server..... Default

DHCP Address Assignment Required..... Disabled

Static IP client tunneling..... Disabled

Tunnel Profile..... Unconfigured

Quality of Service..... Silver

Per-SSID Rate Limits..... Upstream Downstream

Average Data Rate..... 0 0

Average Realtime Data Rate..... 0 0

Burst Data Rate..... 0 0

Burst Realtime Data Rate..... 0 0

Per-Client Rate Limits..... Upstream Downstream

Average Data Rate..... 0 0

Average Realtime Data Rate..... 0 0

Burst Data Rate..... 0 0

Burst Realtime Data Rate..... 0 0

Scan Defer Priority..... 4,5,6

Scan Defer Time..... 100 milliseconds

WMM..... Allowed

WMM UAPSD Compliant Client Support..... Disabled

Media Stream Multicast-direct..... Disabled

CCX - AironetIe Support..... Enabled

CCX - Gratuitous ProbeResponse (GPR)..... Disabled

CCX - Diagnostics Channel Capability..... Disabled

Dot11-Phone Mode (7920)..... Disabled

Wired Protocol..... 802.1P (Tag=0)

Passive Client Feature..... Disabled

Peer-to-Peer Blocking Action..... Disabled

Radio Policy..... All

DTIM period for 802.11a radio..... 1

DTIM period for 802.11b radio..... 1

Radius Servers

Authentication..... Global Servers

Accounting..... Global Servers

Interim Update..... Enabled

Interim Update Interval..... 0

Framed IPv6 Acct AVP ..... Prefix

Dynamic Interface..... Disabled

Dynamic Interface Priority..... wlan

Local EAP Authentication..... Disabled

Radius NAI-Realm..... Disabled

Mu-Mimo..... Enabled

Security

802.11 Authentication:..... Open System

FT Support..... Disabled

Static WEP Keys..... Disabled

802.1X..... Disabled

Wi-Fi Protected Access (WPA/WPA2)..... Disabled

Wi-Fi Direct policy configured..... Disabled

EAP-Passthrough..... Disabled

CKIP ..... Disabled

Web Based Authentication..... Disabled

Web Authentication Timeout..... 300

Web-Passthrough..... Disabled

Mac-auth-server..... 0.0.0.0

Web-portal-server..... 0.0.0.0

Conditional Web Redirect..... Disabled

Splash-Page Web Redirect..... Disabled

Auto Anchor..... Disabled

FlexConnect Local Switching..... Enabled

FlexConnect Central Association..... Disabled

flexconnect Central Dhcp Flag..... Disabled

flexconnect nat-pat Flag..... Disabled

flexconnect Dns Override Flag..... Disabled

flexconnect PPPoE pass-through..... Disabled

flexconnect local-switching IP-source-guar.... Disabled

FlexConnect Vlan based Central Switching ..... Disabled

FlexConnect Local Authentication..... Disabled

FlexConnect Learn IP Address..... Enabled

Client MFP..... Optional but inactive (WPA2 not configured)

PMF..... Disabled

PMF Association Comeback Time..... 1

PMF SA Query RetryTimeout..... 200

Tkip MIC Countermeasure Hold-down Timer..... 60

Eap-params..... Not Applicable

Flex Avc Profile Name..... None

Flow Monitor Name..... None

Split Tunnel Configuration

Split Tunnel..... Disabled

Call Snooping..... Disabled

Roamed Call Re-Anchor Policy..... Disabled

SIP CAC Fail Send-486-Busy Policy..... Enabled

SIP CAC Fail Send Dis-Association Policy..... Disabled

KTS based CAC Policy..... Disabled

Assisted Roaming Prediction Optimization..... Disabled

802.11k Neighbor List..... Disabled

802.11k Neighbor List Dual Band..... Disabled

802.11v Directed Multicast Service..... Disabled

802.11v BSS Max Idle Service..... Enabled

802.11v BSS Transition Service..... Disabled

802.11v BSS Transition Disassoc Imminent..... Disabled

802.11v BSS Transition Disassoc Timer..... 200

802.11v BSS Transition OpRoam Disassoc Timer..... 40

DMS DB is empty

Band Select..... Disabled

Load Balancing..... Disabled

Multicast Buffer..... Disabled

Universal Ap Admin..... Disabled

Mobility Anchor List

WLAN ID	IP Address	Status	Priority
-------	---------------	------	--------

802.11u..... Disabled

MSAP Services..... Disabled

Local Policy

Priority	Policy Name
--------	---------------

WLAN Configuration

WLAN Identifier..... 2

Profile Name..... IP_Dev All WPA/WPA2 PSK

Network Name (SSID)..... IP_Dev

Status..... Enabled

MAC Filtering..... Disabled

Broadcast SSID..... Enabled

AAA Policy Override..... Disabled

Network Admission Control

Client Profiling Status

Radius Profiling ..... Disabled

DHCP ..... Disabled

HTTP ..... Disabled

Local Profiling ..... Disabled

DHCP ..... Disabled

HTTP ..... Disabled

Radius-NAC State..... Disabled

SNMP-NAC State..... Disabled

Quarantine VLAN..... 0

Maximum number of Associated Clients..... 0

Maximum number of Clients per AP Radio..... 200

ATF Policy..... 0

Number of Active Clients..... 2

Exclusionlist Timeout..... 60 seconds

Session Timeout..... 1800 seconds

User Idle Timeout..... Disabled

Sleep Client..... disable

Sleep Client Timeout..... 720 minutes

User Idle Threshold..... 0 Bytes

NAS-identifier..... none

CHD per WLAN..... Enabled

Webauth DHCP exclusion..... Disabled

Interface..... ip_dev

Multicast Interface..... Not Configured

WLAN IPv4 ACL..... unconfigured

WLAN IPv6 ACL..... unconfigured

WLAN Layer2 ACL..... unconfigured

mDNS Status..... Disabled

mDNS Profile Name..... unconfigured

DHCP Server..... Default

DHCP Address Assignment Required..... Disabled

Static IP client tunneling..... Disabled

Tunnel Profile..... Unconfigured

Quality of Service..... Silver

Per-SSID Rate Limits..... Upstream Downstream

Average Data Rate..... 0 0

Average Realtime Data Rate..... 0 0

Burst Data Rate..... 0 0

Burst Realtime Data Rate..... 0 0

Per-Client Rate Limits..... Upstream Downstream

Average Data Rate..... 0 0

Average Realtime Data Rate..... 0 0

Burst Data Rate..... 0 0

Burst Realtime Data Rate..... 0 0

Scan Defer Priority..... 4,5,6

Scan Defer Time..... 100 milliseconds

WMM..... Allowed

WMM UAPSD Compliant Client Support..... Disabled

Media Stream Multicast-direct..... Disabled

CCX - AironetIe Support..... Enabled

CCX - Gratuitous ProbeResponse (GPR)..... Disabled

CCX - Diagnostics Channel Capability..... Disabled

Dot11-Phone Mode (7920)..... Disabled

Wired Protocol..... 802.1P (Tag=0)

