NIST SPECIAL PUBLICATION 1800-23C

Energy Sector Asset Management

For Electric Utilities, Oil & Gas Industry

Volume C:
How-To Guides

James McCarthy
Glen Joy
National Cybersecurity Center of Excellence
Information Technology Laboratory

Lauren Acierto
Jason Kuruvilla
Titilayo Ogunyale
Nikolas Urlaub
John Wiltberger
Devin Wynne
The MITRE Corporation
McLean, Virginia

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NCCoE
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FEEDBACK

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

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

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

NATIONAL CYBERSECURITY CENTER OF EXCELLENCE

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

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

NIST CYBERSECURITY PRACTICE GUIDES

NIST Cybersecurity Practice Guides (Special Publication 1800 series) target specific cybersecurity challenges in the public and private sectors. They are practical, user-friendly guides that facilitate the adoption of standards-based approaches to cybersecurity. They show members of the information security community how to implement example solutions that help them align 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

Industrial control systems (ICS) compose a core part of our nation's critical infrastructure. Energy sector companies rely on ICS to generate, transmit, and distribute power and to drill, produce, refine, and transport oil and natural gas. Given the wide variety of ICS assets, such as programmable logic controllers and intelligent electronic devices, that provide command and control information on operational technology (OT) networks, it is essential to protect these devices to maintain continuity of operations. These assets must be monitored and managed to reduce the risk of a cyber attack on ICS-networked environments. Having an accurate OT asset inventory is a critical component of an overall cybersecurity strategy.

The NCCoE at NIST is responding to the energy sector's request for an automated OT asset management solution. To remain fully operational, energy sector entities should be able to effectively identify, control, and monitor their OT assets. This document provides guidance on how to enhance OT asset management practices, by leveraging capabilities that may already exist in an energy organization's operating environment as well as by implementing new capabilities.

KEYWORDS

energy sector asset management; ESAM; ICS; industrial control system; malicious actor; monitoring; operational technology; OT; SCADA; supervisory control and data acquisition

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Name	Organization
Samantha Pelletier	TDi Technologies, Inc.
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Jim Wachhaus	Tripwire, Inc.

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

Technology Partner/Collaborator	Build Involvement
Dragos, Inc.	Dragos Platform v1.5
Forescout Technologies, Inc.	ForeScout CounterACT v8.0.1
FoxGuard Solutions, Inc.	FoxGuard Solutions Patch and Update Management Program v1
KORE Wireless Group, Inc.	KORE Wireless Cellular Connectivity with Cellular Gateway v2.0
Splunk, Inc.	Splunk Enterprise v7.1.3
TDi Technologies, Inc.	TDi Technologies ConsoleWorks v5.2-0u1
Tripwire, Inc.	Tripwire Industrial Visibility v3.2.1

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1 Introduction

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

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

1.1 Practice Guide Structure

This National Institute of Standards and Technology (NIST) Cybersecurity Practice Guide demonstrates a standards-based reference design and provides users with the information they need to replicate this asset management solution in the energy sector. This reference design is modular and can be deployed in whole or in part.

This guide contains three volumes:

- NIST SP 1800-23A: *Executive Summary*
- NIST SP 1800-23B: *Approach, Architecture, and Security Characteristics* – what we built and why
- NIST SP 1800-23C: *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:

Senior IT executives, including chief information security and technology officers, will be interested in the *Executive Summary, NIST SP 1800-23A*, which describes the following topics:

- challenges that enterprises face in operational technology (OT) asset management
- 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 1800-23B, which describes what we did and why. The following sections will be of particular interest:

- Section 3.4, Risk Assessment, provides a description of the risk analysis we performed.
- Section 3.4.4, Security Control Map, maps the security characteristics of this example solution to cybersecurity standards and best practices.

You might share the *Executive Summary,* NIST SP 1800-23A, with your leadership team members to help them understand the importance of adopting a standards-based solution to strengthen their OT asset management practices, by leveraging capabilities that may already exist within their operating environment or by implementing new capabilities.

IT professionals who want to implement an approach like this will find this whole practice guide useful. You can use this How-To portion of the guide, NIST SP 1800-23C, to replicate all or parts of the build created in our lab. This How-To portion of the guide provides specific product installation, configuration, and integration instructions for implementing the example solution. We do not recreate the product manufacturers' documentation, which is generally widely available. Rather, we show how we incorporated the products together in our environment to create an example solution.

This guide assumes that IT professionals have experience implementing security products within the enterprise. While we have used a suite of commercial products to address this challenge, this guide does not endorse these particular products. Your organization can adopt this solution or one that adheres to these guidelines in whole, or you can use this guide as a starting point for tailoring and implementing parts of the energy sector asset management (ESAM) solution. Your organization's security experts should identify the products that will best integrate with your existing tools and IT system infrastructure. We hope that you will seek products that are congruent with applicable standards and best practices. Volume B, Section 3.5, Technologies, lists the products that we used and maps them to the cybersecurity controls provided by this reference solution.

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

Acronyms used in figures can be found in the List of Acronyms appendix.

1.2 Build Overview

The example solution fulfills the need for an automated asset inventory. This example solution allows devices to be identified in multiple ways, depending on the needs of the organization. The architecture is intended as one solution.

The example solution makes use of two "remote" sites, while the National Cybersecurity Center of Excellence (NCCoE) serves as the enterprise location as shown in Figure 1 below. Having a central enterprise location provides flexibility to add multiple sites as well as the ability to collect all data in one place.

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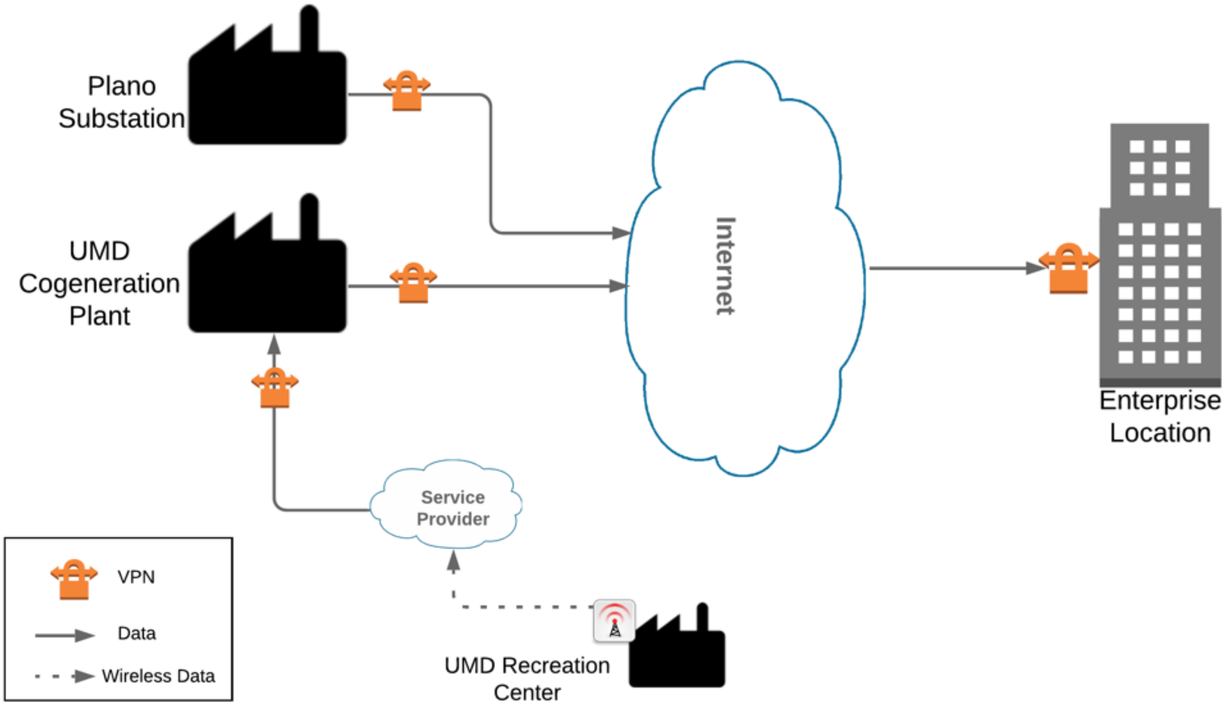
Figure 1-1 High-Level Topology



Different components in the build are installed at each location. However, some components preexist, including the OT assets, networks, routers, and protocol converters. This guide will describe the installation and configuration details of the components installed at each site but not preexisting components. A detailed topology and description of each site can be found in Volume B, Section 4.2, Example Solution.

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1.3 Typographic Conventions

The following table presents typographic conventions used in this volume.

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

1.4 Logical Architecture Summary

A logical architecture summary can be found in Volume B of this practice guide, Section 4.1, Architecture Description.

2 Product Installation Guides

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

2.1 ConsoleWorks

ConsoleWorks performs as a data collection server and a data analysis server. The data collection server is located at the University of Maryland (UMD) and reads data from a steam meter via protocol converters. The data analysis server resides at the NCCoE and normalizes data collected from security information and event management (SIEM) software, for processing by the patch analysis and reporting tool.

2.1.1 ConsoleWorks Configurations at the NCCoE

The following subsections document the software, hardware/virtual machine (VM), and network configurations for the ConsoleWorks server at the NCCoE.

2.1.1.1 VM Configuration

The ConsoleWorks VM is given the following resources:

- CentOS 7.5
- Central processing unit (CPU) cores
- 100 gigabyte (GB) hard disk
- 10 GB random access memory (RAM)
- 1 network interface controller/card (NIC)

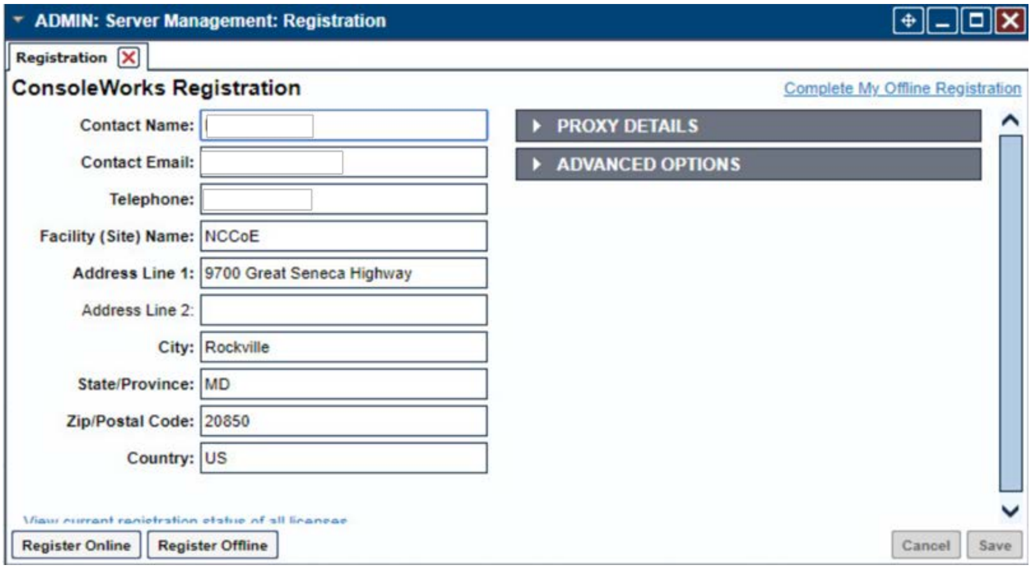
2.1.1.2 Network Configuration

- Dynamic Host Configuration Protocol (DHCP): disabled
- Internet protocol version (IPv)6: ignore
- IPv4: Manual
- IPv4 address: 10.100.100.6
- Netmask: 255.255.255.0

2.1.1.3 Installation

1. Download the installation kit from the http://support.tditechnologies.com website. A username and password are required, so contact TDi Support at support@tditechnologies.com to request them.
2. Create a directory to contain the ConsoleWorks installation files: `#mkdir temp/conworks`
3. Run the following command: `# yum local install consoleworksssssl-<version>_x86_64.rpm`
4. Extract the provided compressed license script to */tmp/conworks.*
5. Run the script from the extracted zip file.
6. Start ConsoleWorks with the following command: `# /opt/ConsoleWorks/bin/cw_start default`

7. Connect to the Console at *https://10.100.100.6:5176*. Log in using the default credentials.



ADMIN: Server Management: Registration

Registration

ConsoleWorks Registration

Contact Name:

Contact Email:

Telephone:

Facility (Site) Name: NCCoE

Address Line 1: 9700 Great Seneca Highway

Address Line 2:

City: Rockville

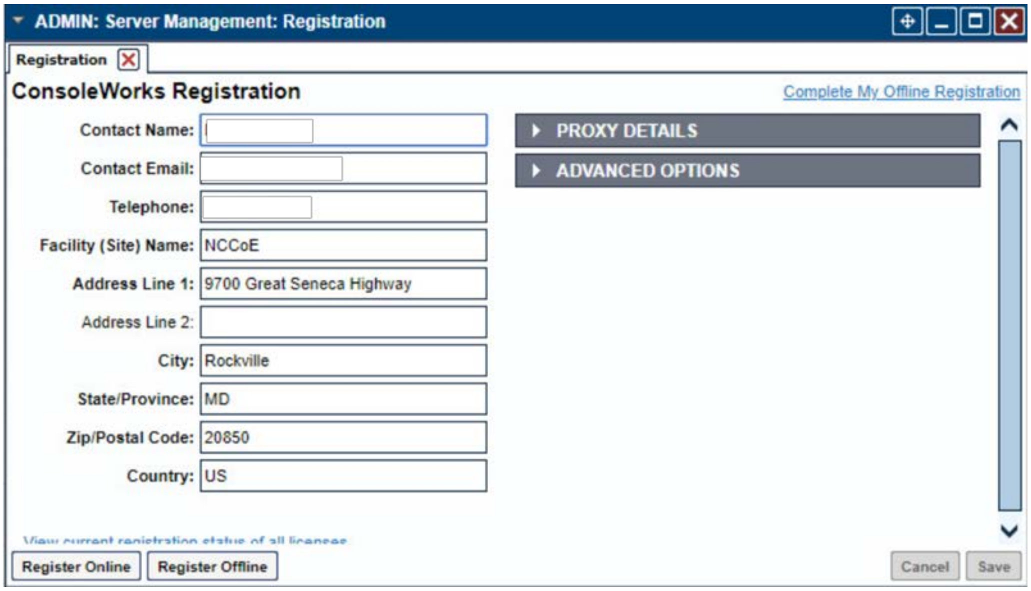
State/Province: MD

Zip/Postal Code: 20850

Country: US

Complete My Offline Registration
PROXY DETAILS
ADVANCED OPTIONS
View current registration status of all licenses
Register Online
Register Offline
Cancel
Save

8. Fill in the details for Registration. Click **Register Online.** Click **Save.**



ADMIN: Server Management: Registration

Registration

ConsoleWorks Registration

Contact Name:

Contact Email:

Telephone:

Facility (Site) Name: NCCoE

Address Line 1: 9700 Great Seneca Highway

Address Line 2:

City: Rockville

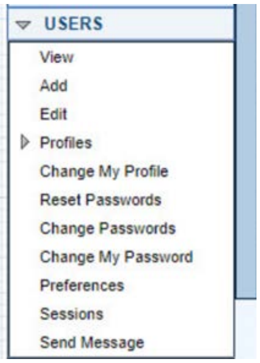
State/Province: MD

Zip/Postal Code: 20850

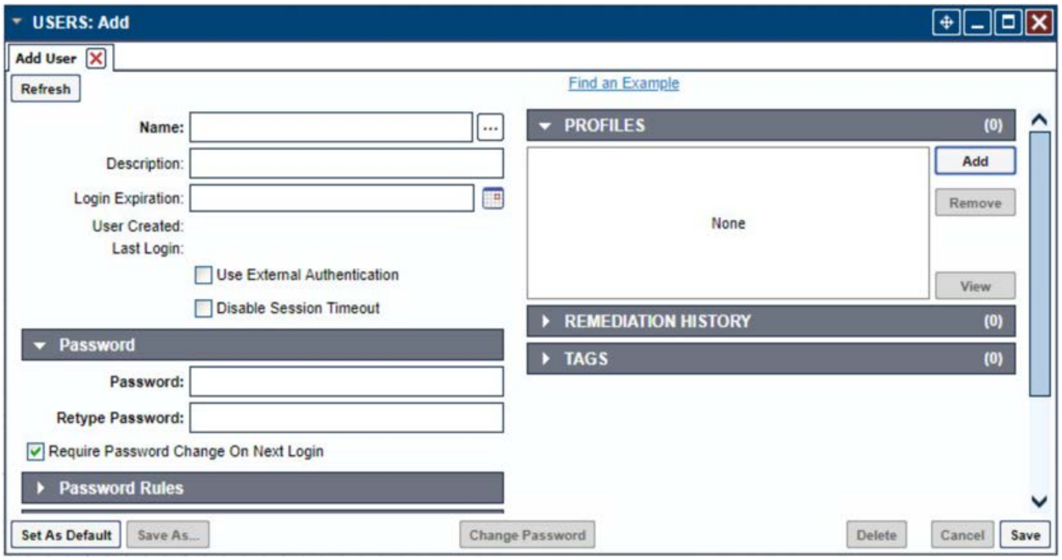
Country: US

Complete My Offline Registration
PROXY DETAILS
ADVANCED OPTIONS
View current registration status of all licenses
Register Online
Register Offline
Cancel
Save

9. Create a new user. Navigate on the left to **Users > Add.**



10. Enter the **Name** and **Password.** Select **Add.**

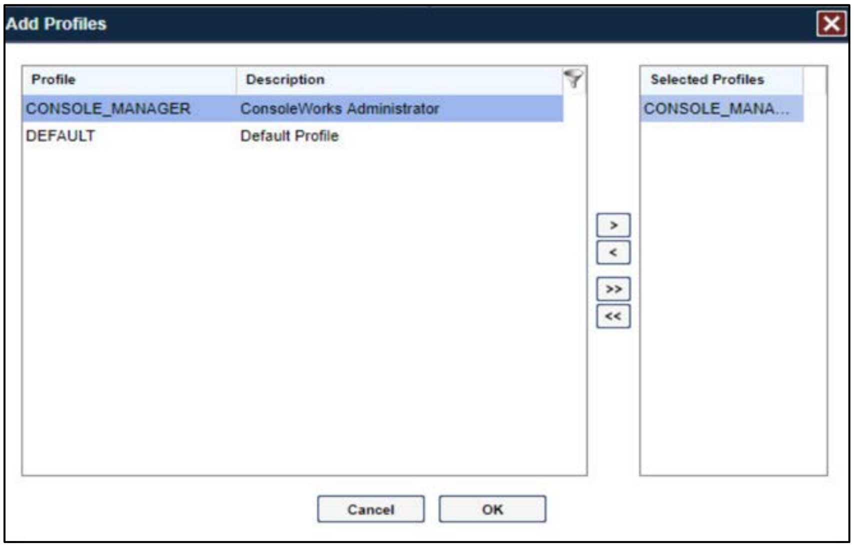


☐ Use External Authentication

☐ Disable Session Timeout

☑ Require Password Change On Next Login

11. Add **CONSOLE_MANAGER** as a selected profile, as shown in the screenshot below. Select **OK.**

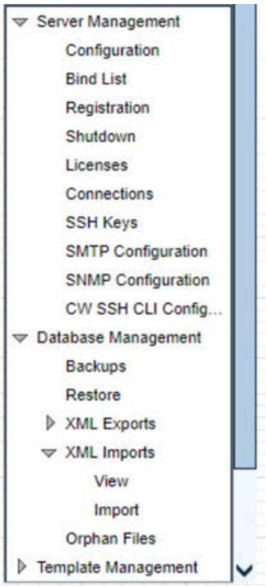


12. Click **Save.**

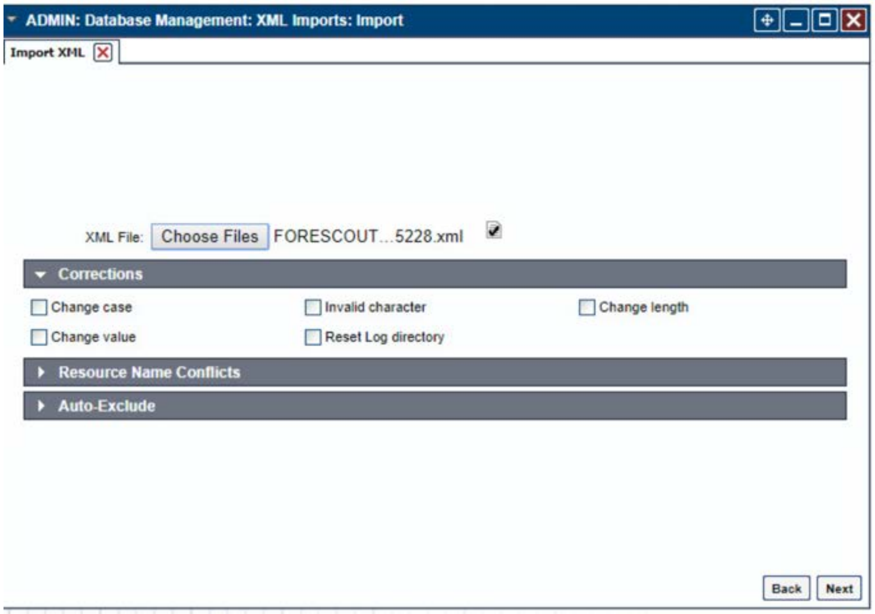
2.1.1.4 Configuration

ConsoleWorks provides the scripts to normalize data, for processing by FoxGuard Patch and Update Management Program (PUMP). The script provided is in extensible markup language (XML) format.

1. Import the provided XML file at **Admin > Database Management > XML Imports > Import.**



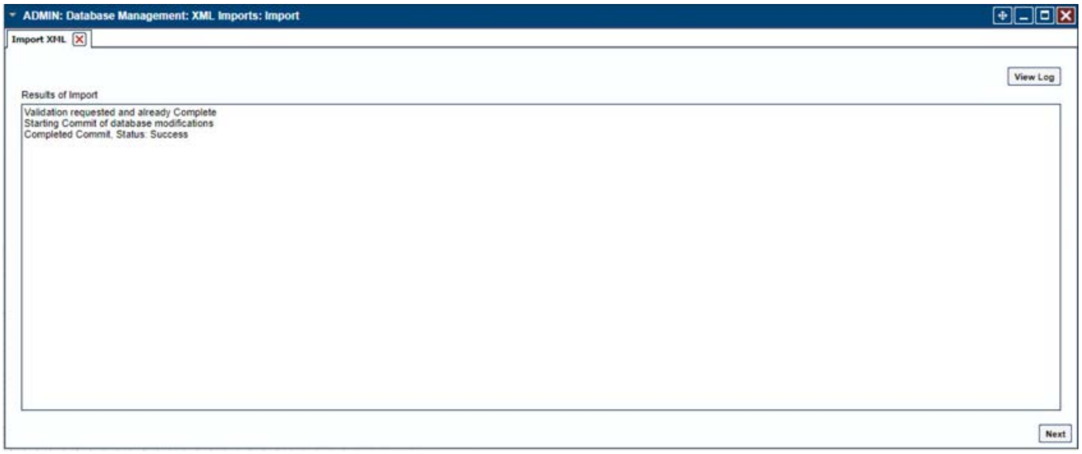
2. Click **Choose Files.** Locate the provided XML file. Select **Next.**



XML File: FORESCOUT…5228.xml ☑

□ Change case
□ Invalid character
□ Change length
□ Change value
□ Reset Log directory

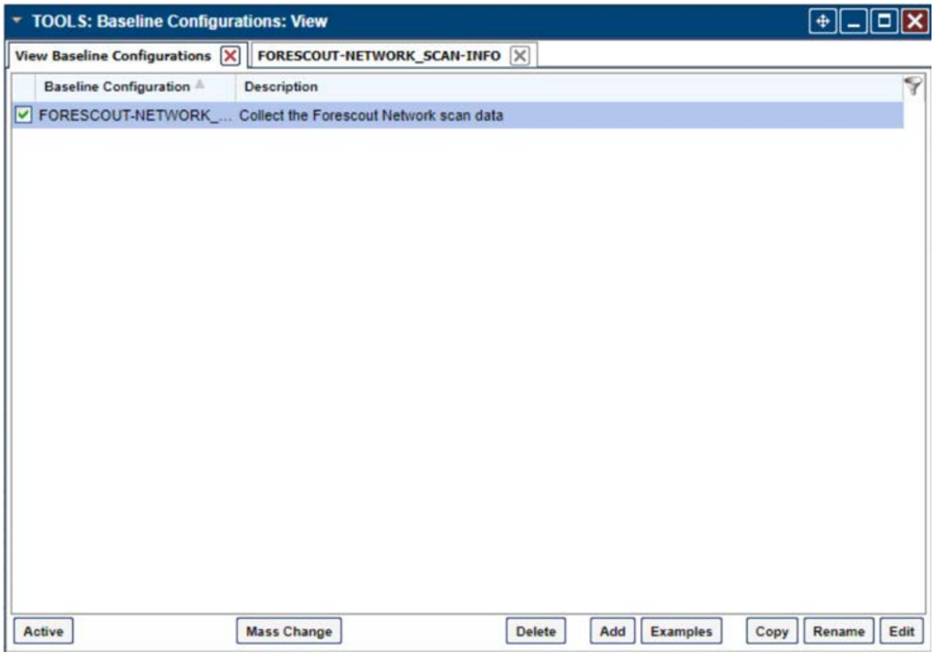
3. Select **Next.** The import is complete.



