

MTL Tofino configurator

Installation and configuration instructions for
MTL Tofino security appliances



Powering Business Worldwide

DECLARATION OF CONFORMITY

A printed version of the Declaration of Conformity has been provided separately within the original shipment of goods. However, you can find a copy of the latest version at -

<http://www.mtl-inst.com/certificates>

DECLARATION OF CONFORMITY	ii
1 INTRODUCTION	1
1.1 Description	1
1.2 Navigating the Eaton Tofino Configurator	2
1.3 Search Functionality	4
2 NINE STEPS TO A SECURE CONTROL SYSTEM	6
3 INSTALLING YOUR EATON TOFINO CONFIGURATOR	8
3.1 Running the Eaton Tofino Configurator Installer	8
3.2 LED Unit Connectors	2
4 PROJECTS	11
4.1 Creating a New Project	12
4.2 Opening an Existing Project	14
4.3 Editing Project Details	14
4.4 Deleting a Project	16
4.5 Duplicating a Project	17
4.6 Exporting a Project File	17
5 TOFINO SAS	19
5.1 Defining the Tofino SAs	19
5.1.1 Manually creating a Tofino SA	20
5.1.2 Discovering a Tofino SA	23
5.2 Editing a Tofino SA	25
5.3 Deleting a Tofino SA	26
5.4 Tofino SA Status Page	27
6 ASSETS	28
6.1 Asset Templates	29
6.1.1 Creating an Asset Template	29
6.1.2 Deleting an Asset Template	32
6.2 Creating Assets	32
6.2.1 Creating an Asset Manually	33
6.2.2 Creating an Asset from a Template	35
6.3 Editing an Asset or an Asset Template	36
6.4 Creating an Asset Template from an Existing Asset	37
6.5 Deleting an Asset	38
6.6 Detecting an Asset	39
7 FIREWALL RULES	42
7.1 Creating Firewall Rules	46
7.2 Suggesting Firewall Rules	49
7.2.1 Suggesting Firewall Rules	51
7.3 Deep Packet Inspection Firewalls	55
7.3.1 Creating a Modbus TCP Enforcer Rule	57
7.3.2 Creating an OPC Classic Enforcer Rule	60
7.3.3 Creating IEC104 Enforcer Firewall Rule	62
7.3.4 Creating an EtherNet/IP Enforcer Rule	65
7.3.4.1 Ethernet IP Wild Card Feature	68
7.3.5 Creating a DNP3 Enforcer Rule	69
7.3.6 Creating a GOOSE Enforcer Rule	71

7.4	Editing Firewall Rules	74
7.5	How Automatic Rule Generation Works	76
7.6	Using Tofino Test Mode to Validate Firewall Rules	79
7.7	Firewall Rules for Grouped Assets	79
7.8	Statistics of Firewall Rules	83
7.9	Digital Input Rules	85
8	EVENT LOGGING	86
8.1	Setting up the Event Logger	86
8.2	Retrieving Log Files	89
8.3	Viewing Syslogs	90
8.3.1	Suggesting Rules From Event Logger View	91
9	APPLYING AND VERIFYING CONFIGURATIONS	92
9.1	Applying a Tofino SA Configuration	92
9.1.1	Loading Your Tofino SA via USB	95
9.1.2	Validation Mechanism for Firewall Rules	96
9.2	Verifying a Tofino SA Configuration	98
9.3	Transferring Data from Your Tofino SA via USB	100
9.4	Retrieving Diagnostics File via Network	101
10	ADVANCED TOPIC: PROTOCOLS	103
10.1	Creating a Protocol	103
10.2	Editing Protocols	104
10.3	Deleting a Protocol	106
11	ADVANCED TOPIC: IMPORTING TEMPLATES AND SECURITY PROFILES	107
12	ADVANCED TOPIC: EATON TOFINO CONFIGURATOR SETTINGS	108
12.1	Adding LSM Licenses	108
12.2	Managing User Logging, Access, and Privileges	109
12.2.1	Managing Access to a Project	110
12.2.2	Managing User Activity Logging and Privileges within a Project	111
12.3	Customizing Program Settings and Preferences	112
13	ADVANCED TOPIC: IMPORTING TEMPLATES AND SECURITY PROFILES	116
13.1	Update DNP3 objects for DNP3 enforcer	118
13.2	Update Request/Response	120
13.2.1	Add/delete groups from request/response	120
13.2.2	Add/delete variations from groups	123
13.2.3	Add/delete function codes for variation	125
13.2.4	Add/delete qualifier codes	126
14	ADVANCED TOPIC: PCAP GENERATION	128
15	TC AND CCM INTEGRATION	130
16	CONVERTING CMP LICENSE TO A TC LICENSE	131
17	UPGRADING YOUR TOFINO SA	132
17.1	Upgrading over the Network	132
17.2	Upgrading via USB	133

18	REFERENCE: FIELD DESCRIPTIONS	134
18.1	Tofino SA Fields	134
18.2	Asset and Asset Template Fields	138
19	TROUBLESHOOTING	141
19.1	Tofino SA Diagnostics	141
19.2	Firewall Not Blocking Traffic	145
19.3	USB Storage Device Recommendations	146
19.4	Factory Resetting Your Tofino SA.	147
19.5	Special Rules.	147
19.5.1	Tofino Rapid Network Recovery	147
19.6	The Discovery Feature is Not Finding Tofino SAs	148
19.7	Unable to Open a Project File	148
19.8	Eaton Tofino Configurator Error Logging	149
20	GLOSSARY	150

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1 INTRODUCTION

1.1 Description

The Tofino Industrial Security Solution is a comprehensive package for securing industrial control systems, particularly at the Local Area Network (LAN) level. The system consists of three core components:

- **Tofino Security Appliance:** These industrially hardened devices are installed in front of individual and/or clusters of Human Machine Interfaces (HMI), Distributed Control Systems (DCS), Programmable Logic Controllers (PLC), or Remote Terminal Units (RTU) control devices that require protection.
- **Tofino Loadable Security Modules (LSM):** A variety of software modules providing security services, such as Firewall and Event Logger. Each LSM is activated on the Tofino SAs to allow them to offer customizable security functions, depending on the requirements of the control system. LSMs can be either preloaded at the factory or added in the field via the Tofino Customer Portal.
- **Eaton Tofino Configurator:** A Windows-based management system for the configuration of each Tofino SA.

Use the Eaton Tofino Configurator on your PC to define configuration data for each Tofino SA in your plant. When you have finished editing the configuration, you can transfer the configuration data into the Tofino SAs.

You can also retrieve configuration details from a Tofino SA to verify that the correct configuration is being used in the field.

The Eaton Tofino Configurator will run on any of these supported Microsoft operating systems: Windows XP, Windows 7 (32- and 64-bit), and Windows Server 2003, 2008, and 2008 SR2. No other applications or services (such as Java, .NET, or Flash) are required for the Eaton Tofino Configurator to operate.

1.2 Navigating the Eaton Tofino Configurator

The Eaton Tofino Configurator is designed to look and operate like Windows Explorer, which you use to navigate files and folders on your computer. Being familiar with basic Windows functionality enables you to start using the Eaton Tofino Configurator immediately. The main view is divided into two sections:

- 1 Project Explorer view:** Tofino SAs, Asset Templates, Assets, Protocols, and Special Rules are listed in a tree format similar to the way that files are displayed in Windows Explorer. Any object in the Project Explorer view can be clicked to display its information in the Details view. Clicking the root folder will display a table of defined objects of that type. For example, clicking the Assets folder will display a table listing the assets defined in the project.
- 2 Details view:** The details of what is selected in the Project Explorer view display here. This is where you can edit particular values for an object.

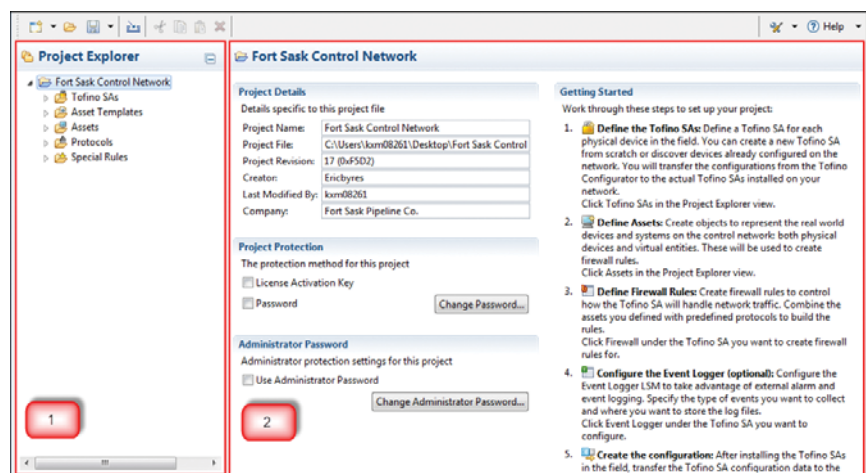


Figure 1: Project explorer and Details views

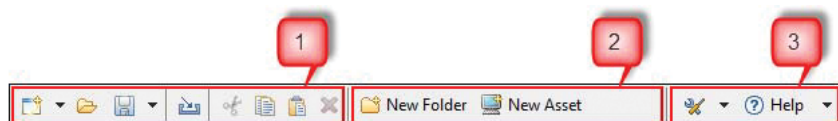


Figure 2: TC toolbar

The toolbar contains 3 sections:

- 1 Project edit commands:** This section appears at the far left of the toolbar and is for commands related to managing project files and their data. It includes:
 - Create new Projects, Assets, Asset Templates, Protocols, or Tofino SAs using a wizard
 - Open an existing project
 - Save and export a project
 - Import predefined Asset Templates, Protocols, Special Rules, and Security Profiles
 - Cut, Copy, Paste, and Delete objects and fields
- 2 Context commands:** This section appears in the center of the toolbar and is for commands related to the content that is currently being worked on. The commands that appear here change depending on the type of object selected in the Project Explorer view.
- 3 Help and Configuration commands:** This section appears at the far right of the toolbar and is for:
 - **Audit Logs:** Viewing and managing the audit system
 - **Preferences:** Setting configurations, such as the location of the audit file
 - **Licensing:** Viewing your software licenses and performing tasks that allow you to obtain new LSM licenses through the Tofino Customer Portal
 - **Help:** Displaying the Online help and Eaton Tofino Configurator product information

1.3 Search Functionality

The Eaton Tofino Configurator has search functionality and is part of the project edit commands on the TC toolbar.

You can search any object- assets, asset templates, protocols and configured firewall rules, with a keyword. A list of objects appears containing that keyword.

You can search objects by the following ways:

- Search by Name- Enter keywords or name of any object and it appears in search result.
- Search by IP/MAC- Enter IP/MAC addresses of objects to search assets and asset templates.
- Search by Parameters- Enter parameters of objects like port number to search TCP/IP protocols.
- Search by Assets and Protocols- Enter parameters of objects like assets, protocols, or IP/MAC to search rules.
- Search Subfolders- Enter the name of a subfolder to perform a search on a folder. This search also works recursively.

Follow these steps to perform a search on any object:

- Click on the search button present on the toolbar.



Figure 3: Search button on toolbar

- A search box appears. Enter a keyword to search, like here, SA is searched. Click on OK button.

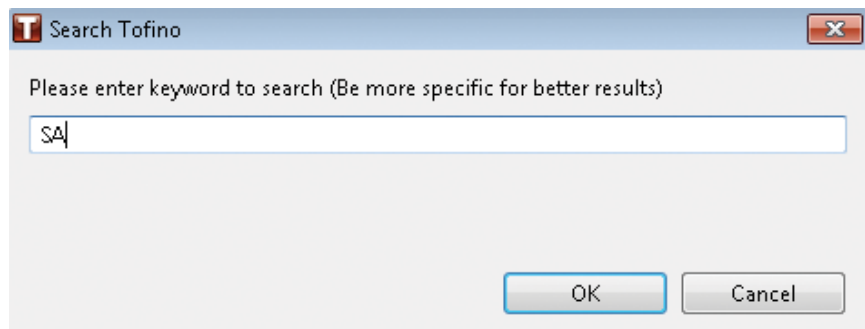


Figure 4: Search keyword

- A detailed search result appears. All objects that have “SA” keyword in them appear in the result list.

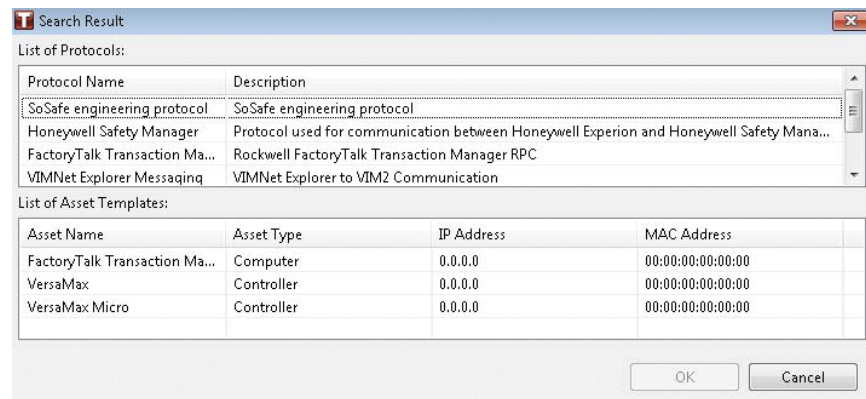


Figure 5: Search result

- Select an object that you want to access. Like here, we have selected one object. Click on OK button.

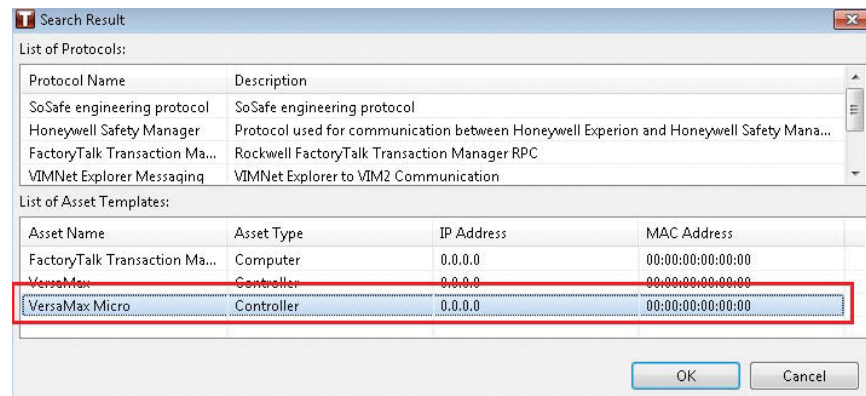


Figure 6: Select object in search result

- The Eaton Tofino Configurator opens the selected object directly from the search result list.

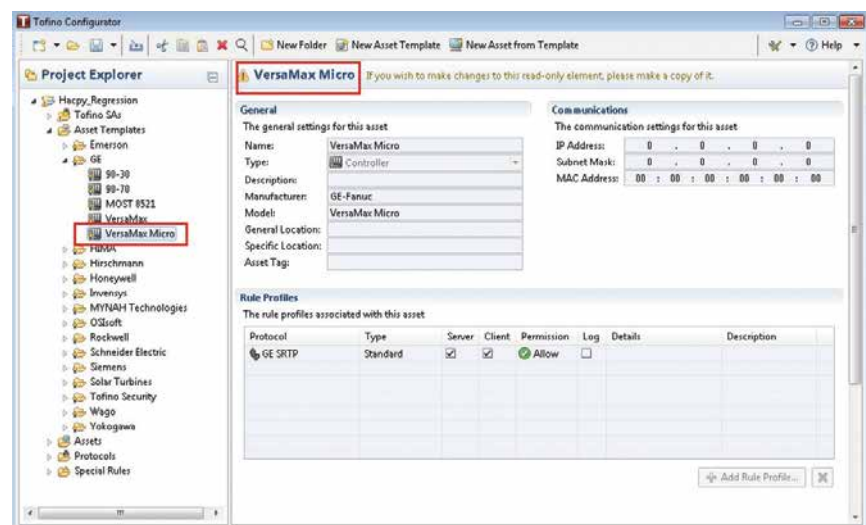


Figure 7: TC opens the selected object

2 NINE STEPS TO A SECURE CONTROL SYSTEM

The Eaton Tofino Configurator was designed to simplify the installation of security firewalls in an industrial control system. The following 9 steps describe how to install and configure your Tofino Industrial Security Solution.