Passive Client Feature..... Disabled

Peer-to-Peer Blocking Action..... Disabled

Radio Policy..... All

DTIM period for 802.11a radio..... 1

DTIM period for 802.11b radio..... 1

Radius Servers

Authentication..... Global Servers

Accounting..... Global Servers

Interim Update..... Enabled

Interim Update Interval..... 0

Framed IPv6 Acct AVP ..... Prefix

Dynamic Interface..... Disabled

Dynamic Interface Priority..... wlan

Local EAP Authentication..... Disabled

Radius NAI-Realm..... Disabled

Mu-Mimo..... Enabled

Security

802.11 Authentication:..... Open System

FT Support..... Disabled

Static WEP Keys..... Disabled

802.1X..... Disabled

Wi-Fi Protected Access (WPA/WPA2)..... Enabled

WPA (SSN IE)..... Enabled

TKIP Cipher..... Enabled

AES Cipher..... Enabled

WPA2 (RSN IE)..... Enabled

TKIP Cipher..... Disabled

AES Cipher..... Enabled

OSEN IE..... Disabled

Auth Key Management

802.1x..... Disabled

PSK..... Enabled

CCKM..... Disabled

FT-1X(802.11r)..... Disabled

FT-PSK(802.11r)..... Disabled

PMF-1X(802.11w)..... Disabled

PMF-PSK(802.11w)..... Disabled

OSEN-1X..... Disabled

FT Reassociation Timeout..... 20

FT Over-The-DS mode..... Disabled

GTK Randomization..... Disabled

SKC Cache Support..... Disabled

CCKM TSF Tolerance..... 1000

Wi-Fi Direct policy configured..... Disabled

EAP-Passthrough..... Disabled

CKIP ..... Disabled

Web Based Authentication..... Disabled

Web Authentication Timeout..... 300

Web-Passthrough..... Disabled

Mac-auth-server..... 0.0.0.0

Web-portal-server..... 0.0.0.0

Conditional Web Redirect..... Disabled

Splash-Page Web Redirect..... Disabled

Auto Anchor..... Disabled

FlexConnect Local Switching..... Disabled

FlexConnect Central Association..... Disabled

flexconnect Central Dhcp Flag..... Disabled

flexconnect nat-pat Flag..... Disabled

flexconnect Dns Override Flag..... Disabled

flexconnect PPPoE pass-through..... Disabled

flexconnect local-switching IP-source-guar.... Disabled

FlexConnect Vlan based Central Switching ..... Disabled

FlexConnect Local Authentication..... Disabled

FlexConnect Learn IP Address..... Enabled

Client MFP..... Optional

PMF..... Disabled

PMF Association Comeback Time..... 1

PMF SA Query RetryTimeout..... 200

Tkip MIC Countermeasure Hold-down Timer..... 60

Eap-params..... Disabled

Flex Avc Profile Name..... None

Flow Monitor Name..... None

Split Tunnel Configuration

Split Tunnel..... Disabled

Call Snooping..... Disabled

Roamed Call Re-Anchor Policy..... Disabled

SIP CAC Fail Send-486-Busy Policy..... Enabled

SIP CAC Fail Send Dis-Association Policy..... Disabled

KTS based CAC Policy..... Disabled

Assisted Roaming Prediction Optimization..... Disabled

802.11k Neighbor List..... Disabled

802.11k Neighbor List Dual Band..... Disabled

802.11v Directed Multicast Service..... Disabled

802.11v BSS Max Idle Service..... Enabled

802.11v BSS Transition Service..... Disabled

802.11v BSS Transition Disassoc Imminent..... Disabled

802.11v BSS Transition Disassoc Timer..... 200

802.11v BSS Transition OpRoam Disassoc Timer..... 40

DMS DB is empty

Band Select..... Disabled

Load Balancing..... Disabled

Multicast Buffer..... Disabled

Universal Ap Admin..... Disabled

Mobility Anchor List

WLAN ID	IP Address	Status	Priority
-------	---------------	------	--------

802.11u..... Disabled

MSAP Services..... Disabled

Local Policy

Priority Policy Name

-------- ---

Policy Configuration

L2ACL Configuration

ACL Configuration

CPU ACL Configuration

CPU Acl Name..... NOT CONFIGURED

Wireless Traffic..... Disabled

Wired Traffic..... Disabled

RADIUS Configuration

Vendor Id Backward Compatibility..... Disabled

Call Station Id Case..... lower

Accounting Call Station Id Type..... Mac Address

Auth Call Station Id Type..... AP's Radio MAC Address:SSID

Extended Source Ports Support..... Enabled

Aggressive Failover..... Enabled

Keywrap..... Disabled

Fallback Test:

Test Mode..... Passive

Probe User Name..... cisco-probe

Interval (in seconds)..... 300

MAC Delimiter for Authentication Messages..... hyphen

MAC Delimiter for Accounting Messages..... hyphen

RADIUS Authentication Framed-MTU..... 1300 Bytes

Authentication Servers

Idx Type Server Address Port State Tout MgmtTout RFC3576 IPSec - AuthMode/Phase1/Group/Lifetime/Auth/Encr/Region

--- ---- ---------- ------ -------- ---- -------- ------- ----------

Accounting Servers

Idx Type Server Address Port State Tout MgmtTout RFC3576 IPSec - AuthMode/Phase1/Group/Lifetime/Auth/Encr/Region

--- ---- ---------- ------ -------- ---- -------- ------- ----------

TACACS Configuration

Fallback Test:

Interval (in seconds)..... 0

Authentication Servers

Idx Server Address Port State Tout MgmtTout

--- ---------- ------ ------- ----- --------

Authorization Servers

Idx Server Address Port State Tout MgmtTout

--- ---------- ------ ------- ----- --------

Accounting Servers

Idx Server Address Port State Tout MgmtTout

--- ---------- ------ ------- ----- --------

LDAP Configuration

Local EAP Configuration

User credentials database search order:

Primary ..... Local DB

Timer:

Active timeout 300

Configured EAP profiles:

EAP Method configuration:

EAP-FAST:

Server key ..... <hidden>

TTL for the PAC 10

Anonymous provision allowed ..... Yes

Authority ID 436973636f00000000000000000000000

Authority Information ..... Cisco A-ID

Dns Configuration

Radius port.....

Radius secret.....

Dns url.....

Dns timeout.....

Dns Serverip.....

Dns state..... Disable

Dns Auth Retransmit Timeout..... 2

Dns Acct Retransmit Timeout..... 2

Dns Auth Mgmt-Retransmit Timeout..... 2

Dns Network Auth..... Enable

Dns Mgmt Auth..... Enable

Dns Network Acct..... Enable

Dns RFC 3576 Auth..... Disable

Tacacs port.....

Tacacs secret..... 2

Dns url.....

Dns timeout.....

Dns Serverip.....

Dns state..... Disable

Fallback Radio Shut configuration:

Fallback Radio Shut: Disabled

Arp-caching: Disabled

Subnet Broadcast Drop: Disabled

FlexConnect Group Summary

FlexConnect Group Summary: Count: 0

Group Name # Aps

FlexConnect Group Detail

FlexConnect Vlan name Summary

Vlan-Name Id Status

--- ---

FlexConnect Vlan Name Detail

Route Info

Number of Routes..... 0

Destination Network Netmask Gateway

---------- ---------- ----------

Peer Route Info

Number of Routes..... 32555

Destination Network Netmask Gateway

---------- ---------- ----------

Qos Queue Length Info

Platinum queue length..... 100

Gold queue length..... 75

Silver queue length..... 50

Bronze queue length..... 25

Qos Profile Info

Description..... For Voice Applications

Maximum Priority..... voice

Unicast Default Priority..... voice

Multicast Default Priority..... voice

Per-SSID Rate Limits..... Upstream Downstream

Average Data Rate..... 0 0

Average Realtime Data Rate..... 0 0

Burst Data Rate..... 0 0

Burst Realtime Data Rate..... 0 0

Per-Client Rate Limits..... Upstream Downstream

Average Data Rate..... 0 0

Average Realtime Data Rate..... 0 0

Burst Data Rate..... 0 0

Burst Realtime Data Rate..... 0 0

protocol..... dot1p

dot1p..... 5

Description..... For Video Applications

Maximum Priority..... video

Unicast Default Priority..... video

Multicast Default Priority..... video

Per-SSID Rate Limits..... Upstream Downstream

Average Data Rate..... 0 0

Average Realtime Data Rate..... 0 0

Burst Data Rate..... 0 0

Burst Realtime Data Rate..... 0 0

Per-Client Rate Limits..... Upstream Downstream

Average Data Rate..... 0 0

Average Realtime Data Rate..... 0 0

Burst Data Rate..... 0 0

Burst Realtime Data Rate..... 0 0

protocol..... dot1p

dot1p..... 4

Description..... For Best Effort

Maximum Priority..... besteffort

Unicast Default Priority..... besteffort

Multicast Default Priority..... besteffort

Per-SSID Rate Limits..... Upstream Downstream

Average Data Rate..... 0 0

Average Realtime Data Rate..... 0 0

Burst Data Rate..... 0 0

Burst Realtime Data Rate..... 0 0

Per-Client Rate Limits..... Upstream Downstream

Average Data Rate..... 0 0

Average Realtime Data Rate..... 0 0

Burst Data Rate..... 0 0

Burst Realtime Data Rate..... 0 0

protocol..... dot1p

dot1p..... 0

Description..... For Background

Maximum Priority..... background

Unicast Default Priority..... background

Multicast Default Priority..... background

Per-SSID Rate Limits..... Upstream Downstream

Average Data Rate..... 0 0

Average Realtime Data Rate..... 0 0

Burst Data Rate..... 0 0

Burst Realtime Data Rate..... 0 0

Per-Client Rate Limits..... Upstream Downstream

Average Data Rate..... 0 0

Average Realtime Data Rate..... 0 0

Burst Data Rate..... 0 0

Burst Realtime Data Rate..... 0 0

protocol..... dot1p

dot1p..... 1

Mac Filter Info

Authorization List

Authorize MIC APs against Auth-list or AAA ..... disabled

Authorize LSC APs against Auth-List ..... disabled

APs Allowed to Join

AP with Manufacturing Installed Certificate.... yes

AP with Self-Signed Certificate..... no

AP with Locally Significant Certificate..... no

Load Balancing Info

Aggressive Load Balancing..... per WLAN enabling

Aggressive Load Balancing Window..... 5 clients

Aggressive Load Balancing Denial Count..... 3

Aggressive Load Balancing Uplink Threshold..... 50

Statistics (client-count based)

Total Denied Count..... 0 clients

Total Denial Sent..... 0 messages

Exceeded Denial Max Limit Count..... 0 times

None 5G Candidate Count..... 0 times

None 2.4G Candidate Count..... 0 times

Statistics (uplink-usage based)

Total Denied Count..... 0 clients

Total Denial Sent..... 0 messages

Exceeded Denial Max Limit Count..... 0 times

None 5G Candidate Count..... 0 times

None 2.4G Candidate Count..... 0 times

DHCP Info

DHCP Opt-82 RID Format: <AP radio MAC address>

DHCP Opt-82 Format: binary

DHCP Proxy Behaviour: disabled

Exclusion List ConfigurationUnable to retrieve exclusion-list entry

CDP Configuration

cdp version v2

Country Channels Configuration

```
Configured Country..... US  - United States
     KEY: * = Channel is legal in this country and may be configured manually.
          A = Channel is the Auto-RF default in this country.
          . = Channel is not legal in this country.
          C = Channel has been configured for use by Auto-RF.
          x = Channel is available to be configured for use by Auto-RF.
        (-,-) = (indoor, outdoor) regulatory domain allowed by this country.
-----------------:+-+-+-+-+-+-+-+-+-+-+-+-+-+-
   802.11bg     :
   Channels     :               1 1 1 1 1
                : 1 2 3 4 5 6 7 8 9 0 1 2 3 4
-----------------:+-+-+-+-+-+-+-+-+-+-+-+-+-+-
 US (-A   ,-AB  ): A * * * * A * * * * A . . .
-----------------:+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-
   802.11a      :                   1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
   Channels     : 3 3 3 4 4 4 4 4 5 5 6 6 0 0 0 1 1 2 2 2 3 3 4 4 4 5 5 6 6 6 7
                : 4 6 8 0 2 4 6 8 2 6 0 4 0 4 8 2 6 0 4 8 2 6 0 4 9 3 7 1 5 9 3
-----------------:+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-
 US (-AB  ,-AB  ): . A . A . A . A A A A A A A A A A A A A A A A A A A A A * . .
-----------------:+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-
 4.9GHz 802.11a  :
   Channels     :               1 1 1 1 1 1 1 1 1 2 2 2 2 2 2
                : 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6
-----------------:+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-
 US (-AB  ,-AB  ): * * * * * * * * * * * * * * * * * * * * A * * * * * A
-----------------:+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-
```

WPS Configuration Summary

Auto-Immune

Auto-Immune..... Disabled

Auto-Immune by aWIPS Prevention..... Disabled

Client Exclusion Policy

Excessive 802.11-association failures..... Enabled

Excessive 802.11-authentication failures..... Enabled

Excessive 802.1x-authentication..... Enabled

IP-theft..... Enabled

Excessive Web authentication failure..... Enabled

Maximum 802.1x-AAA failure attempts..... 3

Signature Policy

Signature Processing..... Enabled

Management Frame Protection

Global Infrastructure MFP state..... DISABLED (*all infrastructure settings are overridden)

AP Impersonation detection..... Disabled

Controller Time Source Valid..... False

		WLAN	Client
WLAN ID	WLAN Name	Status	Protection
1	IP_Dev No Encryption	Disabled	Optional but inactive (WPA2 not configured)

2 IP_Dev All WPA/WPA2 PSK Enabled Optional

Custom Web Configuration

Radius Authentication Method..... PAP

Cisco Logo..... Enabled

CustomLogo..... None

Custom Title..... None

Custom Message..... None

Custom Redirect URL..... None

Web Authentication Type..... Internal Default

Logout-popup..... Enabled

External Web Authentication URL..... None

Configuration Per Profile:

Core dump Configuration

Core Dump upload is disabled

Rogue AP Configuration

Rogue Detection Security Level..... custom

Rogue Pending Time..... 180 secs

Rogue on wire Auto-Contain..... Disabled

Rogue using our SSID Auto-Contain..... Disabled

Valid client on rogue AP Auto-Contain..... Disabled

Rogue AP timeout..... 1200

Rogue Detection Report Interval..... 10

Rogue Detection Min Rssi..... -90

Rogue Detection Transient Interval..... 0

Rogue Detection Client Num Thershold..... 0

Validate rogue AP against AAA..... Disabled

Rogue AP AAA validation interval..... 0 secs

Total Rogues(AP+Ad-hoc) supported..... 800

Total Rogues classified..... 41

MAC Address	Classification	# APs	# Clients	Last Heard
04:bd:88:b5:2f:40	Friendly	2	0	Thu Aug 18 20:06:04 2016
04:bd:88:b5:2f:45	Friendly	2	0	Thu Aug 18 20:06:04 2016
04:bd:88:b5:2f:50	Friendly	0	0	Not Heard
04:bd:88:b5:2f:55	Friendly	0	0	Not Heard
04:bd:88:b5:4e:e0	Friendly	0	0	Not Heard
04:bd:88:b5:4e:f0	Friendly	0	0	Not Heard
04:bd:88:b5:5a:20	Unclassified	2	0	Thu Aug 18 20:06:04 2016
04:bd:88:b5:5a:21	Unclassified	2	0	Thu Aug 18 20:06:04 2016
04:bd:88:b6:0d:60	Friendly	0	0	Not Heard
04:bd:88:b6:0d:70	Friendly	0	0	Not Heard
04:bd:88:b6:0d:75	Friendly	0	0	Not Heard