Results of Import

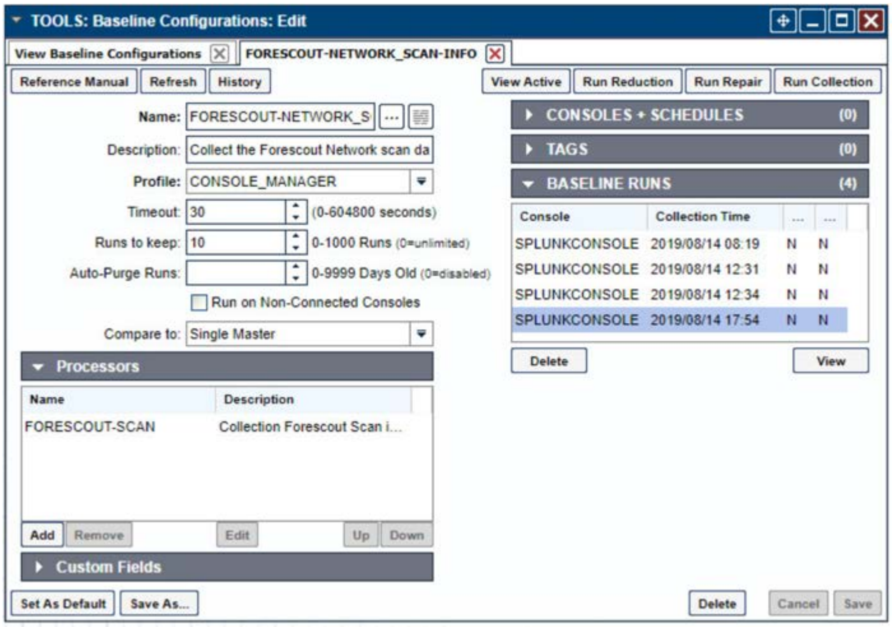
```
Validation requested and already Complete
Starting Commit of database modifications
Completed Commit, Status: Success
```

4. Open the baseline configuration at **Tools > Baseline Configurations > View.** Select **Edit.**


TOOLS: Baseline Configurations: View
View Baseline Configurations
FORESCOUT-NETWORK_SCAN-INFO
Active
Mass Change
Delete
Add
Examples
Copy
Rename
Edit

Baseline Configuration	Description
☑ FORESCOUT-NETWORK_...	Collect the Forescout Network scan data

5. Under **Processors,** select the scan, and click **Edit.**



Name: FORESCOUT-NETWORK_S

Description: Collect the Forescout Network scan da

Profile: CONSOLE_MANAGER

Timeout: 30 (0-604800 seconds)

Runs to keep: 10 0-1000 Runs (0=unlimited)

Auto-Purge Runs: 0-9999 Days Old (0=disabled)

□ Run on Non-Connected Consoles

Compare to: Single Master

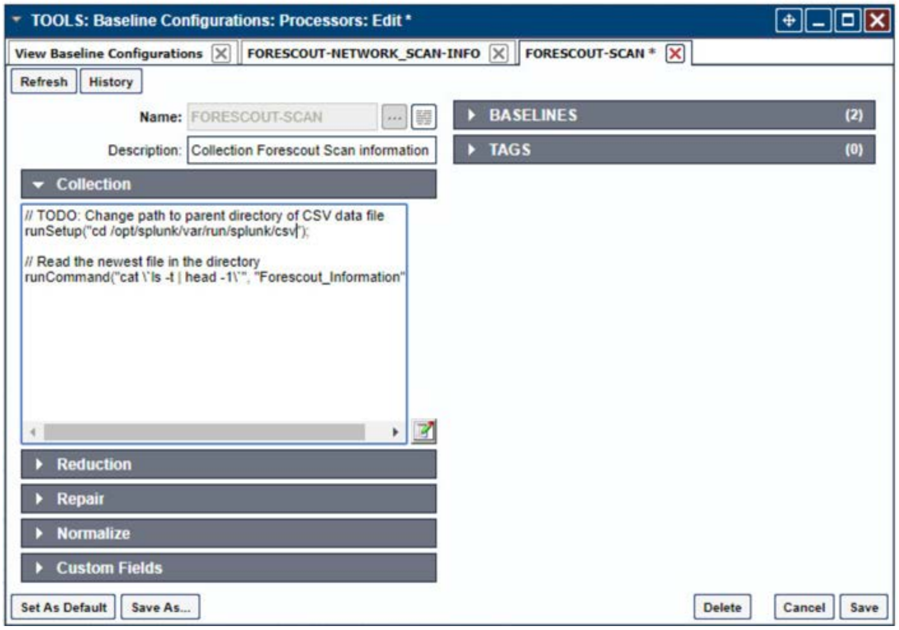
Name	Description
FORESCOUT-SCAN	Collection Forescout Scan i...

Console	Collection Time	...	...
SPLUNKCONSOLE	2019/08/14 08:19	N	N
SPLUNKCONSOLE	2019/08/14 12:31	N	N
SPLUNKCONSOLE	2019/08/14 12:34	N	N
SPLUNKCONSOLE	2019/08/14 17:54	N	N

6. Under **Collection,** update the path to match where Splunk saves the inventory, as shown in the screenshot.

```
// TODO: Change path to parent directory of CSV data file
```

```
runSetup("cd /opt/splunk/var/run/splunk/csv");

// Read the newest file in the directory

runCommand("cat \`ls -t | head -1\`", "Forescout_Information", 5);
```

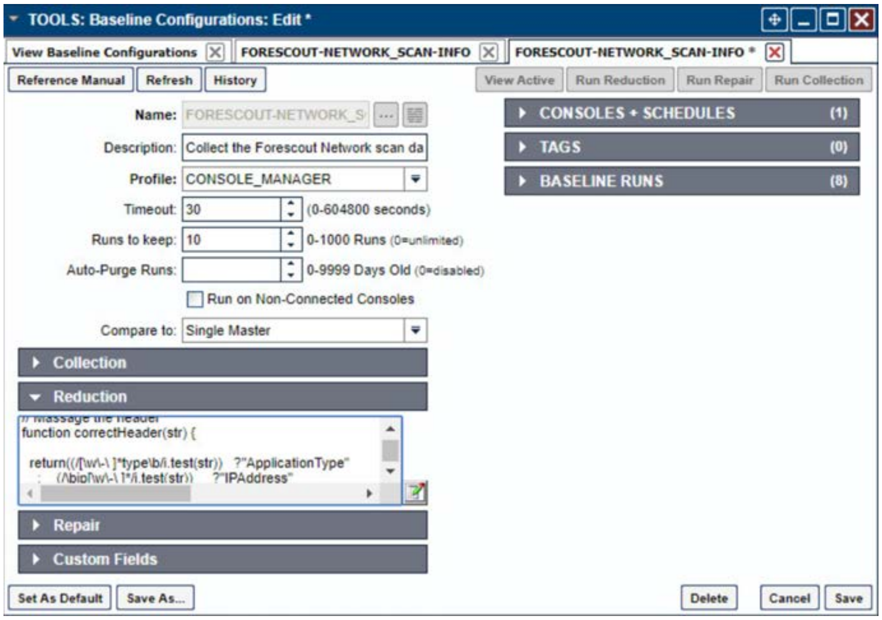


Name: FORESCOUT-SCAN

Description: Collection Forescout Scan information

```
// TODO: Change path to parent directory of CSV data file
runSetup("cd /opt/splunk/var/run/splunk/csv");

// Read the newest file in the directory
runCommand("cat \`ls -t | head -1\`", "Forescout_Information"
```

7. Under **Reduction,** enter the following script, as shown in the screenshot below.



Name: FORESCOUT-NETWORK_S

Description: Collect the Forescout Network scan da

Profile: CONSOLE_MANAGER

Timeout: 30 (0-604800 seconds)

Runs to keep: 10 0-1000 Runs (0=unlimited)

Auto-Purge Runs: 0-9999 Days Old (0=disabled)

☐ Run on Non-Connected Consoles

Compare to: Single Master

```
// Massage the header
function correctHeader(str) {

  return((/[\w\-\ ]*type\b/i.test(str))   ?"ApplicationType"
    :    (/\bip[\w\-\ ]*/i.test(str))    ?"IPAddress"
```

```
include("UTIL");

include("UTIL_CUSTOM_FILE");

include("UTIL_JSON");

////////////////////////////////////////////////////////////////////////////////
//////////////////////////

// Massage the header

function correctHeader(str) {

return((/[\w\-\ ]*type\b/i.test(str))   ?"ApplicationType"

 :    (/\bip[\w\-\ ]*/i.test(str))    ?"IPAddress"

   :    (/\bmac[\w\-\ ]*/i.test(str))    ?"MACAddress"

   :    (/\bmodel[\w\-\ ]*/i.test(str))  ?"ModelNumber"

   :    (/\bpart[\w\-\ ]*/i.test(str))   ?"PartNumber"

   :    (/\basset.?id\b/i.test(str))    ?"PK"

:    (/\bproduct[\w\-\ ]*/i.test(str))?"ProductName"

   :    (/\bserial[\w\-\ ]*/i.test(str)) ?"SerialNumber"

   :    (/\bvendor/i.test(String(str)))  ?"VendorName"

   :    (/version/i.test(String(str)))   ?"VersionName"

   :                                String(str).replace(/[\W\_]+/g, "
").camelSpaced().toCapCase().replace(/\ +/g, ""));

}

////////////////////////////////////////////////////////////////////////////////
//////////////////////////

// ref: http://stackoverflow.com/a/1293163/2343

function CSVToArray(strData, strDelimiter) {

  // Check to see if the delimiter is defined. If not, then default to comma.

  strDelimiter=(typeof strDelimiter!='undefined')?strDelimiter:",";

  // Create a regular expression to parse the CSV values.

  //                    Delimiters                     Quoted fields
Standard fields.

  var objPattern=new
RegExp(("(\\"+strDelimiter+"|\\r?\\n|\\r|^)(?:\"([^\"]*(?:\"\"[^\"]*)*)\"|([^\"
\\"+strDelimiter+"\\r\\n]*))"), "gi");

  // Create an array to hold our data. Give the array a default empty first row.
  var arrData=[[]];
  // Create an array to hold our individual pattern matching groups.
  var arrMatches=null;
  // Keep looping over the regular expression matches until we can no longer
find a match.
  while(arrMatches=objPattern.exec(strData)) {
   // Get the delimiter that was found.
   var strMatchedDelimiter=arrMatches[1];
   // Check to see if the given delimiter has a length (is not the start of
string) and if it matches field delimiter.
   // If it does not, then we know that this delimiter is a row delimiter.
   if(strMatchedDelimiter.length && strMatchedDelimiter!==strDelimiter) {
    // Since we have reached a new row of data, add an empty row to our data
array.
    arrData.push([]);
   }
   var strMatchedValue;
   // Now that we have our delimiter out of the way, let's check to see which
kind of value we captured (quoted or unquoted).
   if(arrMatches[2]) {
    // We found a quoted value. When we capture this value, unescape any
double quotes.
    //strMatchedValue=arrMatches[2].replace(new RegExp( "\"\"", "g" ), "\"");
    strMatchedValue=arrMatches[2].replace(/\"{2}/g, '"');
   } else {
    // We found a non-quoted value.
    strMatchedValue=arrMatches[3];
   }
   // Now that we have our value string, let's add it to the data array.
   arrData[arrData.length-1].push(strMatchedValue);
  }
  // Return the parsed data.
```

```
  return(arrData);
}
///////////////////////////////////////////////////////////////////////////////
//////////////////////////
function procCSV(csv) {
  // Convert string to YYYYMMDD_HHMMSS for readability
  var outputDir="/FOXGUARD/"+(now.slice(0,8));
  var outputFile=""+outputDir+"/"+(now.slice(8,14));
  var result=[];
  // Default of negative feedback
  var tracker=false;
  if(typeof csv!='undefined' && csv.length>0) {
    try {
      var lines=CSVToArray(csv);
      lines.shift();
      if(lines.length>1) {
        try {
          // Header names
          var props=lines[0];
          if(props.length>0) {
            // Massage header names
            for(var k=0;k<props.length;k++) {
              if(props[k].length>0) {
                props[k]=correctHeader(props[k]);
              }
            }
            for(i=1;i<lines.length;i++) {
              var j=lines[i];
              if(j.length>0) {
                var obj={
                  "ApplicationType": "Firmware",
                  "ModelNumber": "unspecified",
                  "PartNumber": "unspecified",
                  "PK": "unspecified",
                  "ProductName": "unspecified",
                  "SerialNumber": "unspecified",
                 "VendorName": "unspecified",
                 "VersionName": "unspecified"
                };

   if(String(ServerConfig.getList()[0].conwrksinvo).split("/")[3]!="default") {

   obj.Site=String(ServerConfig.getList()[0].conwrksinvo).split("/")[3];
                 }
                 for(var k=0;k<props.length;k++) {
               if(Boolean(j[k]) && j[k]!="-") {
                 switch(props[k]) {
                  case "IPAddress":

//obj.IPAddress=(rEIPv4.test(j[k]))?j[k].match(rEIPv4)[1]:(rEIPv6.test(j[k]))?j[k].
match(rEIPv6)[1]:"unspecified";
                    break;
                  case "MACAddress":

//obj.MACAddress=(rEMAC.test(j[k]))?j[k].match(rEMAC)[1]:"unspecified";
                    break;
                  case "OperatingSystem":
                    obj.ApplicationType="Operating System";
                    obj.OperatingSystem=j[k];
                    obj.ProductName=j[k];
                    break;
                  case "VendorName":
                    if(obj.VendorName=="unspecified") {
```

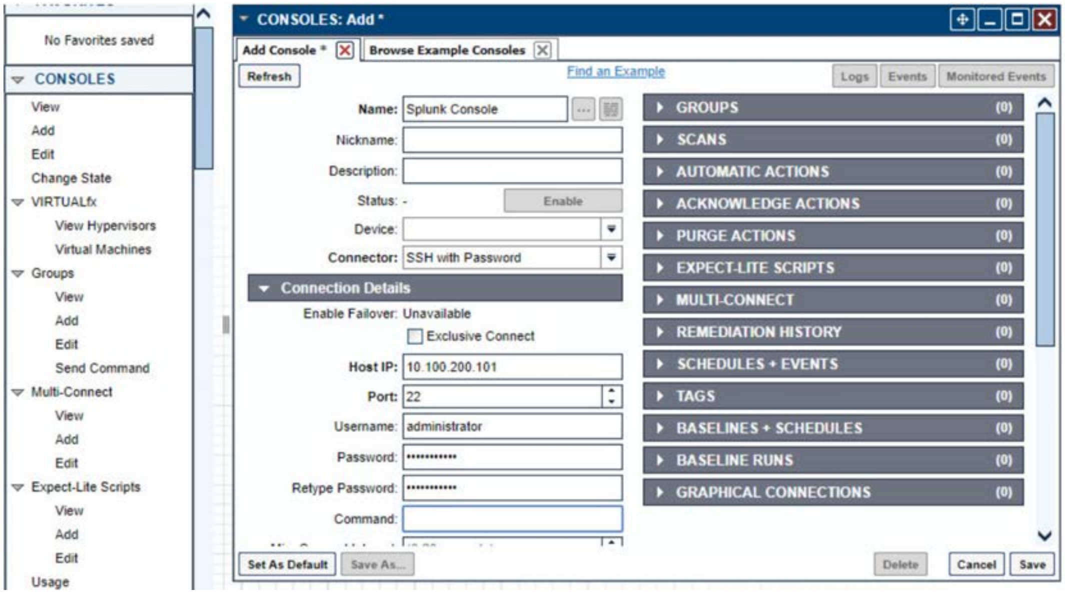
```
          obj.VendorName=j[k];
        }
        break;
      case "VersionName":
        obj.VersionName=j[k];
        if(rESEL.test(j[k])) {
          obj.ModelNumber=j[k].match(rESEL)[1];
          obj.VendorName="Schweitzer";
        }
        break;
      default:
        obj[props[k]]=j[k];
        break;
    }
  }
}
if(obj.hasOwnProperty('OperatingSystem')) {
  obj.OperatingSystemVersion=obj.VersionName;
  //delete obj.VersionName;
}
for(var p in obj) {
  // These are required properties
  if(["ProductName", "VendorName", "VersionName"].indexOf(p)<0) {
    // Not a required property, and no useful data, get rid of it!
    if(Boolean(obj[p])==false || obj[p]=="unspecified") {
      delete obj[p];
    }
  }
}
result.push({
```

```
         "AssetIdentifiers": obj,
         "FUI": null
        });
       }
      }
      try {
       setReduction("Forescout_Information", JSON.stringify(result, null, 2));
       makeDirectory(""+outputDir);
       // File for FoxGuard
       setCustomFileContents(""+outputFile+".txt", JSON.stringify(result, 
null, 2));
       // Copy of original input
       //setCustomFileContents(""+outputFile+".csv", csv);
       // If everything goes great, return with positive feedback
       tracker=true;
      } catch(ex) {
       print("ERROR: "+ex);
      }
     } else {
      print("ERROR: Missing header data");
     }
    } catch(ex) {
     print("ERROR: "+ex);
    }
   } else {
    print("ERROR: Going to need more data than this");
   }
  } catch(ex) {
   print("ERROR: "+ex);
  }
 } else {
    print("ERROR: We got nothing!");
  }
  return(tracker);
}
//////////////////////////////////////////////////////////////////////////////////
//////////////////////
// value for TZ offset
var d=0;
try {
  d=new Date().getTimezoneOffset();
} catch(ex) {
  print("ERROR: "+ex);
}
// Create string of YYYYMMDDHHMMSS
var now=String(new Date(Date.now()-(d*60000)).toJSON()).replace(/\D/g,
"").slice(0,14);
// IPv4
var rEIPv4=/\b((?:(?:25[0-5]|2[0-4][0-9]|1[0-9][0-9]|[1-9]?[0-9])\.){3}(?:25[0-
5]|2[0-4][0-9]|1[0-9][0-9]|[1-9]?[0-9]))\b/;
// IPv6
var rEIPv6=/\b([\da-fA-F]{1,4}(?:\:[\da-fA-F]{0,4}){2,6}[\da-fA-F]{1,4})\b/;
// MAC
var rEMAC=/\b((?:[\da-fA-F]{2}\:){5}[\da-fA-F]{2})\b/;
// SEL
var rESEL=/\b(SEL-.+)-R/;
try {
  procCSV(getOutput("Forescout_Information"));
} catch(ex) {
  print("ERROR: "+ex);
    }
```

8. Select **Save.**

9. Navigate to **Consoles > Add.**

10. Enter a name and connection details for the Splunk server. Select **Save.**



CONSOLES: Add *

Name: Splunk Console

Nickname:

Description:

Status: -

Device:

Connector: SSH with Password

Connection Details

Enable Failover: Unavailable

□ Exclusive Connect

Host IP: 10.100.200.101

Port: 22

Username: administrator

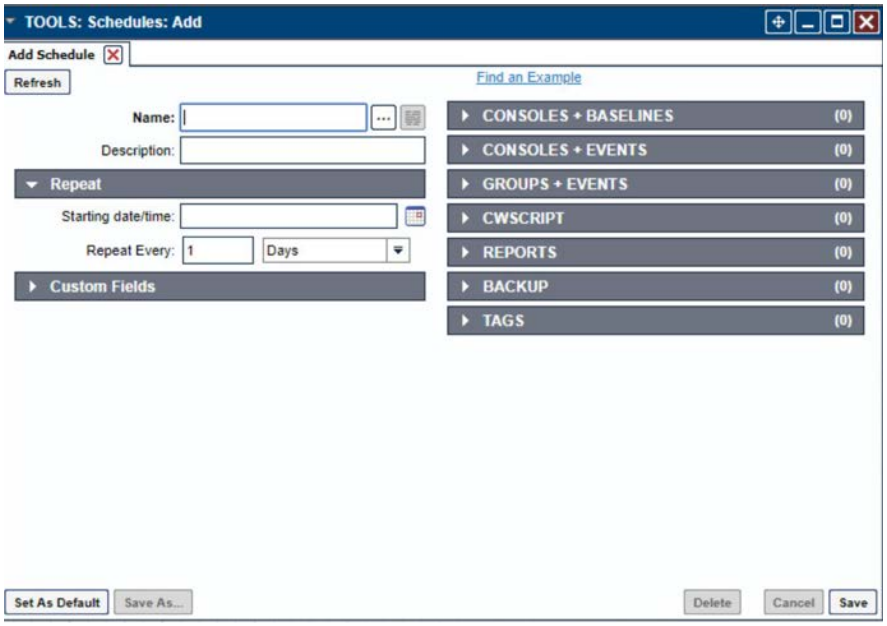
Password: •••••••••••

Retype Password: •••••••••••

Command:

11. Navigate to **Tools > Schedule.** Click **Add.**

12. Name the schedule. Set the time to run at an acceptable interval (this build set the interval to repeat daily). Under **CONSOLES + BASELINES,** click **Add.**



TOOLS: Schedules: Add

Name:

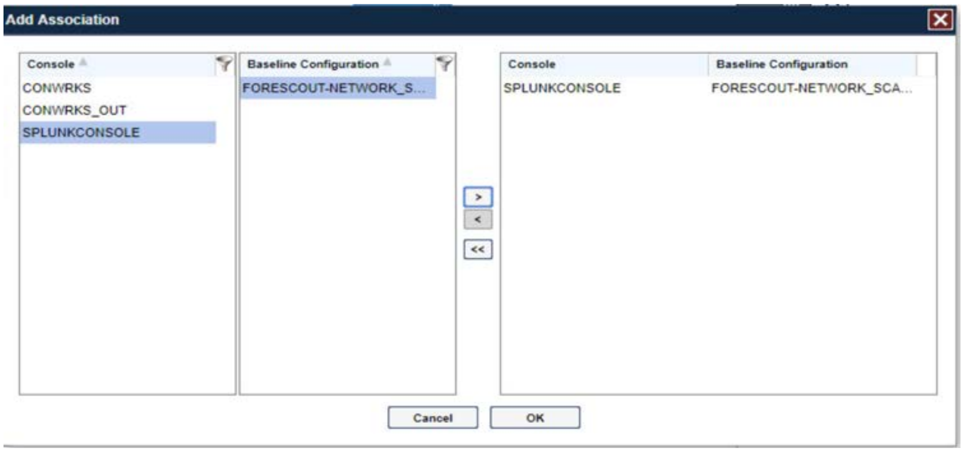
Description:

Repeat

Starting date/time:

Repeat Every: 1 Days

13. Select the previously created Splunk console and the imported baseline configuration. Click the arrow. Click **OK.**



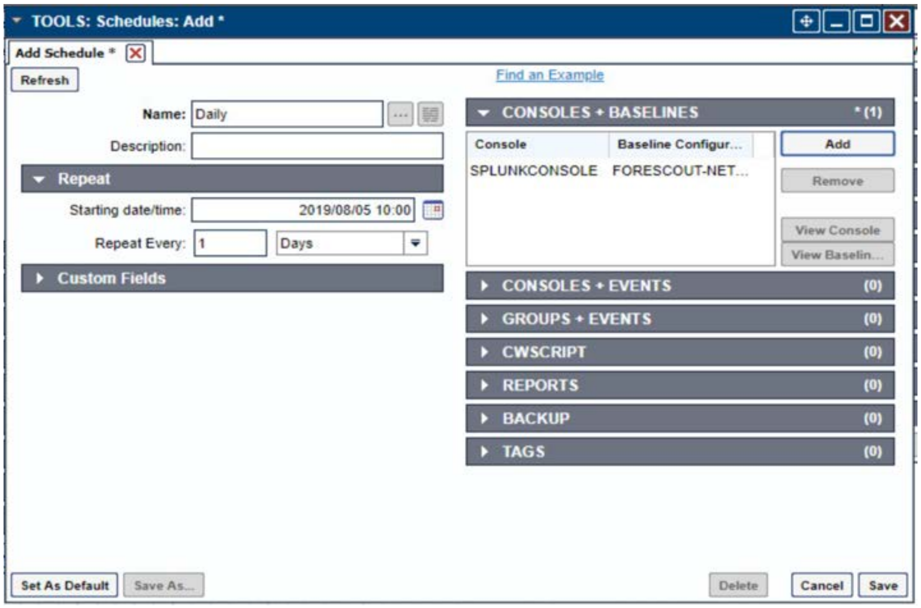
Add Association

Console
CONWRKS
CONWRKS_OUT
SPLUNKCONSOLE

Baseline Configuration
FORESCOUT-NETWORK_S...

Console	Baseline Configuration
SPLUNKCONSOLE	FORESCOUT-NETWORK_SCA...

14. Click **Save.**



TOOLS: Schedules: Add *

Add Schedule *

Name: Daily

Description:

Repeat

Starting date/time: 2019/08/05 10:00

Repeat Every: 1 Days

Custom Fields

CONSOLES + BASELINES *(1)

Console	Baseline Configur...
SPLUNKCONSOLE	FORESCOUT-NET...

CONSOLES + EVENTS (0)

GROUPS + EVENTS (0)

CWSCRIPT (0)

REPORTS (0)

BACKUP (0)

TAGS (0)

2.1.1.5 ConsoleWorks Configurations UMD

The following subsections document the software, hardware/VM, and network configurations for the ConsoleWorks server at UMD.

2.1.1.6 VM Configuration

The UMD ConsoleWorks VM is given the following resources:

- Windows Server 2016

- 2 CPU cores
- 100 GB hard Disks
- 12 GB RAM
- 2 NIC

2.1.1.7 Network Configuration

Network Configuration (Interface 1):

- DHCP: disabled
- IPv6: ignore
- IPv4: Manual
- IPv4 address: 10.100.1.6
- Netmask: 255.255.255.0

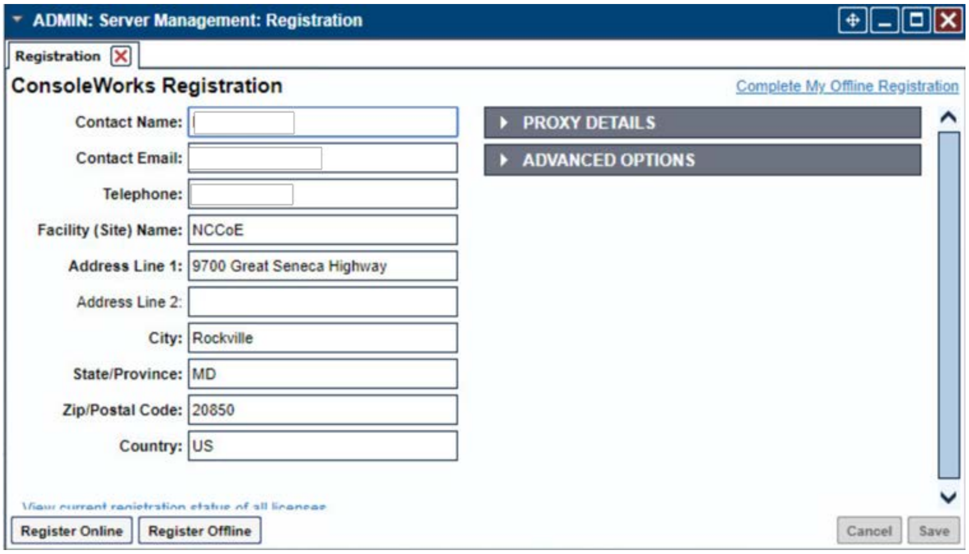
Network Configuration (Interface 2):

- DHCP: disabled
- IPv6: ignore
- IPv4: Manual
- IPv4 address: 172.16.2.82
- Netmask: 255.255.255.248

2.1.1.8 Installation

1. Download the installation kit from the http://support.tditechnologies.com website. A username and password are required, so contact TDi Support at support@tditechnologies.com to request them.
2. Run the installer *cw_server_<version>.exe.*
3. Download the Splunk universal forwarder installer from the https://www.splunk.com/en_us/download/universal-forwarder.html website. A username and password are required. An account can be created on the Splunk website.
4. Use the splunkforwarder-<version>-x64-release.msi installer to install the Splunk Universal Forwarder on the machine running the ConsoleWorks.