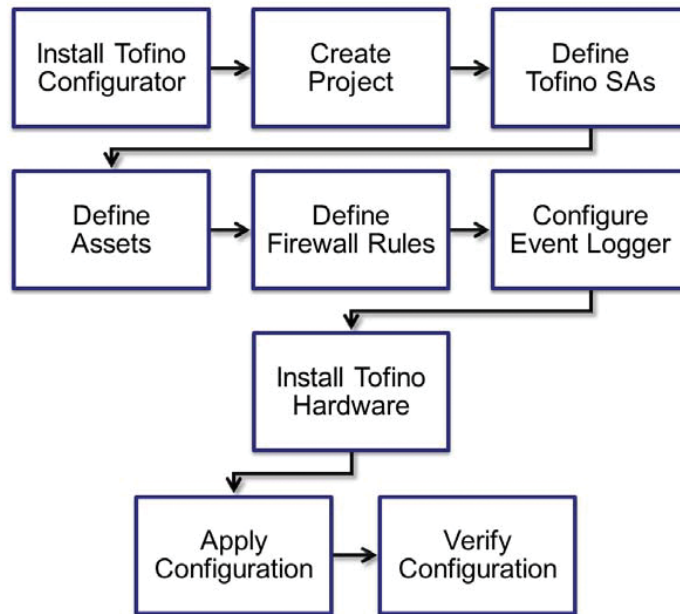


Figure 8: Steps to install and configure TC

- **Install the Eaton Tofino Configurator on your computer.**
- **Create a project.**
- **Define the Tofino SAs for your project.**
Create a virtual representation of the physical Tofino SA devices. You can manually create these or discover existing devices. This information will be used to configure the actual Tofino SAs that will be installed on your network.
- **Define assets for your project.**
These objects represent both real network entities (such as HMIs and PLCs) and virtual entities (such as Broadcast Addresses and subnets) on your network. They are used to simplify tasks like creating firewall rules.
- **Define firewall rules for your Tofino SAs.**
These use the assets you created earlier, along with predefined protocols and special rules that are supplied with the Eaton Tofino Configurator, to determine what network traffic the Tofino SA will allow or block. The various Deep Packet Inspection (DPI) Enforcer modules are accessed through the Firewall selection.

- **Configure the Event Logger (optional).**

Enter the details for your syslog server where you want Tofino SA alarms and events sent. You can also configure the Tofino SA to save logs locally on the Tofino SA for later offloading via a USB storage device.

- **Install your Tofino SA hardware.**

The Tofino SA gets installed on the network between the device(s) to be protected and the rest of the network.

- **Apply the configuration settings to the Tofino SAs in the field.**

Depending on the options you have purchased, you can transfer the configuration data from the Eaton Tofino Configurator to the Tofino SA(s) over the network or using a USB storage device.

- **Apply the configuration settings to the Tofino SAs in the field.**

You can transfer the configuration data from the Eaton Tofino Configurator to the Tofino SA(s) over the network or using a USB storage device.

- **Verify the configuration.**

Retrieves the configuration load reports sent over the network or from the USB storage device that was used to load configurations onto one or more Tofino SAs. This will allow you to record the configuration of Tofino SAs in the field and save it in your project.

You have successfully installed the Tofino Industrial Security Solution and significantly improved the security of your process network.

NOTE
The Tofino SA will pass network traffic freely during the initial configuration or when its configuration is being updated. Firewall rules take effect after completion of the initial configuration or update of the Tofino SA so that network operations are not affected before the full rule set can be loaded. A typical configuration load will finish in approximately 30 seconds.

3 INSTALLING YOUR EATON TOFINO CONFIGURATOR

This section details the procedure for installing the Eaton Tofino Configurator on a computer that has not previously had the Eaton Tofino Configurator installed on it.

Prior to installing your Eaton Tofino Configurator software, please verify that you have the following materials ready:

- Eaton Tofino Configurator installer downloaded from the Tofino Security website (www.tofinosecurity.com)
- License Activation Key (a 25 string of letters and numbers such as X4QP9-RMNRO-B59SD-AG5H6-KSFRW; this is affixed to the document supplied with the Tofino Firewall product)
- License Activation Key (a string of 25 letters and numbers, such as X4QP9-RMNRO-B59SD-AG5H6-KSFRW)

If you have a License Activation key, download your Eaton Tofino Configurator software as follows:

- Visit www.tofinosecurity.com/licensing and register your product.
- On the Tofino Security website, navigate to the Support page and click them appropriate product.
- Click Software and Security Profiles.
- In the portal, click Download Eaton Tofino Configurator.

If you do not have a License Activation Key, contact your reseller.

3.1 Running the Eaton Tofino Configurator Installer

Running the Eaton Tofino Configurator installer launches the installation wizard. Work through the pages of the wizard to configure the installation, accept the license agreement, and activate your license.

Running the Eaton Tofino Configurator installer launches the installation wizard. Work through the pages of the wizard to configure the installation, accept the license agreement, and activate your license. You need a License

Activation Key (LAK) to perform this final step. The LAK is attached to the Read Me document that was included with the Tofino SA.

To install the Eaton Tofino Configurator, you need a Windows user account with Administrator permissions.

- Run the Eaton Tofino Configurator installer.
- Follow the on-screen instructions to install the Eaton Tofino Configurator.

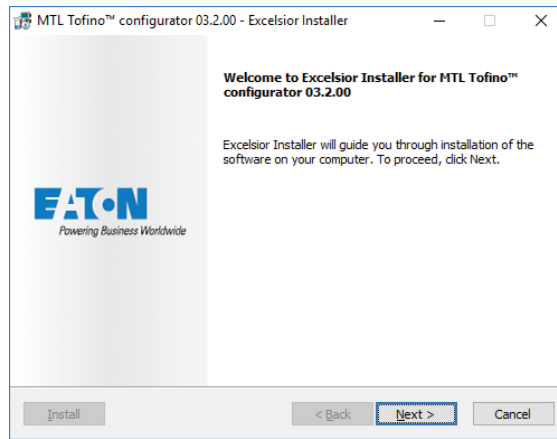


Figure 9: Eaton Tofino Configurator installer

The Eaton Tofino Configurator installation wizard walks you through the steps to configure your installation:

- Accept the license agreement
- Specify the installation type
- Select a destination folder
- Add program icons to specific folders

Click “Next” and “Back” to move between the pages of the wizard.

On the Start Installation page of the wizard, review the settings you selected.

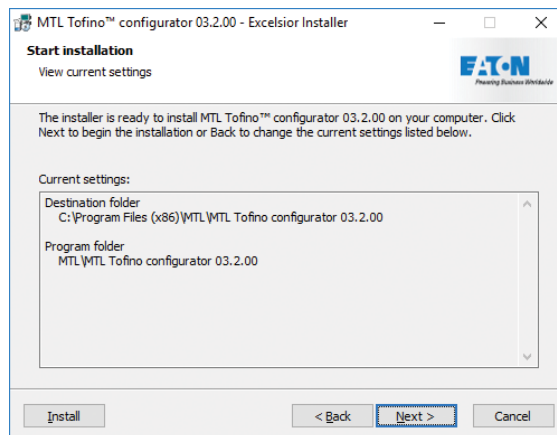


Figure 10: Select the path to install TC

Clicking “Next” on this page begins the installation.

NOTE

To install the Eaton Tofino Configurator with the default installation settings, click “Install” in the bottom left corner at any time.

- To complete the installation, click “Finish” on the final page of the wizard. If this is a new installation of the Eaton Tofino Configurator, the program displays the Activate Your License dialog box.

Figure 11: Enter Activation license key and personal information

- Enter your License Activation Key and contact information. Click “OK.” The Eaton Tofino Configurator will start automatically if you selected the “Start the Eaton Tofino Configurator” check box on the final page of the wizard.

The installation is complete and your license has been activated. Additional configuration steps may be required depending on who will be using this program.

A Windows user with administrator permissions has full access to all Eaton Tofino Configurator functionality. To enable Windows users without Administrator permissions to use the application, perform the following additional steps.

- By default, the Eaton Tofino Configurator preferences and audit log files are located in C:\ProgramData\Tofino Security\Eaton Tofino Configurator. Non-administrator users need permission to write to this location. Using Windows security, allow Write access to this folder. You can choose to relocate the audit log file to a write-accessible location (see “Customizing Program Settings and Preferences”) but you cannot move the preferences file.
- To give non-administrator users full access to a Eaton Tofino Configurator project, save the project file (.tpf) to a folder that allows them Administrator or Read/Write access. To limit their functionality in a project, save the project file to a folder that allows them Read-Only access. See “Managing User Logging, Access, and Privileges” for additional techniques on how to control access to the project file.
- If you plan to use the NetConnect Loadable Security Module (LSM), you need to create firewall exceptions to open ports for both the TCP and UDP protocols. The defined port of Tofino is 6689.

4 PROJECTS

The Eaton Tofino Configurator uses project files to coordinate one or more Tofino SAs that are being used for a common facility or project. Each project file contains the configurations of the Tofino SAs it is managing along with other information, such as network assets and common protocols.

When you start the Eaton Tofino Configurator, you will be asked if you would like to do the following:

- Create a new project (see “Creating a New Project” on page 11)
- Open an existing project

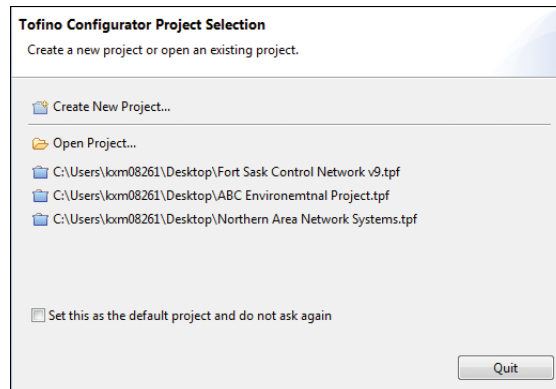


Figure 12: Create a new or open an existing project

Once you create a project file, that file will be visible for you to open from the start-up screen. The last five projects opened display here. You can set a specific project file as the default project so that it automatically opens every time you start the Eaton Tofino Configurator. After you do this, the start-up screen will no longer appear. You set and clear the default project with the Preferences feature (see “Customizing Program Settings and Preferences” on page 112).

Once you load a project file, you can view the project details and protection information. This includes the project name; the name and location of the project file on the computer; the revision number of the project; the users who created and last modified the project file; the company name; the project protection settings; and the administrator protection setting.

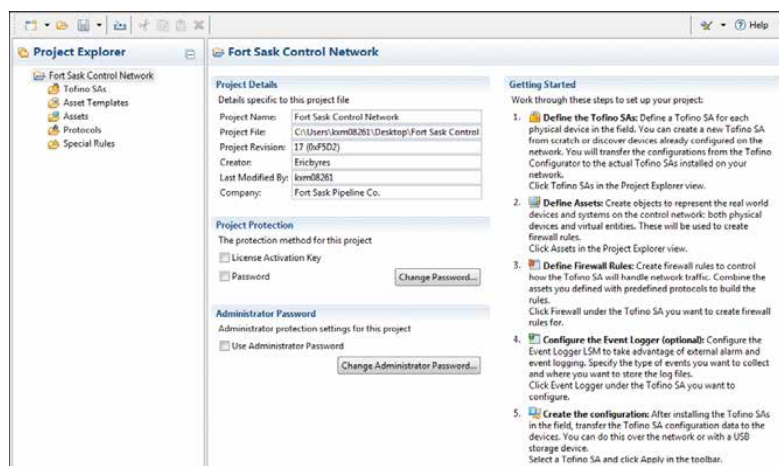


Figure 13: Project details, protection and password information

4.1 Creating a New Project

To begin using the Eaton Tofino Configurator, create a project. You can do this from the start-up screen or from within the application. Create as many projects as you need for your site. While only one project is required, you may choose to segregate your network into smaller projects.

As part of project creation, you can restrict access to the project file with the License Activation Key, a password, or both. Each time the project is saved, the license key and/or the password will be used to encrypt the project file. Anyone who acquires the project file will be unable to access the content without first providing the appropriate key and/or password. When a user attempts to open the project in the Eaton Tofino Configurator, the license key will automatically be read from the program, but the user will be prompted to enter the password.

As an extra layer of protection, you can set an Administrator password. This helps keep users from performing certain functions without approval from the Administrator. When this password is set, users require Administrator permission to change the Project Protection settings or move the project file.

For more information on project protection, see “Managing User Logging, Access, and Privileges.”

- On the start-up screen, click “Create New Project...”

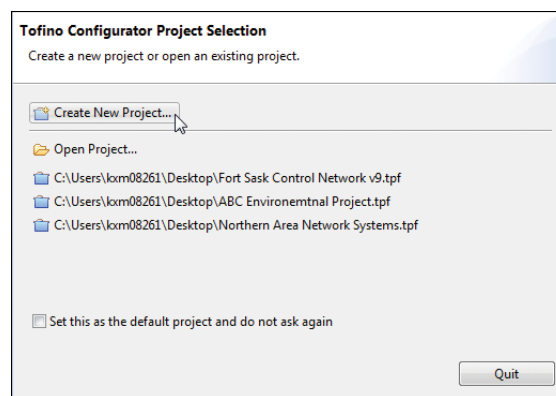


Figure 14: Create a new project

NOTE

Once you set a default project to open automatically, the start-up screen no longer appears.

Alternately, within the application, click the New icon in the toolbar to open the wizard, then select “Project” and click “Next.” If you have another project open, a message informs you that it will be closed. You will be prompted to save the project, if necessary.

Whether you create the project from the start-up screen or from within the application, the New Project Wizard opens. Here you enter the details for the project you are creating.

New Project Wizard
Create a new project.

Project Name: Jasper Pumping Station

Company: AB Oil Co.

< Back Next > Finish Cancel

Figure 15: Enter project details

- Enter a project name and a company name. Click “Next”.
- Select how you want to restrict access to the project file: “License Activation Key” and/or “Password”.

Project Protection
Specify the project protection settings.

The new project will be protected by:

☒ License Activation Key

☒ Password

Password:

Confirm Password:

Password Strength:

Remember your password. You cannot access your project without it.

< Back Next > Finish Cancel

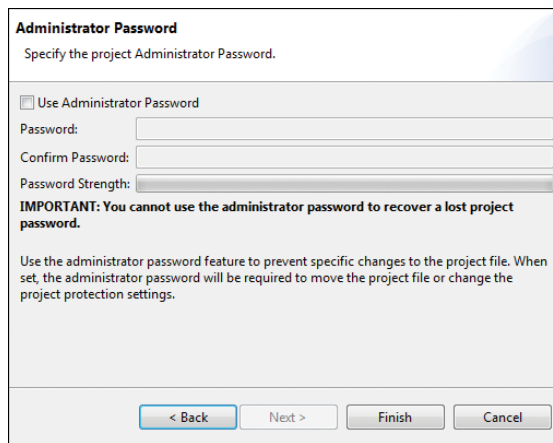
Figure 16: Project protection settings

If you choose password protection, complete the “Password” and “Confirm Password” fields. Create a password that is at least 6 characters long and includes uppercase, lowercase, and special characters.

NOTE
If you leave both check boxes empty, any user will be able to access the information in the .tpf project file.

To restrict access to the project file, you select the License Activation Key option. When selected, the project file will open exclusively on a machine with a matching License Activation Key. You can disable this option when you need to share the project file with technical support or a person in your company who is running a different copy of the Eaton Tofino Configurator. Click “Next”.

- Set an optional administrator password. Select the “Use Administrator Password” check box then complete the “Password” and “Confirm Password” fields.



Administrator Password
Specify the project Administrator Password.

☐ Use Administrator Password

Password:

Confirm Password:

Password Strength:

IMPORTANT: You cannot use the administrator password to recover a lost project password.

Use the administrator password feature to prevent specific changes to the project file. When set, the administrator password will be required to move the project file or change the project protection settings.

< Back Next > Finish Cancel

Figure 17: Specify administrator password

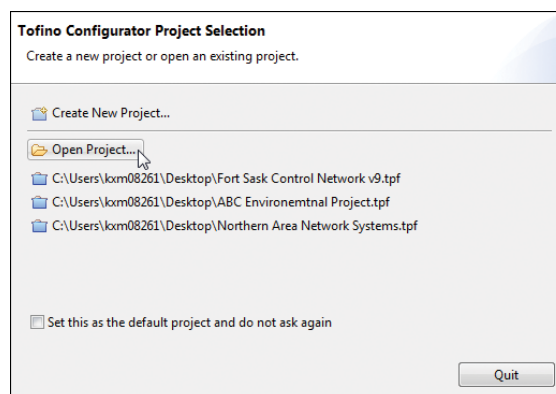
Create a password that is at least 6 characters long and includes uppercase, lowercase, and special characters.

- Click "Finish". The project is created but has not yet been saved.
- Click the Save icon in the toolbar. The standard Windows Save As dialog box opens.
- Select a location on your computer to store the project file and enter a name for the project. The filename will be appended with .tpf.
- Click "Save".

4.2 Opening an Existing Project

You can open an existing project file when you start the Eaton Tofino Configurator or you can open a project from within the application.

- On the start-up screen, click "Open Project..."



Tofino Configurator Project Selection
Create a new project or open an existing project.

C:\Users\kxm08261\Desktop\Fort Sask Control Network v9.tpf

C:\Users\kxm08261\Desktop\ABC Environemtnal Project.tpf

C:\Users\kxm08261\Desktop\Northern Area Network Systems.tpf

☐ Set this as the default project and do not ask again

Quit

Figure 18: Open an existing project

For convenience, the start-up screen displays the last six projects opened. If the project you want to open appears in this list, click it to load the project.

NOTE

Once you set a default project, that project will load automatically when you start the Eaton Tofino Configurator.

Alternately, within the application, click the Open icon in the toolbar. If you have another project open, a message informs you that it will be closed. You will be prompted to save the project, if necessary.

- Locate the project file on your computer. The filename will be appended with .tpf.
- Click the file you want to open to select it. Click “Open”.
- When the project is password protected, the program prompts you to enter the password. Type the project password and click “OK”.

4.3 Editing Project Details

You can view and edit the details of the project you currently have open in the Eaton Tofino Configurator. You can also change the protection settings and passwords.

- Click the project name in the Project Explorer view. The details for the current project display.