04:bd:88:b6:0e:e0 Friendly 0 0 Not Heard

04:bd:88:b6:0e:f0 Friendly 0 0 Not Heard

04:bd:88:b6:0e:f5 Friendly 0 0 Not Heard

04:bd:88:b6:10:00 Friendly 0 0 Not Heard

04:bd:88:b6:10:10 Friendly 0 0 Not Heard

04:bd:88:b6:10:15 Friendly 0 0 Not Heard

04:bd:88:b6:10:60 Friendly 2 0 Thu Aug 18 20:06:04 2016

04:bd:88:b6:10:65 Unclassified 2 0 Thu Aug 18 20:06:04 2016

04:bd:88:b6:10:70 Friendly 0 0 Not Heard

04:bd:88:b6:10:75 Friendly 0 0 Not Heard

04:bd:88:b6:10:b5 Friendly 0 0 Not Heard

62:6d:c7:27:a6:98 Unclassified 2 0 Thu Aug 18 20:06:04 2016

6c:72:20:3e:af:26 Friendly 0 0 Not Heard

6c:72:20:3e:af:28 Friendly 0 0 Not Heard

6c:72:20:3e:af:2a Friendly 0 0 Not Heard

88:dc:96:30:d9:1b Friendly 0 0 Not Heard

8a:dc:96:30:d9:1b Friendly 0 0 Not Heard

9a:dc:96:30:d9:1b Friendly 0 0 Not Heard

e0:d1:73:02:b7:ab Friendly 0 0 Not Heard

e0:d1:73:02:b7:af Friendly 0 0 Not Heard

e0:d1:73:02:bc:2b Friendly 0 0 Not Heard

e0:d1:73:02:bc:2f Friendly 0 0 Not Heard

e0:d1:73:02:f6:6b Friendly 0 0 Not Heard

e0:d1:73:02:f6:6f Friendly 0 0 Not Heard

e0:d1:73:02:f9:4b Friendly 0 0 Not Heard

e0:d1:73:02:f9:4f Friendly 0 0 Not Heard

e0:d1:73:02:fa:4b Friendly 0 0 Not Heard

e0:d1:73:02:fa:4f Friendly 0 0 Not Heard

e0:d1:73:02:ff:1b Friendly 0 0 Not Heard

e0:d1:73:02:ff:1f Friendly 0 0 Not Heard

Rogue AP RLDP Configuration

Rogue Location Discovery Protocol..... Disabled

RLDP Schedule Config..... Disabled

RLDP Scheduling Operation..... Disabled

RLDP Retry..... 1

RLDP Start Time RLDP End Time Day

--- --- ---

Rogue Auto Contain Configuration

Containment Level..... 1

monitor_ap_only..... false

Adhoc Rogue Configuration

Detect and report Ad-Hoc Networks..... Enabled

Auto-Contain Ad-Hoc Networks..... Disabled

Total Rogues(Ad-Hoc+AP) supported 800

Total Ad-Hoc entries 0

Client MAC Address Adhoc BSSID State # APs Last Heard

--- --- --- --- ---

Rogue Client Configuration

Validate rogue clients against AAA..... Disabled

Validate rogue clients against MSE..... Disabled

Total Rogue Clients supported..... 3000

Total Rogue Clients present..... 0

MAC Address State # APs Last Heard

---------- ---------- ----- ----------

Ignore List Configuration

MAC Address

Rogue Rule Configuration

Priority Rule Name Rule state Class Type Notify State Match Hit Count

-------- ---------- ---------- ---------- -------- -------- ------ ---------

Media-Stream Configuration

Multicast-direct State..... disable

Allowed WLANs.....

Stream Name Start IP End IP Operation Status

---------- ---------- ---------- ----------

URL.....

E-mail.....

Phone.....

Note.....

State..... disable

2.4G Band Media-Stream Configuration

Multicast-direct..... Enabled

Best Effort..... Disabled

Video Re-Direct..... Enabled

Max Allowed Streams Per Radio..... Auto

Max Allowed Streams Per Client..... Auto

Max Video Bandwidth..... 0

Max Voice Bandwidth..... 75

Max Media Bandwidth..... 85

Min PHY Rate..... 6000

Max Retry Percentage..... 80

5G Band Media-Stream Configuration

Multicast-direct..... Enabled

Best Effort..... Disabled

Video Re-Direct..... Enabled

Max Allowed Streams Per Radio..... Auto

Max Allowed Streams Per Client..... Auto

Max Video Bandwidth..... 0

Max Voice Bandwidth..... 75

Max Media Bandwidth..... 85

Min PHY Rate..... 6000

Max Retry Percentage..... 80

Number of Clients..... 0

Client Mac	Stream Name	Stream Type	Radio	WLAN	QoS	Status
----------	----------	----------	----	----	------	-------

WLC Voice Call Statistics

WLC Voice Call Statistics for 802.11b Radio

WMM TSPEC CAC Call Stats

Total num of Calls in progress..... 0

Num of Roam Calls in progress..... 0

Total Num of Calls Admitted..... 0

Total Num of Roam Calls Admitted..... 0

Total Num of exp bw requests received..... 0

Total Num of exp bw requests Admitted..... 0

Total Num of Calls Rejected..... 0

Total Num of Roam Calls Rejected..... 0

Num of Calls Rejected due to insufficent bw.... 0

Num of Calls Rejected due to invalid params.... 0

Num of Calls Rejected due to PHY rate..... 0

Num of Calls Rejected due to QoS policy..... 0

SIP CAC Call Stats

Total Num of Calls in progress..... 0

Num of Roam Calls in progress..... 0

Total Num of Calls Admitted..... 0

Total Num of Roam Calls Admitted..... 0

Total Num of Preferred Calls Received..... 0

Total Num of Preferred Calls Admitted..... 0

Total Num of Ongoing Preferred Calls..... 0

Total Num of Calls Rejected(Insuff BW)..... 0

Total Num of Roam Calls Rejected(Insuff BW).... 0

KTS based CAC Call Stats

Total Num of Calls in progress..... 0

Num of Roam Calls in progress..... 0

Total Num of Calls Admitted..... 0

Total Num of Roam Calls Admitted..... 0

Total Num of Calls Rejected(Insuff BW)..... 0

Total Num of Roam Calls Rejected(Insuff BW).... 0

WLC Voice Call Statistics for 802.11a Radio

WMM TSPEC CAC Call Stats

Total num of Calls in progress..... 0

Num of Roam Calls in progress..... 0

Total Num of Calls Admitted..... 0

Total Num of Roam Calls Admitted..... 0

Total Num of exp bw requests received..... 0

Total Num of exp bw requests Admitted..... 0

Total Num of Calls Rejected..... 0

Total Num of Roam Calls Rejected..... 0

Num of Calls Rejected due to insufficent bw.... 0

Num of Calls Rejected due to invalid params.... 0

Num of Calls Rejected due to PHY rate..... 0

Num of Calls Rejected due to QoS policy..... 0

SIP CAC Call Stats

Total Num of Calls in progress..... 0

Num of Roam Calls in progress..... 0

Total Num of Calls Admitted..... 0

Total Num of Roam Calls Admitted..... 0

Total Num of Preferred Calls Received..... 0

Total Num of Preferred Calls Admitted..... 0

Total Num of Ongoing Preferred Calls..... 0

Total Num of Calls Rejected(Insuff BW)..... 0

Total Num of Roam Calls Rejected(Insuff BW).... 0

KTS based CAC Call Stats

Total Num of Calls in progress..... 0

Num of Roam Calls in progress..... 0

Total Num of Calls Admitted..... 0

Total Num of Roam Calls Admitted..... 0

Total Num of Calls Rejected(Insuff BW)..... 0

Total Num of Roam Calls Rejected(Insuff BW).... 0

WLC IPv6 Summary

Global Config..... Enabled

Reachable-lifetime value..... 300

Stale-lifetime value..... 86400

Down-lifetime value..... 30

RA Throttling..... Disabled

RA Throttling allow at-least..... 1

RA Throttling allow at-most..... 1

RA Throttling max-through..... 10

RA Throttling throttle-period..... 600

RA Throttling interval-option..... passthrough

NS Mulitcast CacheMiss Forwarding..... Disabled

NA Mulitcast Forwarding..... Enabled

IPv6 Capwap UDP Lite..... Enabled

Operating System IPv6 state..... Enabled

mDNS Service Summary

Number of Services..... 10

Mobility learning status ..... Enabled

Service-Name	LSS	Origin	No SP	Service-string
AirTunes	No	All	0	_raop._tcp.local.
Airplay	No	All	0	_airplay._tcp.local.
Googlecast	No	All	0	_googlecast._tcp.local.
HP_Photosmart_Printer_1	No	All	0	_universal._sub._ipp._tcp.local.
HP_Photosmart_Printer_2	No	All	0	_cups._sub._ipp._tcp.local.
HomeSharing	No	All	0	_home-sharing._tcp.local.
Printer-IPP	No	All	0	_ipp._tcp.local.
Printer-IPPS	No	All	0	_ipps._tcp.local.
Printer-LPD	No	All	0	_printer._tcp.local.
Printer-SOCKET	No	All	0	_pdl-datastream._tcp.local.