5. Connect to the Console at *https://10.100.1.6:5176*. Log in using the default credentials.



ADMIN: Server Management: Registration

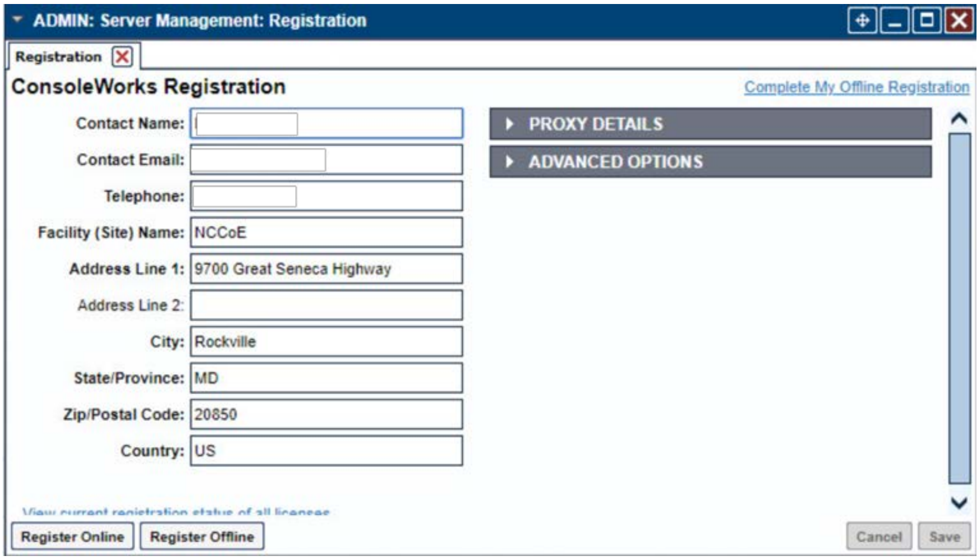
Registration

ConsoleWorks Registration

Contact Name:
Contact Email:
Telephone:
Facility (Site) Name: NCCoE
Address Line 1: 9700 Great Seneca Highway
Address Line 2:
City: Rockville
State/Province: MD
Zip/Postal Code: 20850
Country: US

Complete My Offline Registration
PROXY DETAILS
ADVANCED OPTIONS
View current registration status of all licenses
Register Online
Register Offline
Cancel
Save

6. Fill in the details for **Registration**. Click **Register Online.** Click **Save.**



ADMIN: Server Management: Registration

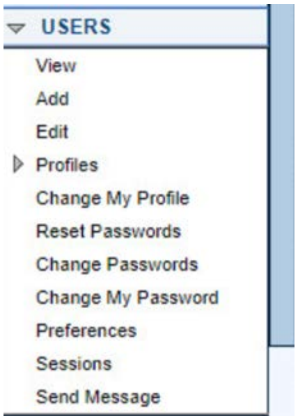
Registration

ConsoleWorks Registration

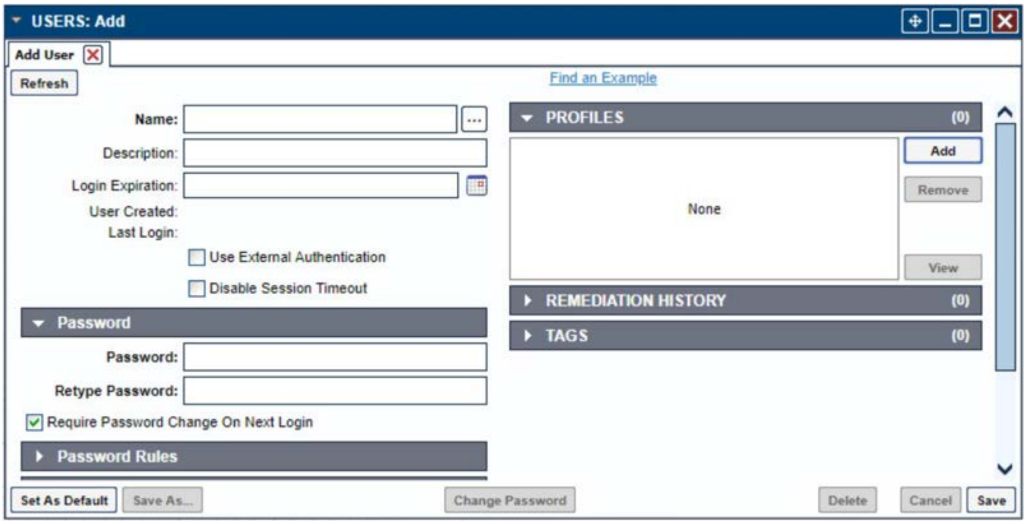
Contact Name:
Contact Email:
Telephone:
Facility (Site) Name: NCCoE
Address Line 1: 9700 Great Seneca Highway
Address Line 2:
City: Rockville
State/Province: MD
Zip/Postal Code: 20850
Country: US

Complete My Offline Registration
PROXY DETAILS
ADVANCED OPTIONS
View current registration status of all licenses
Register Online
Register Offline
Cancel
Save

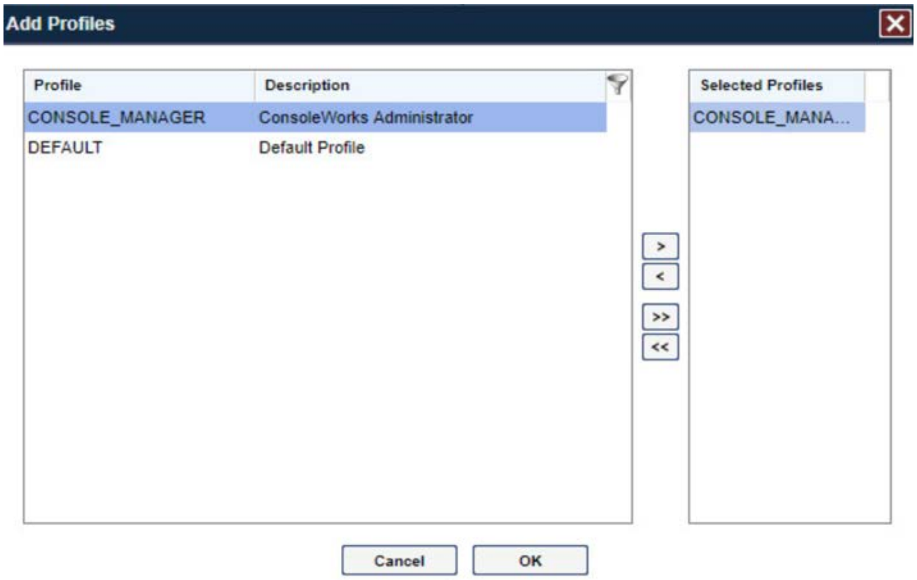
7. Create a new user. Navigate on left to **Users > Add.**



8. Enter the name and password. Select **Add.**



9. Add **CONSOLE_MANAGER** as a selected profile, as shown in the screenshot below. Select **OK.**



Add Profiles

Profile	Description
CONSOLE_MANAGER	ConsoleWorks Administrator
DEFAULT	Default Profile

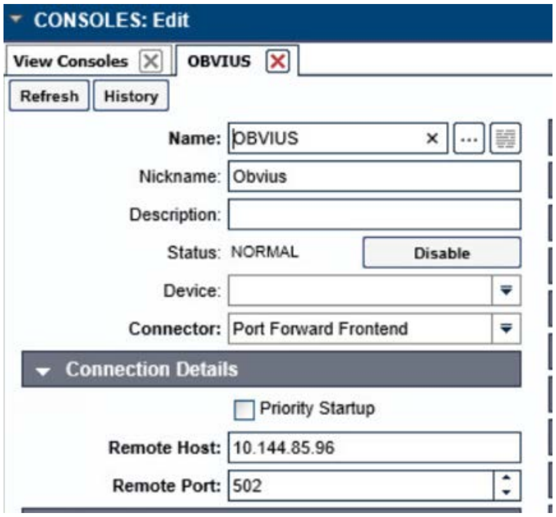
Selected Profiles
CONSOLE_MANA...

10. Click **Save.**

2.1.1.9 Configuration

ConsoleWorks provides the scripts to query the Modbus server. The script provided is in XML format.

1. Navigate to **Consoles > Add.**
2. Enter a name and connection details that will be used to connect to the Obvius data acquisition server. Select **Save.**



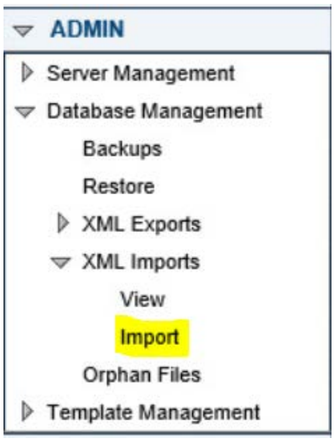
CONSOLES: Edit

Name: OBVIUS
Nickname: Obvius
Description:
Status: NORMAL
Device:
Connector: Port Forward Frontend

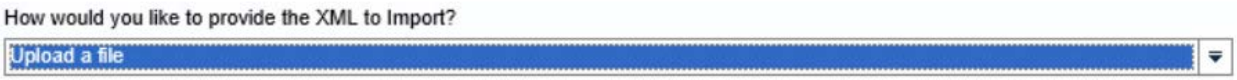
Connection Details

□ Priority Startup
Remote Host: 10.144.85.96
Remote Port: 502

3. Navigate to **Admin > Database Management > XML Imports > Import.**



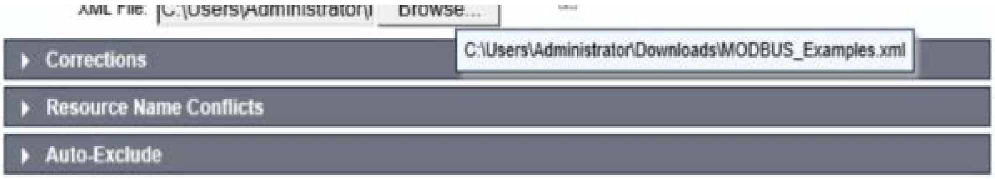
4. Select **Upload a file,** then click **Next.**



How would you like to provide the XML to Import?

Upload a file

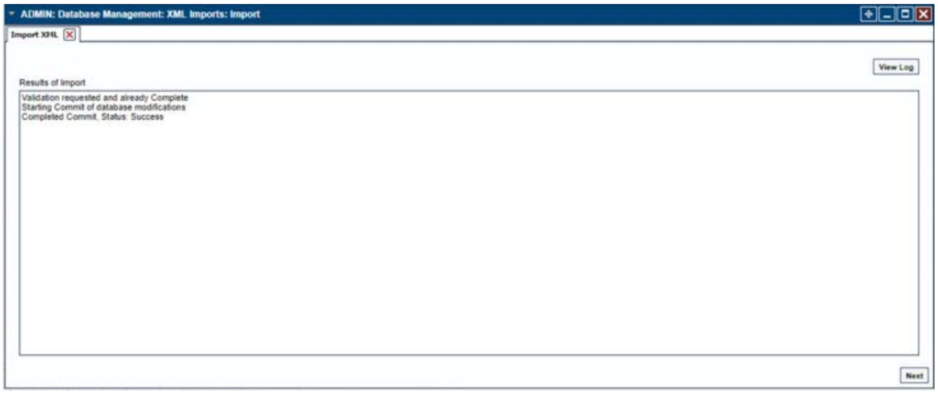
5. Click **Browse,** then find the XML file.



XML File: C:\Users\Administrator\ Browse...

C:\Users\Administrator\Downloads\MODBUS_Examples.xml

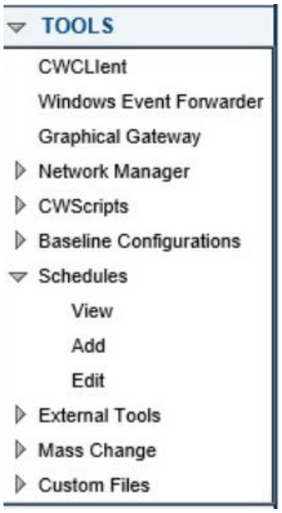
6. Click **Next.** ConsoleWorks will import the two CWScripts: *UTIL_MODBUS* and *UTIL_MODBUS_GE.*



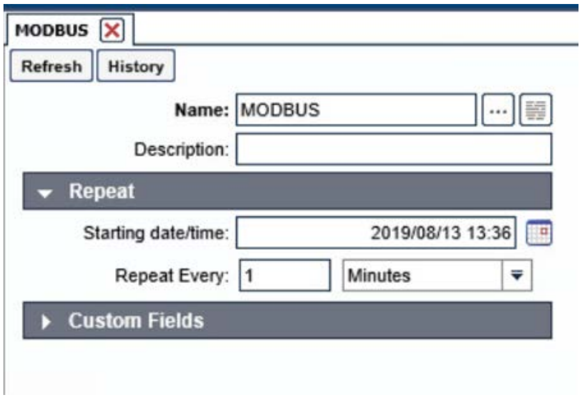
Results of Import

```
Validation requested and already Complete
Starting Commit of database modifications
Completed Commit, Status: Success
```

7. Navigate to **Tools > Schedule.** Click **Add.**



8. Name the schedule. Set the time to run at an acceptable interval, then **save.**



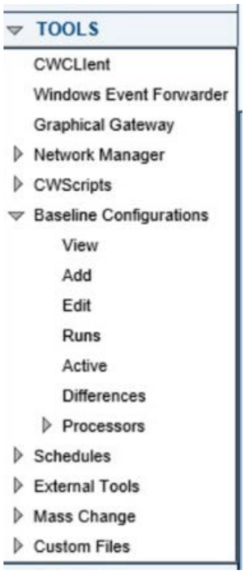
Name: MODBUS

Description:

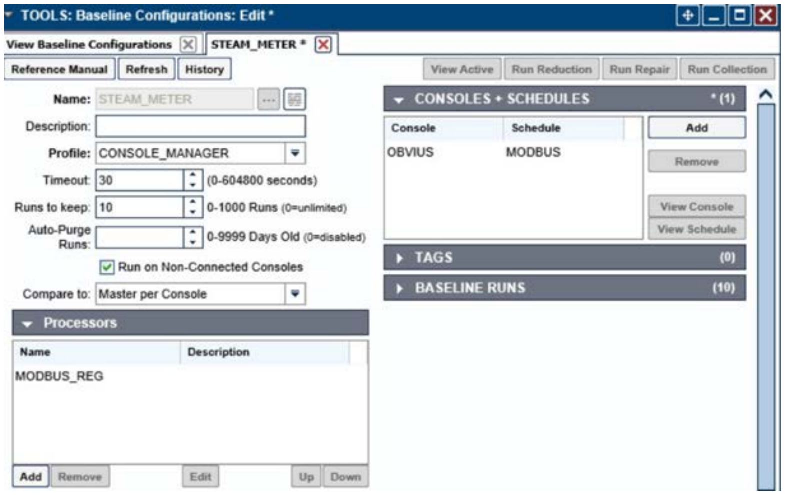
Starting date/time: 2019/08/13 13:36

Repeat Every: 1 Minutes

9. Navigate to **Tools > Baseline Configurations > Add.**



10. Name the baseline, and set the Profile to **CONSOLE_MANAGER.**



Name: STEAM_METER

Description:

Profile: CONSOLE_MANAGER

Timeout: 30 (0-604800 seconds)

Runs to keep: 10 0-1000 Runs (0=unlimited)

Auto-Purge Runs: 0-9999 Days Old (0=disabled)

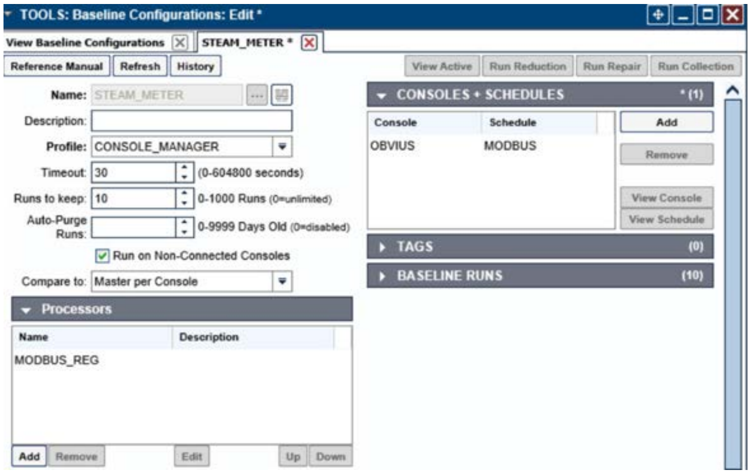
☑ Run on Non-Connected Consoles

Compare to: Master per Console

Console	Schedule
OBVIUS	MODBUS

Name	Description
MODBUS_REG	

11. Create a Processor to collect the information from the OBVIUS server. Click **Add** under **Processors.**

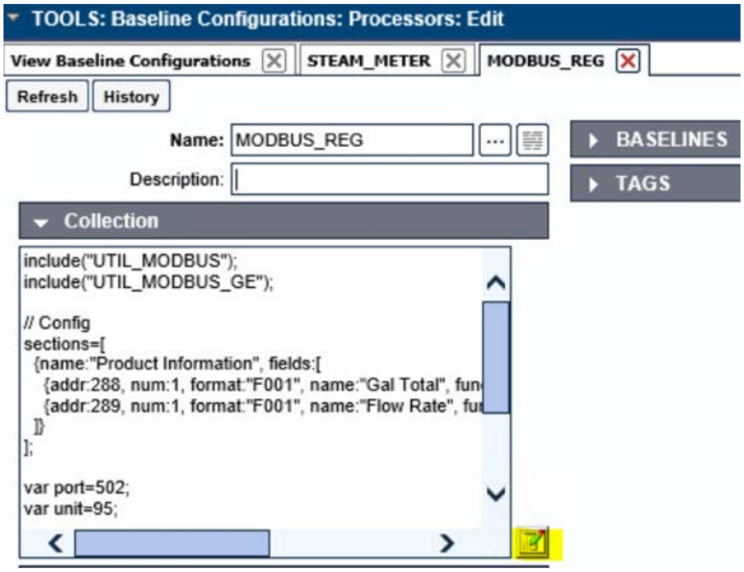


Name: STEAM_METER
Description:
Profile: CONSOLE_MANAGER
Timeout: 30 (0-604800 seconds)
Runs to keep: 10 0-1000 Runs (0=unlimited)
Auto-Purge Runs: 0-9999 Days Old (0=disabled)
☑ Run on Non-Connected Consoles
Compare to: Master per Console

Console	Schedule
OBVIUS	MODBUS

Name	Description
MODBUS_REG	

12. Name the Processor, then click the highlighted button. Enter the text that follows, then click **Save.**


TOOLS: Baseline Configurations: Processors: Edit
View Baseline Configurations
STEAM_METER
MODBUS_REG
Refresh
History
BASELINES
TAGS
Collection

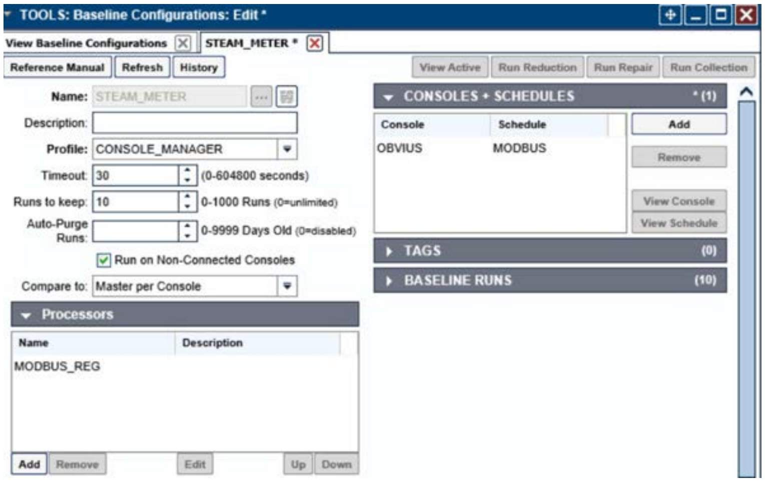
Name: MODBUS_REG
Description:

```
include("UTIL_MODBUS");
include("UTIL_MODBUS_GE");

// Config
sections=[
  {name:"Product Information", fields:[
    {addr:288, num:1, format:"F001", name:"Gal Total", fun
    {addr:289, num:1, format:"F001", name:"Flow Rate", fu
  ]}
];

var port=502;
var unit=95;
```

```
include("UTIL_MODBUS");
include("UTIL_MODBUS_GE");

// Config
sections=[
  {name:"Product Information", fields:[
    {addr:288, num:1, format:"F001", name:"Gal Total", functionName:
readHoldingRegisters},
    {addr:289, num:1, format:"F001", name:"Flow Rate", functionName:
readHoldingRegisters},
  ]}
];
```

```
var port=502;
var unit=95;

// Execute
var server=console.port;

for(var s=0;s<sections.length;s++) {
  setOutput(sections[s].name, formatGEOutput(modbusConnection(server, port, unit,
sections[s].fields)));
  log("SPLUNK",formatGEOutput(modbusConnection(server, port, unit,
sections[s].fields)));
}
```

13. Return the **Baseline Configuration**, then under **CONSOLE + SCHEDULES**, select **Add.**



Name: STEAM_METER
Description:
Profile: CONSOLE_MANAGER
Timeout: 30 (0-604800 seconds)
Runs to keep: 10 0-1000 Runs (0=unlimited)
Auto-Purge Runs: 0-9999 Days Old (0=disabled)
☑ Run on Non-Connected Consoles
Compare to: Master per Console

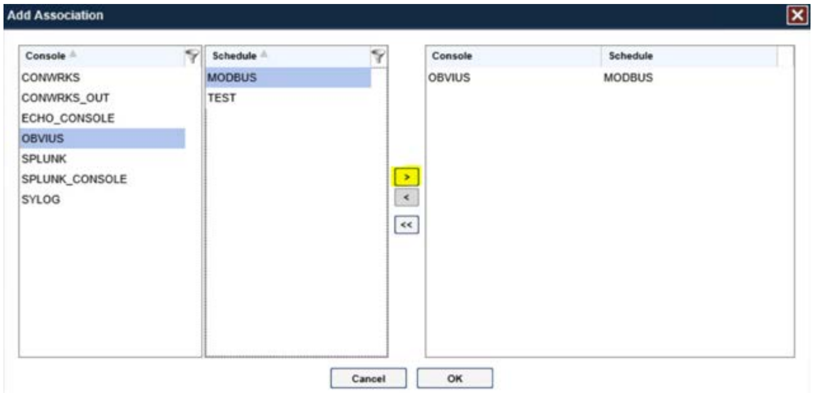
CONSOLES + SCHEDULES * (1)

Console	Schedule
OBVIUS	MODBUS

Processors

Name	Description
MODBUS_REG	

14. Under **Console**, select **OBVIUS,** and select **MODBUS**, then click **>.**

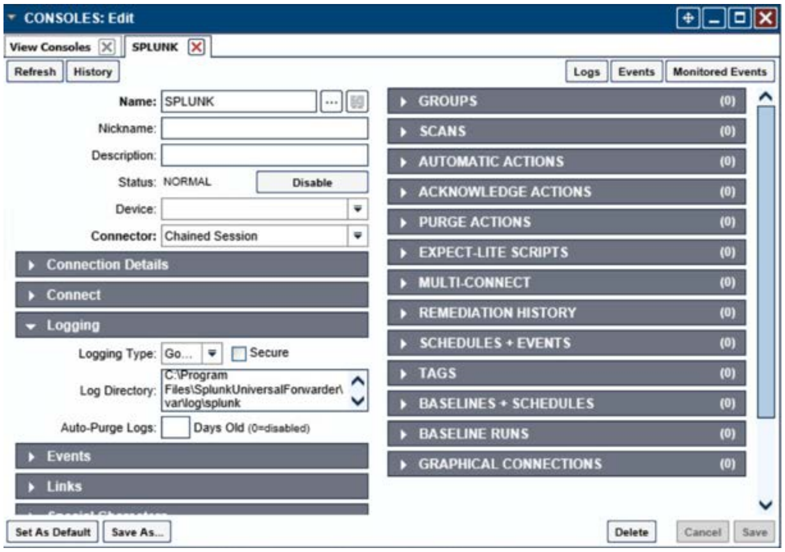


Console
CONWRKS
CONWRKS_OUT
ECHO_CONSOLE
OBVIUS
SPLUNK
SPLUNK_CONSOLE
SYLOG

Schedule
MODBUS
TEST

Console	Schedule
OBVIUS	MODBUS

15. Create the SPLUNK console to log the collected Modbus registers at **Console > Add.**



Name: SPLUNK

Nickname:

Description:

Status: NORMAL

Device:

Connector: Chained Session

Logging Type: Go... □ Secure

Log Directory: C:\Program Files\SplunkUniversalForwarder\var\log\splunk

Auto-Purge Logs: Days Old (0=disabled)

16. Name the **Console**, and set the connector to **Chain Session**, the log type to **Governed**, and the Log Directory to the below location:

```
C:\Program Files\SplunkUniversalForwarder\log\splunk
```

17. Navigate to *C:\Program Files\SplunkUniversalForwarder\etc\system\local\*

18. Add the following lines to the *outputs.conf* file:

```
[tcpout:default-autolb-group]

server = 10.100.200.101:9997

[tcpout-server://10.100.200.101:9997]
```

19. Add the following lines to the *inputs.conf* file:

```
[monitor://$SPLUNK_HOME\var\log\splunk\SPLUNK.LOG*]

index = modbus
```

2.2 Forescout CounterACT

Forescout CounterACT is used as a data collection and inventory tool. The CounterACT appliance actively collects data from the ICS lab in Plano, Texas. The appliance reports back to the CounterACT Enterprise Manager on the enterprise network in Rockville, Maryland. Once installed, the appliance is configured and managed through the enterprise manager.

Forescout CounterACT can be deployed on virtual or physical appliances. For virtualized environments, VMware ESXi, Microsoft Hyper-V, and KVM hypervisors are supported. Large networks that require multiple physical or virtual appliances can be centrally managed by the Enterprise Manager.

https://www.forescout.com/platform/specifications/#virtual-appliance

Note: Some network-related information has been redacted.

2.2.1 CounterACT Enterprise Manager Configuration

2.2.1.1 VM Configuration

The CounterACT Enterprise Manager is configured as follows:

- Red Hat Enterprise Linux 7
- CPU cores
- 16 GB of RAM
- 200 GB of storage
- 1 NIC

2.2.1.2 Network

Network Configuration (Interface 1):

- IPv4: Manual
- IPv6: disabled
- IPv4 address: 10.100.100.33
- Netmask: 255.255.255.0
- Gateway: 10.100.100.1

2.2.1.3 Installation

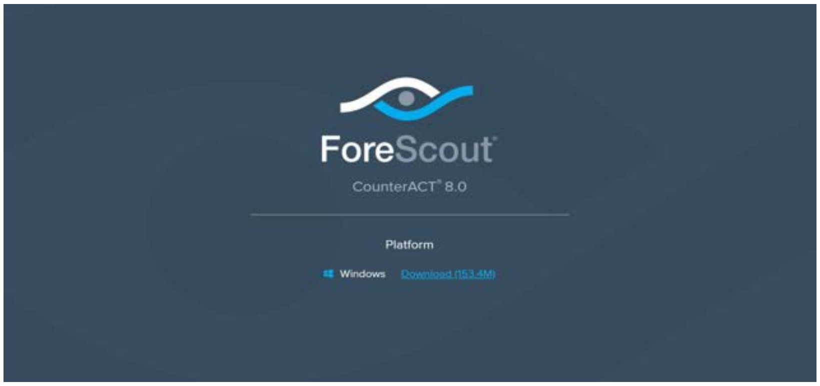
To install CounterACT Enterprise Manager, refer to the installation guide available at https://www.forescout.com/company/resources/forescout-installation-guide-8-1/.

2.2.1.4 Configuration

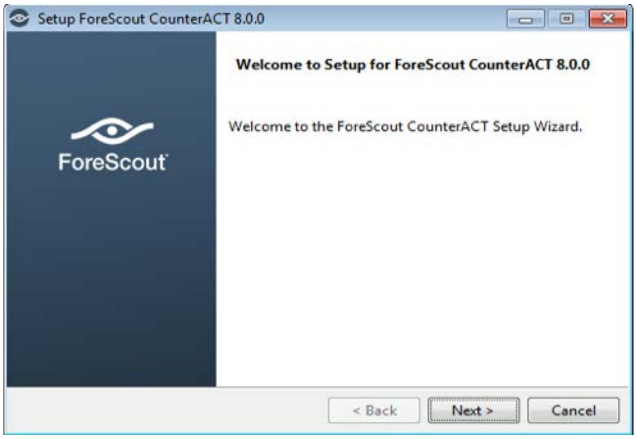
The following steps contain configuration instructions for scanning devices at the Plano location. For additional CounterACT configuration details, refer to the administration guide at https://www.forescout.com/wp-content/uploads/2018/11/counteract-administration-guide-8.0.1.pdf.