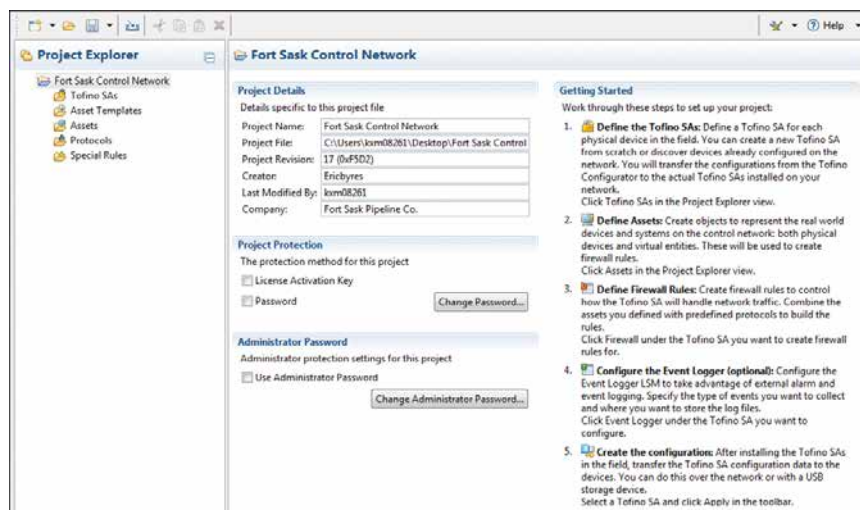


Figure 19: Edit project details

Update the Project Details section as necessary.

- Project Name: A user editable project name.
- Project File: The name of the project file with the location it was loaded from or last saved to. This is also the location where the project will be stored the next time it is saved. This field displays <unsaved> for new, unsaved projects.
- Project Revision: The number of the current version of this project, along with a specially calculated hash code to reduce the chance of accidental duplication of revision numbers. The project revision number is incremented each time the project is saved.

- **Creator:** The user who created the project. This is the Windows user name of the person who was logged in when the project was created.
- **Last Modified By:** The user who last saved the project. This is the Windows user name of the person who was logged in when the project was last saved.
- **Company:** A user editable company name.

In the Project Protection section, change how you want to restrict access to the project file. You can add protection settings, remove protection settings, and change the current password.

- Click a selected check box to turn off a protection setting.
- Click an empty check box to turn on a protection setting.
- Click "Change Password..." to edit the current project protection password, if one is set. You will need to enter the current password and then enter and confirm a new password. Create a password that is at least 6 characters long and includes uppercase, lowercase, and special characters. Click "OK".

In the Administrator Password section, change the administrator setting.

- To make yourself the project administrator, enable the check box if it is not already selected. Set a password and click "OK".
- To remove protection at this level, clear the check box. You will be prompted to confirm the action; click "OK". When prompted, enter the current password and click "OK" to confirm that you have permission to remove the protection.
- To edit the current password, click "Change Administrator Password..." Enter the current password and then enter and confirm a new password. Create a password that is at least 6 characters long and includes uppercase, lowercase, and special characters. Click "OK".

Click the Save icon in the toolbar.

If this is a new project that has not been saved, select a location on your computer to store the project file, enter a name for the project, and click "Save".

4.4 Deleting a Project

You delete a project from outside the Eaton Tofino Configurator. Delete the project file as you would delete any Windows file.

- Open Windows Explorer and locate the project file on your computer.
- Select the .tpf file you want to delete.
- Press DELETE. A message prompts you to confirm the deletion.
- Click "Yes".

4.5 Duplicating a Project

The Save As feature lets you create a copy of your project file. You can also use this feature to save a project file to a new location on your computer.

- Open the project you want to duplicate.
- Open the Save menu and click “Save As”.

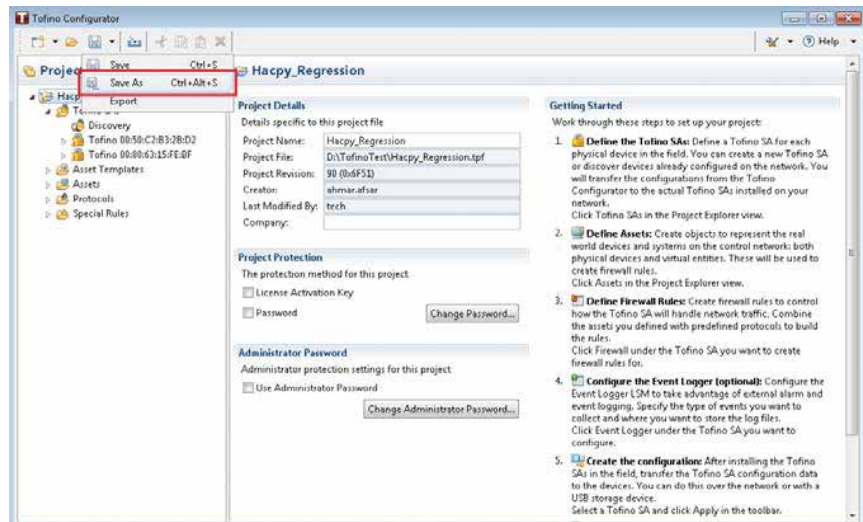


Figure 20: Duplicating project

- Select a location on your computer to store the new project file.
- Edit the filename for the project.
- Click “Save”.

If an administrator password is set for this project, then administrator approval is required to save the project to a new location. To continue you need the project’s administrator password.

4.6 Exporting a Project File

The Export feature lets you create a copy of your project file. Use this action when you need to send a project file to technical support for troubleshooting assistance.

This feature allows users with Read Only or Read/Write access to the project to export the information to outside projects. It also lets users transfer project details to other people, such as Technical Support staff, without having to provide passwords. Sensitive information on your ConneXium Tofino encryption keys is deliberately removed from all export files, so the resulting file cannot be used to connect to any Tofino SAs.

- Open the project you want to export.
- Open the Save menu and click “Export.”

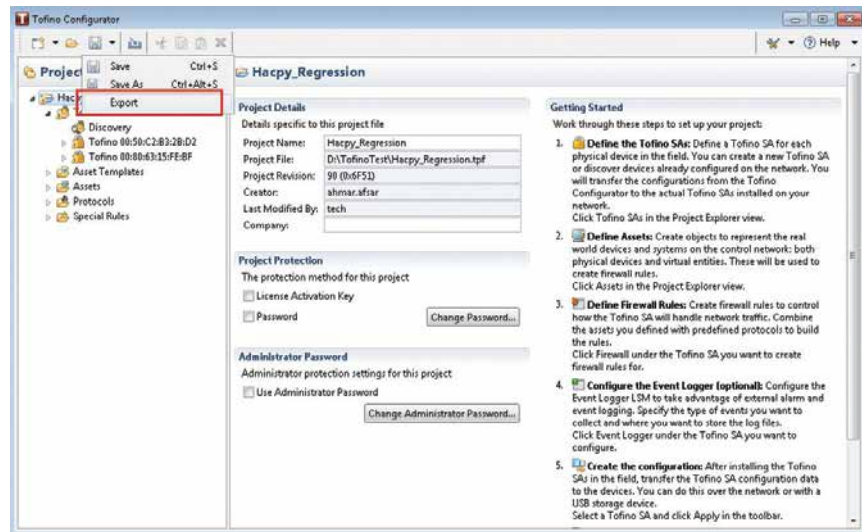


Figure 21: Exporting project file

- Select a location on your computer to store the exported file.
- Edit the filename (optional).
- Click “Save.”

If an administrator password is set for this project, then administrator approval is required to save the export file to a new location. To continue you need the project’s administrator password.

5 TOFINO SAs

Tofino Security Appliances, referred to as Tofino SAs, are the hardware devices installed on your live network. They also exist in the Eaton Tofino Configurator, where you create a Tofino SA to represent each physical device being installed. You configure the devices in the Eaton Tofino Configurator and then transfer the configuration data to the devices, either over the network or with a USB device.

From the Tofino SAs item in the Project Explorer view, you can create, edit, and delete the configuration data for multiple Tofino SAs contained in a single project.

By selecting a specific Tofino SA in the Project Explorer view, you can do the following:

- Create a new Tofino SA
- View and edit the Tofino SA configuration
- Delete a Tofino SA
- View Status of a Tofino SA
- Create a configuration that can be loaded onto a Tofino SA device in the field
- Verify the configuration that is installed on a Tofino SA

Normally you will perform the last two tasks once your Tofino SA is fully configured. After defining a Tofino SA in the project, you may also need to configure event logging and define firewall rules.

The Discovery item in the Project Explorer view lets you search for existing Tofino SAs already configured on your network.

5.1 Defining the Tofino SAs

Within a project, you define a Tofino SA for each Tofino SA hardware device that will be installed on your network. The two most common ways to define a Tofino SA are:

- Create a new Tofino SA manually
- Discover Tofino SA devices already configured on the network

You can also copy and paste a Tofino SA within the same project or across different projects. Once you paste the Tofino SA into the project, edit the settings as necessary.

The Tofino SAs you define appear in the Project Explorer view beneath the item Tofino SAs. Click this top level item to display the current folder structure and the defined Tofino SAs.

Name	Tofino ID	Mode	Configuration Stat...	Type	Version	General Locat...	Specific Locat...
FS_TSA_001	00:00:10:95:EF:A0	Operational	Unknown	Schneider Electric...	01.7.01	Fort Sask Cont...	Rack 1
FS_TSA_002	00:00:10:95:EF:A1	Operational	Unknown	Schneider Electric...	01.7.01	Jasper Control ...	Rack 1
FS_TSA_003	00:00:10:95:EF:A2	Operational	Unknown	Schneider Electric...	01.7.01	Jasper Control ...	Rack 14A
FS_TSA_008	00:00:10:95:EF:A5	Operational	Unknown	Schneider Electric...	01.7.01	Blue River Con...	Rack 14A

Figure 22: List of Tofino SA available

You can create a folder hierarchy to organize your Tofino SAs. Use the New Folder feature in the toolbar to create folders. You can use the Cut and Paste actions in the toolbar to move the devices.

5.1.1 Manually creating a Tofino SA

Create as many Tofino SAs in the project as are needed to represent each physical device being installed on the network.

- Click “Tofino SAs” in the Project Explorer view and then click “ New Tofino SA” in the toolbar.
Alternately, open the New menu in the toolbar and click “ Tofino SA”. The New Tofino SA wizard opens.

Tofino SA

❌ Tofino SA "Tofino ID" is incomplete or invalid.

Tofino ID:

Name:

Description:

General Location:

Specific Location:

Mode:

< Back Next > Finish Cancel

Figure 23: Enter Tofino SA details

- Enter the Tofino ID. This number is found on the face of the Tofino SA device. If you don’t know the Tofino ID of your appliance you can enter a temporary ID of 00:00:00:00:00:XX, where XX is any two digit number. This lets you configure the Tofino SA without the actual ID number. However, you will receive a message indicating “Tofino ID is not a valid Tofino Security Tofino ID”.
- Enter information to identify this specific Tofino SA device in the “Name:”, “Description:”, “General Location:”, and “Specific Location:” fields.
- Select the mode- “Operational” or “Test” - that you want the Tofino SA to run in when the configuration is loaded. Click “Next”.

NOTE

During commissioning, confirm that the Tofino SA is set to Test mode to allow validation of the firewall rules without dropping needed traffic. Once the rules have been validated, set the Tofino SA to Operational mode. For more information on using Test mode, see “Using Tofino Test Mode to Validate Firewall Rules”.

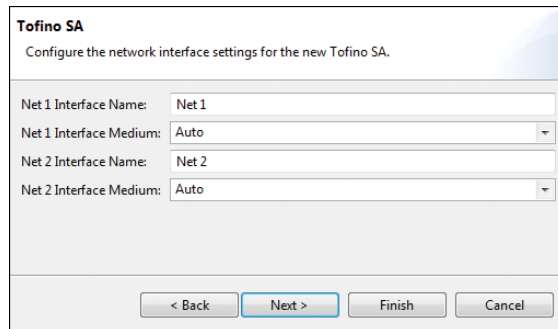


Figure 24: Network interface settings of Tofino SA

- Name the Tofino SA interfaces and set the configuration of each interface. Click “Next”.

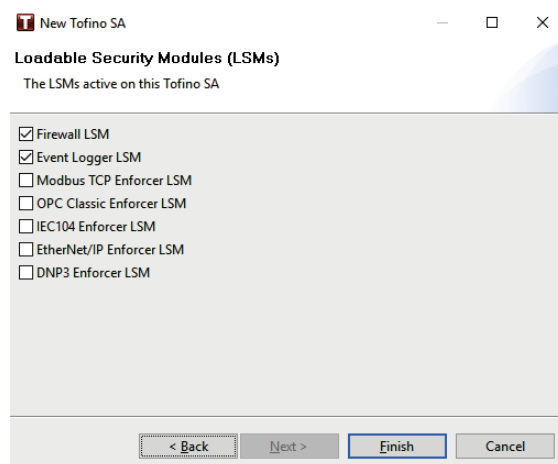


Figure 25: Select LSMs

On the final page of the wizard, select the LSMs you want to activate for this Tofino SA.

- **NetConnect LSM:** The Tofino NetConnect LSM enables the Eaton Tofino Configurator and the Tofino SA to communicate over the network. This allows you to perform certain tasks, such as applying and verifying configuration, from your PC without having to physically visit the Tofino SA in the field. The NetConnect LSM will automatically activate itself once the Eaton Tofino Configurator communicates with a Tofino SA licensed with that LSM.

- **Firewall LSM:** The Tofino Firewall LSM checks the communications on your control network against a list of traffic rules that are defined by your controls engineer. Any communication that is not on the allowed list will be blocked and reported by the Firewall LSM.
- **Event Logger LSM:** The Tofino Event Logger LSM records security events and alarm information. It can record and back up this information simultaneously to both a remote IT syslog server and a non-volatile memory in the Tofino SA.
- **Modbus TCP Enforcer LSM:** The Tofino Modbus TCP Enforcer LSM checks every Modbus command and response against a list of allowed commands defined by your controls engineer. Any command that is not on the allowed list, or any attempt to access a register or coil that is outside the allowed range, will be blocked and reported. It also filters traffic based on the validity of the Modbus TCP messages, screening out messages that have been either deliberately or accidentally malformed.
- **OPC Classic Enforcer LSM:** The Tofino OPC Classic Enforcer LSM inspects, tracks, and helps secure every connection that is created by an OPC application. It dynamically opens only the TCP ports that are required for each connection, and only between the specific OPC client and server that created the connection. It also filters traffic based on the validity of the OPC Classic messages, screening out messages that have been either deliberately or accidentally malformed.
- **IEC104 Enforcer LSM:** The Tofino IEC104 Enforcer LSM enables DPI capabilities for IEC 104 traffic. The protocol enables the Master Station to request data from Substations using the predefined commands and Substations to respond by transmitting the requested data. This enforcer has a feature- Sanity Check, that blocks and reports any traffic that does not match the IEC 104 standards.
- **EtherNet/IP Enforcer LSM:** The Tofino EtherNet/IP Enforcer LSM checks EtherNet/IP explicit messages for CIP objects or services, and compares them against selected lists of allowed commands. This gives you the capability to restrict traffic to data read-only, data read/write, or programming messages to PLC and other devices, as required for your security strategy. It also filters traffic based on the validity of the EtherNet/IP messages, screening out messages that have been either deliberately or accidentally malformed.
- **DNP3 Enforcer LSM:** The Tofino DNP3 Enforcer LSM enables Deep Packet Inspection (DPI) capabilities for DNP3 traffic. It ensures that end values are greater than the starting values. If this isn't the case, the Tofino security appliance should drop the packet regardless of data content. Only correctly formatted DNP3 traffic is allowed. DNP3 validation includes checking of common header byte fields, packet lengths, and DNP3 CRC values.
- Click "Finish".
The new Tofino SA appears in the Project Explorer view.
- Expand the Tofino SA and click "General" to display the General settings page. See the reference section "Tofino SA Fields" for a detailed description of the fields on this page.
- Confirm the information for this device is correct. Check the Communications section, which defaults to "Both USB and Network". Change this setting as necessary.

You can specify whether you want to transfer configuration data to the Tofino SA device over the network or with a USB device. If you do not have a license for the NetConnect LSM, choose "USB Only".

5.1.2 Discovering a Tofino SA

The Discovery feature lets you search your network for new and existing Tofino SA devices. By scanning IP address ranges, the Tofino SAs can be discovered and then added to your project.

A Tofino SA does not have its own IP address. During Discovery, the Eaton Tofino Configurator sends discovery messages to addresses of devices on the opposite side from the Tofino SA. The Eaton Tofino Configurator may be located anywhere in the network, as long as it is able to communicate with at least one device on the opposite side of the Tofino SAs. If any routers or firewalls are located between the Eaton Tofino Configurator and a Tofino SA in the network, configure each router and firewall device to allow the Eaton Tofino Configurator traffic to pass through these devices. See “Communications” for more information.

When working with multiple Tofino SAs, you may want to organize them in folders. You can create the folder hierarchy before you discover the devices or when you enter the scan details. To create folders prior to configuring the scan settings, use the New Folder feature in the toolbar. Select “Tofino SAs” or an existing folder in the Project Explorer view to display this button.

- In the Project Explorer view, expand the Tofino SA you are working with and click “Discovery.”
On the Tofino Discovery page, you configure a scan on the left side of the page. On the right side, you view the progress and results of the scan.