* -> If access policy is enabled LSS will be ignored.

mDNS service-group Summary

Access Policy Status..... Disabled

Total number of mDNS Policies..... 1

Number of Admin configured Policies..... 1

Sl No	Service Group Name	Description	Origin
1	default-mdns-policy	Default Access Policy created by WLC	WLC

mDNS profile detailed

Profile Name..... default-mdns-profile

Profile Id..... 1

No of Services..... 10

Services..... AirTunes

Airplay

Googlecast

HP_Photosmart_Printer_1

HP_Photosmart_Printer_2

HomeSharing

Printer-IPP

Printer-IPPS

Printer-LPD

Printer-SOCKET

No. Interfaces Attached..... 0

No. Interface Groups Attached..... 0

No. Wlans..... 0

No. Local Policies Attached..... 0

mDNS AP Summary

Number of mDNS APs..... 0

PMIPv6 Global Configuration

PMIPv6 Profile Summary

No Profile Created.

PMIPv6 MAG Statistics

PMIPv6 domain has to be configured first

EoGRE Global Configuration

Heartbeat Interval.....60

Max Heartbeat Skip Count.....3

Interface.....management

EoGRE Gateway Configuration

EoGRE Domain Configuration

Domain Name Gateways Active Gateway

---------- ---------- ----------

EoGRE Profile Configuration

WLAN Express Setup Information.

WLAN Express Setup - ..... False

Flex Avc Profile summary.

Profile-Name	Number of Rules	status
==========	==========	========

Flex Avc Profile Detailed Configuration.

Certificate Summary.

Web Administration Certificate..... 3rd Party

Web Authentication Certificate..... Locally Generated

Certificate compatibility mode:..... off

Lifetime Check Ignore for MIC ..... Disable

Lifetime Check Ignore for SSC ..... Disable

Smart-licensing status Summary.

Call-home Summary.

Hotspot Icon Summary.

Unable to find Icon directory in flash.

Coredump Summary

Core Dump upload is disabled

Memory Summary

---------- System Memory Summary ----------

System Name:wlc Primary SW Ver:8.2.111.0

Current Time:Thu Aug 18 20:06:33 2016 System UP Time:6 days 3 hrs 49 mins 39 secs

NAME: "Chassis" , DESCR: "Cisco Wireless Controller"

PID: AIR-CTVM-K9, VID: V01, SN: 96NTPERK0A6

Total System Memory..... (2057560 KB) 2009 MB

Total System Free Memory..... (909360 KB) 888 MB (44 %)

Total Memory in Buffers..... (1104 KB)

Total Memory in Cache..... (266564 KB) 260 MB

Total Active Memory..... (511540 KB) 499 MB

Total InActive Memory..... (238112 KB) 232 MB

Total Memory in Anon Pages..... (481984 KB) 470 MB

Total Memory in Slab..... (11004 KB) 10 MB

Total Memory in Page Tables..... (2748 KB) 2 MB

WLC Peak Memory..... (1402280 KB) 1369 MB

WLC Virtual Memory Size..... (1383912 KB) 1351 MB

WLC Resident Memory..... (506340 KB) 494 MB

WLC Data Segment Memory..... (1318240 KB) 1287 MB

Total Heap Including Mapped Pages..... (399115 KB) 389 MB

Total Memory in Pmalloc Pools..... (350174 KB) 341 MB

Total Used Memory in Pmalloc Pools..... (324913 KB) 317 MB

Total Free Memory in Pmalloc Pools..... (16706 KB) 16 MB

---------- Pmalloc Pools Information ----------

Index Pool-Size Chunks-In-Pool Chunks-In-Use Memory(Size/Used/Free)KB

0 16 50000 5351 5468 /4771 /697

1 64 40000 16626 6250 /4789 /1460

2 128 52800 52677 11550 /11534 /15

3 256 9400 9377 3231 /3225 /5

4 384 6000 287 2812 /670 /2142

5 512 16000 15 9500 /1507 /7992

6 1024 13100 12985 14328 /14213 /115

7 2048 1000 712 2093 /1517 /576

8 4096 1000 74 4093 /389 /3704

9 Raw-Pool 0 524 290800 /290800 /0

---------- MBUF Information ----------

Maximum number of Mbufs..... 24576

Number of Mbufs Free..... 24560

Number of Mbufs In Use..... 16

Mesh Configuration

Mesh Range..... 12000

Mesh Statistics update period..... 3 minutes

Backhaul with client access status..... disabled

Backhaul with extended client access status..... disabled

Background Scanning State..... disabled

Subset Channel Sync State..... disabled

Backhaul Amsdu State..... enabled

Backhaul RRM..... disabled

Mesh Auto RF..... disabled

Mesh Security

Security Mode..... EAP

External-Auth..... disabled

Use MAC Filter in External AAA server..... disabled

Force External Authentication..... disabled

LSC Only MAP Authentication..... disabled

Mesh Alarm Criteria

Max Hop Count..... 4

Recommended Max Children for MAP..... 10

Recommended Max Children for RAP..... 20

Low Link SNR..... 12

High Link SNR..... 60

Max Association Number..... 10

Association Interval..... 60 minutes

Parent Change Numbers..... 3

Parent Change Interval..... 60 minutes

Mesh Multicast Mode..... In-Out

Mesh CAC Mode..... enabled

Mesh Full Sector DFS..... enabled

Mesh Ethernet Bridging VLAN Transparent Mode..... enabled

Mesh DCA channels for serial backhaul APs..... disabled

Outdoor Ext. UNII B Domain channels(for BH)..... disabled

Mesh Advanced LSC..... disabled

Advanced LSC AP Provisioning ..... disabled

Open Window..... disabled

Provision Controller..... disabled

Mesh Slot Bias..... enabled

Mesh Convergence Method..... standard

Mesh Channel Change Notification..... disabled

Mesh Ethernet Bridging STP BPDU Allowed..... disabled

Mesh RAP downlink backhaul..... 802.11Radio-A (Slot 1)

Appendix B Sample Pump Configuration Parameters

B.1 Example of Pump Configuration File

SN=2011304

Pump serial number - must match SN of receiving pump

SIGMA Spectrum Settings

[NETWORK CONFIGURATION]

DHCP=0 DHCP disabled - IP, GATEWAY, NETMASK, and DNS must be valid

DHCP=1 DHCP enabled - IP, GATEWAY, NETMASK, and DNS must be blank

DHCP=1

IP=

GATEWAY=

NETMASK=

DNS=

Leave either SIGMAGW or MULTICAST blank

SIGMAGW set to DNS name or IP address of SIGMA gateway server

SIGMAGW=192.168.140.165

MULTICAST group default is 239.237.12.87

MULTICAST=

DEVICEID set to device alias

Limited to 20 alpha-numeric characters (0-1,A-Z,a-z), blank is acceptable

DEVICEID=000345

[WIFI CONFIGURATION]