The CounterACT Enterprise Manager and CounterACT Appliance can be managed through the CounterACT console. Complete the following steps to install the console on a Windows desktop:

1. Download the executable from a Forescout portal.
2. Select the CounterACT Console Setup file. The CounterACT Console software download screen opens.



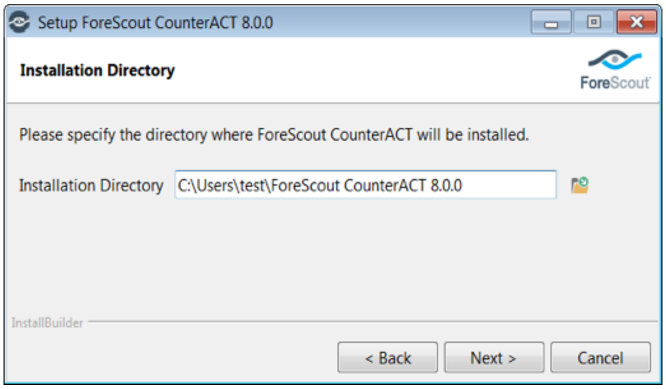
3. Select the download link required, and save the EXE file.
4. Select and run the file to begin the installation. The **Setup Wizard** opens. Select **Next.**



Welcome to Setup for ForeScout CounterACT 8.0.0

Welcome to the ForeScout CounterACT Setup Wizard.

5. Use the default installation directory. Click **Next.**



Setup ForeScout CounterACT 8.0.0

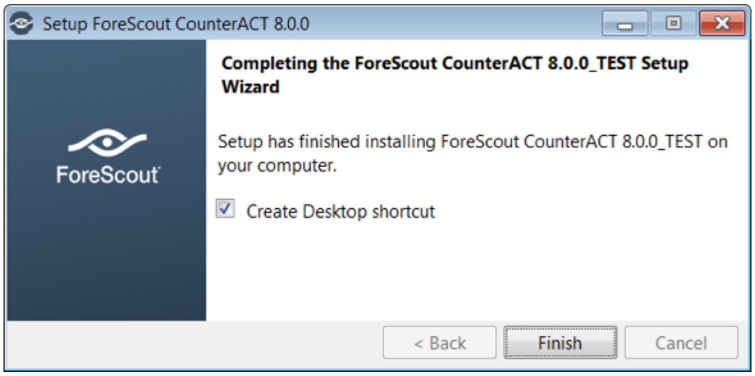
Installation Directory

Please specify the directory where ForeScout CounterACT will be installed.

Installation Directory: C:\Users\test\ForeScout CounterACT 8.0.0

6. Click **Next.**

7. The installation begins. When completed, click **Finish.**



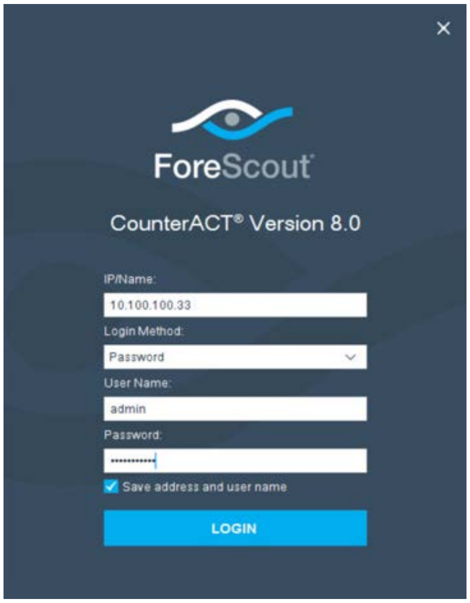
Setup ForeScout CounterACT 8.0.0

Completing the ForeScout CounterACT 8.0.0_TEST Setup Wizard

Setup has finished installing ForeScout CounterACT 8.0.0_TEST on your computer.

☑ Create Desktop shortcut

8. Connect to the Enterprise Manager with the Console and the password used during the CounterACT Enterprise Manager installation.



IP/Name: 10.100.100.33

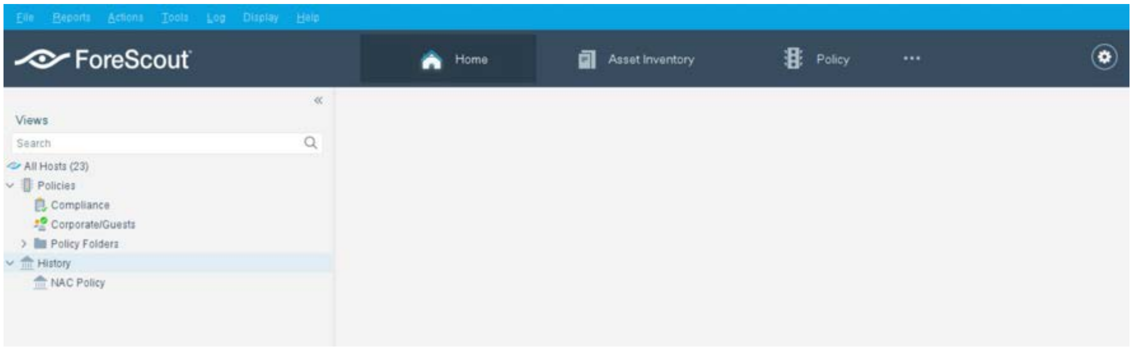
Login Method: Password

User Name: admin

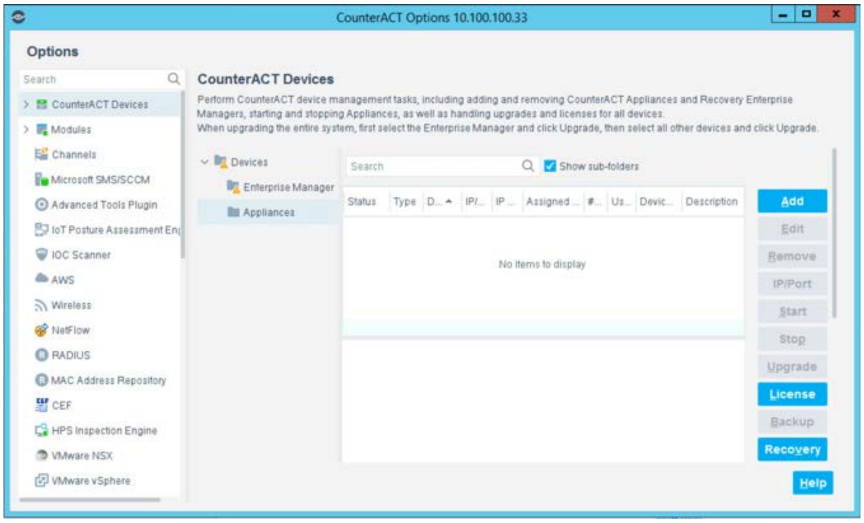
Password: •••••••••••

☑ Save address and user name

9. Select the gear icon in the top right of console.



10. Select **Add.**

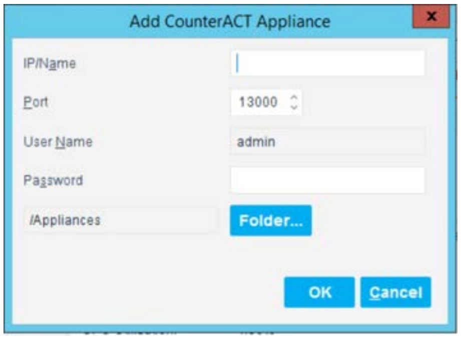


CounterACT Devices

Perform CounterACT device management tasks, including adding and removing CounterACT Appliances and Recovery Enterprise Managers, starting and stopping Appliances, as well as handling upgrades and licenses for all devices.
When upgrading the entire system, first select the Enterprise Manager and click Upgrade, then select all other devices and click Upgrade.

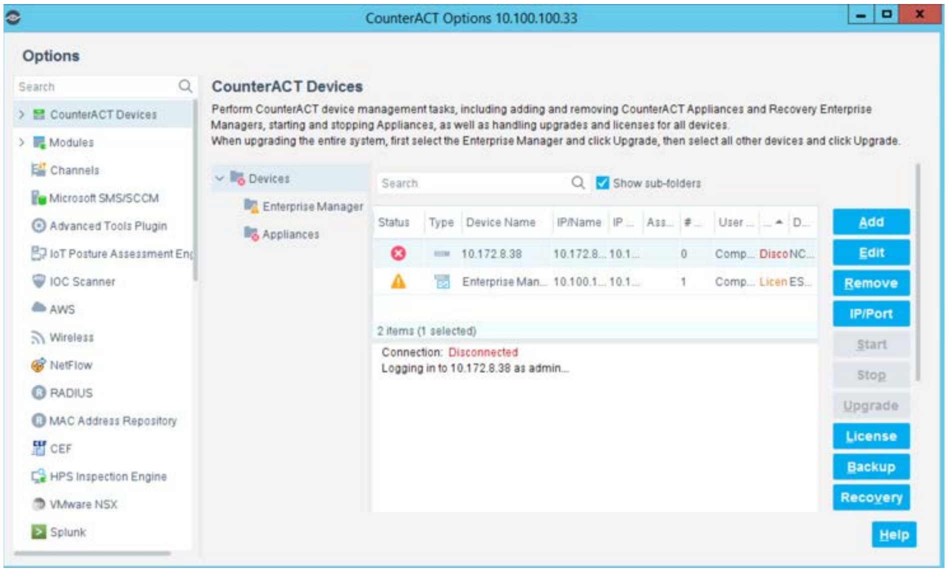
11. Enter the internet protocol (IP) address of the appliance, and the admin password used in setup.

12. Select **OK.**



IP/Name
Port 13000
User Name admin
Password
/Appliances

13. Highlight the new appliance, and select **License.**



CounterACT Options 10.100.100.33

Options

Search

CounterACT Devices
Modules
Channels
Microsoft SMS/SCCM
Advanced Tools Plugin
IoT Posture Assessment Eng
IOC Scanner
AWS
Wireless
NetFlow
RADIUS
MAC Address Repository
CEF
HPS Inspection Engine
VMware NSX
Splunk

CounterACT Devices

Perform CounterACT device management tasks, including adding and removing CounterACT Appliances and Recovery Enterprise Managers, starting and stopping Appliances, as well as handling upgrades and licenses for all devices.
When upgrading the entire system, first select the Enterprise Manager and click Upgrade, then select all other devices and click Upgrade.

Devices
Enterprise Manager
Appliances

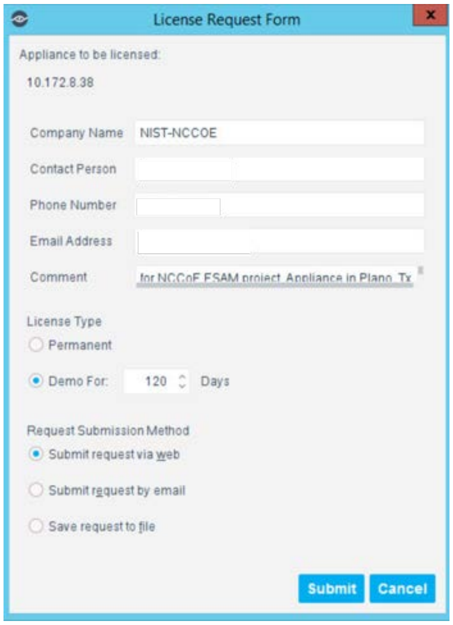
Search ☑ Show sub-folders

Status	Type	Device Name	IP/Name	IP ...	Ass...	# ...	User ...	... ▲	D...
✖		10.172.8.38	10.172.8...	10.1...		0	Comp...	Disco	NC...
⚠		Enterprise Man...	10.100.1...	10.1...		1	Comp...	Licen	ES...

2 items (1 selected)

Connection: Disconnected
Logging in to 10.172.8.38 as admin...

14. Enter the required information. Select **Submit.**



License Request Form

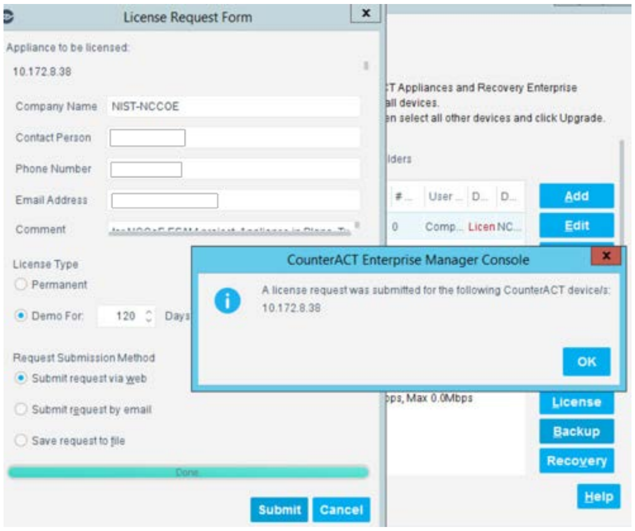
Appliance to be licensed:
10.172.8.38

Company Name	NIST-NCCOE
Contact Person	
Phone Number	
Email Address	
Comment	for NCCoE ESAM project. Appliance in Plano, Tx

License Type
○ Permanent
● Demo For: 120 Days

Request Submission Method
● Submit request via web
○ Submit request by email
○ Save request to file

15. Select **OK.**



License Request Form

Appliance to be licensed:

10.172.8.38

Company Name: NIST-NCCOE

Contact Person:

Phone Number:

Email Address:

License Type

○ Permanent

● Demo For: 120 Days

Request Submission Method

● Submit request via web

○ Submit request by email

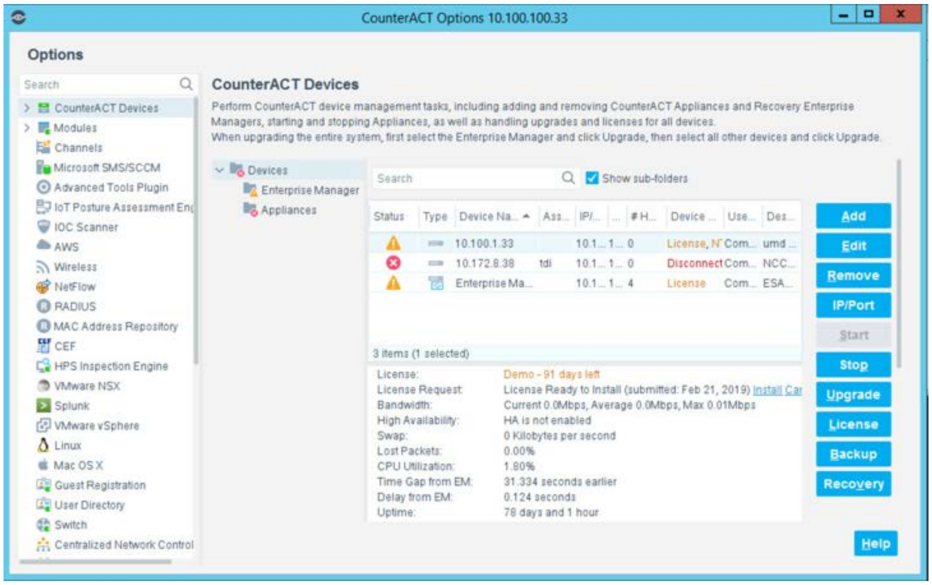
○ Save request to file

CounterACT Enterprise Manager Console

A license request was submitted for the following CounterACT device/s:
10.172.8.38

2.2.1.4.1 Appliance Interfaces Configurations

1. Under **Options**, highlight the appliance, and select **Edit.**



CounterACT Options 10.100.100.33

CounterACT Devices

Perform CounterACT device management tasks, including adding and removing CounterACT Appliances and Recovery Enterprise Managers, starting and stopping Appliances, as well as handling upgrades and licenses for all devices.
When upgrading the entire system, first select the Enterprise Manager and click Upgrade, then select all other devices and click Upgrade.

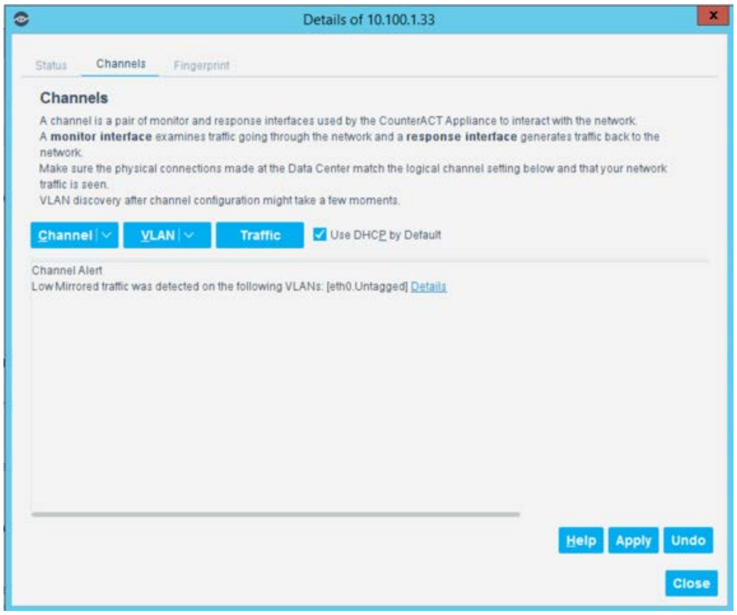
☑ Show sub-folders

Status	Type	Device Na...	Ass...	IP/...	...	# H...	Device ...	Use...	Des...
⚠		10.100.1.33		10.1...	1...	0	License, N	Com...	umd ...
⊗		10.172.8.38	tdi	10.1...	1...	0	Disconnect	Com...	NCC...
⚠		Enterprise Ma...		10.1...	1...	4	License	Com...	ESA...

3 items (1 selected)

License:	Demo - 91 days left
License Request:	License Ready to Install (submitted: Feb 21, 2019) Install Car
Bandwidth:	Current 0.0Mbps, Average 0.0Mbps, Max 0.01Mbps
High Availability:	HA is not enabled
Swap:	0 Kilobytes per second
Lost Packets:	0.00%
CPU Utilization:	1.80%
Time Gap from EM:	31.334 seconds earlier
Delay from EM:	0.124 seconds
Uptime:	78 days and 1 hour

2. Select the **Channels** tab.



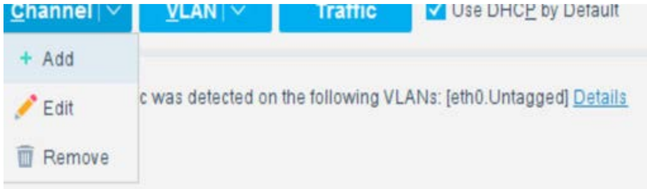
Channels

A channel is a pair of monitor and response interfaces used by the CounterACT Appliance to interact with the network.
A **monitor interface** examines traffic going through the network and a **response interface** generates traffic back to the network.
Make sure the physical connections made at the Data Center match the logical channel setting below and that your network traffic is seen.
VLAN discovery after channel configuration might take a few moments.

☑ Use DHCP by Default

Channel Alert
Low Mirrored traffic was detected on the following VLANs: [eth0.Untagged] Details

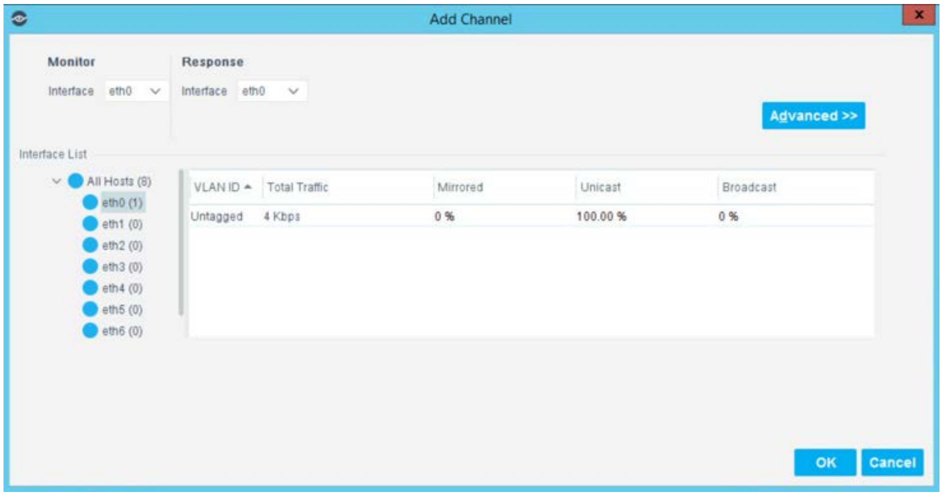
3. Under **Channel,** select **Add.**



☑ Use DHCP by Default

c was detected on the following VLANs: [eth0.Untagged] Details

4. Use the drop-down to select the interface listening on a switched port analyzer (SPAN) switch for both **Monitor** and **Response.** Select **OK.**



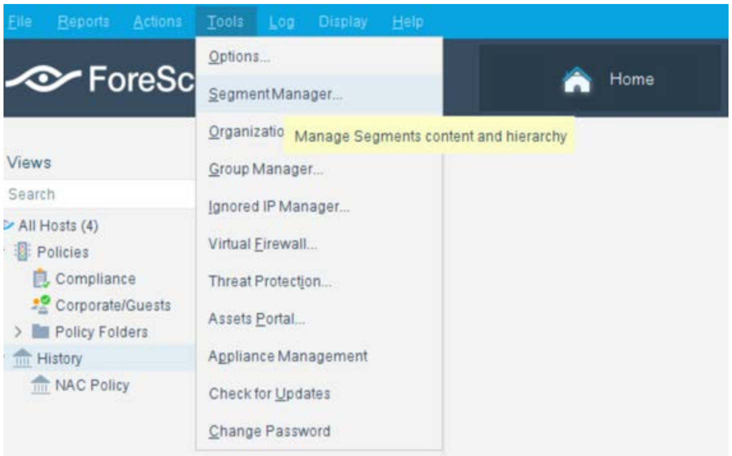
Monitor
Interface eth0

Response
Interface eth0

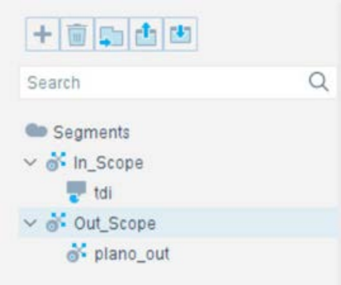
Interface List
- All Hosts (8)
  - eth0 (1)
  - eth1 (0)
  - eth2 (0)
  - eth3 (0)
  - eth4 (0)
  - eth5 (0)
  - eth6 (0)

VLAN ID ▲	Total Traffic	Mirrored	Unicast	Broadcast
Untagged	4 Kbps	0 %	100.00 %	0 %

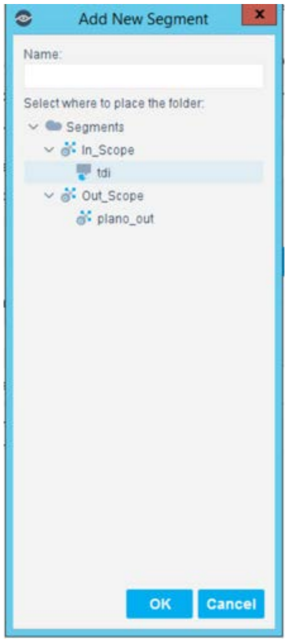
5. Under **Tools,** select **Segment Manager.**



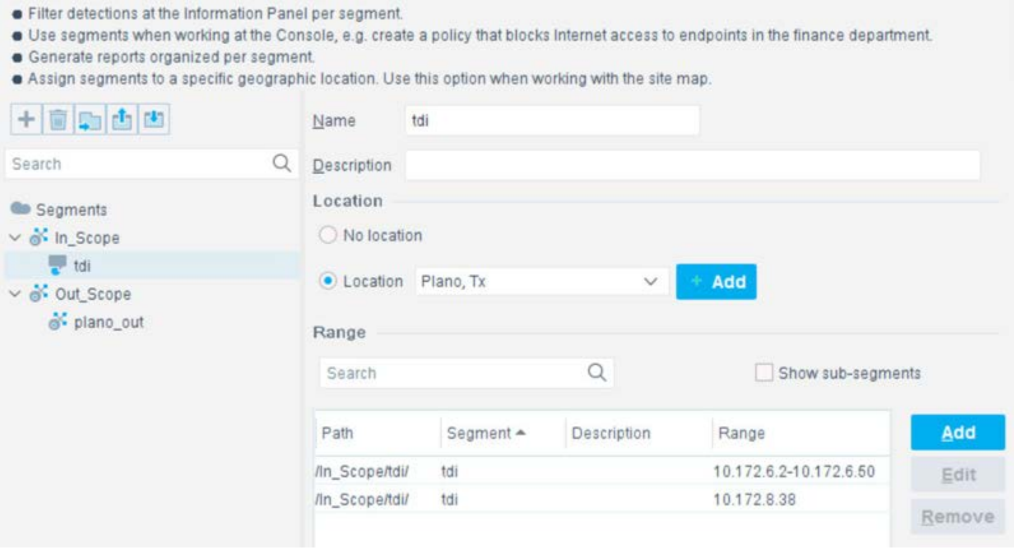
6. Select the **+** to add and name two segments called *In_Scope* and *Out_Scope*. Click **OK.** These will indicate which IP range should be scanned and which should not be scanned.



7. Select the plus icon again to add two subsegments shown in the screenshot below. Click **OK.**



8. Highlight the *tdi* segment. Click **Add** to add the range of IP addresses to scan. Click **OK.**



- Filter detections at the Information Panel per segment.
- Use segments when working at the Console, e.g. create a policy that blocks Internet access to endpoints in the finance department.
- Generate reports organized per segment.
- Assign segments to a specific geographic location. Use this option when working with the site map.

Name: tdi

Description:

Location

○ No location

● Location: Plano, Tx

Range

□ Show sub-segments

Path	Segment	Description	Range
/In_Scope/tdi/	tdi		10.172.6.2-10.172.6.50
/In_Scope/tdi/	tdi		10.172.8.38

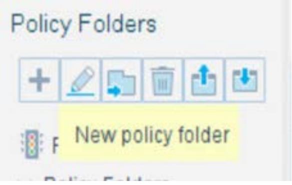
9. Repeat for the *plano_out* segment for IP address to not scan. Click **OK.**

2.2.1.4.2 Upload Network Scan Policies

Forescout network scan policies are prewritten and delivered as an XML file.

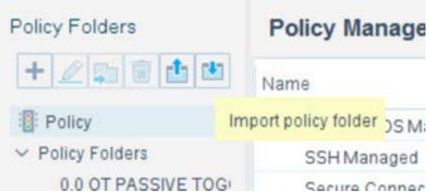
1. First, create a folder to house the polices. From the **Enterprise Manager** Console, select the **Policy** tab.