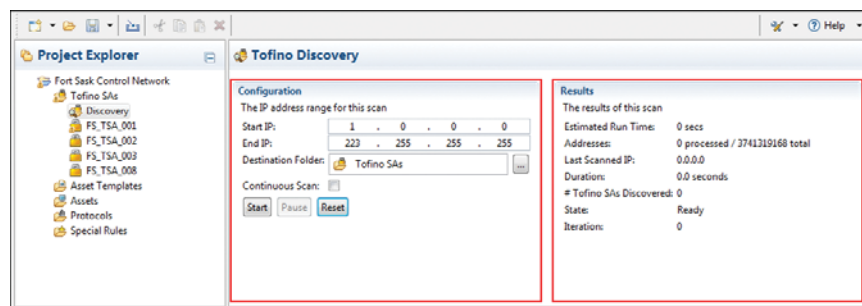


Figure 26: Discover Tofino SA

- In the “Start IP: ” and “End IP: ” fields, enter the starting and ending IP addresses for the range you want to scan.
The number of addresses to be scanned and the estimated runtime is calculated and displayed in the Results section.

NOTE

When setting scan ranges, it is helpful to keep them as small as possible as scanning is deliberately slow so that it does not impact the process network in any way. One scan message is sent each second, so scanning larger ranges (greater than 5000 addresses) may take several hours.

Specify the folder where you want to save the Tofino SAs that are discovered with this scan.

- To display the existing folders, click the button to the right of the "Destination Folder: " field.
- To create a new folder beneath the currently selected folder, click the Add button (+). Enter a name for the new folder and click "OK".
- Select the destination folder for discovered Tofino SAs.
- Click "OK".

To run the scan repeatedly, select the "Continuous Scan: " check box. The scan will run until you manually stop it. This feature enables you to start the scan before the Tofino SA devices are actually installed. As they are installed on the network, the scan will discover them.

To begin the scan, click "Start".

To pause the scan at any time, click "Pause". The scan is held at this point until you click "Start" to begin it again. The "Duration: " field displays how long the scan has been running since the last time "Start" was clicked. To return the scan Results fields to the default values, click "Reset".

The progress of the scan displays in the Results section. There are four states:

- Ready: The scan is configured but has not been started.
- Complete: The entire address range has been scanned.
- Paused: The user has paused the scan.
- Rescanning: The scan is in progress for the entire address range. When Continuous Scan option is enabled, this state relates to the "Iteration: " feature. The "Iteration: " value indicates how many times the range has been scanned.

As devices are discovered, they appear in the Project Explorer view at the specified location. The General settings page is populated with basic device information: Tofino ID, Name, and Hardware Type. A network connection is automatically attempted and, if successful, provides additional device details.

5.2 Editing a Tofino SA

Selecting or expanding a Tofino SA in the Project Explorer view displays links that let you navigate to pages where you can edit the device configuration.

The configuration and setting options available for a Tofino SA will depend on its associated LSMs. Typically, the available settings include:

- General settings: Configure the general settings for the selected Tofino SA. This includes general information, communication parameters, and LSM selection.
- Event Logger LSM settings: Configure alarm and event logging for the selected Tofino SA.
- Firewall LSM settings: Configure firewall rules for the selected Tofino SA.

When you copy a Tofino SA from another project, review the configuration settings to verify that it is set up properly for the new location.

- In the Project Explorer view, expand the Tofino SA you want to work with and click “General”.
The page displayed shows the general configuration settings for this Tofino SA.

The screenshot shows the 'General' configuration page for a Tofino SA with ID 00:50:C2:B3:2B:D2. The page is divided into several sections:

- General:** Fields for Name (Tofino 00:50:C2:B3:2B:D2), Description, General Location, Specific Location, and NTP Time Sync (checked).
- Status:** A table showing operational status: Mode (Operational), Configuration Status (Verified), Latest Configuration Revision (6 (0x49A)), Verified Configuration Revision (6 (0x49A)), Hardware Type (Tofino Xenon TX/TX), Model (TofinoXe-4200T1T1SD0Z9000ZTAT02.2.00), and Firmware Version (02.2.00).
- Network Interfaces:** Settings for two network interfaces. Net 1 Name is 'Net 1' and Net 1 Medium is 'Auto'. Net 2 Name is 'Net 2' and Net 2 Medium is 'Auto'.
- Communications:** Radio buttons for 'Network Only', 'USB Only', and 'Both USB and Network' (selected). Below is a 'Contact Assets' list with one entry: '5.5.5.13 [Discovery]'.
- Loadable Security Modules (LSMs):** A list of checkboxes for selecting LSMs to activate: NetConnect LSM, Firewall LSM, Event Logger LSM, Modbus TCP Enforcer LSM, OPC Classic Enforcer LSM, and EtherNet/IP Enforcer LSM. All are checked.

Figure 27: General settings of Tofino SA

- Update the Tofino SA configuration as necessary. See the reference section “Tofino SA Fields” for a detailed description of the fields on this page.
- Click the Save icon in the toolbar. Editing a Tofino SA

5.3 Deleting a Tofino SA

Delete a Tofino SA if you no longer need it in the current project. The Tofino SA in your Eaton Tofino Configurator project is a virtual representation of the physical Tofino SA device. Special keys are stored in both of these locations to enable communication between them. Deleting a Tofino SA from the project deletes its configuration data, including the special keys. This will block any future network communication between the Eaton Tofino Configurator and that Tofino SA device until a factory reset is performed on the Tofino SA device. The factory reset clears the second of the two keys and opens the door for a new Eaton Tofino Configurator/Tofino SA pairing to be established.

- In the Project Explorer view, click the Tofino SA you want to delete.
- Click the Delete icon in the toolbar.

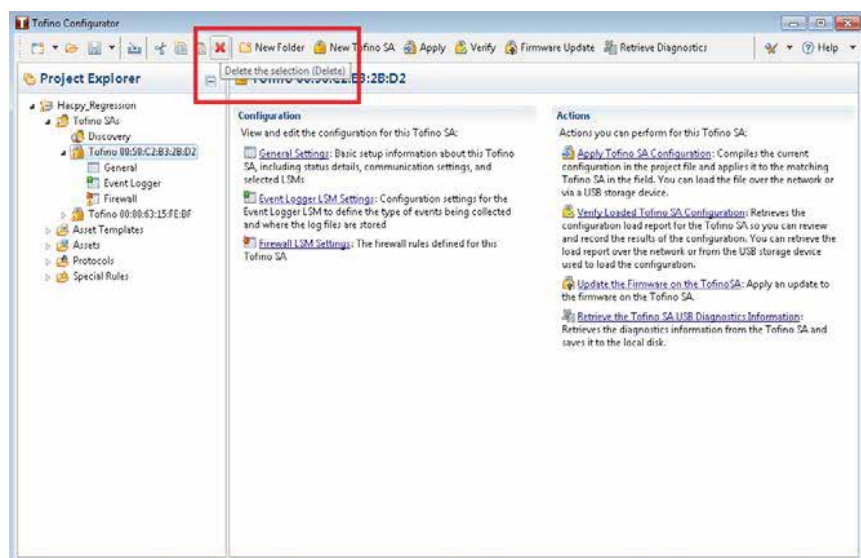


Figure 28: Deleting Tofino SA

When the Communications setting is “Network Only” or “Both USB and Network,” a message asks if you want to perform a factory reset on the Tofino SA. Click “Yes.” The Eaton Tofino Configurator automatically resets the Tofino SA to the factory settings.

When the Communications setting is “USB Only,” you need to perform the factory reset manually. See “Factory Resetting Your Tofino SA.”

- A message prompts you to confirm the deletion. Click “OK” to proceed.

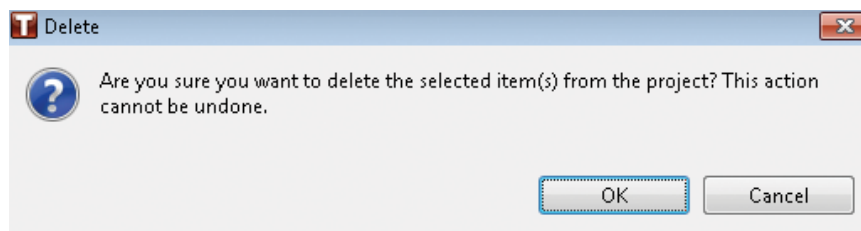


Figure 29: Confirm prompt

5.4 Tofino SA Status Page

Tofino SA Status page shows the current status of parameters in a particular TSA. These parameters reflect the data of both the interfaces. Tofino Status Page is part of the specific Tofino SA folder; it can be navigated like other pages (General, Event Logger etc.).

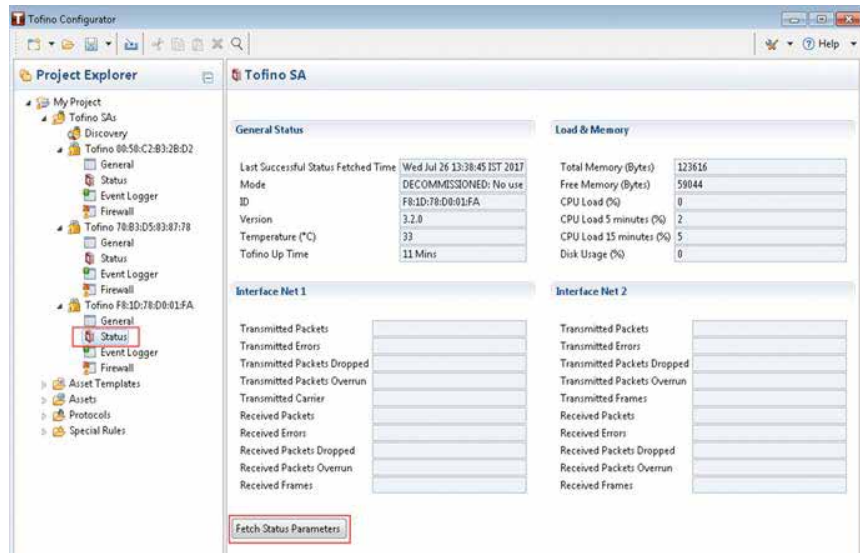


Figure 30: Tofino SA Status page

The listed parameters are divided into four categories:

- General Status
- Load & Memory
- Interface 1
- Interface 2

These categories have the information about memory, transmitted/received parameters of both the interfaces, sysUptime, Temperature and Load with units and many more such parameters.

To fetch the latest parameters of a Tofino SA, follow these steps:

- Click on Status page of TSA.
- Click on “Fetch Status Parameters” button located at the bottom of the page.

Eaton Tofino Configurator now fetches latest parameters of that particular Tofino SA.

NOTE

Previously fetched values of Tofino Status parameters remain saved if you navigate to the other pages in the TC project explorer. However, if you close a project, then you need to fetch the stats again as these are not saved in project file.

6 ASSETS

In the Eaton Tofino Configurator, assets represent the real world devices and systems on the control network. An asset can represent a physical device, such as a PLC, a computer, or network equipment. It can also represent a virtual asset, such as a broadcast address range, a network, or a multicast address. This provides flexibility when creating firewall rules.

By selecting a specific asset in the Project Explorer view, you can do the following:

- Create a new asset manually
- Create a folder
- View and edit the asset's details
- Create an asset template from the selected asset
- Delete an asset

You can create a new asset manually or from a template.

Computer, Controller, Device, and Network Equipment Assets

Most assets used in the Eaton Tofino Configurator are real devices. These typically use messages known as Unicast messages. A Unicast message is network traffic directed from a specific device to another specific device. When you define an asset to be a computer, controller, device, or network equipment, the Eaton Tofino Configurator assumes it is a physical device on your network and helps create rules appropriate for that type of device.

Network Assets

Network assets are a virtual representation of the devices contained in a specific network or subnetwork. When you define an asset to be a network, the Eaton Tofino Configurator assumes it is a collection of devices on your network that belong to a group of IP addresses known as a subnet. Thus, if you use a network asset in a rule, the Eaton Tofino Configurator helps create rules that allow or deny traffic from that range of addresses.

Broadcast and Multicast Assets

In most networks there are messages that are sent to a general address and are expected to be received by everyone on the network. These are called Broadcast and Multicast messages. The Eaton Tofino Configurator has special assets designed to handle these types of messages.

- **Broadcast:** This asset represents an address that is used for IP broadcasts. Broadcast packets, which are a normal part of network operation, are transmitted by a device to a broadcast address that many devices listen to. For example, IP networks use broadcasts to resolve network addresses using Address Resolution Protocol (ARP). The exact broadcast address is dependent on the subnet defined for a given network. If the node address is 192.168.1.1 the broadcast address might be 192.168.1.255, depending on the subnet of the node. This type of asset is required if you wish to provide broadcast filtering rules in the Firewall LSM.
- **Multicast:** This asset represents an address that is used for IP multicasts. Multicast packets are transmitted to a multicast address that a set of devices listen to. Typically these are IP addresses in the range between 224.0.0.0 through 239.255.255.255 and depend on the manufacturer of controller hardware, the protocols in use, and the network configuration. For example, 239.192.22.121 is often used in EtherNet/IP networks, while 234.5.6.7 is often used with Fault Tolerant Ethernet Systems. This is required if you wish to provide multicast filtering rules in the Firewall LSM.

6.1 Asset Templates

An asset template is a tool to help you create multiple assets quickly. It contains predefined fields that can be used to rapidly create similar assets. For example, if you have ten PLCs in your plant that are a similar make and model, you can create an asset template (or use a pre-existing template) to represent that type of PLC. Then you can quickly generate assets to represent the ten similar PLCs.

The Eaton Tofino Configurator comes with a number of templates preloaded for Schneider Automation products. You can also import new templates or create templates of your own.

The Eaton Tofino Configurator comes with a number of templates preloaded for common automation products. You can also import new templates or create templates of your own.

By selecting a specific asset template in the Project Explorer view, you can do the following:

- Create a new asset template
- Create a folder
- Create a new asset from the selected template
- View and edit the asset template's details
- Delete the asset template

The templates that you create appear in the Project Explorer view in the Asset Templates folder.

You can create a folder hierarchy to organize your templates. Use the New Folder feature in the toolbar to create folders. You can create a template in a specific folder, or you can use the Cut and Paste actions in the toolbar to relocate templates.

Some templates are factory defined, and cannot be cut or deleted.

6.1.1 Creating an Asset Template

Create as many asset templates in a project as you need to simplify the process of creating assets. When you have several assets that are similar, it will save time to create a template containing the common information and then use that to create your assets.

You can create rule profiles for asset templates. When you create a template you can specify the protocols that this type of asset typically uses, along with how you want those protocols managed. The New Firewall Rule Wizard can use this information to automatically create rules for the assets created from this template. For more information, see "Rule Profiles".

NOTE
To add rule profiles to preloaded templates, first make a copy of the template and then add the rule profiles.

- Click “Asset Templates” in the Project Explorer view and then click “New Asset Template” in the toolbar.

Alternately, open the New menu in the toolbar and click “Asset Template” The templates that you create appear in the Project Explorer view in the Asset Templates folder.

NOTE

This creates an asset template at the top level. Select a folder before clicking “New Asset Template” to create the template in a specific location. Use the New Folder feature in the toolbar to create folders to organize the templates.

The New Asset Template dialog box opens.

Asset Template
Create a new asset template.

Name: UnityPro

Type: Computer

Description: Unity Pro Programming Station

Manufacturer:

Model: Unity Pro

General Location:

Specific Location:

Asset Tag:

Finish Cancel

Figure 31: New asset template

- Enter a name for this asset template and select the type of asset it represents.
- Complete the remaining fields (optional).
- Click “Finish”.
The program adds the new template in the specified location in the Project Explorer view. The details view displays the template configuration.

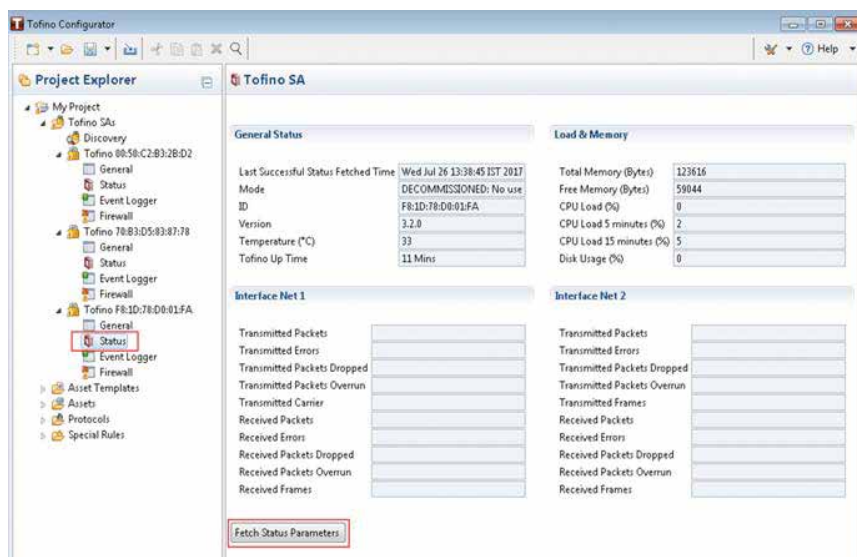


Figure 32: Detail view of an asset

Generally, you will not complete the Communications section. A user will add these details when creating a specific asset from this template.

You can now define rule profiles. This lets you specify the protocols that an asset uses, along with how you want the protocols managed. The New Firewall Rule Wizard uses this information to automatically create rules for the asset. For more information, see “Rule Profiles”.