BSS=0 Infrastructure mode (Access point)

BSS=1 Join or Create Ad-Hoc (peer-to-peer)

BSS=2 Join only Ad-Hoc (peer-to-peer)

BSS=3 Join any

BSS=0

SSID= set to wireless network name

SSID=IP_Dev_Cert

802.11 Mode - 'b', 'g', and/or 'a'

802.11b=1

802.11g=1

802.11a=1

CHANNEL=0 search channels

CHANNEL=0

SECURITY=0 Any available security method

SECURITY=1 Open system (no-encryption)

SECURITY=2 WEP shared key

SECURITY=3 WPA pre-shared key

SECURITY=4 WPA with 802.1x authentication

SECURITY=5 WEP with 802.1x authentication

SECURITY=6 LEAP

SECURITY=7 EAP-FAST

SECURITY=4

WEPKEYINDEX=0-3

WEPKEYINDEX=0

WEPKEY may be blank or 10 (64-bit) or 26 (128-bit) hex (0-1 and a-f)

characters long

WEPKEY=

WPAENCRYPTION=0 Any

WPAENCRYPTION=1 WEP

WPAENCRYPTION=2 TKIP

WPAENCRYPTION=3 CCMP (AES)

WPAENCRYPTION=4 Open (no encryption)

WPAENCRYPTION=3

WPAPSK must be blank if WPA PSK is not used

WPAPSK may 64 hex (0-1 and a-f) characters long to specify a PSK

WPAPSK may be 8-63 ascii characters long to specify a passphrase

WPAPSK=

802.1X/EAP Authentication method

Set one, or more, authentication methods to 1 to enable them, all others should be 0

LEAP=0

PEAP/MSCHAPv2=0

EAP-TLS=1

EAP-FAST=0

IDENTITY= 802.1X Identity (username)

IDENTITY=BaxterCert

PASSWORD= 802.1X Password

PASSWORD=

Certificate information follows, required for authentication modes that use a certificate.

All certificates and private keys must be PEM format (base64 encoded).

Client certificate, both cert and private key are required.

Certificate and key information is not output for security reasons.

Certificate information is radio specific, so the MAC address of the Wireless Battery Module

of the attached, or soon to be attached module must match.

If the certs or keys required a password, it should be specified in the 802.1x PASSWORD field above.

The MAC address specified below must match the module connected to the pump.

MAC=00:40:9d:66:db:45

CLIENTCERT=

-----BEGIN RSA PRIVATE KEY-----

MIIEowIBAAKCAQEAuhKvGS9womnF7tmM1IOWuzbvMct7u+TDYtoQSNEitAYe5Bjr

XR+tQOT/2b08nJUjVNl91/+3t2i9qUDDU58DTKKir9dmR5ridHlaIyhts8fB7h2a

rZ74YK+4/A1C2mNpmwqwDQlwWhJzJgSe5XeZF0ALTdS3LEggwpuPb6Eo2Wbnqwr0

/tbsRvaeEjwcIGOwmuy1v8TkrbSKeFt9I4B54Pcl3KsxbnnUjH7JIV9h/0nyrOKi

z2P+3maogCnOwxRQp79j/IgCS3JbUBMG14gKnxorJgLuBovqpsWIYO6k/qohIpyg

Vevc0UUj8XiyEun1ldT1SCXYke/I9jauLBB6OQIDAQABAoIBAHjnmw7qXG2r/Qju

IywTNOYBE/tvFL9KLgsVVm96NOp0762W45hm9NSt9/ErnS7BWWvQxoyLhHyQemx3
wHOdZy9snflUJQlyAqNcFs2xf1bJ/aETa2ZVXV61z6U3mLD+16f+kdZmw7JDOr8B
UZ4Y0EjjPHUeOsdzNpY9Lj6CoWBg+V3+TEo3WCqHsqHN8yoVKP30Xnfb1JMgRLf/
infhI6Qg6QKBM++vWQjlUYuM4hbQtQ6HmwWv2epu8YHFdmm3jTSrv+W8lBbY2N5D
N9tZsdUJ54NHiVZTjVmAXCxSpBp3+yTOMRpnzgW0v8MLMhFanjIC5QypG712HIQx
gk7LZGECgYEA4vB26UpZNxsOlgzcEQP8fQ82Dk5xNjb9e7qDSD85LUppR6F4xwNs
QPyFVYRemb+pQyIwn1X2SNAdRvsDwSsFVTV9ENi1PzlHbOfaBWE9/VNMaz8vCjfr
teC3So6bIWllHNeoOl8d1wrTOtGZFENH/H4DoOBC7U0aoYjvtnYBplMCgYEA0eaJ
mITPESmZRZI8kaCb/TrWLTZmH2SOCPgC/qVmJ2FiQ8iT3KJXJ5d8ophY84Kay4le
axVUUgIdKNyvNrf038Rx0DirN+qznSKPJuMdY+tnCxaXBjTj/tSwkeiNamZOXHeH
boVlReX6ONDvT+u9MkvMxDmhwBb9G4izw26a88MCgYAhqyFJLTGdPlNkqZXApIHC
IA6aAsNDEtd6kspFXrPh50dFTEx54iUeYxh4/oF2d/vprNnf2cYHOXEOhdEhyHsr
EBt082G4dowFOUScRbgHrGMLCj21W2SKAEPROOUFCPjqVYhs2I25yK5b7Jq0aeL1
L9Dj/kGPqT/JNWKzBEDsZwKBgQDFNt5BN0d20Kb5/xR5n3Xwz788a8g35rqtIplt
uOnqRk2Vcne67a0FvgeUnZ+17BiU9FSKOFgpVWMgaXkW6HBjbqehBB2bRCHOmhH2
b53Fq//9IxRy+G7fl+busJluRwGJT6Un6p3kttgLWgQAC3aQMzgJhjy7xt25aQ+9
p8ZfEQKBgB6jQAT31FxvPFHyjU4NdFeogJd2c2nFbkC7aqOEPKNG9Nbzn/VVWh7x
Rx7Axua3D2OYrCH7V1NcR9X1dInpyj/hYXc5/VdtLZ2yhEc2GiG/jfgNWk2W2BZd
2NLf54bgV67lkC2yKMK/5wBru+V73WmqvWfQ4KsMesLLBBzMRvJa

-----END RSA PRIVATE KEY-----
-----BEGIN CERTIFICATE-----
MIIFWzCCBEOgAwIBAgIQAr0FxoUrLR0mLxVp3m/RJzANBgkqhkiG9w0BAQsFADBx
MQswCQYDVQQGEwJVUzEVMBMGA1UEChMMRGlnaUNlcnQgSW5jMRkwFwYDVQQLExB3
d3cuZGlnaWNlcnQuY29tMTAwLgYDVQQDEydEaWdpQ2VydCBUZXN0IEludGVybWVk
aWF0ZSBSb290IENBIFNIQTIwHhcNMTcwMzE1MDAwMDAwWhcNMTgwMzE1MTIwMDAw
WjCBiDELMAkGA1UEBhMCVVMxCzAJBgNVBAgTAk1EMRIwEAYDVQQHEwlSb2Nrdmls
bGUxNzA1BgNVBAoTLk5hdGlvbmFsIEluc3RpdHV0ZSBvZiBTdGFuZGFyZHMgYW5k
IFRlY2hub2xvZ3kxDjAMBgNVBAsTBU5DQ29FMQ8wDQYDVQQDEwZCYXh0ZXIwggEi
MA0GCSqGSIb3DQEBAQUAA4IBDwAwggEKAoIBAQC6Eq8ZL3CiacXu2YzUg5a7Nu8x