2. Select the plus icon to create a new folder.

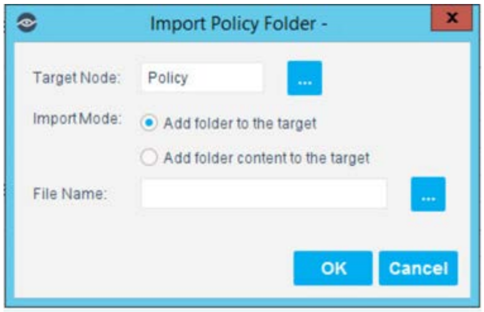


3. Name the folder. Click **OK.**

4. Select the **import policy** icon.



5. Select **…** to locate the XML file.



Target Node: Policy ...

Import Mode: ● Add folder to the target

○ Add folder content to the target

File Name: ...

6. Select the XML file.

7. Select **OK.**

8. Repeat Steps 4 to 7 for each XML policy file.

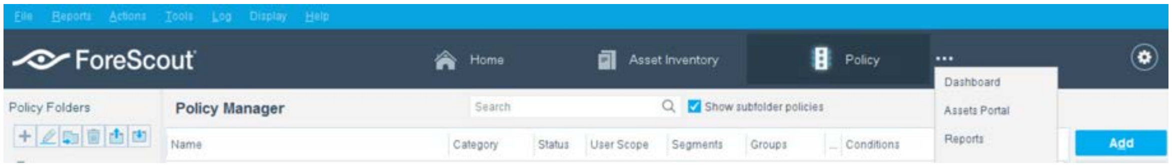
9. Select **Start.** Select **Apply** to start and apply the changes.

2.2.1.4.3 Splunk Integration

To complete Forescout Integration with Splunk, follow Forescout documentation found at https://www.forescout.com/platform/forescout-app-guide-splunk-2-7-0 and https://www.forescout.com/company/resources/extended-module-for-splunk-configuration-guide-2-8/.

2.2.1.4.4 Schedule Reporting

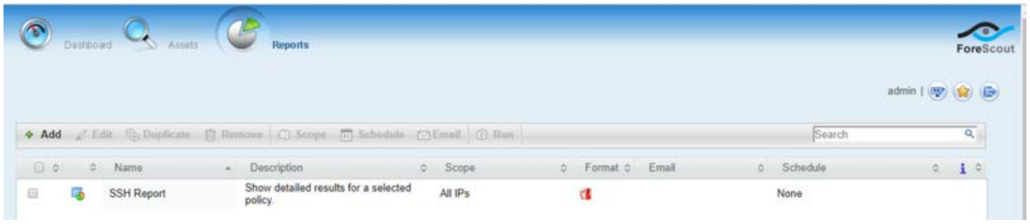
1. From the **Enterprise Manager** Console, select the ellipsis next to **Policy.** Select **Reports.**



2. Log in using the same credentials as the **Enterprise Manager** Console.

3. Select **Reports.**

4. Select **Add.**



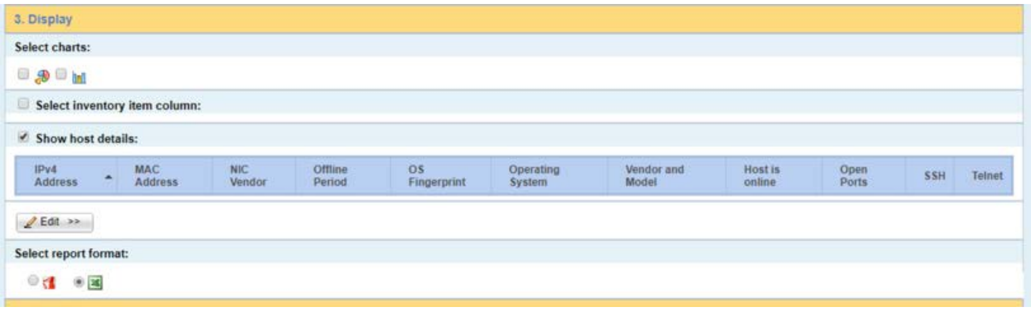
Name	Description	Scope	Format	Email	Schedule
SSH Report	Show detailed results for a selected policy.	All IPs			None

5. Select the **Asset Inventory** template. Click **Next.**

6. Name the report. Select the **All IPs** toggle**.**

7. Select only the **Show host details.**

8. Edit the host details to show the following properties:



3. Display

Select charts:

□ □

□ Select inventory item column:

☑ Show host details:

IPv4 Address	MAC Address	NIC Vendor	Offline Period	OS Fingerprint	Operating System	Vendor and Model	Host is online	Open Ports	SSH	Telnet

Select report format:

○ ●

9. Set a schedule. Enter an email address. Select **Save.**

2.2.2 CounterACT Appliance Configuration

2.2.2.1 Host Configuration

The CounterACT Appliance is delivered on a Dell PowerEdge R640 server with version 8.0.0.

2.2.2.2 Network

Network Configuration (Interface 1):

- IPv4: Manual
- IPv6: disabled
- IPv4 address: 10.172.8.38
- Netmask: 255.255.255.0
- Gateway: 10.172.8.1

2.2.2.3 Installation

To install the CounterACT Appliance, follow the installation steps found at https://www.forescout.com/wp-content/uploads/2018/10/CounterACT_Installation_Guide_8.0.1.pdf.

2.2.2.4 Configuration

After the CounterACT Appliance is installed, follow the steps outlined in Section 2.2.1, to connect the appliance to the enterprise manager and complete the configuration.

2.3 Dragos Platform

The Dragos Platform is an industrial control system cybersecurity-monitoring platform based around threat-behavior analytics. It is being used in this build to provide asset discovery and monitoring. A Dragos Sitestore is installed at the NCCoE enterprise site, and a midpoint sensor is installed at the Plano site. The Dragos sensor is managed by the site store.

2.3.1 Dragos Sitestore Configuration

In the example implementation, Dragos Sitestore is deployed as a pre-built appliance from the vendor. The appliance was still configured with parameters necessary for our environment. Connect to the Dragos appliance by navigating the web browser to *https://<IP address>*.

2.3.1.1 Host Configuration

The Dragos Platform is delivered to the customer, preconfigured for the environment. The NCCoE received a Dell server utilizing iDRAC for virtualization. On the iDRAC server, VMware ESXi was installed and utilized for creating the server.

The VMs created to house the product have the following specifications:

- Operating system (OS) Version: CentOS 7 (64-bit)
- CPU: 48 cores

- Memory: 192 GB
- Hard disc drive (HDD) 1: 200 GB
- HDD 2: 10 terabytes (TB)

2.3.1.2 Network

Networking for the device included a single network within ESXi to which the VM was connected. The Dell iDRAC server housing the Dragos Sitestore Puppet Server was connected to the ESAM network with the following IP addresses:

- iDRAC: 10.100.200.6
- ESXi: 10.100.200.7
- Dragos Sitestore Puppet: 10.100.200.8

2.3.1.3 Installation

Installation began with setting up a VM. Utilizing the specifications in Section 2.3.1.1, Host Configuration, a VM was created for the Sitestore/Puppet server. Then the product ISO was added to the CD/DVD Drive 1 location (*DragosCustom-2019-06-18-CentOS-7-x86_64-Everything-1810.iso*).

1. Power on the VM, and open a console. The **Dragos installation** screen will start, allowing options to be selected for installation type.
2. With the Dell R730 server used for the NCCoE, select **Install Dragos Sitestore Kickstart.** The installer automatically installs the Dragos Platform without interaction from the user.

2.3.1.4 Configuration

Once the installation has completed, the Sitestore will be configured with the needed files listed in Table 2-1.

Table 2-1 Dragos Required Files

Dragos Files	
sitestore-orchestration-1.5.1.1-1.noarch.rpm.gpg	*midpoint-images-1.5.1.1-1.x86_64.rpm.gpg*
midpoint-configs-1.5.1.1-1.x86_64.rpm.gpg	*midpoint-manager-1.1.2-1.el7.x86_64.rpm.gpg*
midpoint-1.5.1.1-1.x86_64.rpm.gpg	*mms-cli-1.1.0-1.x86_64.rpm.gpg*
upgrade-1.5.1-3.tar.gz.gpg	*containerd.io-1.2.0-3.el7.x86_64.rpm*
container-selinux-2.68-1.el7.noarch.rpm	*docker-ce-18.09.0-3.el7.x86_64.rpm*
docker-ce-cli-18.09.0-3.el7.x86_64.rpm	

1. Upload these files to the Sitestore VM in */var/opt/releases/.*

2. Change directory to */var/opt/releases/* and run the command `gpg --decrypt-file *.gpg`. Enter the password supplied from Dragos for the installation. This will create all the files required for the installation.
3. Change directory to */root/* and, as root user, run `./puppet_server_setup.sh`

2.3.2 Dragos Midpoint Sensor

Dragos Midpoint Sensor is also deployed as a pre-built appliance from the vendor. Options for the midpoint sensor consist of configurations for small, medium, and large deployments. The appliance is configured with parameters necessary for our environment. The Dragos Midpoint Sensor can be managed from the Sitestore.

2.3.2.1 Network

The midpoint sensor has multiple interfaces. One interface will collect traffic via SPAN port. Another will serve as the management interface to communicate with the device.

Dragos Midpoint Sensor Management Interface:

- DHCP: disabled
- IPv6: ignore
- IPv4: Manual
- IPv4 address: 10.172.6.10
- Netmask: 255.255.255.0

2.3.2.2 Configuration

After the midpoint sensor is deployed and listening on the correct interface, the midpoint sensor can connect back to the Sitestore for further configurations.

2.3.3 Dragos Splunk Integration

The Dragos Splunk application allows data integration from the Dragos Sitestore into the Splunk dashboard. This allows Splunk to aggregate data from Dragos and other products into a central location for analyst visualization. This process assumes the reader has downloaded the Dragos Splunk application from https://splunkbase.splunk.com/app/4601/.

1. To begin, log in to the Splunk instance, and select the gear icon on the top left of the screen next to **Apps,** to configure the applications.
2. On the top right of the screen, select **Install app from the file.**

3. Follow the on-screen instructions to upload the downloaded application.

4. Restart Splunk (either prompted by the installation process or self-directed).

5. From the Splunk **Settings** menu on the top right, select the **Data Inputs** option.

6. Select **Add New** under **Local Inputs** for a transmission control protocol (TCP) listener. (User datagram protocol [UDP] is not recommended, because it will cut off longer messages.)

7. Set the port to the one that you want to transfer data on. (NCCoE build used **10514**.)

8. Select **Next** to configure the Input Settings.

9. Choose **dragos_alert** as the source type.

10. Set the **App Context** to **Dragos Splunk App.**

11. Set the **Index** to **dragos_alerts.** (Create a new index if it does not exist.)

12. Click **Submit.**

Once this process is completed, Splunk is ready to receive data from Dragos. The following instructions will be for configuring the Dragos Sitestore for sending information to Splunk:

1. Navigate to the **Servers** tab at https://<sitestore>/syslog/app/#/servers.

2. Click **+ Add Server** to create a new server.

3. Configure the connection information to point to the Splunk server configured previously.

4. Set the following options:

    a. Protocol: TCP

    b. Message Format: RFC 5424 Modern Syslog

    c. Message Delimiter: Use newline delimiter for TCP and transport layer security (TLS) streams.

5. Click **NEXT: SET TEMPLATE.**

6. Set the following value (must be on one line for Splunk to properly process) as **Message:**

```
{ "app": "dragos:platform", "body": "${content}", "category": "${summary}",
"created_at": "#{createdAt}", "dest": "${dest_asset_ip}",
"dest_dragos_id": "${dest_asset_id}", "dest_host":
"${dest_asset_hostname}", "dest_ip": "${dest_asset_ip}", "dest_mac":
"${dest_asset_mac}", "dest_name": "${dest_asset_domain}",
"dragos_detection_quad": "${detection_quad}", "dragos_detector_id":
"${detector_id}", "dvc": "${asset_ip}", "dvc_dragos_id":
"${dest_asset_id}", "dvc_host": "${dest_asset_hostname}", "dvc_ip":
"${asset_ip}", "dvc_mac": "${dest_asset_mac}", "dvc_name":
```

```
"${dest_asset_domain}", "id": "${id}", "ids_type": "network",
"occurred_at": "#{occurredAt}", "severity_id": "${severity}",
"signature": "${source}", "src": "${src_asset_ip}", "src_dragos_id":
"${src_asset_id}", "src_host": "${src_asset_hostname}", "src_ip":
"${src_asset_ip}", "src_mac": "${src_asset_mac}", "src_name":
"${src_asset_domain}", "subject": "${type}", "type": "alert",
"vendor_product": "Dragos Platform" }
```

7. Select **Save.**

2.4 FoxGuard Patch and Update Management Program

The solution utilizes the FoxGuard PUMP to provide patch availability and vulnerability notifications for identified assets. For this build, ConsoleWorks collects asset data from Splunk then converts that data into the JavaScript object notation (JSON) format required for PUMP. The resulting JSON file includes asset information such as vendor, product, and version, as well as serial and model information about devices from the asset inventory. Asset data often contains critical details. However, PUMP does not require sensitive data, such as asset location and IP address. The file is encrypted and provided to the PUMP team via secure delivery. FoxGuard's preferred method of file transfer is secure file transfer protocol and does not require direct access to an entities network.

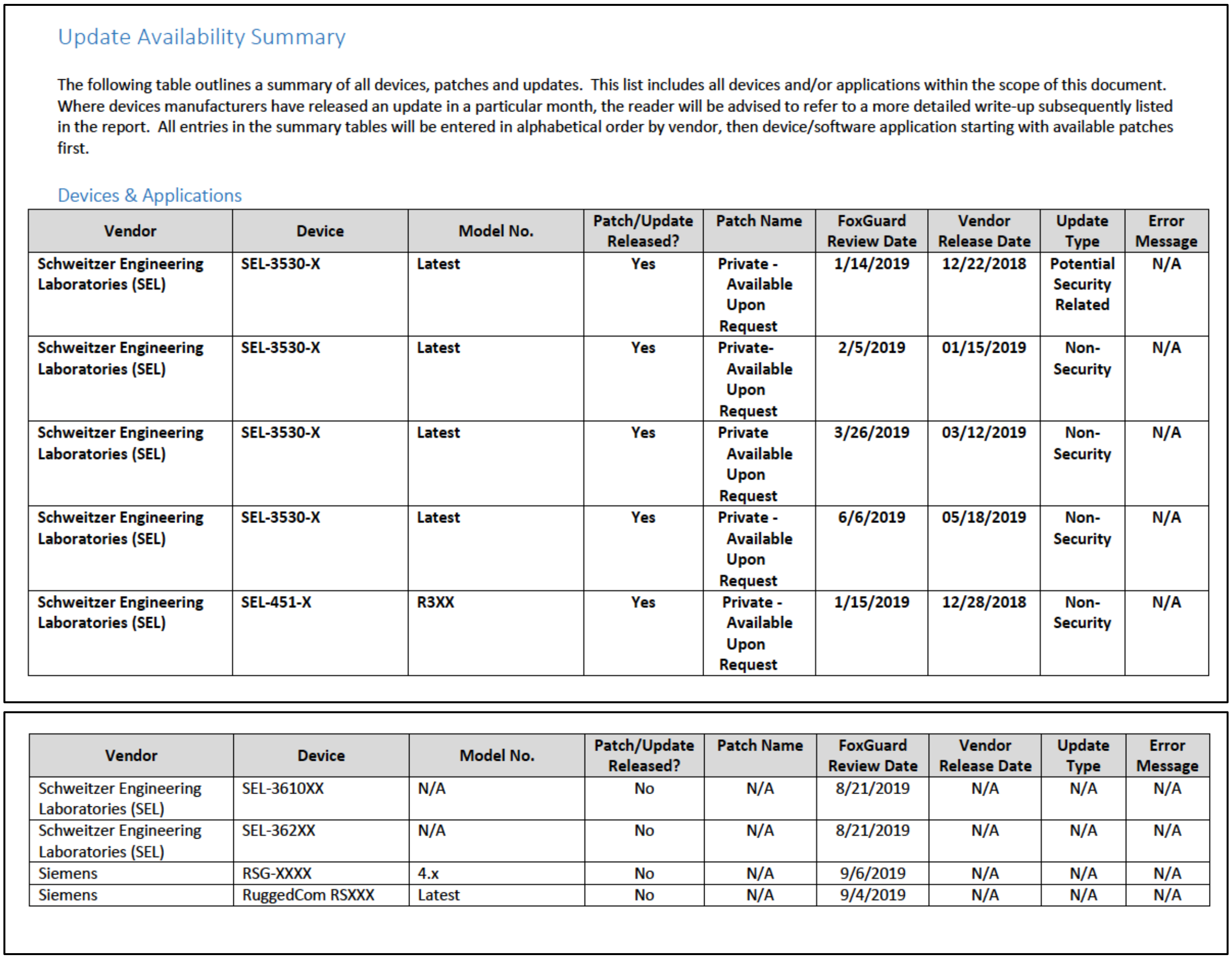
Once the asset data is received, the FoxGuard team analyzes the file for completeness. Any missing data, such as a serial number, version, or access to private patch data, is collected during the onboarding process with the end user. The final report is provided back to ConsoleWorks in a JSON file format and includes available patches and vulnerability notifications for each device. The data is then ingested back into Splunk for viewing and reporting. Reports are also available outside of the ConsoleWorks integration in portable document format (PDF) and comma separated value (CSV) format.

PUMP is a service managed by the FoxGuard team. The patch availability and vulnerability notification report does not require an installation. See Section 2.1 for configuring ConsoleWorks to automatically create the required JSON input file for the integration described in this guide.

2.4.1 Patch Report

Below are screenshots from the final patch report for this build.

Figure 2-1 Update Availability Summary



Update Availability Summary

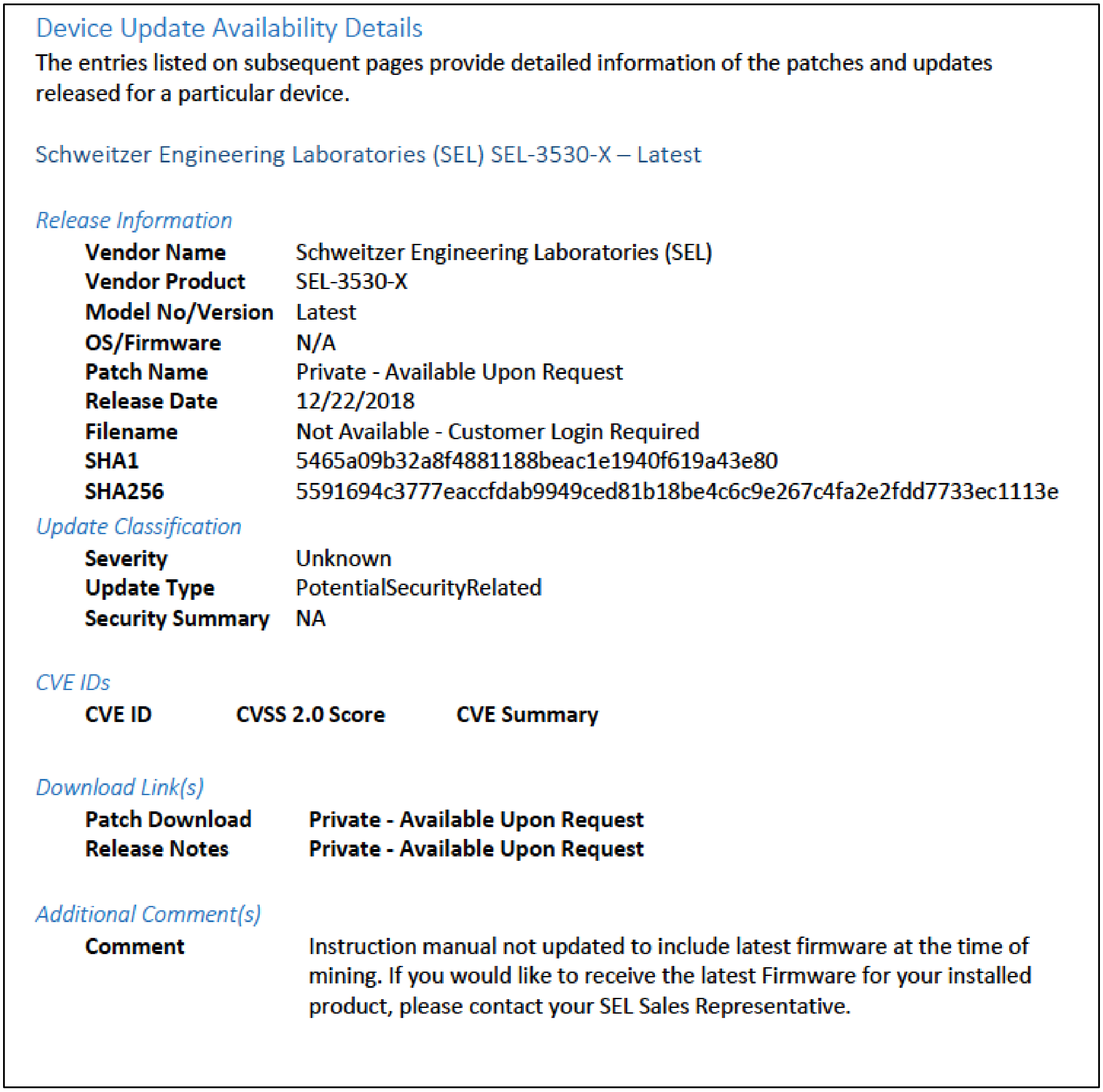
The following table outlines a summary of all devices, patches and updates. This list includes all devices and/or applications within the scope of this document. Where devices manufacturers have released an update in a particular month, the reader will be advised to refer to a more detailed write-up subsequently listed in the report. All entries in the summary tables will be entered in alphabetical order by vendor, then device/software application starting with available patches first.

Devices & Applications

Vendor	Device	Model No.	Patch/Update Released?	Patch Name	FoxGuard Review Date	Vendor Release Date	Update Type	Error Message
Schweitzer Engineering Laboratories (SEL)	**SEL-3530-X**	**Latest**	**Yes**	**Private - Available Upon Request**	**1/14/2019**	**12/22/2018**	**Potential Security Related**	**N/A**
Schweitzer Engineering Laboratories (SEL)	**SEL-3530-X**	**Latest**	**Yes**	**Private- Available Upon Request**	**2/5/2019**	**01/15/2019**	**Non-Security**	**N/A**
Schweitzer Engineering Laboratories (SEL)	**SEL-3530-X**	**Latest**	**Yes**	**Private Available Upon Request**	**3/26/2019**	**03/12/2019**	**Non-Security**	**N/A**
Schweitzer Engineering Laboratories (SEL)	**SEL-3530-X**	**Latest**	**Yes**	**Private - Available Upon Request**	**6/6/2019**	**05/18/2019**	**Non-Security**	**N/A**
Schweitzer Engineering Laboratories (SEL)	**SEL-451-X**	**R3XX**	**Yes**	**Private - Available Upon Request**	**1/15/2019**	**12/28/2018**	**Non-Security**	**N/A**

Vendor	Device	Model No.	Patch/Update Released?	Patch Name	FoxGuard Review Date	Vendor Release Date	Update Type	Error Message
Schweitzer Engineering Laboratories (SEL)	SEL-3610XX	N/A	No	N/A	8/21/2019	N/A	N/A	N/A
Schweitzer Engineering Laboratories (SEL)	SEL-362XX	N/A	No	N/A	8/21/2019	N/A	N/A	N/A
Siemens	RSG-XXXX	4.x	No	N/A	9/6/2019	N/A	N/A	N/A
Siemens	RuggedCom RSXXX	Latest	No	N/A	9/4/2019	N/A	N/A	N/A

Figure 2-2 Device Update Availability Details-1



Device Update Availability Details

The entries listed on subsequent pages provide detailed information of the patches and updates released for a particular device.

Schweitzer Engineering Laboratories (SEL) SEL-3530-X – Latest

Release Information

Vendor Name	Schweitzer Engineering Laboratories (SEL)
Vendor Product	SEL-3530-X
Model No/Version	Latest
OS/Firmware	N/A
Patch Name	Private - Available Upon Request
Release Date	12/22/2018
Filename	Not Available - Customer Login Required
SHA1	5465a09b32a8f4881188beac1e1940f619a43e80
SHA256	5591694c3777eaccfdab9949ced81b18be4c6c9e267c4fa2e2fdd7733ec1113e

Update Classification

Severity	Unknown
Update Type	PotentialSecurityRelated
Security Summary	NA

CVE IDs

CVE ID	**CVSS 2.0 Score**	**CVE Summary**

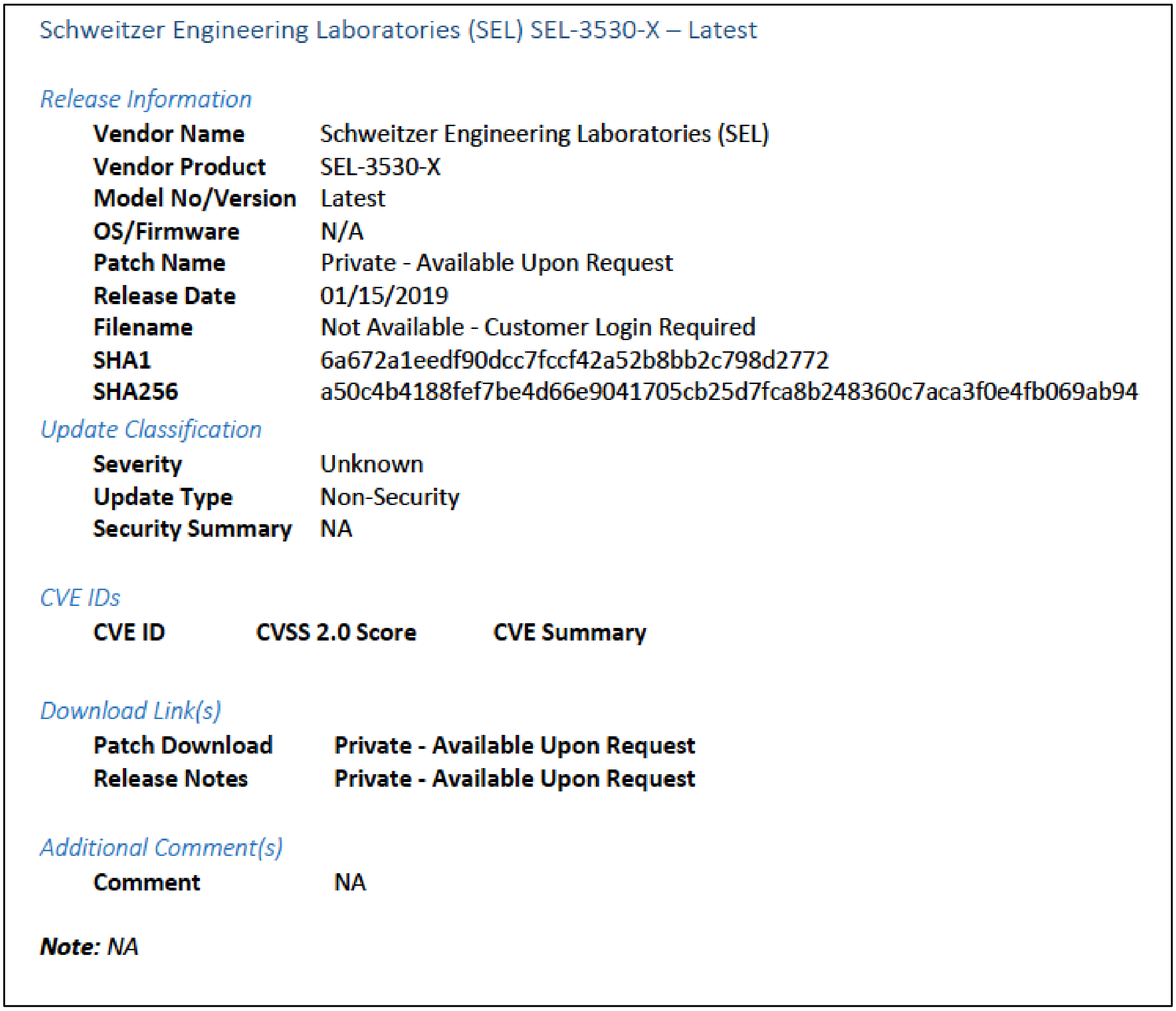
Download Link(s)

Patch Download	**Private - Available Upon Request**
Release Notes	**Private - Available Upon Request**

Additional Comment(s)

Comment	Instruction manual not updated to include latest firmware at the time of mining. If you would like to receive the latest Firmware for your installed product, please contact your SEL Sales Representative.