- To open the New Rule Profile Wizard, click “Add Rule Profile...” beneath the Rule Profiles table.
- Select the type of rule you want to create: standard or special. If you are creating a special rule, you also select a rule type from the list provided. Click “Next.”
- Define the rule profiles.
 - Expand the folders and select the protocols you want to use. Use SHIFT+click to select a range of protocols; use CTRL+click to select multiple protocols out of sequence. The Eaton Tofino Configurator creates a rule profile for each protocol selected.
 - Set the permission. This tells the firewall what to do with a packet that matches the rule profile: allow it to pass (“Allow”) or stop it from passing (“Deny”). The “Enforcer” option inspects and filters the traffic using Deep Packet Inspection. This option is appropriate solely for the Enforcer protocols.
 - To create a log each time the rule is triggered, select the “Enable Logging” check box.
 - Click “Finish.”
The profiles created appear in the Rule Profiles table.
- Select the rule protocol in this table and finish configuring it in the Rule Details section.

Rule Profiles
The rule profiles associated with this asset

Protocol	Type	Server	Client	Permission	Log	Details	Description
MODBUS/TCP	Standard	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/> Allow	<input type="checkbox"/>		

Rule Details
Additional options for the selected firewall rule

☒ General

Rate Limit: / second

Burst Limit:

Figure 33: New rule profile wizard

You can adjust advanced settings, such as traffic rate limiting, for most rule profiles. Additional settings for the selected rule profile are displayed in one or more tabs below the table.

- Click the Save icon in the toolbar.
See the reference section “Asset and Asset Template Fields” for a detailed description of the fields on this page.

6.1.2 Deleting an Asset Template

Delete an asset template if you no longer need it in the current project. The templates reside in the “Asset Templates” folder.

- In the Project Explorer view, locate the asset template you want to delete and click it in the tree to select it.
- View the details to verify that this is the correct template.
- Click the Delete icon in the toolbar. A message prompts you to confirm the deletion.
- Click “OK” to proceed.

6.2 Creating Assets

To build your asset library, you can create assets manually or from existing templates. Asset templates contain default asset details, allowing you to create similar assets quickly.

You can also copy and paste an asset or asset template into the Assets folder to create an asset. However, this does not run the wizard. To make the asset unique, you need to edit the details manually.

6.2.1 Creating an Asset Manually

Creating an asset involves defining its general information, communication parameters, and rule profiles.

You can create as many assets as needed for your project. When working with multiple assets, you may want to organize them in folders. Use the New Folder feature in the toolbar to create the folder hierarchy.

- In the Project Explorer view, expand “Assets” and click the folder where you want the new asset to reside. To create the asset at the top level, click “Assets”.
- Click “ New Asset” in the toolbar. Alternately, open the New menu in the toolbar and click “ Asset.” The New Asset wizard opens.

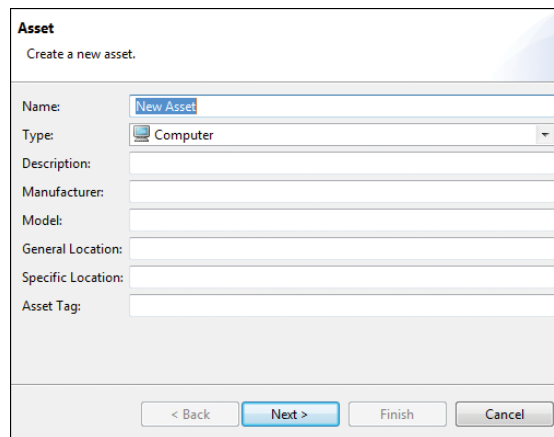


Figure 34: Create asset manually

- Enter a name for this asset and select its type.
- Complete the remaining fields to identify the asset (optional). Click “Next”.
- Enter an IP address and/or a MAC address for this asset. This information will be used by the Eaton Tofino Configurator when creating firewall rules for this asset.
- Click “Finish”.
The new asset appears in the specified location in the Project Explorer view. The details view displays the asset details.

FS_HMI_004

General
The general settings for this asset

Name: FS_HMI_004
Type: Computer
Description: Main Pump Station #4
Manufacturer: Schneider
Model: CitectSCADA
General Location: Main Pump Station Control Room
Specific Location:
Asset Tag:

Communications
The communication settings for this asset

IP Address: 192 . 168 . 1 . 18
Subnet Mask: 0 . 0 . 0 . 0
MAC Address: 00 : 00 : 00 : 00 : 00 : 00

Rule Profiles
The rule profiles associated with this asset

Protocol	Type	Server	Client	Permission	Log	Details	Description

[Add Rule Profile...](#)

Figure 35: Detail view of an asset

You can now define rule profiles. This lets you specify the protocols that an asset uses, along with how you want the protocols managed. The New Firewall Rule Wizard uses this information to automatically create rules for the asset. For more information, see “Rule Profiles”.

- To open the New Rule Profile Wizard, click “Add Rule Profile...” beneath the Rule Profiles table.
- Select the type of rule you want to create: standard or special. If you are creating a special rule, you also select a rule type from the list provided. Click “Next”.
- Define the rule profiles.
 - Expand the folders and select the protocols you want to use. Use SHIFT+click to select a range of protocols; use CTRL+click to select multiple protocols out of sequence. The Eaton Tofino Configurator creates a rule profile for each protocol selected.
 - Set the permission. This tells the firewall what to do with a packet that matches the rule profile: allow it to pass (“Allow”) or stop it from passing (“Deny”). The “Enforcer” option inspects and filters the traffic using Deep Packet Inspection. This option is appropriate solely for the Enforcer protocols.
 - To create a log each time the rule is triggered, select the “Enable Logging” check box.
 - Click “Finish”.
The profiles created appear in the Rule Profiles table.
- Select the rule protocol in this table and finish configuring it in the Rule Details section

Rule Profiles
The rule profiles associated with this asset

Protocol	Type	Server	Client	Permission	Log	Details	Description
MODBUS/TCP	Standard	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/> Allow	<input type="checkbox"/>		

[+ Add Rule Profile...](#) [X](#)

Rule Details
Additional options for the selected firewall rule

General

Rate Limit: / second

Burst Limit:

Figure 36: Rule profile section

You can adjust advanced settings, such as traffic rate limiting, for most rule profiles. Additional settings for the selected rule profile are displayed in one or more tabs below the table.

- Click the Save icon in the toolbar.
See the reference section “Asset and Asset Template Fields” for a detailed description of the fields on this page.

6.2.2 Creating an Asset from a Template

Use a template to quickly create an asset with default values already completed.

Assets created from a template are placed in the Assets folder in alphabetical order. You can reorganize the assets into specific folders as needed.

- In the Project Explorer view, expand “Asset Templates” and locate the template you want to use to create an asset.
- Click the asset template to select it and click “ New Asset from Template” in the toolbar.
The New Asset wizard opens with default values populating some of the fields completed.

Asset
Create a new asset.

Name:

Type:

Description:

Manufacturer:

Model:

General Location:

Specific Location:

Asset Tag:

Figure 37: Create an asset from template

- Change the entry in the “Name: ” field to identify the asset you are creating.
- Complete the remaining fields to identify the asset (optional). Click “Next”.
- Enter an IP address and/or a MAC address for this asset. This information will be used by the Eaton Tofino Configurator when creating firewall rules for this asset.
- Click “Finish”
The program adds the new asset to the Assets folder in the Project Explorer view. The Rule Profiles table displays any rule profiles configured for the template.
- Click the Save icon in the toolbar.
- To relocate the asset to another folder, use the Cut and Paste actions in the toolbar.

See the reference section “Asset and Asset Template Fields” for a detailed description of the fields on this page.

6.3 Editing an Asset or an Asset Template

Selecting an asset or an asset template in the Project Explorer view displays the configuration details for the selected item. From here you can edit the settings. This page includes general information, communication parameters, and rule profiles.

The Rule Profiles table displays the rule profiles created for the selected asset or template. You can make changes directly on this page: in the table and in the Rule Details section.

- In the Project Explorer view, click the asset or template you want to edit. The configuration details are displayed.

The screenshot shows the configuration window for an asset named 'FS_HMI_001'. It is divided into three main sections: General, Communications, and Rule Profiles.

General
The general settings for this asset

Name:	FS_HMI_001
Type:	Computer
Description:	Main Pump Station HMI #1
Manufacturer:	Schneider
Model:	CitectSCADA
General Location:	Main Pump Station Control Room
Specific Location:	Right Desk
Asset Tag:	675849-23

Communications
The communication settings for this asset

IP Address:	192 . 168 . 1 . 15
Subnet Mask:	255 . 255 . 255 . 0
MAC Address:	00 : 00 : 00 : 00 : 00 : 00

Rule Profiles
The rule profiles associated with this asset

Protocol	Type	Server	Client	Permission	Log	Details	Description
MODBUS/TCP	Standard	<input type="checkbox"/>	<input checked="" type="checkbox"/>	Allow	<input type="checkbox"/>		
DHCP/BOOTP	Standard	<input type="checkbox"/>	<input checked="" type="checkbox"/>	Allow	<input type="checkbox"/>		
ICMP Ping Only	Standard	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	Allow	<input type="checkbox"/>		
HTTP	Standard	<input type="checkbox"/>	<input checked="" type="checkbox"/>	Allow	<input type="checkbox"/>		

At the bottom right, there is a button labeled '+ Add Rule Profile...'.

Figure 38: Editing an asset template

- Update the fields in the General and Communications sections.

NOTE
Generally, you will not complete the Communications section for an asset template. A user will add these details when creating a specific asset from this template.

- In the Rule Profiles table, click the cell you want to edit and make the necessary change in the table. Depending on the cell selected, you will be able to:
 - Change the state of a check box
 - Select an entry in a list
 - Open a dialog box and select from a list of appropriate values
 - Enter text

To delete a rule profile, select it in the table and click the Remove button (x) beneath the table.
- On the General and Enforcer tabs in the Rule Details section, update the settings as necessary for the currently selected rule profile.
- Click the Save icon in the toolbar.
See the reference section "Asset and Asset Template Fields" for a detailed description of the fields on this page.

6.4 Creating an Asset Template from an Existing Asset

You may find yourself in the situation where you need to create several assets that are similar to one you already have in your project. You can create an asset template from that existing asset. This will then allow you to quickly create the additional assets from the template.

- In the Project Explorer view, locate the asset you want to use as the basis for an asset template.
- View the details to verify that this is the correct asset.
- In the Project Explorer view, right click that asset and click "Copy".
- Right click the folder where you want the new asset template to reside and click "Paste". You can place it in the Asset Templates folder or one of the subfolders.
The asset appears in the specified location.

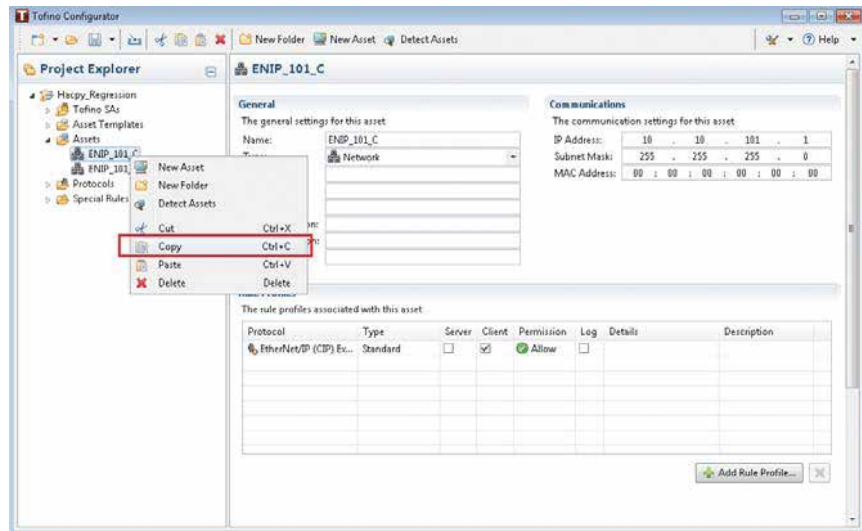


Figure 39: Create asset from an existing template

- In the Project Explorer view, click the new asset template to display its details. Make any changes necessary so that it can be used to quickly create assets.
- Click the Save icon in the toolbar.

6.5 Deleting an Asset

Delete an asset if it no longer belongs in the current project. The assets reside in the Assets folder or in a subfolder.

- In the Project Explorer view, locate the asset you want to delete and click it in the tree to select it.
- View the details to verify that this is the correct asset.
- Click the Delete icon in the toolbar.

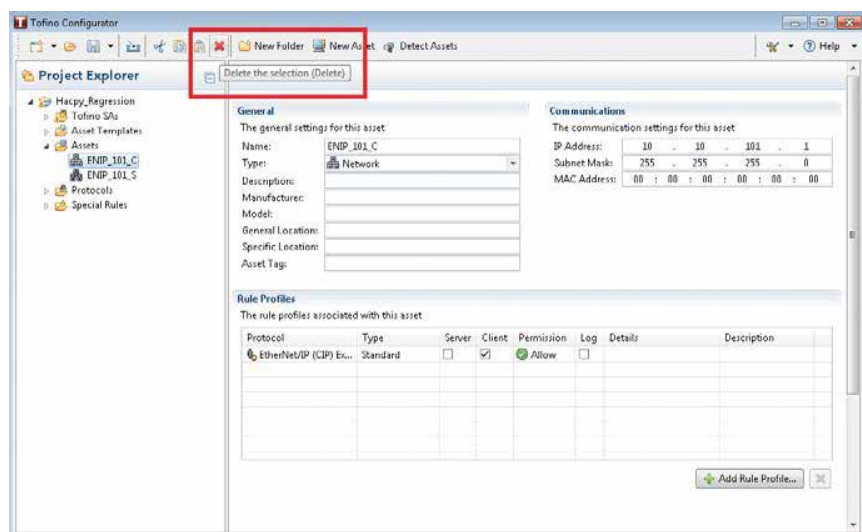


Figure 40: Delete asset

If the selected asset is referenced in a firewall rule, you will receive a message with three options. You can choose to cancel the deletion; delete the asset and replace the references to it with its current address; or delete the asset and fix the detected errors later.

When you choose to delete the asset, a message prompts you to confirm the action. Click “OK” to proceed. Canceling the deletion at this prompt will not reinstate the asset in any firewall rules from which it was removed.

6.6 Detecting an Asset

There are a few prerequisites to enable the Tofino to gather asset information:

- The Tofino must have the Firewall LSM and Event Logger enabled and active.
- The Tofino must be in TEST mode to gather network traffic passing through.
- The Tofino must be allowed 10-15 minutes to gather information.

Use the “Detect Assets” button on the TC toolbar to detect the existing asset(s).

- Click “Assets” in the Project Explorer view.
- Click the “Detect Assets” button in the toolbar.
- Click the check box in the “Asset Detection Wizard” pop-up box to select the Tofino SA (TSA) for which asset(s) is to be detected. You can select only one Tofino SA. You receive an error message if more than one TSA is selected.

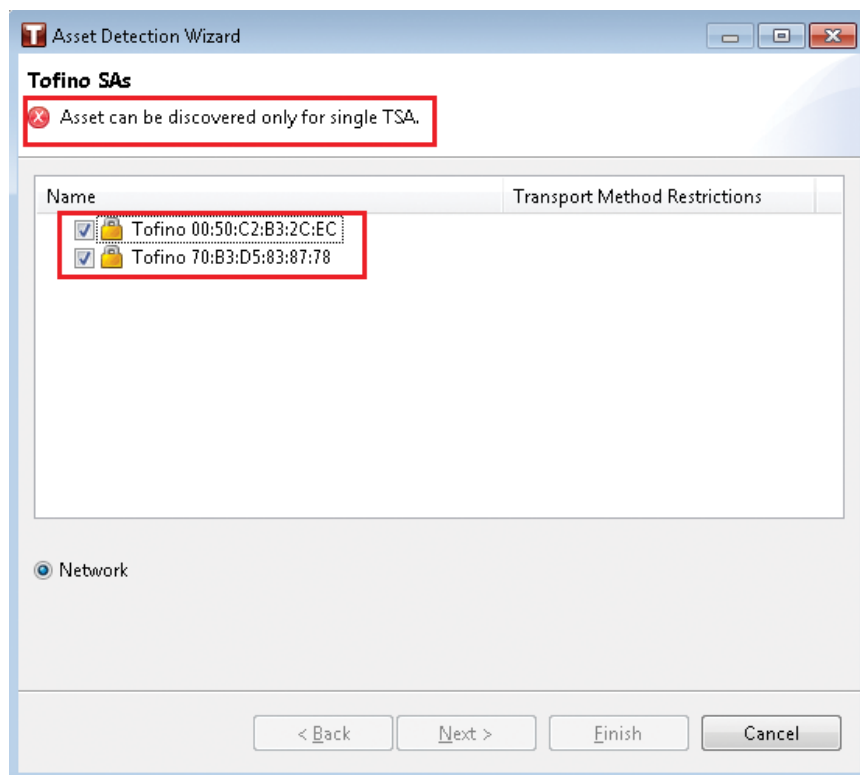


Figure 41: Error when more than one asset selected

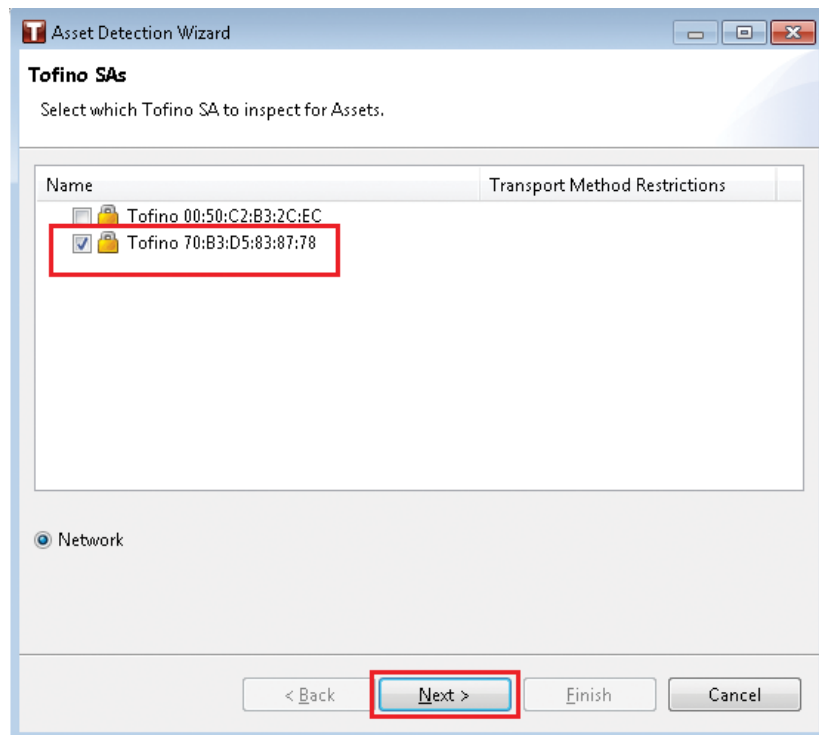


Figure 42: Select one asset

- Click the “Next” button
- Select the suggested assets to be added to the Assets folder and click the “Finish” button.
The selected suggested assets are added in the “Assets” folder view.