y3u75MNi2hBI0SK0Bh7kGOtdH61A5P/ZvTyclSNU2X3X/7e3aL2pQMNTnwNMoqKv
12ZHmuJ0eVojKG2zx8HuHZqtnvhgr7j8DULaY2mbCrANCXBaEnMmBJ7ld5kXQAtN
1LcsSCDCm49voSjZZuerCvT+1uxG9p4SPBwgY7Ca7LW/xOSttIp4W30jgHng9yXc
qzFuedSMfskhX2H/SfKs4qLPY/7eZqiAKc7DFFCnv2P8iAJLcltQEwbXiAqfGism
Au4Gi+qmxYhg7qT+qiEinKBV69zRRSPxeLIS6fWV1PVlJdiR78j2Nq4sEHo5AgMB
AAGjggHVMIIB0TAfBgNVHSMEGDAWgBSJVf2JvOIQPPttTh8w+fmCi1xh4jAdBgNV
HQ4EFgQU3PsIuQqjWZ2eFYrcKNhdYi7Rf1owEQYDVR0RBAowCIIGQmF4dGVyMA4G
A1UdDwEB/wQEAwIFoDAdBgNVHSUEFjAUBggrBgEFBQcDAQYIKwYBBQUHAwIwgZUG
A1UdHwSBjTCBijBDoEGgP4Y9aHR0cDovL2NybDN0ZXN0LmRpZ2ljZXJ0LmNvbS9E
aWdpQ2VydFRlc3RJbnRlcm1lZGlhdGVTSEEyLmNybDBDoEGgP4Y9aHR0cDovL2Ny
bDN0ZXN0LmRpZ2ljZXJ0LmNvbS9EaWdpQ2VydFRlc3RJbnRlcm1lZGlhdGVTSEEy
LmNybDAhBgNVHSAEGjAYMAwGCmCGSAGG/WxjAQEwCAYGZ4EMAQICMIGDBggrBgEF
BQcBAQR3MHUwKAYIKwYBBQUHMAGGHGh0dHA6Ly9vY3NwdGVzdC5kaWdpY2VydC5j
b20wSQYIKwYBBQUHMAKGPWh0dHA6Ly9jYWNlcnRzLmRpZ2ljZXJ0LmNvbS9EaWdp
Q2VydFRlc3RJbnRlcm1lZGlhdGUtU0hBMi5jcnQwDAYDVR0TAQH/BAIwADANBgkq
hkiG9w0BAQsFAAOCAQEAe7Rc6PbIfEjSQpCZ3UpZ7zqWruov44nmSKvR/X4MJITM
z9k3S+TzGOGYnq7bHBF1mjLt0l5K/BDWSG6LY5clSYJuGCbC/dSNFk9G+lzBKs5S
5xJxk8HeAt4OHOWmtEhZ7S4np7zUBcRu1koHbw4vW/lYJBvxRF1Sdd0ypyBP4X81
D2mX+LmFo2rlLSExurr5rd1s6Pna2FRBEjoyM78ID9AmKENqeioDi+hxGLlQROOt
y7aZU8yWcec7nad9iUGO/pMDdhbWexpvp4CBihxYkUMQcf8RaqTkJM8fLAdvPq9P
oQuBuMi+qPtI3WkTgfwr49usBzgbrdNPc/5MRQEz8Q==

-----END CERTIFICATE-----
Client certificate expiration date, GMT in the format: MM/DD/YYYY HH:MM:SS.
CLIENTCERTEXPIRE=
Trusted certificates, maximum of 5.
TRUSTEDCERTS=
-----BEGIN CERTIFICATE-----
MIIGSTCCBTGgAwIBAgIEM6qqqjANBgkqhkiG9w0BAQsFADBkMQswCQYDVQQGEwJV

UzEVMBMGA1UEChMMRGlnaUNlcnQgSW5jMRkwFwYDVQQLExB3d3cuZGlnaWNlcnQu
Y29tMSMwIQYDVQQDExpEaWdpQ2VydCBUZXN0IFJvb3QgQ0EgU0hBMjAeFw0wNjEx
MTAwMDAwMDBaFw0zMTExMTAwMDAwMDBaMHExCzAJBgNVBAYTAlVTMRUwEwYDVQQK
EwxEaWdpQ2VydCBJbmMxGTAXBgNVBAsTEHd3dy5kaWdpY2VydC5jb20xMDAuBgNV
BAMTJ0RpZ2lDZXJ0IFRlc3QgSW50ZXJtZWRpYXRlIFJvb3QgQ0EgU0hBMjCCASIw
DQYJKoZIhvcNAQEBBQADggEPADCCAQoCggEBAJiahU+gQ8Brmcov1LwvynLKgxMc
buqjeyYeiDEUXtTEJKoPm1Pc5YE39fBY1ydwaBJ6k3LbLZM+zqw2pCXwaf4LBhLv
t4ppHMfXlgI2IVpWibSYVcvJ4waD09AQ47u/SQhDHSVf17HRUIs1tIw+MMpMyGH0
9YzgI/ZI5KTWBY+nlnz9t1/RpPdcJfAWin3T/s7xNu364OFDURX+3Rxb7bVnV1xI
GZUwQx23GGcSnypsflr1rBc2yvXaUnwl4DbQMUo10tdZtd1wZNQE3C1L3MXndvn0
WdFB4cM6kQlSky0RFW+TJqQIMmb29n09P/ez7Ipo0cpV3vlBAC0DWm2z/FMCAwEA
AaOCAvQwggLwMA4GA1UdDwEB/wQEAwIBhjCCAcYGA1UdIASCAb0wggG5MIIBtQYL
YIZIAYb9bAEDAAIwggGkMDoGCCsGAQUFBwIBFi5odHRwOi8vd3d3LmRpZ2ljZXJ0
LmNvbS9zc2wtY3BzLXJlcG9zaXRvcnkuaHRtMIIBZAYIKwYBBQUHAgIwggFWHoIB
UgBBAG4AeQAgAHUAcwBlACAAbwBmACAAdABoAGkAcwAgAEMAZQByAHQAaQBmAGkA
YwBhAHQAZQAgAGMAbwBuAHMAdABpAHQAdQB0AGUAcwAgAGEAYwBjAGUAcAB0AGEA
bgBjAGUAIABvAGYAIAB0AGgAZQAgAEQAaQBnAGkAQwBlAHIAdAAgAEMAUAAvAEMA
UABTACAAYQBuAGQAIAB0AGgAZQAgAFIAZQBsAHkAaQBuAGcAIABQAGEAcgB0AHkA
IABBAGcAcgBlAGUAbQBlAG4AdAAgAHcAaABpAGMAaAAgAGwAaQBtAGkAdAAgAGwA
aQBhAGIAaQBsAGkAdAB5ACAAYQBuAGQAIABhAHIAZQAgAGkAbgBjAG8AcgBwAG8A
cgBhAHQAZQBkACAAaABlAHIAZQBpAG4AIABiAHkAIAByAGUAZgBlAHIAZQBuAGMA
ZQAuMA8GA1UdEwEB/wQFMAMBAf8wOAYIKwYBBQUHAQEELDAqMCgGCCsGAQUFBzAB
hhxodHRwOi8vb2NzcHRlc3QuZGlnaWNlcnQuY29tMIGIBgNVHR8EgYAwfjA9oDug
OYY3aHR0cDovL2NybDN0ZXN0LmRpZ2ljZXJ0LmNvbS9EaWdpQ2VydFRlc3RSb290
Q0FTSEEyLmNybDA9oDugOYY3aHR0cDovL2NybDR0ZXN0LmRpZ2ljZXJ0LmNvbS9E
aWdpQ2VydFRlc3RSb290Q0FTSEEyLmNybDAdBgNVHQ4EFgQUiVX9ibziEDz7bU4f
MPn5gotcYeIwHwYDVR0jBBgwFoAU9kZ+Gxa7N5lj9z/YhSzkyepYDx4wDQYJKoZI
hvcNAQELBQADggEBALFxPxkcHgaXBuoZ10FGWsq3bybGnxC6llfDETcWVrPajudx
asm8EXOTSVnqKNIXZTlm1BY0chhnVGA3YyNN7XF7XrT1HtRH5NDhWO2lzFEGSFLw
hlCiGQBuzKOelbBWDhpN7icm+Y/u+DPaK6oFu0tX/u9kPzoc8OYSBe412sHAD1/l

kUDPAEO4yHSXDnoe0fhk24/yCuO6Wc+mMe7YXzEkq8pOEWjNw/9E1dsP20L7jD3F
97q5uVNe1wEaeE3U5Eq1xKUBdyQqitinpTv/yo/UPTDLpfjBmK2nh2HK6r0RH+YC
OicqQ99N+q6YeAlhejLa7+7FkKYKK1YEAbE1Icc=