Figure 2-3 Device Update Availability Details-2



Schweitzer Engineering Laboratories (SEL) SEL-3530-X – Latest

Release Information

Vendor Name	Schweitzer Engineering Laboratories (SEL)
Vendor Product	SEL-3530-X
Model No/Version	Latest
OS/Firmware	N/A
Patch Name	Private - Available Upon Request
Release Date	01/15/2019
Filename	Not Available - Customer Login Required
SHA1	6a672a1eedf90dcc7fccf42a52b8bb2c798d2772
SHA256	a50c4b4188fef7be4d66e9041705cb25d7fca8b248360c7aca3f0e4fb069ab94

Update Classification

Severity	Unknown
Update Type	Non-Security
Security Summary	NA

CVE IDs

CVE ID	CVSS 2.0 Score	CVE Summary

Download Link(s)

Patch Download	**Private - Available Upon Request**
Release Notes	**Private - Available Upon Request**

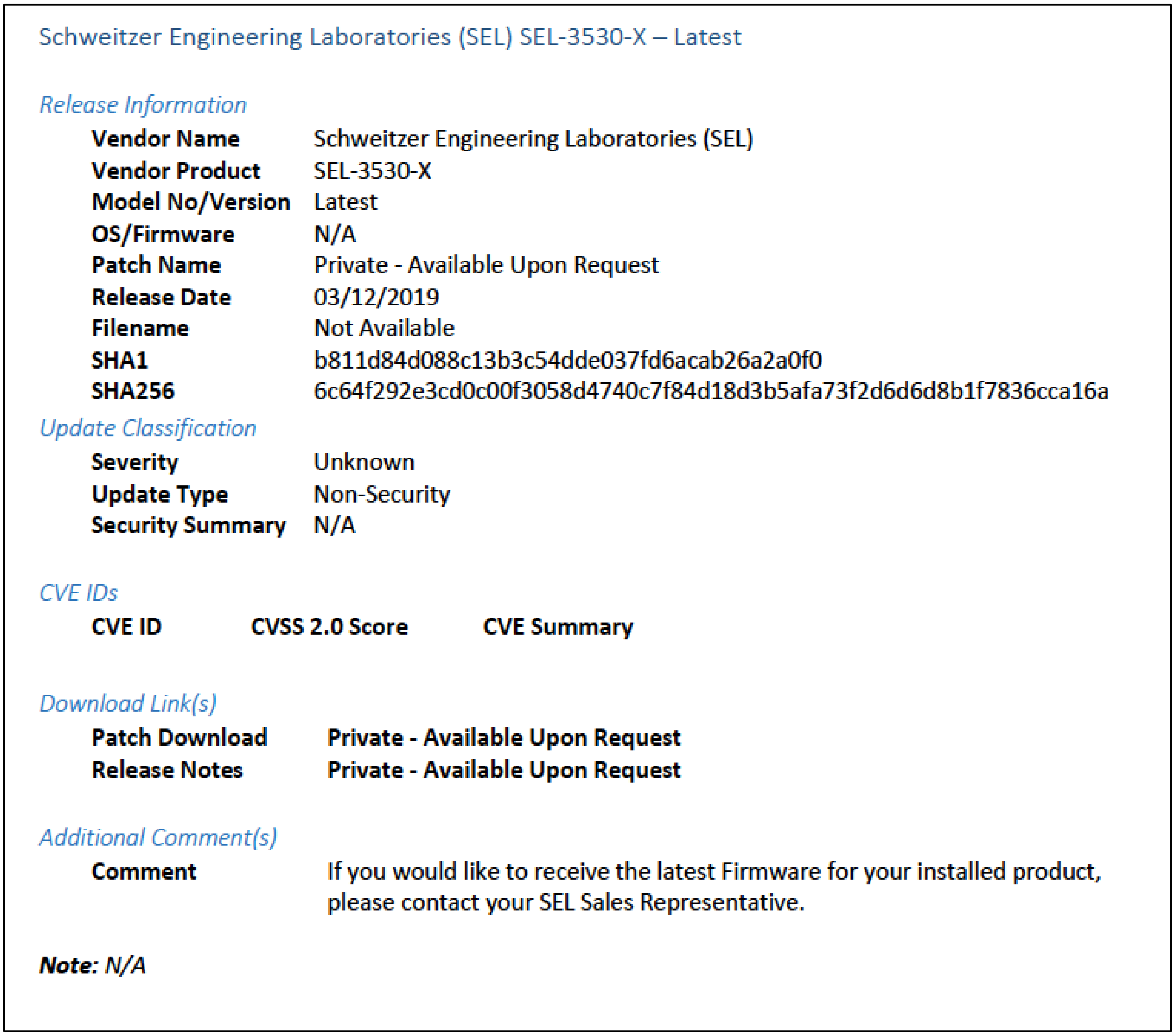
Additional Comment(s)

Comment	NA

***Note**: NA*

This publication is available free of charge from: http://doi.org/10.6028/NIST.SP.1800-23.

Figure 2-4 Device Update Availability Details-3



Schweitzer Engineering Laboratories (SEL) SEL-3530-X – Latest

Release Information

Vendor Name	Schweitzer Engineering Laboratories (SEL)
Vendor Product	SEL-3530-X
Model No/Version	Latest
OS/Firmware	N/A
Patch Name	Private - Available Upon Request
Release Date	03/12/2019
Filename	Not Available
SHA1	b811d84d088c13b3c54dde037fd6acab26a2a0f0
SHA256	6c64f292e3cd0c00f3058d4740c7f84d18d3b5afa73f2d6d6d8b1f7836cca16a

Update Classification

Severity	Unknown
Update Type	Non-Security
Security Summary	N/A

CVE IDs

CVE ID	**CVSS 2.0 Score**	**CVE Summary**

Download Link(s)

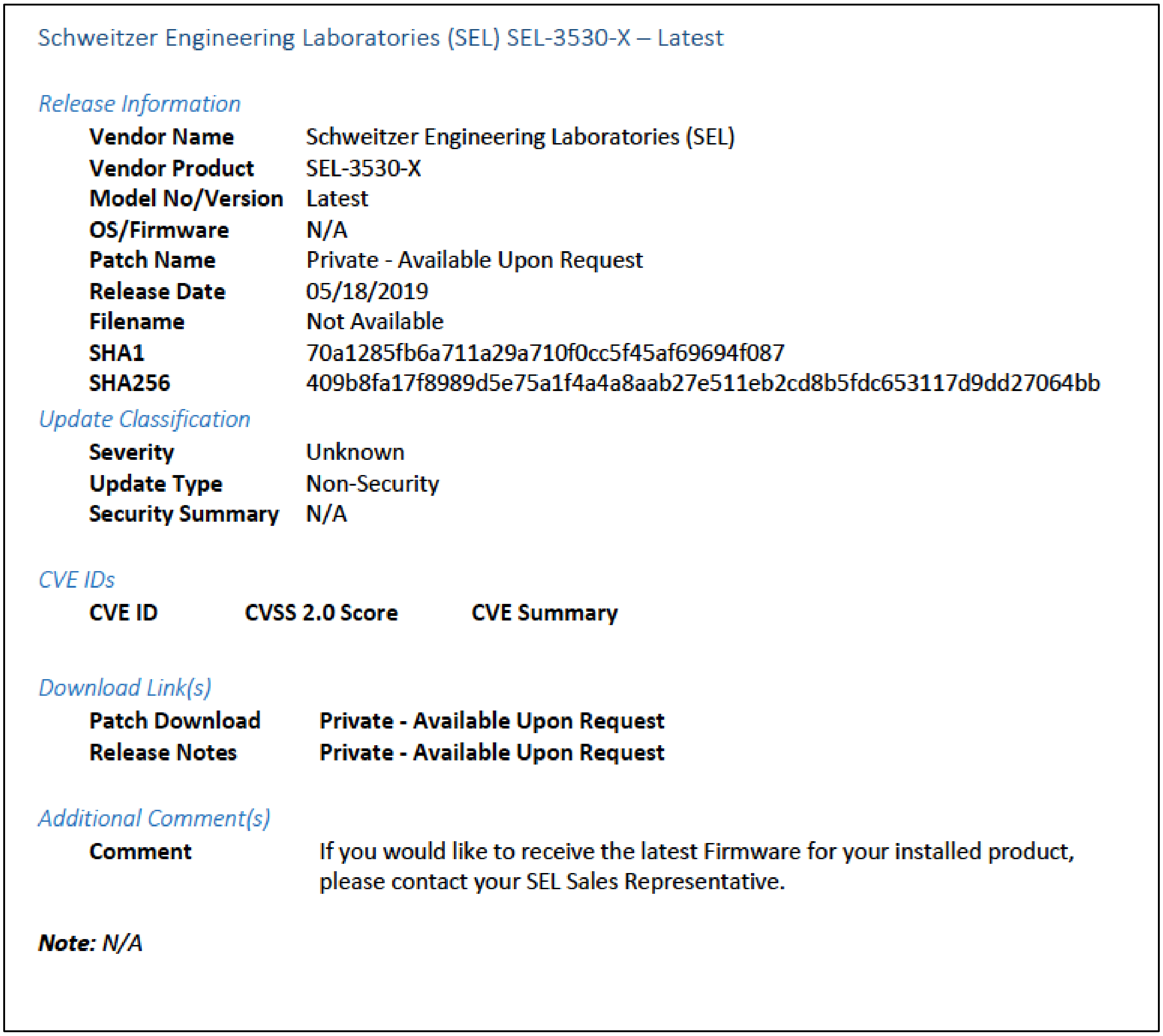
Patch Download	**Private - Available Upon Request**
Release Notes	**Private - Available Upon Request**

Additional Comment(s)

Comment	If you would like to receive the latest Firmware for your installed product, please contact your SEL Sales Representative.

Note: *N/A*

Figure 2-5 Device Update Availability Details-4



Schweitzer Engineering Laboratories (SEL) SEL-3530-X – Latest

Release Information

Vendor Name	Schweitzer Engineering Laboratories (SEL)
Vendor Product	SEL-3530-X
Model No/Version	Latest
OS/Firmware	N/A
Patch Name	Private - Available Upon Request
Release Date	05/18/2019
Filename	Not Available
SHA1	70a1285fb6a711a29a710f0cc5f45af69694f087
SHA256	409b8fa17f8989d5e75a1f4a4a8aab27e511eb2cd8b5fdc653117d9dd27064bb

Update Classification

Severity	Unknown
Update Type	Non-Security
Security Summary	N/A

CVE IDs

CVE ID	**CVSS 2.0 Score**	**CVE Summary**

Download Link(s)

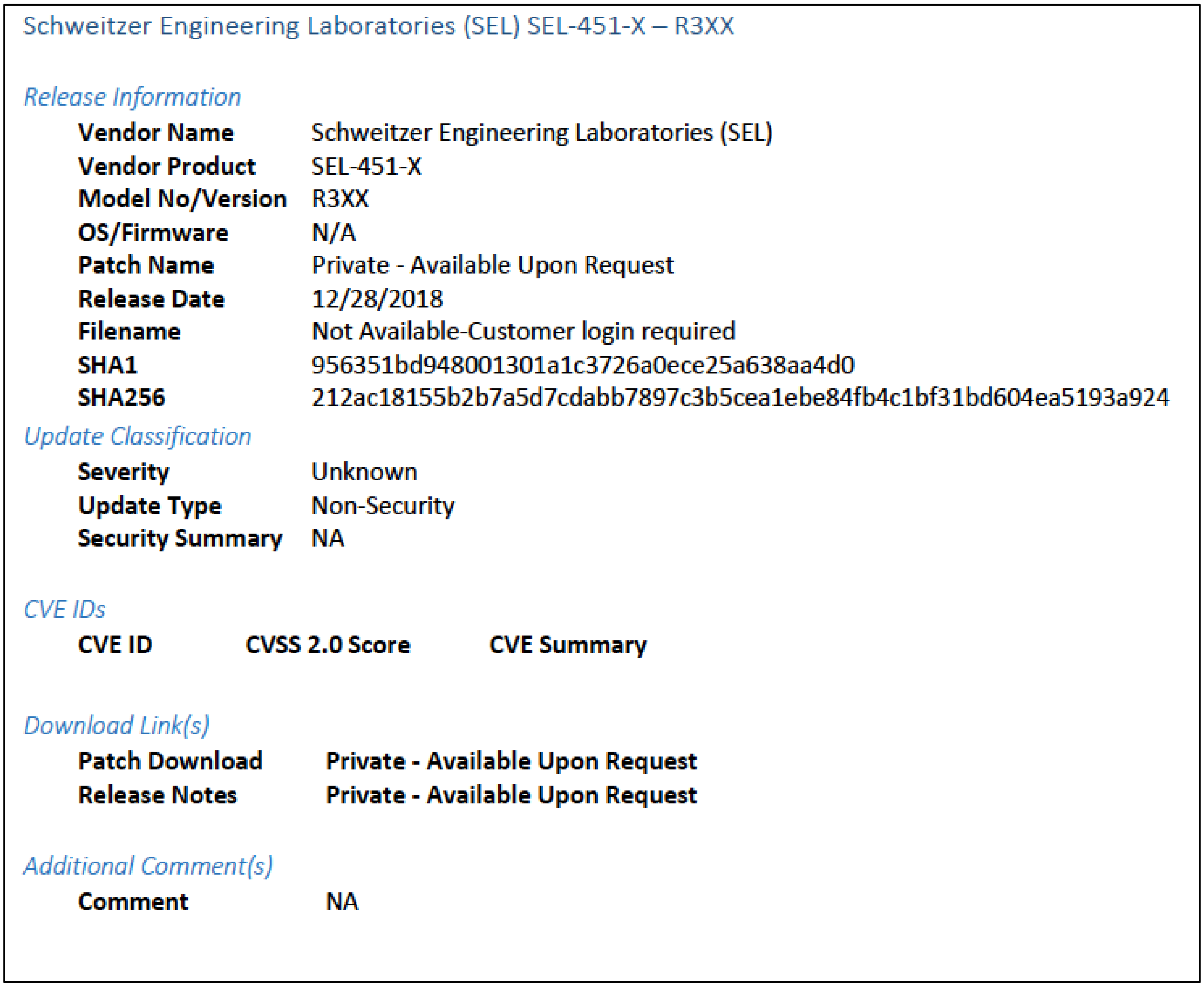
Patch Download	**Private - Available Upon Request**
Release Notes	**Private - Available Upon Request**

Additional Comment(s)

Comment	If you would like to receive the latest Firmware for your installed product, please contact your SEL Sales Representative.

Note: *N/A*

Figure 2-6 Device Update Availability Details-5



Schweitzer Engineering Laboratories (SEL) SEL-451-X – R3XX

Release Information

Vendor Name	Schweitzer Engineering Laboratories (SEL)
Vendor Product	SEL-451-X
Model No/Version	R3XX
OS/Firmware	N/A
Patch Name	Private - Available Upon Request
Release Date	12/28/2018
Filename	Not Available-Customer login required
SHA1	956351bd948001301a1c3726a0ece25a638aa4d0
SHA256	212ac18155b2b7a5d7cdabb7897c3b5cea1ebe84fb4c1bf31bd604ea5193a924

Update Classification

Severity	Unknown
Update Type	Non-Security
Security Summary	NA

CVE IDs

CVE ID	**CVSS 2.0 Score**	**CVE Summary**

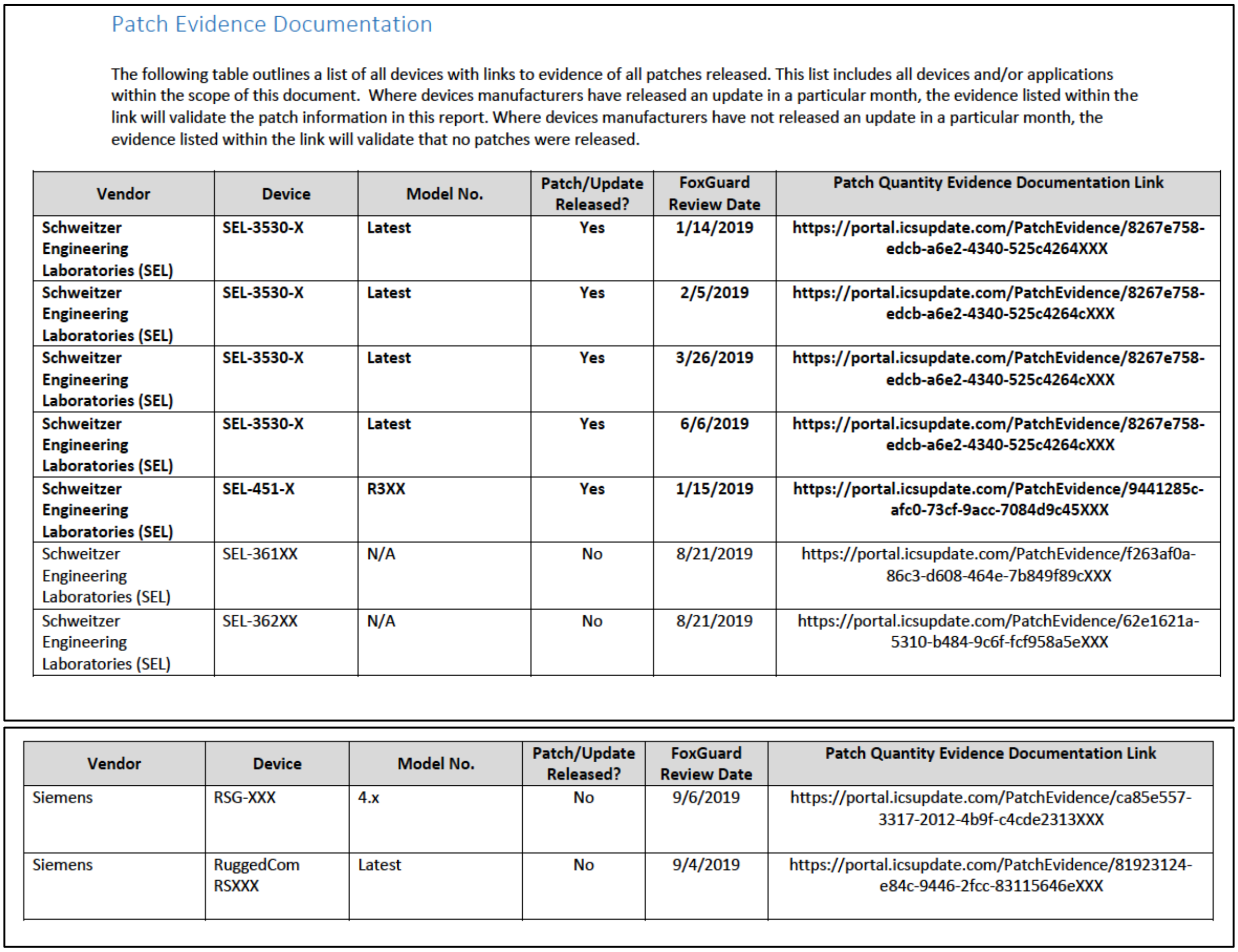
Download Link(s)

Patch Download	**Private - Available Upon Request**
Release Notes	**Private - Available Upon Request**

Additional Comment(s)

Comment	NA

Figure 2-7 Patch Evidence Documentation



Patch Evidence Documentation

The following table outlines a list of all devices with links to evidence of all patches released. This list includes all devices and/or applications within the scope of this document. Where devices manufacturers have released an update in a particular month, the evidence listed within the link will validate the patch information in this report. Where devices manufacturers have not released an update in a particular month, the evidence listed within the link will validate that no patches were released.

Vendor	Device	Model No.	Patch/Update Released?	FoxGuard Review Date	Patch Quantity Evidence Documentation Link
Schweitzer Engineering Laboratories (SEL)	**SEL-3530-X**	**Latest**	**Yes**	**1/14/2019**	**https://portal.icsupdate.com/PatchEvidence/8267e758-edcb-a6e2-4340-525c4264XXX**
Schweitzer Engineering Laboratories (SEL)	**SEL-3530-X**	**Latest**	**Yes**	**2/5/2019**	**https://portal.icsupdate.com/PatchEvidence/8267e758-edcb-a6e2-4340-525c4264cXXX**
Schweitzer Engineering Laboratories (SEL)	**SEL-3530-X**	**Latest**	**Yes**	**3/26/2019**	**https://portal.icsupdate.com/PatchEvidence/8267e758-edcb-a6e2-4340-525c4264cXXX**
Schweitzer Engineering Laboratories (SEL)	**SEL-3530-X**	**Latest**	**Yes**	**6/6/2019**	**https://portal.icsupdate.com/PatchEvidence/8267e758-edcb-a6e2-4340-525c4264cXXX**
Schweitzer Engineering Laboratories (SEL)	**SEL-451-X**	**R3XX**	**Yes**	**1/15/2019**	**https://portal.icsupdate.com/PatchEvidence/9441285c-afc0-73cf-9acc-7084d9c45XXX**
Schweitzer Engineering Laboratories (SEL)	SEL-361XX	N/A	No	8/21/2019	https://portal.icsupdate.com/PatchEvidence/f263af0a-86c3-d608-464e-7b849f89cXXX
Schweitzer Engineering Laboratories (SEL)	SEL-362XX	N/A	No	8/21/2019	https://portal.icsupdate.com/PatchEvidence/62e1621a-5310-b484-9c6f-fcf958a5eXXX
Siemens	RSG-XXX	4.x	No	9/6/2019	https://portal.icsupdate.com/PatchEvidence/ca85e557-3317-2012-4b9f-c4cde2313XXX
Siemens	RuggedCom RSXXX	Latest	No	9/4/2019	https://portal.icsupdate.com/PatchEvidence/81923124-e84c-9446-2fcc-83115646eXXX

2.5 Kore Wireless

This solution leverages a Kore Wireless virtual private network (VPN) to provide secure remote access to remote assets. In this case, the remote asset is an Obvius A8812 Data Acquisition Server that provides access to data from a Yokogawa flow meter.

Note: Some network information is excluded for security.

This publication is available free of charge from: http://doi.org/10.6028/NIST.SP.1800-23.

2.5.1 Bridge Configuration

2.5.1.1 Installation

1. Connect the MultiConnect eCell Ethernet port to the Ethernet port on the Obvius A8812 Data Acquisition Server.

2. Connect the Obvius A8812 RS485 to the multidrop Modbus network with the remote steam meter asset.

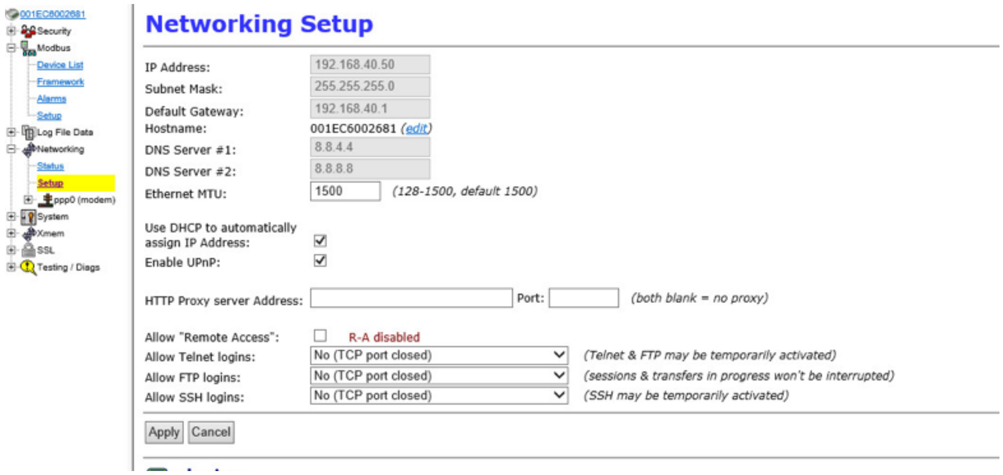
2.5.1.2 Network

1. Set Obvius A8812 to **DHCP.**

   a. Navigate the IP address of the Obvius A8812. Default is *192.168.40.50*.

   b. Open the **Networking** drop-down menu, and select **Setup**.

   c. Check the **Use DHCP to automatically assign IP Address** checkbox.