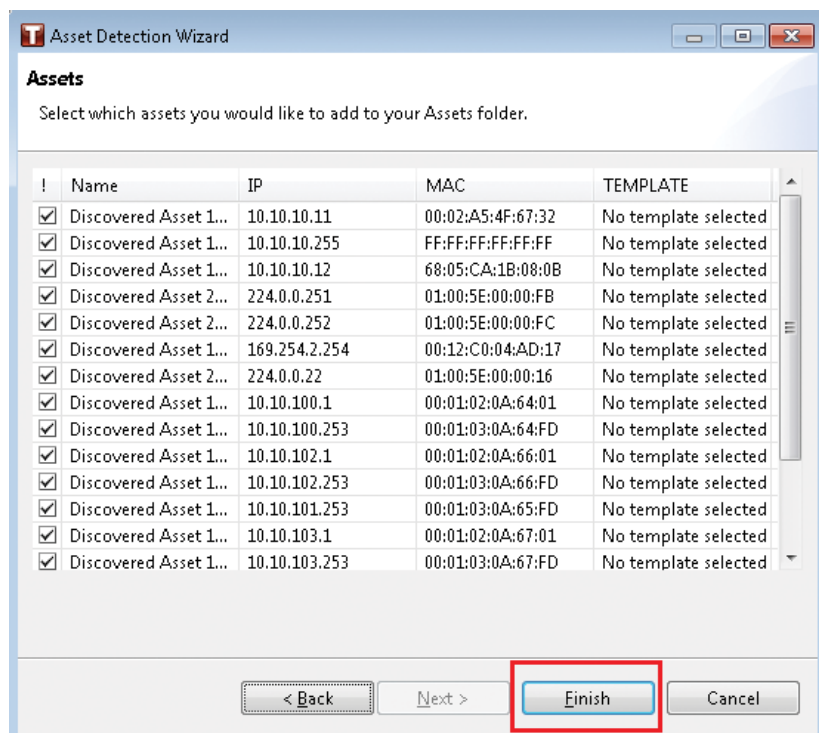
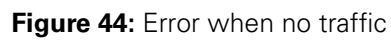


Figure 43: Select suggested assets

- When there is no traffic, no log files are created and the following error message displays.



7 FIREWALL RULES

A firewall is a mechanism used to control and monitor traffic between two networks (or two portions of the same network) to increase the level of security on the network. It compares the traffic passing through the firewall to a predefined set of rules, discarding traffic that does not meet the rule criteria. In effect, it is a filter that blocks unwanted network traffic and places limitations on the amount and type of communication that occurs between devices (or networks) in need of protection and other systems, such as the corporate network or another portion of a site's control network.

The Tofino Firewall is a Loadable Security Module (LSM) that is activated on the Tofino SA to process traffic. On its own, it is a stateful layer 2, 3, and 4 firewall. When combined with the Enforcer LSMs, it also offers stateful Deep Packet Inspection.

An Enforcer is an advanced firewall for specific SCADA and ICS protocols. It allows you to filter traffic based on high level message content, such as the commands and services being used or the memory locations being accessed. Enforcers are designed to be add-ons to the standard Tofino Firewall LSM. There are multiple Enforcers that you can activate and use; each one provides Deep Packet Inspection for a different protocol. The following Enforcers are available in the current version of the Eaton Tofino Configurator:

- Modbus TCP Enforcer
- OPC Classic Enforcer
- IEC104 Enforcer
- EtherNet/IP Enforcer
- DNP3 Enforcer
- GOOSE Enforcer

The Tofino SA model and the installed LSM licenses determine the Enforcers available in the Eaton Tofino Configurator.

The Firewall details page lists the firewall rules configured for the selected Tofino SA. On this page you can create a new firewall rule and manage the existing rules. You can do the following:

- Create a new firewall rule
- View and edit the rules
- Reorder rules
- Cut, copy, and paste rules
- Delete rules

The Rule Table supports multiple selection. Use SHIFT+click to select a range of rules; use CTRL+click to select multiple rules out of sequence. This lets you copy multiple rules from one Tofino SA and paste them into another.

Selecting a rule in the table displays additional information for that rule and protocol in the Rule Details section at the bottom of the page.

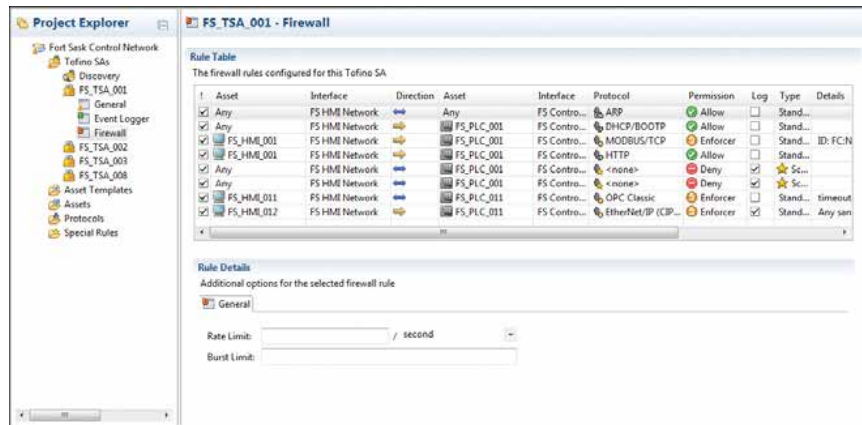


Figure 45: Firewall rule table

- **Firewall Rule Order**

The Tofino SA inspects packets in a sequential manner according to the order that the rules are displayed in the firewall rule table. Having the same rules but placing them in a different order can alter how the Tofino SA manages traffic.

When the Tofino SA receives a packet, it compares it against the first rule, then the second, then the third, and so on. When it finds a rule that matches, it stops checking and applies that rule. If the packet goes through each rule without finding a match, then that packet is denied.

You can manually reorder the rules by selecting a rule and clicking “ Move Up” and “ Move Down” in the toolbar.

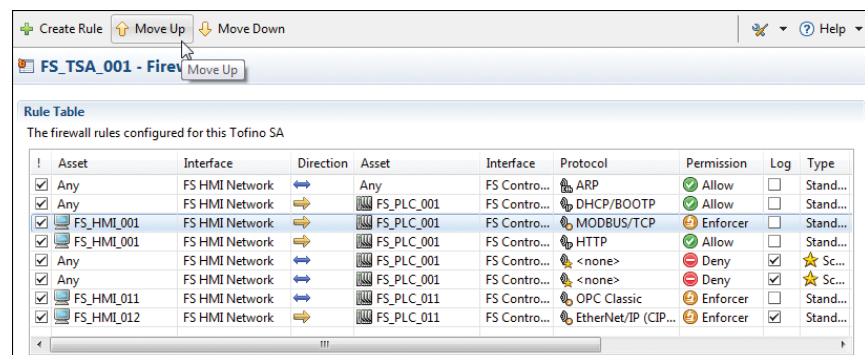


Figure 46: Move up and down the rules

Keep in mind that the first rule in the Tofino SA that matches is applied to the packet: not the rule that is the most appropriate match. Based on this, set the more specific rules at the top of the list, followed by the more general rules. This helps to prevent a general rule being matched before hitting a more specific rule.

There are certain exceptions to this strategy: for example, rules using MAC addresses need to be evaluated before rules using IP addresses. The Eaton Tofino Configurator advises you if this is required..

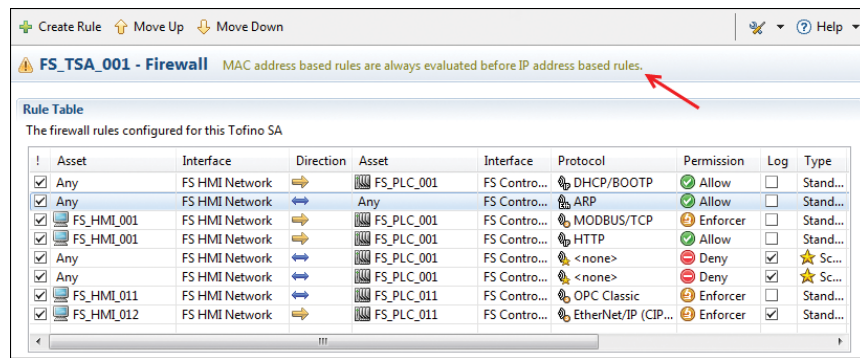


Figure 47: MAC based rules evaluated before IP based rules

• Assisted Firewall Rule Creation

Some firewall rules are needed for other rules to work correctly. For example, because the devices using the TCP protocol use the ARP protocol to determine each other's addresses, an ARP Allow rule is needed in order for a TCP rule to work. The Tofino SA detects when an additional rule is needed and prompts you to insert it. The message displays in the title bar above the rule table.

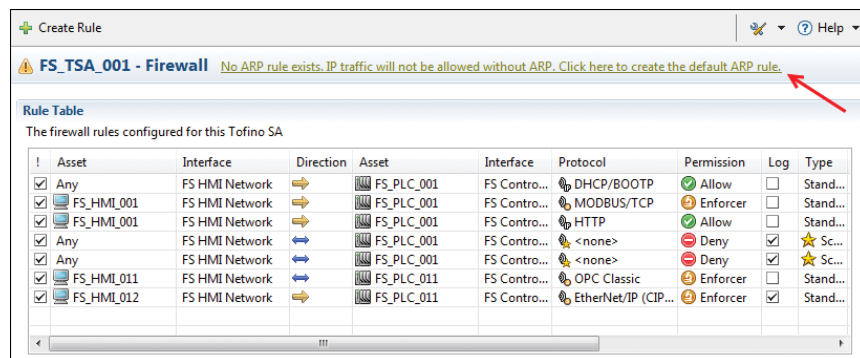


Figure 48: ARP rule is must for IP traffic

• Firewall Rate Limiting

The Rate Limit fields are advanced settings that are available for firewall rules. These define the rate at which packets that have met the other criteria for a given rule are allowed through the firewall. The rate limiting uses a token bucket filter algorithm with three settings:

- Rate Limit: the average packet allow rate over the defined time interval
- Interval: the time interval used for the rate limit (second, minute, hour, day)
- Burst Limit: the maximum initial number of packets allowed

To understand how token bucket filtering works, picture a 'bucket' of 'tokens'. It costs one token for the firewall to forward one packet. If the bucket is out of tokens, then the firewall will drop packets until there are more tokens in the bucket. The number of tokens (and thus the number of forwarded packets) is controlled by two settings: Rate Limit and Burst Limit.

The Rate Limit is the rate at which the bucket is refilled with tokens. The rate limit setting is calculated over an interval set by the user (such as per second or per minute). If the rate limit is 50 and the interval is set to seconds, then 50 tokens per second will be placed in the bucket and 50 packets per second will be let through the firewall. Keep in mind that the bucket is refilled gradually over an interval and not at the start of the interval.

The Burst Limit is the initial number of tokens in the bucket, as well as the maximum number of tokens the bucket can hold. In other words, this helps to prevent the number of tokens from building up during times of low traffic.

The firewall will immediately allow through any burst of packets equal to the number of tokens in the bucket. Once the bucket is empty, the firewall can only forward packets as the bucket refills over time at the rate specified by the rate limit. If the rate of packets is faster than the rate limit, the bucket will empty at the rate of packets and then will be limited by the rate limit which refills the bucket. In other words, if your burst limit is 100, your rate limit is 25 per second, and 1000 packets are sent to the firewall, then the first 100 will be allowed, followed by another 25 packets per second after that. Other packets will be dropped.

- **Direction: Right, Left, Bidirectional**

The arrow in the rule table indicates which device establishes a connection between the two nodes. The direction indicator does not refer to packet flow. For example, if a Human Machine Interface (HMI) is using Modbus/TCP to request data from a PLC, the HMI will be the device initially setting up the communications connection. Once the connection is established, then packets will flow in both directions.

Another way of thinking about this is to consider a normal telephone system. The person dialing the phone number (Person 1) is the one setting up (i.e., establishing) the connection. Once the other person (Person 2) answers the phone, then speech can flow both ways.

There are three direction options for a Tofino Firewall LSM:

- **Right:** Connections can be established by the left asset (as defined in the rule table) and will flow to the right.

Example: Consider an HMI is the left asset and a PLC is the right asset with the direction set to Right. This would allow the HMI to initiate the connection and the PLC to respond, but the PLC would not be allowed to initiate a session.

- **Left:** Connections can be established by the right asset (as defined in the rule table) and will flow to the left.

Example: Consider a Workstation with a browser client is the right asset and a Web Server is the left asset with the direction set to Left. This would allow the Workstation to initiate web sessions and the Web Server to respond, but the Web Server would be unable to initiate a session.

- **Bidirectional:** The connections can be established by either device.

Once the connection is established, traffic will be able to flow in both directions regardless of the direction set in the rule.

7.1 Creating Firewall Rules

The Eaton Tofino Configurator allows you to create two types of firewall rules:

- Standard rules
- Special rules

Standard firewall rules are designed to allow or deny specific protocols passing through the firewall. They let you set the source, destination, direction, permission and rate limits for traffic of a particular protocol type. For example, if you want to allow Modbus/TCP traffic between two devices, a standard rule can be used.

Special Rules are highly complex rules that go beyond simple allow or deny. For example, a Special Rule could be used to block a subset of a particular type of traffic. The available Special Rules can be viewed in the Special Rules folder.

You will normally use standard rules. Use special rules solely in exceptional cases.

- In the Project Explorer view, expand the Tofino SA you want to work with and click " Firewall"
- Click " Create Rule" in the toolbar.

The New Firewall Rule Wizard opens.

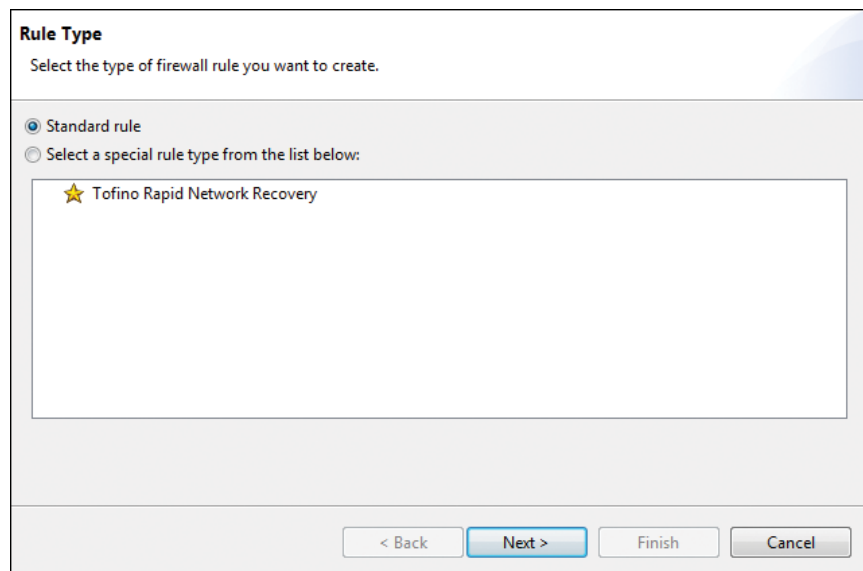


Figure 49: Create new firewall rule

- Select the type of rule you want to create: standard or special. If you are creating a special rule, you also select a rule type from the list provided.
Click "Next".
- Define the assets involved in the firewall rule and click "Next".

Figure 50: Select the assets involved

For each asset you:

- Select the interface where the asset or address is found.
- Specify the asset or address that the rule applies to. You can enter a specific address or select from a list of known assets. You can also specify that the rule applies to any asset.
- Set the direction to indicate which asset can establish the connection. The options are left, right, and bidirectional.
- Define the rule protocols for the selected assets.