-----END CERTIFICATE-----
-----BEGIN CERTIFICATE-----
MIIDpjCCAo6gAwIBAgIBMzANBgkqhkiG9w0BAQsFADBkMQswCQYDVQQGEwJVUzEV
MBMGA1UEChMMRGlnaUNlcnQgSW5jMRkwFwYDVQQLExB3d3cuZGlnaWNlcnQuY29t
MSMwIQYDVQQDExpEaWdpQ2VydCBUZXN0IFJvb3QgQ0EgU0hBMjAeFw0wNjExMTAw
MDAwMDBaFw0zMTExMTAwMDAwMDBaMGQxCzAJBgNVBAYTAlVTMRUwEwYDVQQKEwxE
aWdpQ2VydCBJbmMxGTAXBgNVBAsTEHd3dy5kaWdpY2VydC5jb20xIzAhBgNVBAMT
GkRpZ2lDZXJ0IFRlc3QgUm9vdCBDQSBTSEEyMIIBIjANBgkqhkiG9w0BAQEFAAOC
AQ8AMIIBCgKCAQEA0DLGgpMXqI2YZ15ULS61yqyqiBMpmRtM9/w/1pqoA/GEri19
VMFuvtPTWgu9IQf0dQsRMy2d8V4INSj43YyQeXnxPzanTSqza95yoH/h4xUM/pNq
AlXlO8c+cYMyCDzTQ0vrEWcvPZOtXYABac9E9ceT015RdD5pORjMwTcb6NxydZr8
nRd9/J66L4R17IKvTU74IwA6fwNd0UnXbhVhGdeEAe+eIEvJ5WlWxDeS6ZdZuSZv
h24QxhxpucTzSq81HHCHw4a1kOel2oqlDlUY698atS0nxfw3IR30heQ/g793Mce9
SX9u2dPPAZtSaW8/38TwKbNOa9zkRFn7oF+cZQIDAQABo2MwYTAOBgNVHQ8BAf8E
BAMCAYYwDwYDVR0TAQH/BAUwAwEB/zAdBgNVHQ4EFgQU9kZ+Gxa7N5lj9z/YhSzk
yepYDx4wHwYDVR0jBBgwFoAU9kZ+Gxa7N5lj9z/YhSzkyepYDx4wDQYJKoZIhvcN
AQELBQADggEBAAeQacFm1sFPOIEvXDVi3IH2RKF7he0p/M0bK2Soj137LMf+ctpM
3bFKJPY97YIE0g7T1qgR8TN2sK0moumMTPjWCdFWJyN4yakS6tPIWEG2XobJ9H1r
iuVXLKd2M/1yhqUyt1o5KtbOGQXLFd3qdp4A1tcXuK2wyMTiSCYS3Uow61JdEw6M
eyrMIpZl9GtvaXTz6LdnozAbhKC7bVUy7ob0T4E03fQ8hIQCNPupvY7Db1/XmIw8
QWVd6AOH7EE3P8xbWOvcTWZ5XbstWY014GeJFXZ7YreaAg8sYa6CzasuHkr/rxeZ
8yzOmCTTTSPk5Ju5bTfAyEpgkl5fDvntJQg=

-----END CERTIFICATE-----

Appendix C References

[1] J. Moy, *OSPF Version 2*, Internet Engineering Task Force (IETF) Network Working Group Request for Comments (RFC) 2328, April 1998. https://www.ietf.org/rfc/rfc2328.txt [accessed 4/20/2017]

[2] *Cisco Adaptive Security Virtual Appliance (ASAv) Quick Start Guide, 9.6* [Web site], http://www.cisco.com/c/en/us/td/docs/security/asa/asa96/asav/quick-start/asav-quick/intro-asav.html [accessed 4/20/17]

[3] Bider and M. Baushke *SHA-2 Data Integrity Verification for the Secure Shell (SSH) Transport Layer Protocol* Internet Engineering Task Force (IETF) Request for Comments (RFC) 6668, July 2012. https://tools.ietf.org/html/rfc6668 [accessed 4/20/2017]

[4] J. Postel *Internet Control Message Protocol DARPA Internet Program Protocol Specification,* Internet Engineering Task Force (IETF) Network Working Group Request for Comments (RFC) 792, September 1981. https://tools.ietf.org/html/rfc792 [accessed 4/20/2017]

[5] J. Case, M. Fedor, M. Schoffstall, and J. Davin *A Simple Network Management Protocol (SNMP)* Internet Engineering Task Force (IETF) Network Working Group Request for Comments (RFC) 1157, May 1990. https://tools.ietf.org/html/rfc1157 [accessed 4/20/2017]

[6] R. Droms *Dynamic Host Configuration Protocol* Internet Engineering Task Force (IETF) Network Working Group Request for Comments (RFC) 2131, March 1997. https://www.ietf.org/rfc/rfc2131.txt [accessed 4/20/2017]

[7] Institute of Electrical and Electronics Engineers (IEEE), *802.1Q-2014 - Bridges and Bridged Networks,* December 2014 http://www.ieee802.org/1/pages/802.1Q-2014.html [accessed 4/20/2017]

[8] Institute of Electrical and Electronics Engineers (IEEE), 802.11i-2004 Part 11: Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) specifications, Amendment 6: Medium Access Control (MAC) Security Enhancements. http://ieeexplore.ieee.org/stamp/stamp.jsp?arnumber=1318903

[9] D. Mills, J. Martin, Ed, J. Burbank, and W. Kasch *Network Time Protocol Version 4: Protocol and Algorithms Specification* Internet Engineering Task Force (IETF) Request for Comments (RFC) 5905, June 2010. https://www.ietf.org/rfc/rfc5905.txt [accessed 4/20/2017]

[10] U.S. Department of Commerce. *Announcing the Advanced Encryption Standard (AES)* Federal Information Processing Standards (FIPS) Publication 197, November 2001. http://nvlpubs.nist.gov/nistpubs/FIPS/NIST.FIPS.197.pdf [accessed 4/20/2017]

[11] D. Simon, B. Aboba, and R. Hurst *The EAP-TLS Authentication Protocol* Internet Engineering Task Force (IETF) Network Working Group Request for Comments (RFC) 5016, March 2008. https://www.ietf.org/rfc/rfc5216.txt [accessed 4/20/2017]

[12] C. Rigney, S. Willens, A. Rubens, and W. Simpson *Remote Authentication Dial In User Service (RADIUS)* Internet Engineering Task Force (IETF) Network Working Group Request for Comments (RFC) 2865, June 2000. https://tools.ietf.org/html/rfc2865 [accessed 4/20/2017]

[13] S. Santesson, M. Myers, R. Ankney, A. Malpani, S. Galperin, and C. Adams *X.509 Internet Public Key Infrastructure Online Certificate Status Protocol – OCSP* Internet Engineering Task Force (IETF) Request for Comments (RFC) 6960, June 2013. https://tools.ietf.org/html/rfc6960 [accessed 4/20/2017]