Networking Setup

IP Address: 192.168.40.50
Subnet Mask: 255.255.255.0
Default Gateway: 192.168.40.1
Hostname: 001EC6002681 (*edit*)
DNS Server #1: 8.8.4.4
DNS Server #2: 8.8.8.8
Ethernet MTU: 1500 *(128-1500, default 1500)*

Use DHCP to automatically assign IP Address: ☑
Enable UPnP: ☑

HTTP Proxy server Address: Port: *(both blank = no proxy)*

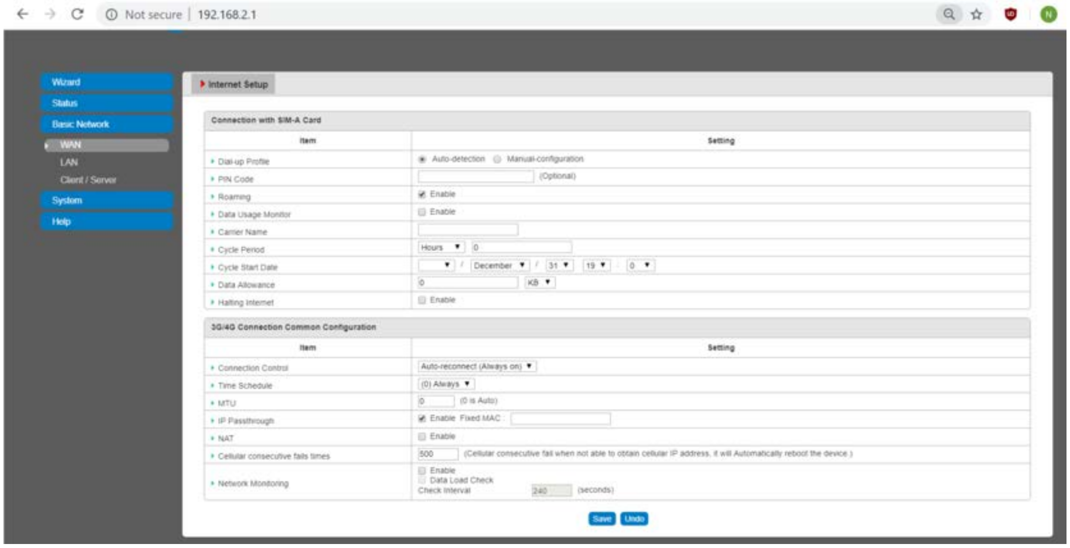
Allow "Remote Access": ☐ R-A disabled
Allow Telnet logins: No (TCP port closed) *(Telnet & FTP may be temporarily activated)*
Allow FTP logins: No (TCP port closed) *(sessions & transfers in progress won't be interrupted)*
Allow SSH logins: No (TCP port closed) *(SSH may be temporarily activated)*

2. Set MultiConnect eCell to Auto-detect Dialup profiles.

   a. Navigate the IP address of the MultiConnect eCell. Default is *192.168.40.50*.

   b. Open the **WAN** menu.

c. Set the Dial-up Profile to **Auto-detection.**



Connection with SIM-A Card

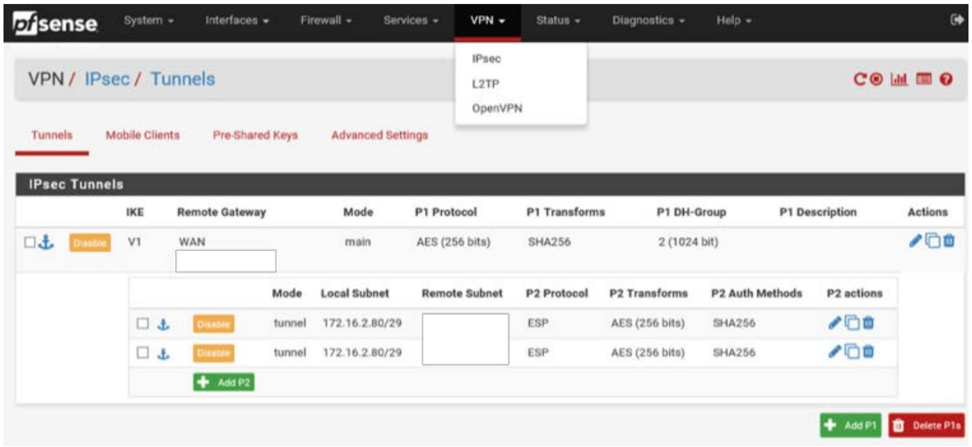
Item	Setting
Dial-up Profile	● Auto-detection ○ Manual-configuration
PIN Code	(Optional)
Roaming	☑ Enable
Data Usage Monitor	☐ Enable
Carrier Name	
Cycle Period	Hours 0
Cycle Start Date	/ December / 31 19 : 0
Data Allowance	0 KB
Halting Internet	☐ Enable

3G/4G Connection Common Configuration

Item	Setting
Connection Control	Auto-reconnect (Always on)
Time Schedule	(0) Always
MTU	0 (0 is Auto)
IP Passthrough	☑ Enable Fixed MAC :
NAT	☐ Enable
Cellular consecutive fails times	500 (Cellular consecutive fail when not able to obtain cellular IP address, it will Automatically reboot the device)
Network Monitoring	☐ Enable ☐ Data Load Check Check Interval 240 (seconds)

2.5.2 Virtual Private Network Configuration

1. Navigate to **VPN > IPsec** in pfsense.



IPsec Tunnels

	IKE	Remote Gateway	Mode	P1 Protocol	P1 Transforms	P1 DH-Group	P1 Description	Actions
☐ Disable	V1	WAN	main	AES (256 bits)	SHA256	2 (1024 bit)		

	Mode	Local Subnet	Remote Subnet	P2 Protocol	P2 Transforms	P2 Auth Methods	P2 actions
☐ Disable	tunnel	172.16.2.80/29		ESP	AES (256 bits)	SHA256	
☐ Disable	tunnel	172.16.2.80/29		ESP	AES (256 bits)	SHA256	

2. Click the **Add P1** button.

3. Set **Remote Gateway.**

4. Set **Authentication Method** to `Mutual PSK`.

5. Set **Pre-Shared Key.**

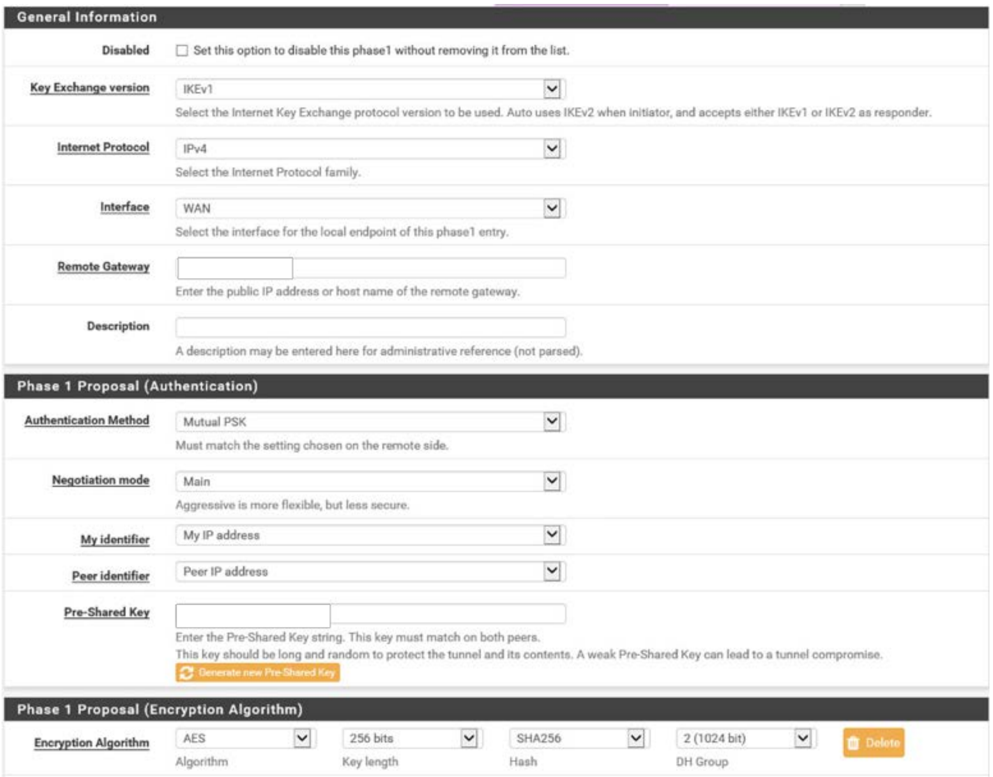
6. Set **Encryption Algorithm** settings:

a. **Algorithm:** AES

b. **Key Length:** `256 bits`

c. **Hash:** SHA256

d. **Diffie-Hellman Group:** `2 (1024 bit)`



General Information

Disabled: □ Set this option to disable this phase1 without removing it from the list.

Key Exchange version: IKEv1
Select the Internet Key Exchange protocol version to be used. Auto uses IKEv2 when initiator, and accepts either IKEv1 or IKEv2 as responder.

Internet Protocol: IPv4
Select the Internet Protocol family.

Interface: WAN
Select the interface for the local endpoint of this phase1 entry.

Remote Gateway:
Enter the public IP address or host name of the remote gateway.

Description:
A description may be entered here for administrative reference (not parsed).

Phase 1 Proposal (Authentication)

Authentication Method: Mutual PSK
Must match the setting chosen on the remote side.

Negotiation mode: Main
Aggressive is more flexible, but less secure.

My identifier: My IP address

Peer identifier: Peer IP address

Pre-Shared Key:
Enter the Pre-Shared Key string. This key must match on both peers.
This key should be long and random to protect the tunnel and its contents. A weak Pre-Shared Key can lead to a tunnel compromise.

Phase 1 Proposal (Encryption Algorithm)

Encryption Algorithm: AES (Algorithm), 256 bits (Key length), SHA256 (Hash), 2 (1024 bit) (DH Group)

7. Return to **VPN > IPsec.**

8. Click the **Add P2** button.

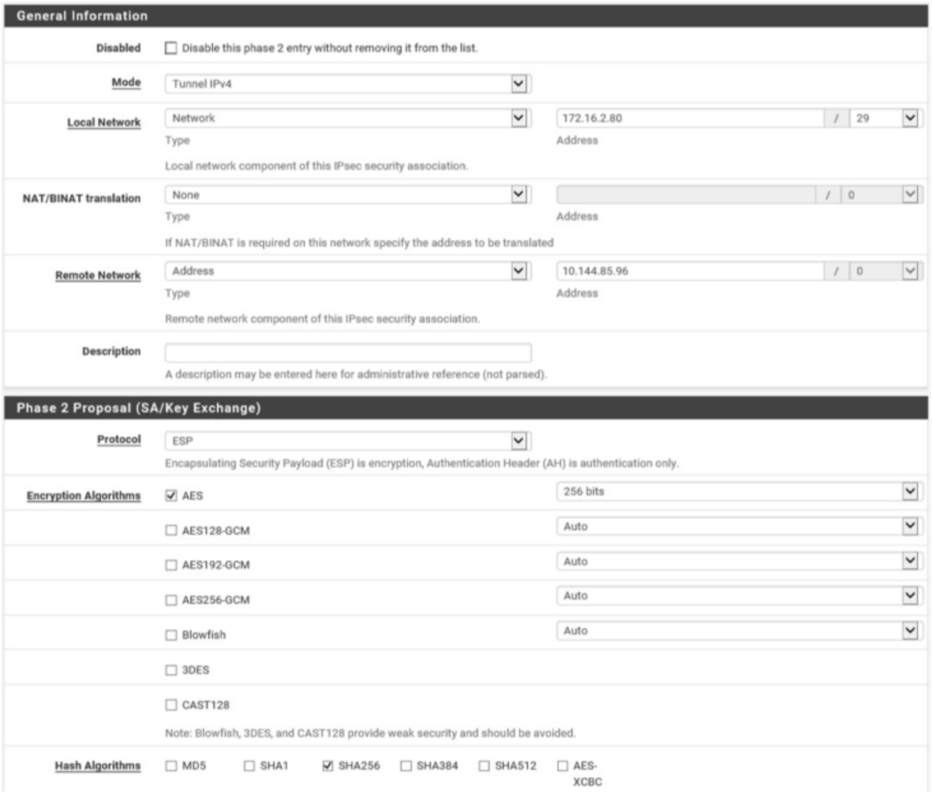
9. Set **Local Network** to `172.16.2.80/29`.

10. Set **Remote Network.**

11. Set **Protocol** to ESP.

12. Set **Encryption Algorithm** to `AE 256 bits`.

13. Set **Hash Algorithm** to `SHA256`.



General Information

Disabled: ☐ Disable this phase 2 entry without removing it from the list.

Mode: Tunnel IPv4

Local Network: Network (Type) — 172.16.2.80 / 29 (Address)
Local network component of this IPsec security association.

NAT/BINAT translation: None (Type) — / 0 (Address)
If NAT/BINAT is required on this network specify the address to be translated

Remote Network: Address (Type) — 10.144.85.96 / 0 (Address)
Remote network component of this IPsec security association.

Description:
A description may be entered here for administrative reference (not parsed).

Phase 2 Proposal (SA/Key Exchange)

Protocol: ESP
Encapsulating Security Payload (ESP) is encryption, Authentication Header (AH) is authentication only.

Encryption Algorithms:
☑ AES — 256 bits
☐ AES128-GCM — Auto
☐ AES192-GCM — Auto
☐ AES256-GCM — Auto
☐ Blowfish — Auto
☐ 3DES
☐ CAST128
Note: Blowfish, 3DES, and CAST128 provide weak security and should be avoided.

Hash Algorithms: ☐ MD5 ☐ SHA1 ☑ SHA256 ☐ SHA384 ☐ SHA512 ☐ AES-XCBC

2.6 pfSense VPN

pfSense is an open-source firewall/router used to create both site-to-site VPN tunnels. The following configuration file can be used to upload all configurations to the enterprise location edge router. Both the UMD and Plano edge routers are excluded for security purposes.

2.6.1 Plano and UMD VPN Configuration

To configure a site-to-site OpenVPN connection, refer to https://docs.netgate.com/pfsense/en/latest/vpn/openvpn/index.html.

2.7 Splunk

Splunk is a security information and event management (SIEM) system that allows collecting and parsing logs and data from multiple systems.

2.7.1 Splunk Enterprise Configuration

2.7.1.1 VM Configuration

The Splunk VM is configured as follows:

- Ubuntu Mate 16.04.2
- 2 CPU cores
- 10 GB of RAM
- 2 TB of storage
- 1 NIC

2.7.1.2 Network

Network Configuration (Interface 1):

- IPv4: Manual
- IPv6: disabled
- IPv4 address: *10.100.200.101*
- Netmask: *255.255.255.0*
- Gateway: *10.100.200.1*

2.7.1.3 Installation

Note: A Splunk account will be needed to download Splunk Enterprise. The account is free and can be set up at https://www.splunk.com/page/sign_up.

Download Splunk Enterprise from https://www.splunk.com/en_us/download/splunk-enterprise.html. This build uses Version 7.1.3. Splunk can be installed on Windows, Linux, Solaris, and Mac OS X. Each of these installation instructions is provided at http://docs.splunk.com/Documentation/Splunk/7.1.3/Installation/Beforeyouinstall.

2.7.1.4 Universal Forwarder

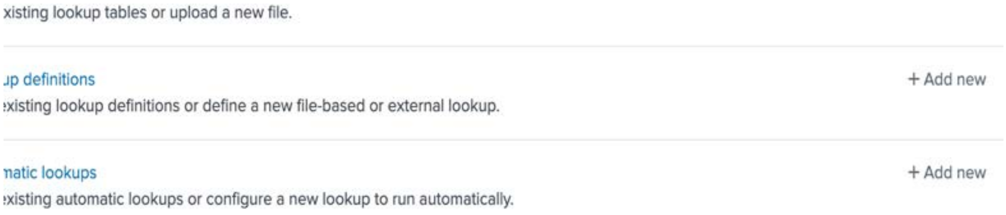
To install the universal forwarder, refer to documentation found at https://docs.splunk.com/Documentation/Forwarder/7.3.1/Forwarder/Installtheuniversalforwardersoftware.

Refer to each individual product to configure the universal forwarder or another means of integration with Splunk.

2.7.1.5 Reports and Alerts

If desired, lookup tables can be used to cross-check automated detections with human knowledge of a device. Some properties are cross-checked with human knowledge at both the UMD and Plano sites. Patch information from PUMP also uses a lookup table to cross-check results with devices. To upload lookup tables:

1. Log in to Splunk.
2. Go to **Settings > Lookups.**
3. Select **+ Add New** under **Lookup table files.**



xisting lookup tables or upload a new file.

ıp definitions

:xisting lookup definitions or define a new file-based or external lookup.

+ Add new

natic lookups

:xisting automatic lookups or configure a new lookup to run automatically.

+ Add new

4. Choose **Search** as the **Destination App.**
5. Browse for the CSV file. Name the Lookup file. Select **Save.**

The UMD lookup CSV file contains the following fields:

```
Asset Id,IP,Device,Platform
```

The Plano lookup CSV file contains the following fields:

```
Asset Id,IP,Vendor,Product Name,Serial Number,Version
```

Once integrations are complete, the following Splunk queries will create the desired reports:

2.7.1.5.1 Asset Report for Both Sites

```
index=_* OR index=* sourcetype=CTD_csv | table asset_id site_id name_ ip_ mac_ type_
vendor_ criticality_ risk_level is_ghost | sort site_id | where isnum(asset_id)
```

2.7.1.5.2 Asset Report for UMD

```
index=_* OR index=* sourcetype=CTD_csv | where isnum(asset_id)  | table asset_id
site_id name_ ip_ mac_ type_ vendor_ criticality_ risk_level is_ghost Device Platform
| sort site_id | search ip_=206.189.122* | lookup umd_lookup.csv "Asset Id" AS
asset_id OUTPUT "Device" AS Device, Platform AS Platform
```

2.7.1.5.3 Asset Report for Plano (Static)

```
index=_* OR index=* sourcetype=CTD_csv | where isnum(asset_id)  | table asset_id
site_id name_ ip_ mac_ type_ vendor_ criticality_ risk_level is_ghost Serial_Number
Version | sort site_id | search ip_=10.172.6* | lookup plano_lookup.csv "Asset Id" AS
asset_id OUTPUT "Serial Number" AS Serial_Number, Version AS Version
```

2.7.1.5.4 Asset Report for Plano (Dynamic)

```
index=forescout

|table ip mac "host_properties.nmap_banner7{}.value" nbthost
"host_properties.nmap_def_fp5{}.value" "host_properties.user_def_fp{}.value"
"host_properties.server_session{}.value"

|stats
values(mac),values("host_properties.nmap_banner7{}.value"),values(nbthost),values("hos
t_properties.nmap_def_fp5{}.value"),values("host_properties.user_def_fp{}.value"),valu
es("host_properties.server_session{}.value") by ip

|rename values(mac) as mac_address, values(host_properties.nmap_banner7{}.value) as
ports_and_services, values(nbthost) as hostname,
values(host_properties.nmap_def_fp5{}.value) as device_footprints,
values(host_properties.user_def_fp{}.value) as device_footprints2,
values(host_properties.server_session{}.value) as server_session_properties
```

2.7.1.5.5 UMD Steam Meter Data

```
index=modbus |rex "CWScript BCM:(?<name>.\w+)" | rex field=_raw "Flow Rate :
(?<flowRate>.*)" | rex field=_raw "Gal Total : (?<GalTotal>.*)" | transaction
maxspan=30s | table name _time flowRate GalTotal
```

2.7.1.5.6 UMD Device Data Calls

```
(index=* OR index=_*) (index=main host="10.100.100.111" NOT "cs2=UP") | table shost
src smac dhost dst dmac cs6 cs3 cs7 cs8 msg
```

2.7.1.5.7 Patch Report for FoxGuard PUMP

```
index=test sourcetype="csv" | lookup plano_lookup.csv "Asset Id" AS Asset_Id OUTPUT
"Serial Number" AS Serial_Number, Version AS Version | table Asset_Id IP Mac Vendor
"Operating System" Serial_Number Version Criticality Protocols | join IP type=left
[search index=test sourcetype=CTD_csv_report] | fields "Asset Id" IP Mac Vendor
"Operating System" Serial_Number Version | where isnotnull(Serial_Number) OR
isnotnull(Version) | sort IP | outputcsv patchreport.csv
```

2.8 Tripwire Industrial Visibility

Tripwire Industrial Visibility is used to passively scan the industrial control environments at both the College Park and Plano locations in the build. Tripwire Industrial Visibility builds a baseline of assets and network traffic between those assets then alerts on anomalous activity. Logs and alerts are reported up to the SIEM.

Tripwire Industrial Visibility is installed at three locations: Plano, Texas (TDi); UMD; and the NCCoE. This section describes how to deploy Tripwire Industrial Visibility 3.0.0.

Tripwire Industrial Visibility taps into OT network communication by listening through the SPAN port of routers and switches connected to the network segment, opening data packets, and interpreting protocols without disrupting normal operations.

By reading network traffic, it isolates all assets on the network and maps the flow of traffic between them. This data is then used to create graphical network maps.

2.8.1 Tripwire Industrial Visibility Configuration UMD

The following subsections document the software, hardware/VM, and network configurations for the Tripwire Industrial Visibility servers.

2.8.1.1 VM Configuration

The Tripwire Industrial Visibility VM was given the following resources:

- CentOS 7.5
- 4 CPU cores
- 100 GB hard disk
- 32 GB RAM
- 2 NICs

2.8.1.2 Network Configuration

Network Configuration:

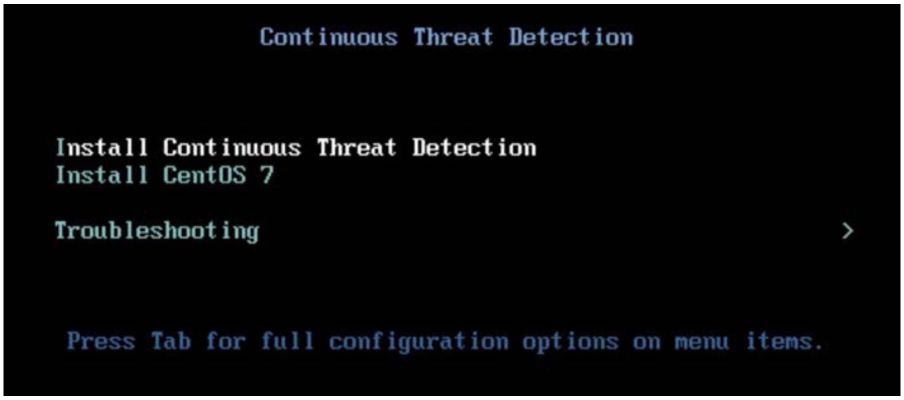
- DHCP: disabled
- IPv6: ignore
- IPv4: Manual
- IPv4 address: *10.100.100.111*
- Netmask: *255.255.255.0*
- Gateway: *10.100.100.1*

2.8.1.3 Installation

Tripwire supplied the Tripwire Industrial Visibility as an ISO installer. To configure TIV, use the ISO installer for each instance at Plano, UMD, and the NCCoE. Tripwire Industrial Visibility is configured in a sensor-server architecture. Plano and UMD instances act as sensors, and the NCCoE instance is the central server.

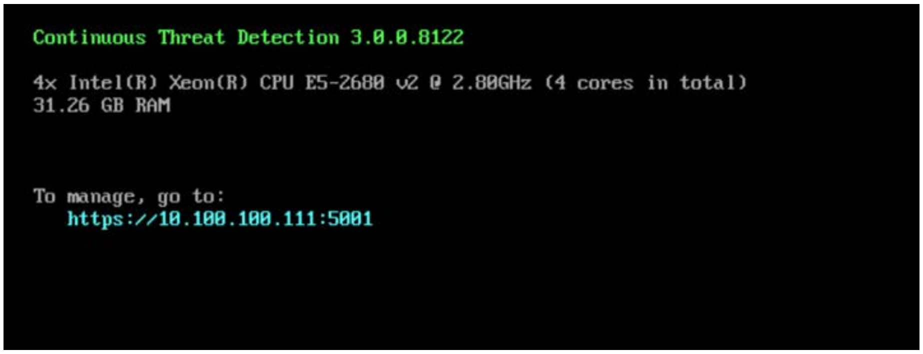
To begin installation, mount the provided image to the VM, and complete the following steps:

1. From the boot menu, select **Install Continuous Threat Detection.**



```
                    Continuous Threat Detection



  Install Continuous Threat Detection
  Install CentOS 7

  Troubleshooting                                              >



     Press Tab for full configuration options on menu items.
```

2. When the system is up, navigate to the configurator tool by using a browser.



```
Continuous Threat Detection 3.0.0.8122

4x Intel(R) Xeon(R) CPU E5-2680 v2 @ 2.80GHz (4 cores in total)
31.26 GB RAM



To manage, go to:
   https://10.100.100.111:5001
```

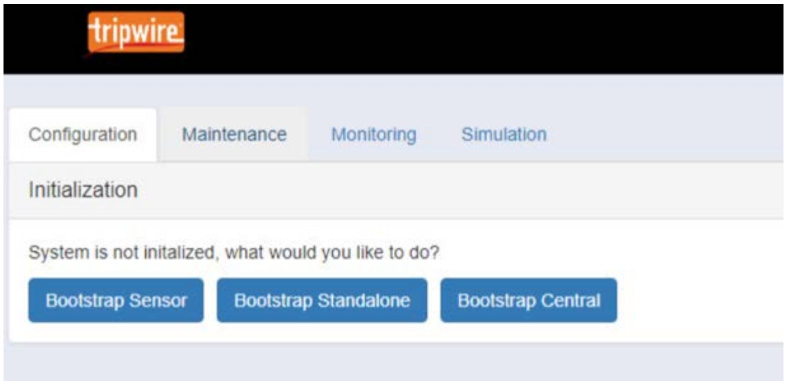
2.8.1.4 Configuration

Configure the Tripwire Industrial Visibility sensors.

1. Connect to the configuration tool by entering the following URL into the browser: *https://10.100.100.11:5001.*

2. Enter the default credentials.

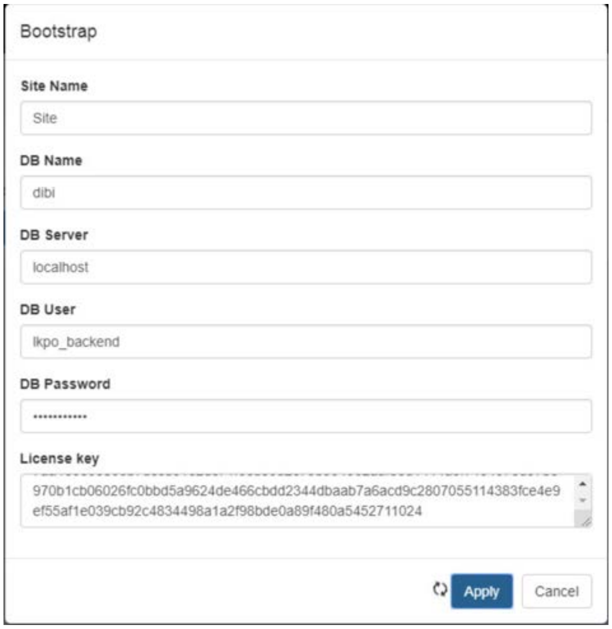
3. On the **Configuration** tab, the system will need to be initialized. Select **Bootstrap Sensor** (for Plan and UMD sites).



Initialization

System is not initalized, what would you like to do?