When the assets selected have no rule profiles associated with them, the Protocol page opens where you manually create the rule profiles.

However, when one or both of the assets selected is associated with a rule profile, a prompt appears. You can choose to use the existing profile to build the firewall rules or create the firewall rules manually.

Figure 51: Either use assets profile or manual mode

- If prompted, select how you want to create the firewall rules and click "Finish".
When you choose to manually create the rule profiles, you are directed to the Protocol page.

When you choose to use the existing rule profiles, the Eaton Tofino Configurator checks both of the assets for protocols listed in their rule profiles. The automatic rule generator then creates one rule for every protocol that the two assets have in common. The New Firewall Rule Wizard closes and the rules created display in the table on the Firewall page. If the assets have no protocols in common, no rules are generated. Similarly, if they have protocols in common but are both clients or are both servers, no rules are generated. In these cases, a message informs you of the situation and you will need to define the protocols manually on the Protocol page.

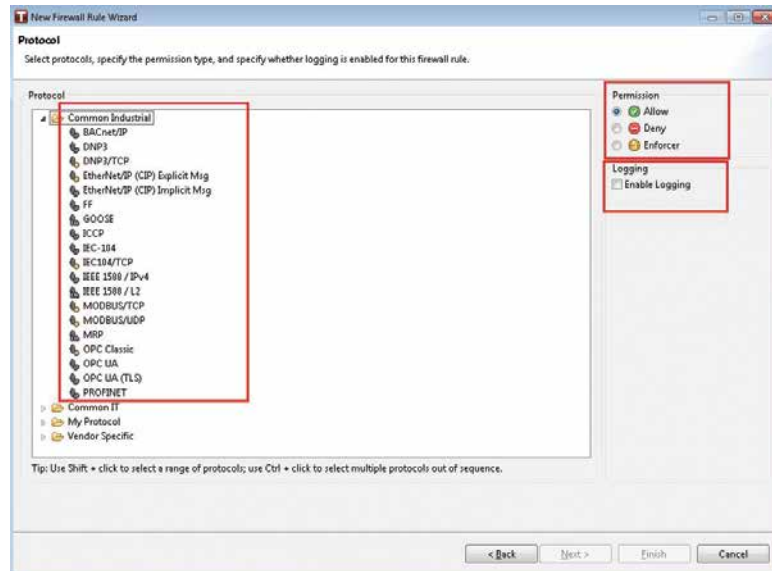


Figure 52: Select protocol, specify permissions and enable logging

- To create rules manually on the Protocol page, expand the folders and select the protocols you want to use for the asset rules. Use SHIFT+click to select a range of protocols; use CTRL+click to select multiple protocols out of sequence. A rule will be created for each protocol selected.
- Set the permission. This tells the firewall what to do with a packet that matches the rule: allow it to pass ("Allow") or stop it from passing ("Deny"). The "Enforcer" option inspects and filters the traffic using Deep Packet Inspection. This option is appropriate solely for the Enforcer protocols.
- To create a log each time the rule is triggered, select the "Enable Logging" check box.
- Click "Finish".
- Finish configuring the firewall details in the Rule Details section. Many firewall rules allow you to adjust advanced settings, such as traffic rate limiting. Additional settings for the selected rule are displayed in one or more tabs below the rules table. The Details column in the rules table displays a summary of these advanced settings. For more information on setting these rule details, see "Firewall Rate Limiting" and the appropriate sections on Enforcer rules: "Creating a Modbus TCP Enforcer Rule", "Creating an OPC Classic Enforcer Rule", "Creating IEC104 Enforcer Firewall Rule", "Creating an EtherNet/IP Enforcer Rule", "Creating a DNP3 Enforcer Rule", "Creating a GOOSE Enforcer Rule".
- Manually reorder the rules as necessary.
- Click the Save icon in the toolbar.

7.2 Suggesting Firewall Rules

The firewall rules determine what traffic is allowed to pass through the Tofino SA once it is placed in the OPERATIONAL mode. In the TEST mode, the Tofino allows all the traffic to pass, but flags the traffic which would be flagged and blocked by a standard Firewall rule or an Enforcer rule while in OPERATIONAL mode, given the current list of firewall rules.

There are a few pre-requisites to enable the Tofino to gather asset information:

- The Tofino must have the Firewall LSM and Event Logger enabled and active.
- The Tofino must be in TEST mode to gather network traffic passing through.
- The Tofino must be allowed 10-15 minutes to gather information.

Use the steps below to generate suggested firewall rules.

- In the Project Explorer view, expand the Tofino SA and click “Firewall”
- Click the “Suggest Firewall Rules” button on the toolbar.

The “Suggested Firewall Rules Wizard” opens.

- Select the suggested firewall rules to be added to the specific Tofino SA.
- Click the “Finish” button.

The selected rule(s) display under the Firewall “Rule Table”

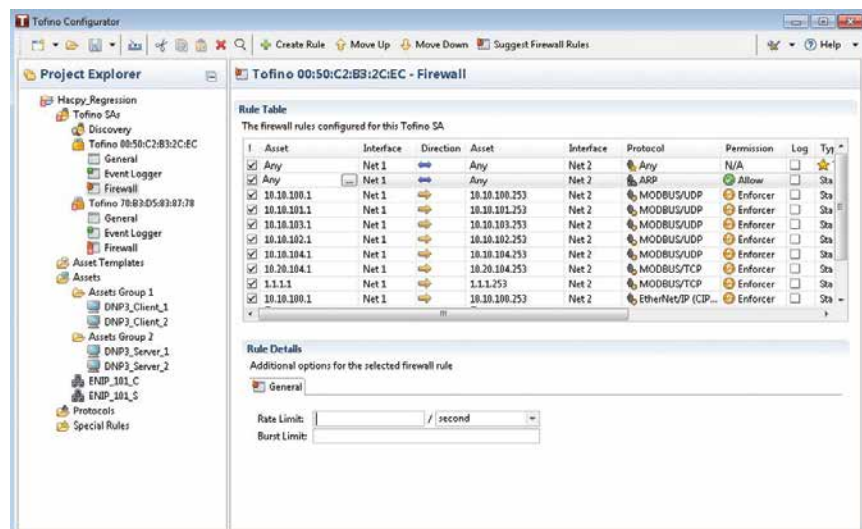


Figure 53: Firewall Rule Table for SA

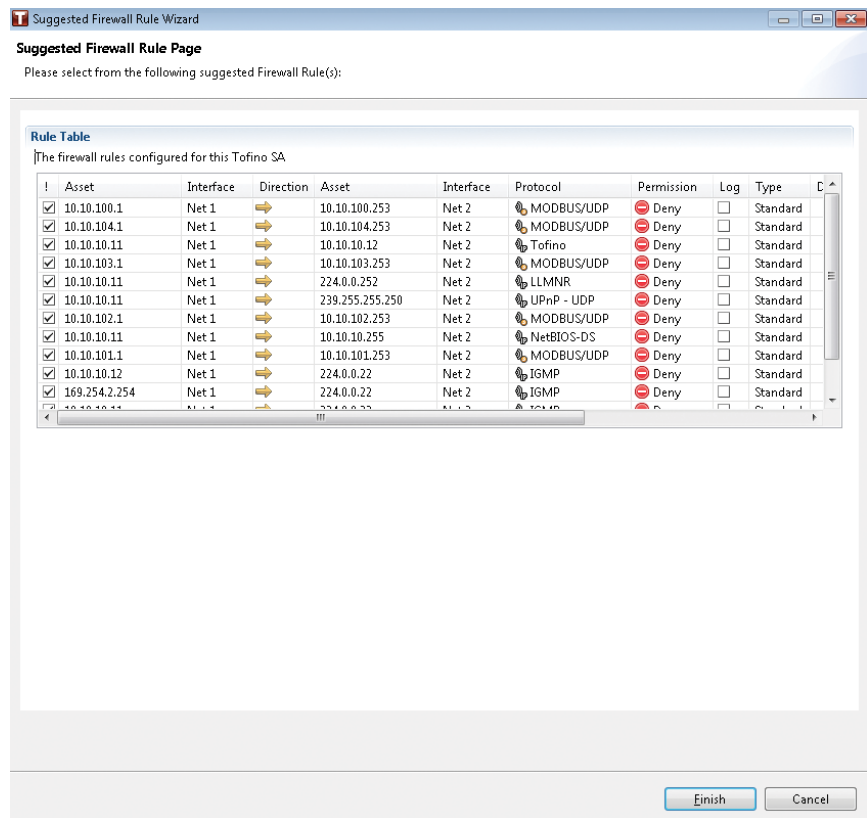


Figure 54: Suggested Firewall Rule Page

When there is no traffic, no log file are created and the following error message displays.



Figure 55: No Logs Found Error

7.2.1 Suggesting Firewall Rules

The rule suggestion supports enforcer rules. The enforcer logs are parsed from TSA to suggest the combined and non-duplicate enforcer rules.

Main highlights:

- Currently, enforcer rule suggestion is applicable for EtherNet/IP and MODBUS enforcers only.
- The system suggests EIP Enforcer rule if the relevant log entry is present at TSA log file.
- The system aggregates multiple logs for the same pair of assets and protocols to show a common rule.
- The system does not suggest a duplicate rule.
- The system correctly displays the suggested enforcer rule.

Use the steps below to generate suggested firewall rules.

- In the Project Explorer view, expand the Tofino SA and click “Firewall.”
- Click the “Suggest Firewall Rule” button on the toolbar.

The “Suggested Firewall Rule Wizard” opens.

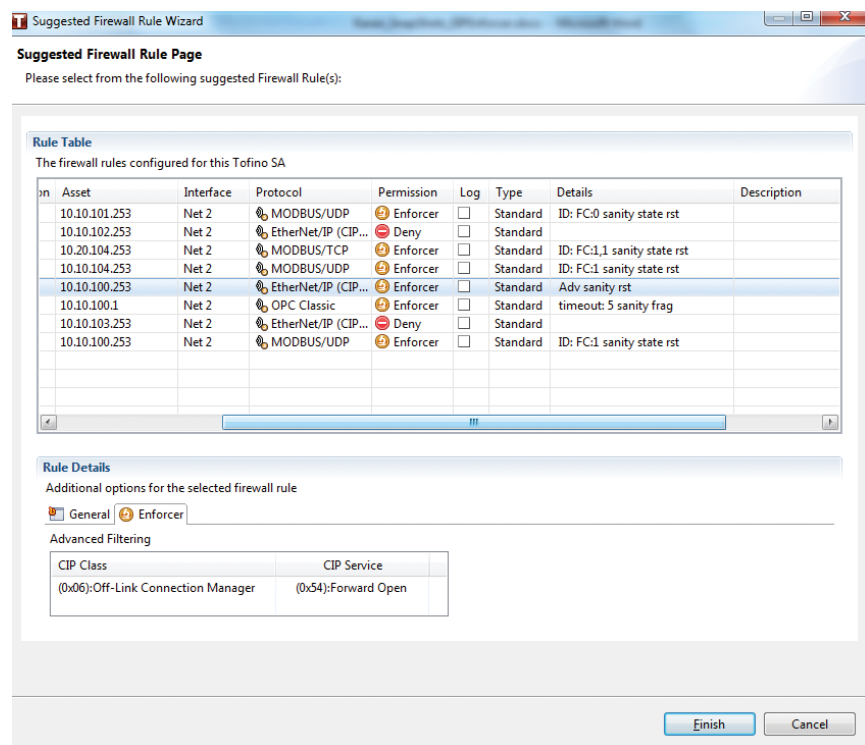


Figure 56: Suggested Firewall Rule Wizard

- Select the suggested firewall rules to be added to the specific Tofino SA.

Here we have highlighted EtherNet/IP.

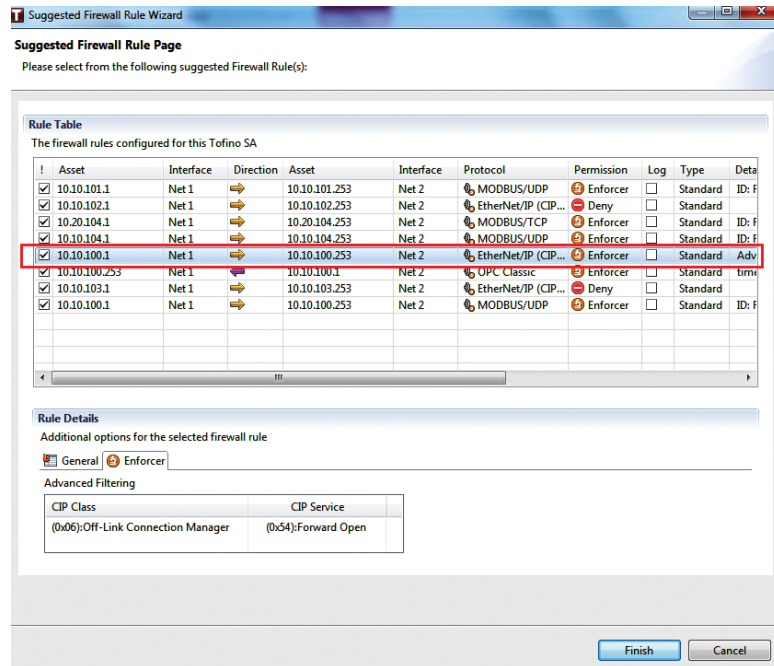


Figure 57: Select EtherNet/IP rule to add in SA

- Likewise, you can also select MODBUS TCP/UDP. Here, MODBUS UDP is highlighted:

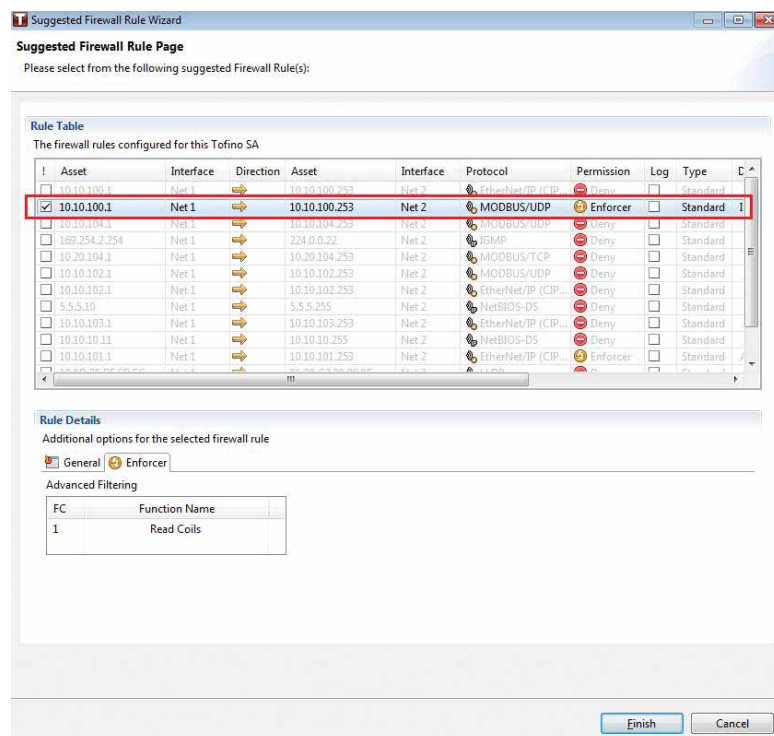


Figure 58: Select MODBUS rule to add in SA

- Click the “Finish” button.

The selected rule(s) display under the Firewall “Rule Table.” Here EtherNet/IP is shown.

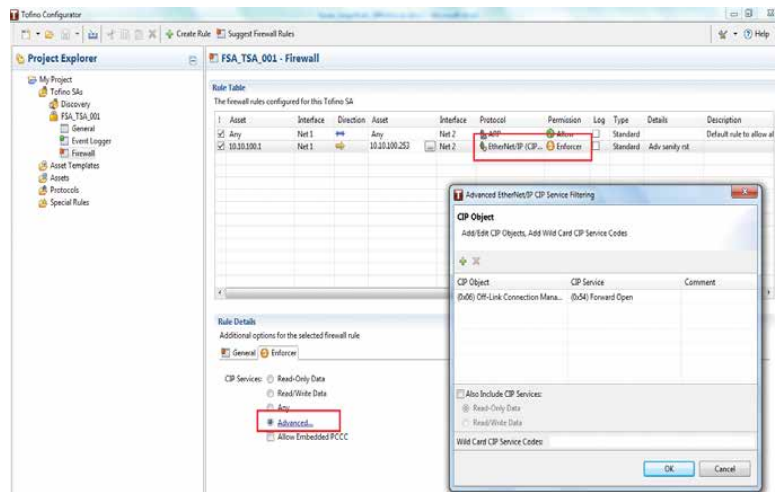


Figure 59: Rules are added in SA

Example - Suggesting Firewall Rules

The given example explains how to suggest firewall rule.

Follow these steps:

- Create rules between two interfaces and apply the configurations.