4. Enter the details and License Key. Select **Apply.**



Bootstrap

Site Name: Site

DB Name: dibi

DB Server: localhost

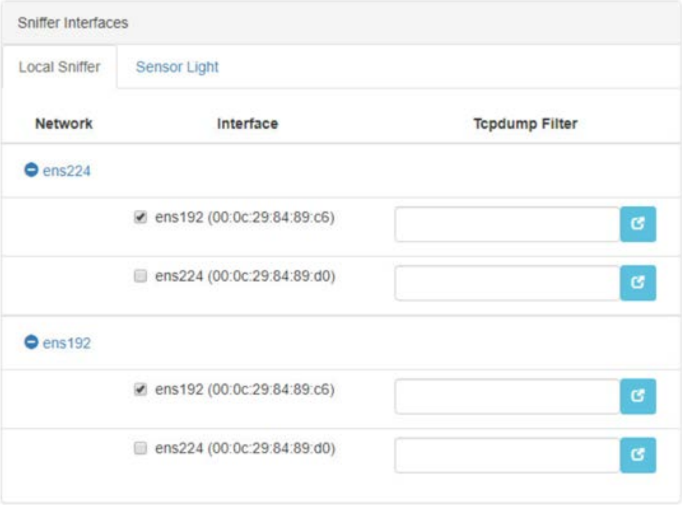
DB User: lkpo_backend

DB Password: ***********

License key:

```
970b1cb06026fc0bbd5a9624de466cbdd2344dbaab7a6acd9c2807055114383fce4e9
ef55af1e039cb92c4834498a1a2f98bde0a89f480a5452711024
```

5. Set the Sniffer Interface on the **Configuration** tab. Select the interfaced used as the SPAN port. Select **Apply.**

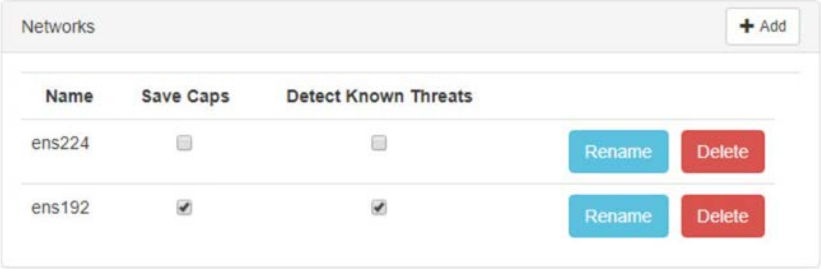


Sniffer Interfaces

Local Sniffer | Sensor Light

Network	Interface	Tcpdump Filter
⊖ ens224		
	☑ ens192 (00:0c:29:84:89:c6)	
	☐ ens224 (00:0c:29:84:89:d0)	
⊖ ens192		
	☑ ens192 (00:0c:29:84:89:c6)	
	☐ ens224 (00:0c:29:84:89:d0)	

6. Under **Networks,** select **Save Caps** and **Detect Known Threats** for the appropriate interface.

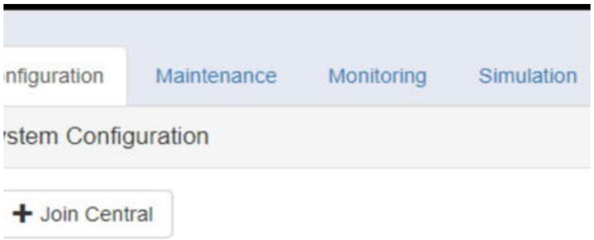


Networks + Add

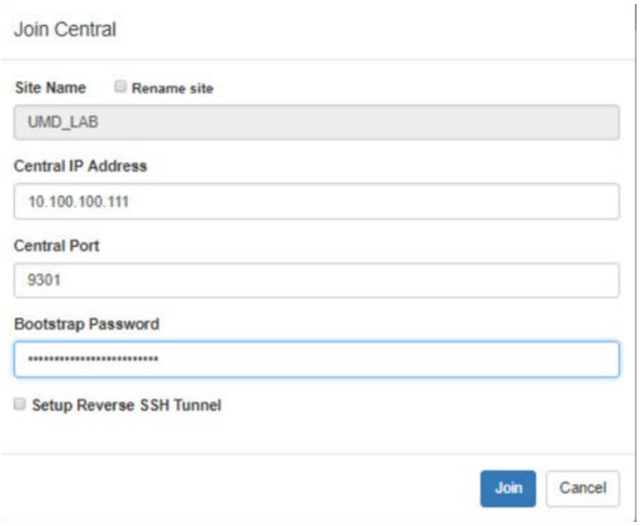
Name	Save Caps	Detect Known Threats	
ens224	☐	☐	Rename Delete
ens192	☑	☑	Rename Delete

7. Next, Join the Sensor to the Sensor Server. Set up the Central Server in Section 2.8.3 before completing these steps.

8. Select **Join Central,** from the **Configuration** tab.



9. Name the Sensor, and enter the IP address of the Central Server. Enter the Bootstrap password found on the Central Server. Select **Join.**



Join Central

Site Name □ Rename site

UMD_LAB

Central IP Address

10.100.100.111

Central Port

9301

Bootstrap Password

••••••••••••••••••••••••

□ Setup Reverse SSH Tunnel

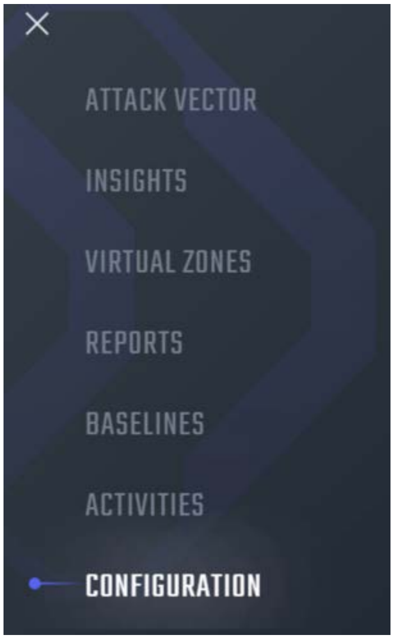
10. Connect to the continuous threat detection (CTD) Dashboard: *https://10.100.1.17:5000*.

The system is started in Training Mode. After an acceptable amount of time passes, place the system in Operational Mode. This build used one month as the training period.

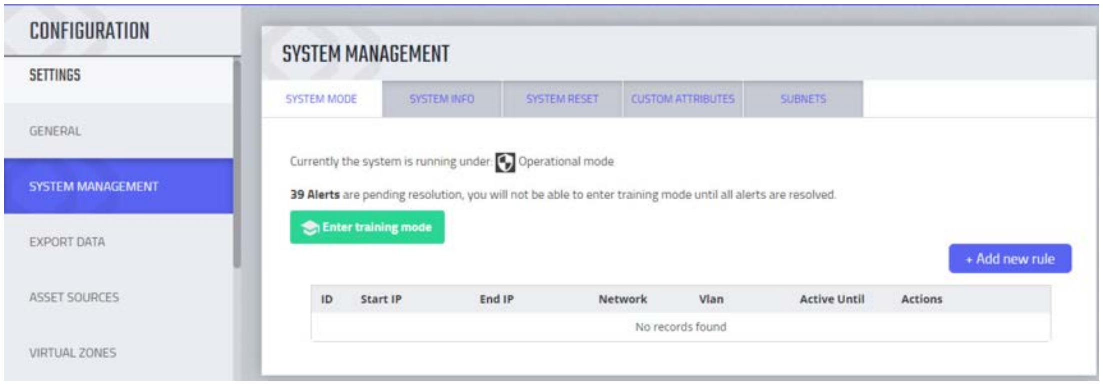
1. Select the hamburger icon in the top left corner.

☰

2. Scroll down to select **Configuration**.



3. Select **System Management.**
4. Select the **System Mode** tab. Click **Enter Operational Mode.** Note: The screen will show **Enter Training Mode,** if the system is already in Operational Mode.

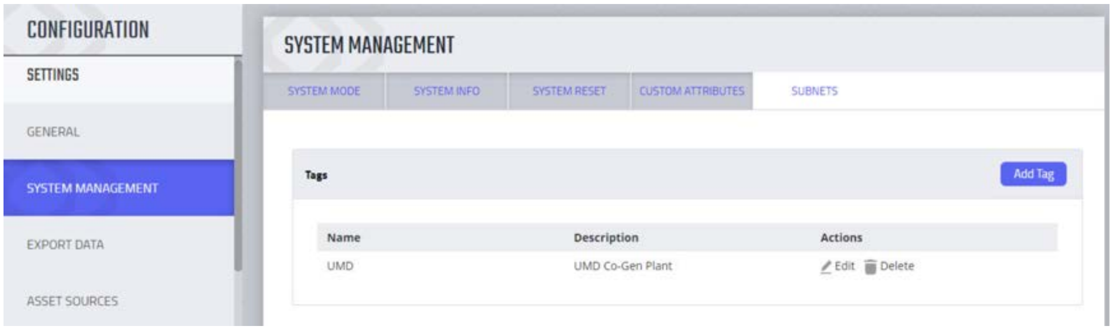


Currently the system is running under: Operational mode

39 Alerts are pending resolution, you will not be able to enter training mode until all alerts are resolved.

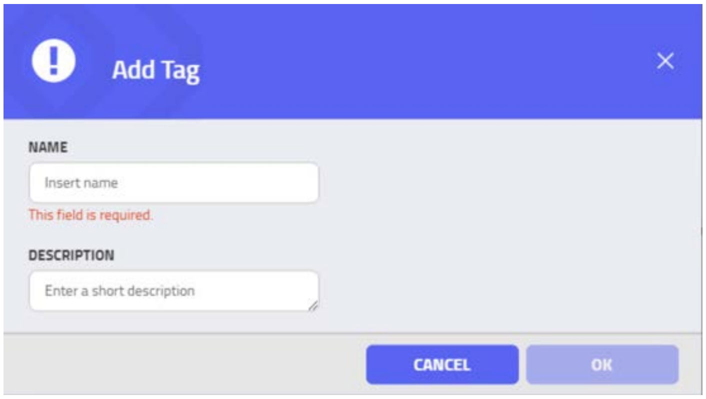
ID	Start IP	End IP	Network	Vlan	Active Until	Actions
No records found						

5. Select the **Subnets** tab. Click **Add Tag.**



Name	Description	Actions
UMD	UMD Co-Gen Plant	Edit Delete

6. Name a new Tag, and add the description. Select **OK.**



NAME

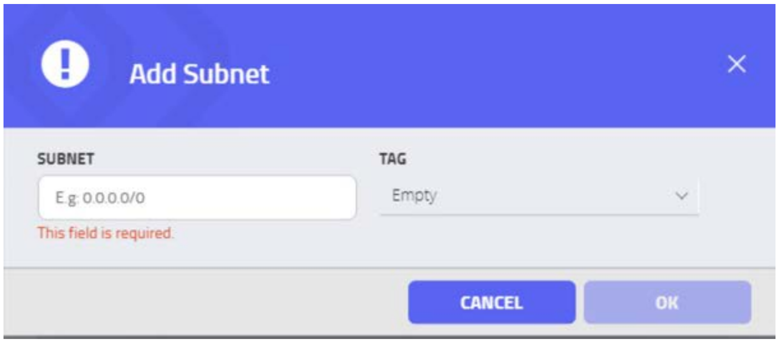
Insert name

This field is required.

DESCRIPTION

Enter a short description

7. Click **Add Subnet.** Enter the Subnet that the assets are on and the previously created TAG. Select **OK.**



8. Repeat Steps 16 and 17 for multiple subnets.

2.8.2 Tripwire Industrial Visibility Configuration Plano

The following subsections document the software, hardware/VM, and network configurations for the Tripwire Industrial Visibility servers.

2.8.2.1 VM Configuration

The Tripwire Industrial Visibility VM was given the following resources:

- CentOS 7.5
- 1 CPU Core
- 8 GB RAM
- 200 GB hard disk
- 3 NICs

2.8.2.2 Network Configuration

Network Configuration:

- DHCP: disabled
- IPv6: ignore
- IPv4: Manual
- IPv4 address: *10.100.100.111*
- Netmask: *255.255.255.0*
- Gateway: *10.100.100.1*

2.8.2.3 Installation

Repeat steps in Section 2.8.1.3.

2.8.2.4 Configurations

Repeat steps in Section 2.8.1.4.

2.8.3 Tripwire Industrial Visibility Configuration National Cybersecurity Center of Excellence

Tripwire Industrial Visibility at the NCCoE serves as the central server.

2.8.3.1 VM Configuration

The Tripwire Industrial Visibility VM was given the following resources:

- CentOS 7.5
- 4 CPU cores
- 80 GB hard disk
- 32 GB RAM
- 1 NIC

2.8.3.2 Network Configuration

Network Configuration:

- DHCP: disabled
- IPv6: ignore
- IPv4: Manual
- IPv4 address: *10.100.100.111*
- Netmask: *255.255.255.0*
- Gateway: *10.100.100.1*

2.8.3.3 Installation

Repeat steps in Section 2.8.1.3.

2.8.3.4 Configurations

Repeat Steps 1–4 in Section 2.8.1.4.

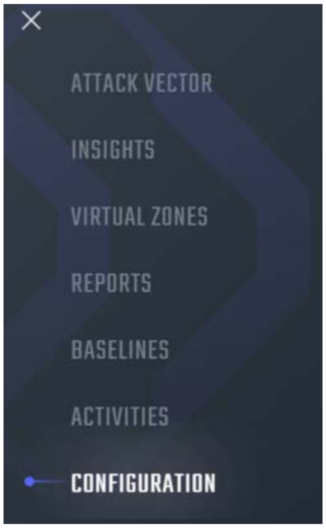
In Step 3, select **Bootstrap Central.**

To complete the configuration: set up syslog, schedule a report, and install the Claroty application on Splunk.

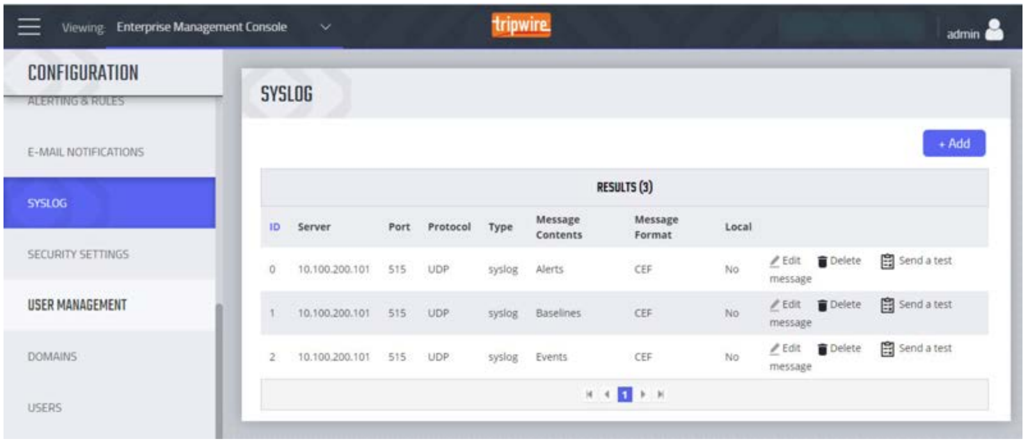
1. Connect to the CTD Dashboard: *https://10.100.100.1111:5000.*

2. Select the hamburger menu in the top left corner.

3. Scroll down to select **Configuration.**



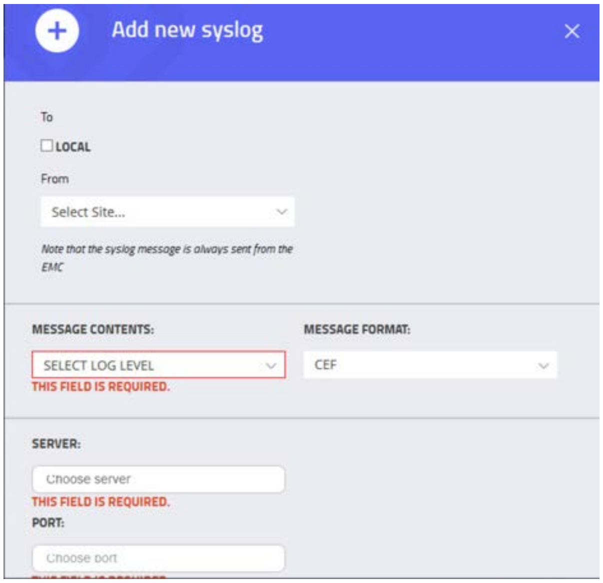
4. Select **Syslog.** Select **Add.**



RESULTS (3)

ID	Server	Port	Protocol	Type	Message Contents	Message Format	Local			
0	10.100.200.101	515	UDP	syslog	Alerts	CEF	No	Edit	Delete	Send a test message
1	10.100.200.101	515	UDP	syslog	Baselines	CEF	No	Edit	Delete	Send a test message
2	10.100.200.101	515	UDP	syslog	Events	CEF	No	Edit	Delete	Send a test message

5. Uncheck **Local.** Do not Select a Site.



Add new syslog

To

□ LOCAL

From

Select Site...

Note that the syslog message is always sent from the EMC

MESSAGE CONTENTS: SELECT LOG LEVEL

THIS FIELD IS REQUIRED.

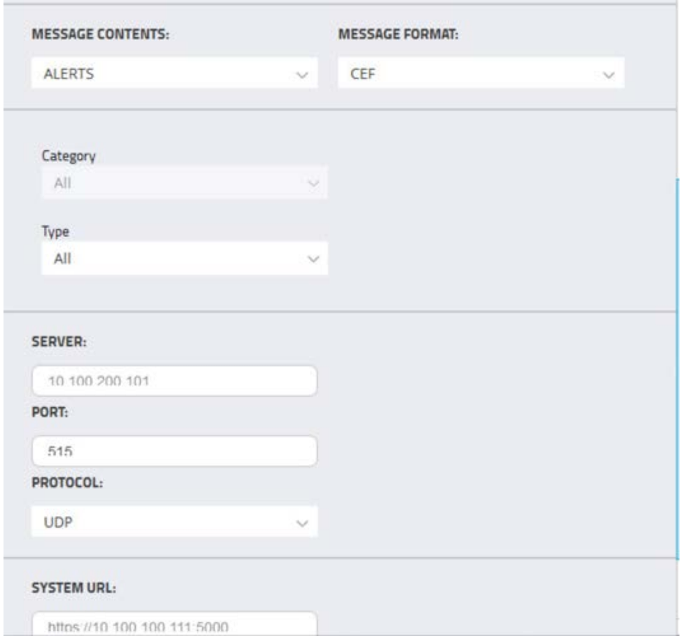
MESSAGE FORMAT: CEF

SERVER: Choose server

THIS FIELD IS REQUIRED.

PORT: Choose port

6. Select Alerts for the **Log Level.** Enter the IP address for the Splunk server under **Server.** Enter **Port** `515` and **Protocol** `UDP`**.** Select all boxes under **Category** and all boxes under **Type.** Leave the **System URL** and the **Message Format** as the default.



MESSAGE CONTENTS: ALERTS

MESSAGE FORMAT: CEF

Category: All

Type: All

SERVER: 10.100.200.101

PORT: 515

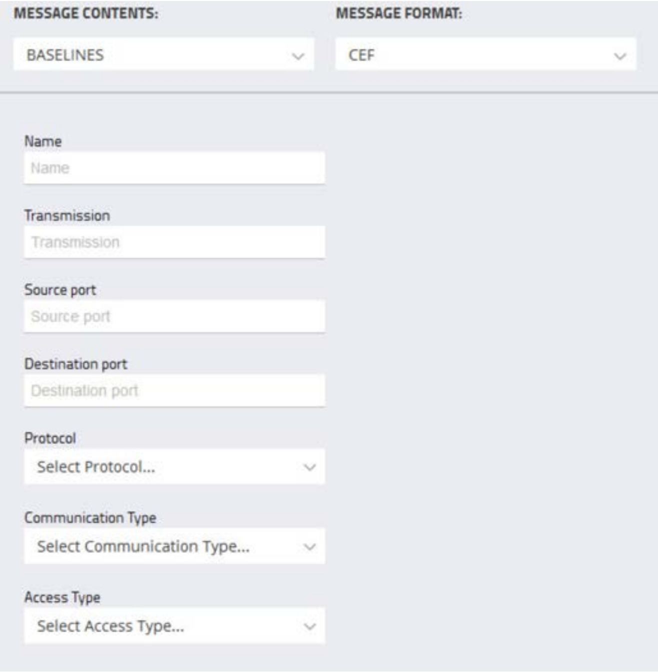
PROTOCOL: UDP

SYSTEM URL: https://10.100.100.111:5000

7. Select **Save**.

8. Select **Add** to add another.

9. Select **Baselines** under **Message Contents.**



MESSAGE CONTENTS: BASELINES

MESSAGE FORMAT: CEF

Name: Name

Transmission: Transmission

Source port: Source port

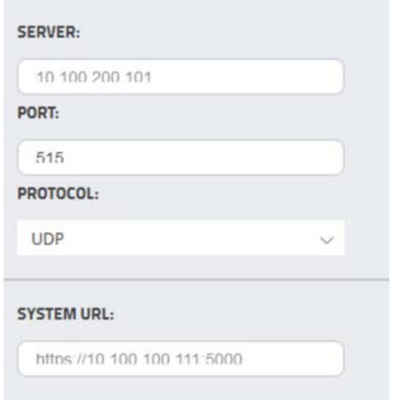
Destination port: Destination port

Protocol: Select Protocol...

Communication Type: Select Communication Type...

Access Type: Select Access Type...

10. Enter the Splunk IP for **Server, Port** `515`, and **Protocol** `UDP`. Leave **System URL** as the default. Click **Save.**



SERVER: 10.100.200.101

PORT: 515

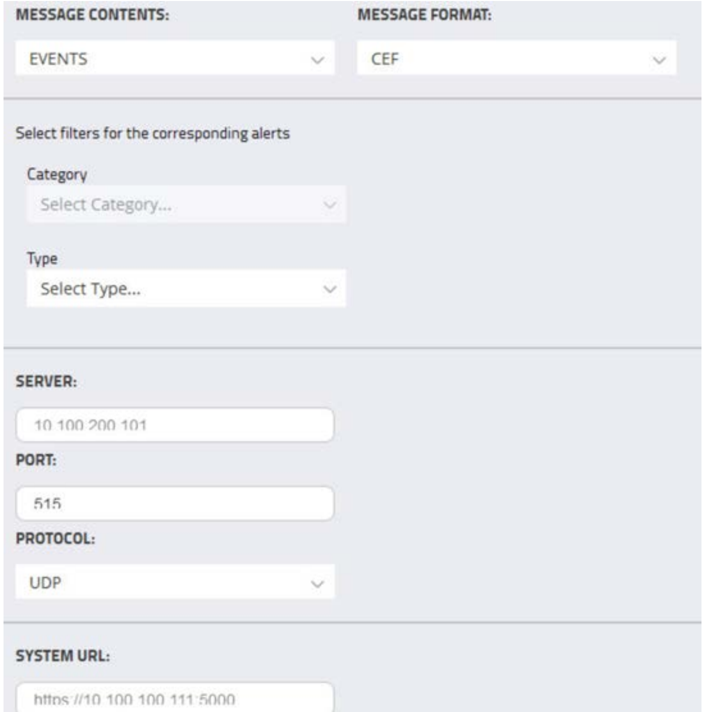
PROTOCOL: UDP

SYSTEM URL: https://10.100.100.111:5000

11. Select **Add** to add another.

12. Select **EVENTS** for **Message Contents**. Enter the Splunk IP for **Server, Port** `515`, and **Protocol** `UDP`. Leave the **System URL** as default.

This publication is available free of charge from: http://doi.org/10.6028/NIST.SP.1800-23.



MESSAGE CONTENTS: EVENTS

MESSAGE FORMAT: CEF

Select filters for the corresponding alerts

Category: Select Category...

Type: Select Type...

SERVER: 10.100.200.101

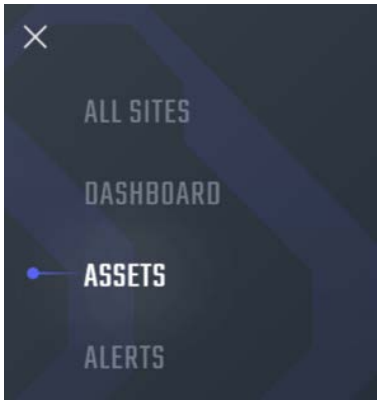
PORT: 515

PROTOCOL: UDP

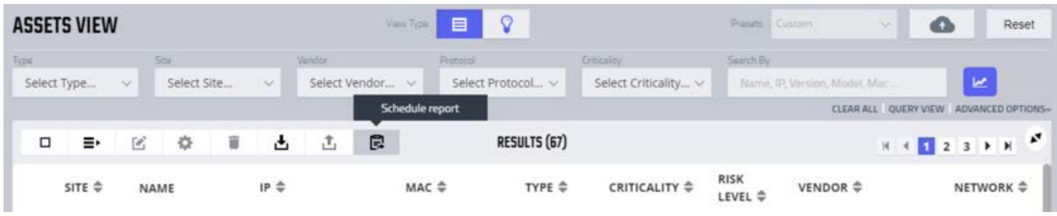
SYSTEM URL: https://10.100.100.111:5000

13. Click **Save.**

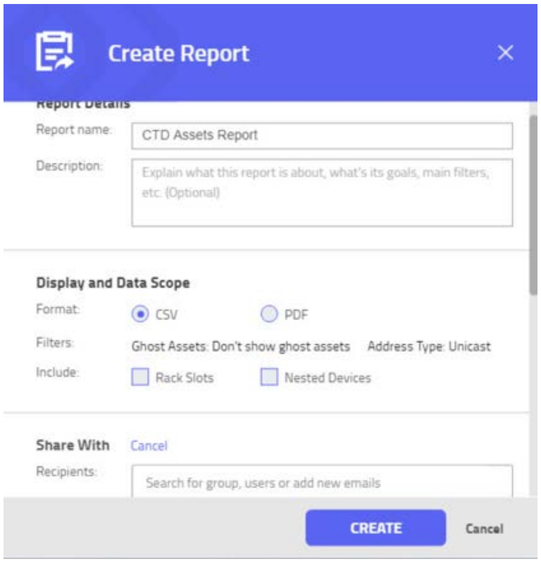
14. To configure Asset Reporting, select **Assets** from the hamburger menu.



15. From the **Assets** list, select the report icon in the menu bar, to schedule a report.



16. Name the report, and select **CSV** as the **Format.** Enter a recipient to receive and download the report. Schedule the report to run at an acceptable interval. This build scheduled the report to run daily. Click **Create.**



Report name: CTD Assets Report

Description: Explain what this report is about, what's its goals, main filters, etc. (Optional)

Format: ● CSV ○ PDF

Filters: Ghost Assets: Don't show ghost assets Address Type: Unicast

Include: □ Rack Slots □ Nested Devices

Recipients: Search for group, users or add new emails

2.8.3.5 Tripwire Splunk Integration

To integrate Tripwire with Splunk, install the Claroty Continuous Detection Application for Splunk. Additionally, install the Splunk Universal Forwarder to forward the CSV report.

1. Download the Claroty Continuous Detection Application for Splunk from https://splunkbase.splunk.com/app/4529/.
2. Log in to Splunk.
3. On the **Apps** menu, click **Manage Apps.**
4. Click **Install app** from file.
5. In the **Upload app** window, click **Choose File.**
6. Locate the downloaded *.tar.gz* file, and then click **Open** or **Choose.**
7. Click **Upload.**
8. Click **Restart Splunk,** and then confirm the restart.
9. To install Splunk Universal Forwarder, follow the steps in Section 2.7.1.4.
10. Place the following text in the */opt/splunkforwarder/etc/system/local/outputs.conf* file:

```
[tcpout]
defaultGroup = default-autolb-group
[tcpout:default-autolb-group]
Server = 10.100.200.101:9997
[tcpout-server://10.100.200.101:9997]
```

11. Place the following text in the */opt/splunkforwarder/etc/system/local/deploymentclient.conf* file:

12. `[target-broker:deploymentserver]`

13. `targetURI = 10.100.200.101:8089`

14. Log in to Splunk. Go to **Settings > Data Inputs > Files & Directories.**

15. Select **New Remote File & Directory.**

16. Select the host on which the forwarder is installed. Name the Server Class. Click **Next.**

17. Input the CSV file to monitor, i.e., /home/esam/attachments/report.csv.

18. Select **Next.**

19. Select **Review.**

20. Select **Submit.**

Appendix A List of Acronyms

CSV	Comma Separated Value
CPU	Central Processing Unit
CTD	Continuous Threat Detection
DHCP	Dynamic Host Configuration Protocol
DVD	Digital Versatile Disc
ESAM	Energy Sector Asset Management
ESP	Encapsulating Security Payload
GB	Gigabyte
HDD	Hard Disk Drive
IP	Internet Protocol
IPv	Internet Protocol version
ISO	Optical Disc Image
IT	Information Technology
NCCoE	National Cybersecurity Center of Excellence
NIC	Network Interface Controller/Card
NIST	National Institute of Standards and Technology
OS	Operating System
OT	Operational Technology
PUMP	Patch and Update Management Program
RAM	Random Access Memory
SIEM	Security Information and Event Management
SPAN	Switched Port Analyzer
TB	Terabyte
TCP	Transmission Control Protocol
TLS	Transport Layer Security
UDP	User Datagram Protocol
UMD	University of Maryland
VM	Virtual Machine
VPN	Virtual Private Network
XML	Extensible Markup Language