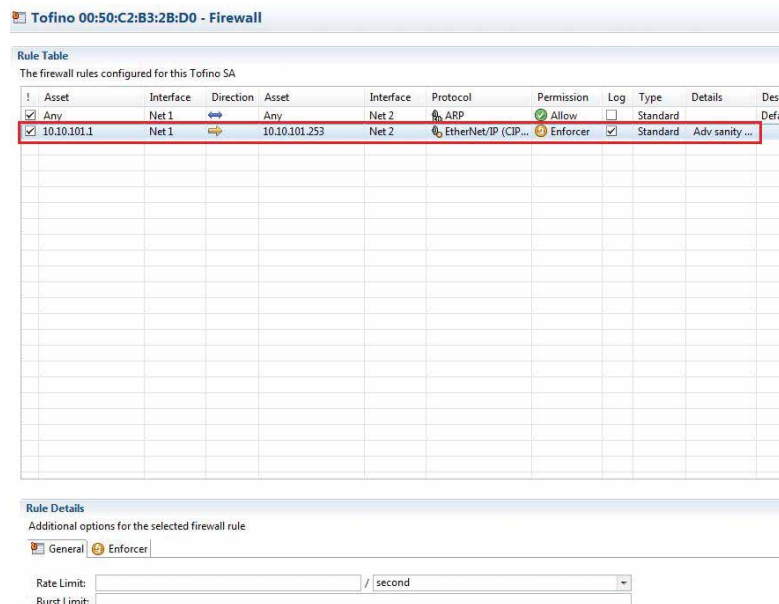


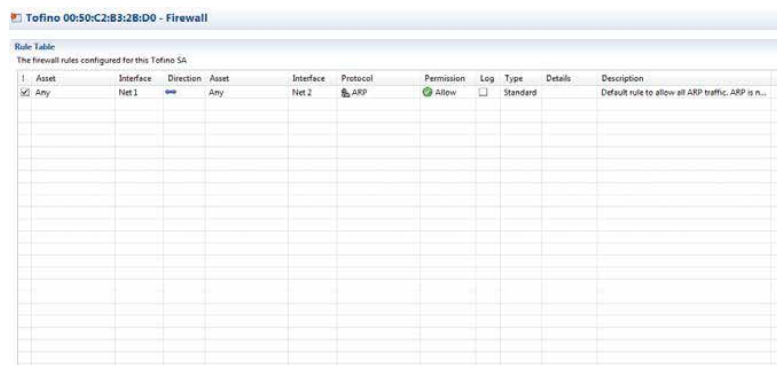
Figure 60: Create a rule

- Send any allowed/dis-allowed data packets between the interfaces. (Sending dis-allowed packets is required in case of Enforcer rule because only denied packets logs will get be logged in the heartbeat, not for the allowed packets).
- Check if Enforcer specific messages are seen in the Event Logger.

Here is how a USB log looks like:

```
Filter Check|6|msg=EtherNet/IP Command 0x0070 - CIP Service
0x4b:Unknown Vendor Specific Service - CIP Class
0x0002:Message Router is not permitted
TofinoMode=OPERATIONAL smac=00:01:02:0a:65:01
src=10.10.101.1 spt=57988 dmac=00:01:03:0a:65:fd
dst=10.10.101.253 dpt=44818 proto=IPv4/TCP TofinoEthType=800
TofinoTTL=64 TofinoPhysIn=eth0
```

- Now delete the configured rule from the existing firewall detail page under TSA. (This is important because firewall rule suggestion filters out the duplicate rules as it sees that it already exists in the rules list and does not need to be suggested for that particular TSA).



The screenshot shows the 'Tofino 00:50:c2:83:28:d0 - Firewall' configuration window. It displays a 'Rule Table' with the following data:

	Asset	Interface	Direction	Asset	Interface	Protocol	Permission	Log	Type	Details	Description
1	Any	Net 1	→	Any	Net 2	ARP	Allow	<input type="checkbox"/>	Standard		Default rule to allow all ARP traffic. ARP is n...

Figure 61: Delete the rule

- Press Suggest Firewall Rule button to open the firewall rule suggestion wizard. This shows the rule corresponding to logs logged in the Event Logger. (Make sure that TSA is in TEST mode.)

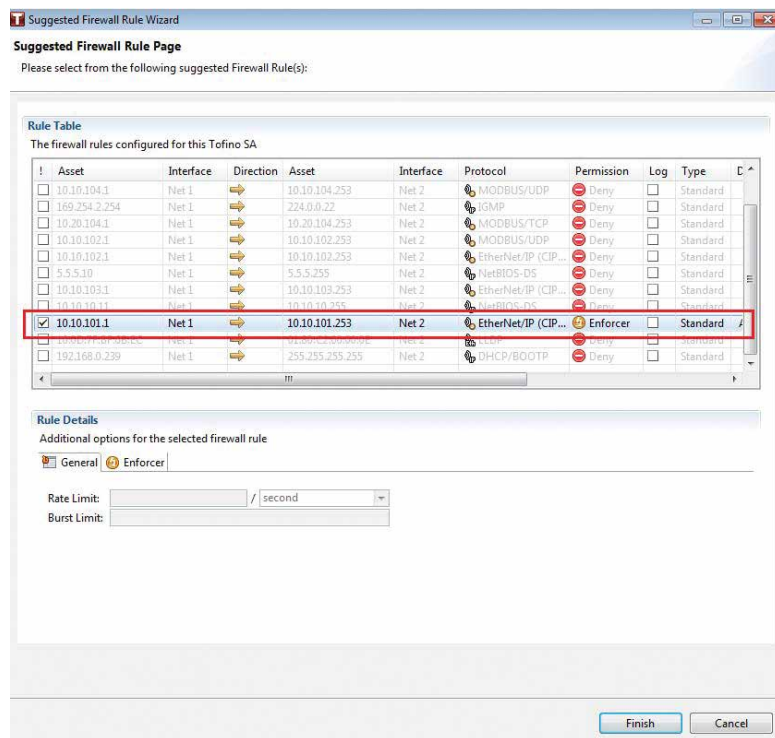


Figure 62: Rules suggested in wizard

7.3 Deep Packet Inspection Firewalls

A Deep Packet Inspection firewall digs deeper into the protocols to understand exactly what the protocol is being used for. After the traditional firewall rules have been applied, the Enforcer firewall inspects the content of the contained messages and applies more detailed rules. It then makes a more informed decision on what should be allowed and what should be blocked.

There are multiple Enforcers that you can activate and use; each one provides Deep Packet Inspection for a different protocol.

- Checks to determine if each Modbus packet conforms to the protocol specification and then allows or rejects this packet as appropriate.
- Allows you to specify what classes of Modbus traffic are permitted, such as data read-only, data read-write, or programming messages.
- Allows you to define specific Modbus functions, as well as register or coil locations, that should be allowed or denied by the Tofino SA.
- Monitors the state of Modbus TCP connections to determine that incoming messages are expected and in sequence.

The OPC Classic Enforcer LSM provides security features for managing OPC traffic. This LSM does the following:

- Inspects, tracks, and secures every connection that is created by an OPC application.
- Dynamically opens only the TCP ports that are required for each connection between the specific OPC client and server.
- Checks to determine if each packet is properly formed and follows the RPC and OPC specifications.
- Checks to determine if OPC session connection requests are fragmented.

- Can be directed to block messages that are not properly formed or are fragmented.

The IEC 104 Enforcer LSM enables DPI capabilities for IEC 104 traffic. This LSM does the following:

- The protocol enables the Master Station to request data from Substations using the predefined commands.
- The Substations to respond by transmitting the requested data.
- The IEC 104 has Sanity Check feature.
- Sanity Check blocks and reports any traffic that does not match the IEC 104 standards.

The EtherNet/IP Enforcer LSM provides security features for managing EtherNet/IP and CIP traffic. This LSM does the following:

- Checks to determine if each packet conforms to the protocol specification and then allows or rejects this packet accordingly.
- Allows you to specify what classes of EtherNet/IP traffic are permitted, such as data read-only, data read-write, or programming messages.
- Allows you to specify CIP classes and services that should be allowed or denied by the Tofino SA.
- Allows embedded PCCC.

The DNP3 Enforcer LSM enables DPI capabilities of DNP3 traffic. This LSM

- The protocol ensures that end values are greater than the starting values.
- If this isn't the case, the Tofino security appliance should drop the packet regardless of data content.
- Allows only correctly formatted DNP3 traffic.
- The DNP3 validation includes checking of common header byte fields, packet lengths, and DNP3 CRC values.

The GOOSE Enforcer LSM enables DPI capabilities of GOOSE protocol. This LSM does the following:

- It performs Deep Packet Inspection- a series of checking on the packet content on every received GOOSE packet, guided by the GOOSE configuration
- The enforcer supports DPI for GOOSE PDU packets. Checking can be classified into two classes: standard checking meant to always perform and configuration checking meant to perform based on the configuration.
- The enforcer performs the following checks in GOOSE-PDU, if either of the checks failed, the packet is dropped:
- Destination address of a packet should be either broadcast or multicast.
- Match the incoming packet's source MAC address against the list of configured connection filter policies via searching top-down until the first one matching is found.

The Tofino SA model and the installed LSM licenses determine the Enforcers available in the Eaton Tofino Configurator.

7.3.1 Creating a Modbus TCP Enforcer Rule

The Modbus TCP Enforcer LSM is an advanced Deep Packet Inspection firewall for the Modbus TCP protocol. It allows you to filter traffic based on specific Modbus function codes, register ranges, and the validity of the Modbus messages. The Modbus TCP Enforcer LSM is an optional loadable security module. You can order it as a factory loaded option in specific models or you can license it in the field.

The Modbus TCP Enforcer LSM is an advanced Deep Packet Inspection firewall for the Modbus TCP protocol. It allows you to filter traffic based on specific Modbus function codes, register ranges, and the validity of the Modbus messages. The Modbus TCP Enforcer LSM is a security software module that is part of the standard ConneXium Tofino Firewall.

NOTE

To create and apply a Modbus TCP Enforcer rule, the Modbus TCP Enforcer LSM needs to be licensed for activation in your Tofino SA. Without a license for the LSM, you can create trial Enforcer rules in the Eaton Tofino Configurator; however, you will be unable to load them into the Tofino SA.

- Open the General settings page for the Tofino SA you are configuring. Check that the “Firewall LSM” and “Modbus TCP Enforcer LSM” options are selected in the Loadable Security Modules list.
- Open the Firewall settings page and click “ Create Rule”.
- Work through the New Firewall Rule Wizard to define a firewall rule with the following settings:
- On the Rule Type page, select “Standard rule.” Click “Next”.
- On the Assets page, create a firewall rule between two assets. Set the direction so that it is FROM the Modbus Master TO the Modbus Slave. The Bidirectional option is not an appropriate selection for the Modbus TCP Enforcer LSM. Click “Next”.
- On the Protocol page, expand the “Common Industrial” folder and select either “Modbus TCP” or “Modbus UDP”. In the Permission section, select “Enforcer”.

NOTE

If you select “Allow” or “Deny” as the permission setting, the Tofino SA will allow or block the Modbus TCP traffic between the two assets accordingly without reference to the Modbus TCP Enforcer.

- Click “Finish”. The Eaton Tofino Configurator creates the Enforcer firewall rule and adds it to the table. Configure the firewall settings in the Rule Details section on the next page.

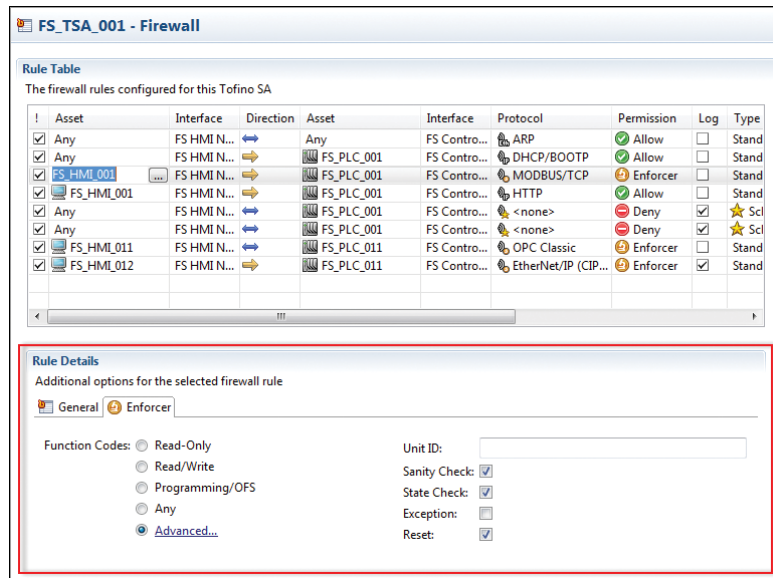


Figure 63: Modbus firewall rule table

Select the "General" tab. Set rate and burst limits as required.

Select the "Enforcer" tab and configure the rule as follows.

Select the appropriate function code. The options are:

- Read-Only: Function codes that are data read commands are permitted.
- Read/Write: Function codes that are data read or data write commands are permitted.
- Programming/OFS: Function codes that are either data read/write or programming commands are permitted.
- Any: All Modbus function codes are permitted.
- Advanced: Opens a new window where you select from a list of available function codes. Select a function code and then add the register or coil ranges that you wish to allow for the rule, as appropriate. You can add a comment for each code and reorder the codes. Add as many function codes as needed to one rule, but select a single instance of each function code per rule. Click the Add Function Code Rule button (+) to display the available codes. Use the Move Up and Move Down icons to reorder the codes. Click "OK" when you are done.

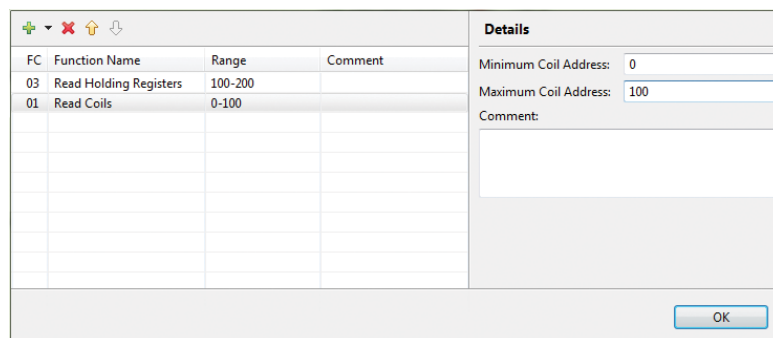


Figure 64: Advanced mode of function codes

You can use the Tofino SA in test mode to determine if the selected function code is suitable for your application.

- Specify the "Unit ID: "
Modbus master devices use the unit identifier to communicate through devices such as Modbus bridges and gateways. It allows these devices to use a single IP address to support multiple independent Modbus end units. If you want the Unit ID to be inspected, enter one or more comma separated values in this field. If you do not require restrictions on the Unit ID, leave this field blank.
- To have the Tofino SA check that the messages for well-known Modbus commands (1-6, 15, 16, 20-24) are properly formed and follow the Modbus specification, select "Sanity Check: ". If a message does not follow the specification, the Tofino SA will block it. For example, if a Modbus Write Multiple Registers command (Function Code 16) has a value in its length field that is either illegal or does not match the amount of data being sent, then the message would be dropped. This option may have to be disabled for Modbus devices that do not conform to the Modbus/TCP 1.1b specification.
The Tofino SA performs a sanity check on the Modbus MBAP header whether or not this option is selected.
- To have the Tofino SA block and report any Modbus command or response that is out of sequence for the current state of the connection, select "State Check: ".
Examples of 'out-of-state' traffic include a command sent by the slave device to the master or a response sent by the master device to the slave.

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Select the **Modbus Exception** option only when you are using the product in a test environment.

Failure to follow these instructions can result in injury or equipment damage.

- To have the Tofino SA send a Modbus TC exception response, if appropriate, to the Modbus device that generated a blocked message, select "Exception: ".
Setting this option may make some Windows-based client applications unresponsive. This can happen when the operating system incorrectly processes TCP reset packages (sent when the firewall blocks traffic) if those packets also contain additional information. When this occurs, the TCP/IP session remains open, leaving the client in a wait state.
- To have the Tofino SA send a TCP reset message to both Modbus devices when it blocks a message, select "Reset: ". This can keep session from locking up.
- Click the Save icon in the toolbar.

7.3.2 Creating an OPC Classic Enforcer Rule

The Tofino OPC Classic Enforcer Loadable Security Module (LSM) inspects, tracks and helps to secure every connection that is created by an OPC application. It dynamically opens the TCP ports that are required for each connection, and between the specific OPC client and server that created the connection. No configuration changes are required on the OPC clients and servers, and it is more secure than conventional firewall or tunneler solutions.

NOTE
To create and apply an OPC Classic Enforcer rule, the OPC Classic Enforcer LSM needs to be licensed for activation in your Tofino SA. Without a license for the LSM, you can create trial Enforcer rules in the Eaton Tofino Configurator; however, you will be unable to load them into the Tofino SA.

NOTE
If you have a pre-existing OPC connection, you need to re-establish it when switching Tofino from TEST to OPERATIONAL mode.

- Open the General settings page for the Tofino SA you are configuring.
Check that the " Firewall LSM" and " OPC Classic Enforcer LSM" options are selected in the Loadable Security Modules list.
- Open the Firewall settings page and click " Create Rule".
- Work through the New Firewall Rule Wizard to define a firewall rule with the following settings:
- On the Rule Type page, select "Standard rule". Click "Next".
- On the Assets page, create a firewall rule between two assets. Set the direction to Bidirectional to allow OPC callbacks from servers. Click "Next".
- On the Protocol page, expand the "Common Industrial" folder and select "OPC Classic". In the Permission section, select "Enforcer".

NOTE
If you select "Allow" or "Deny" as the permission setting, the Tofino SA will allow or block the OPC traffic between the two assets accordingly without reference to the OPC Enforcer.

- Click "Finish". The Eaton Tofino Configurator creates the Enforcer firewall rule and adds it to the table. Configure the firewall settings in the Rule Details section at the bottom of the page.

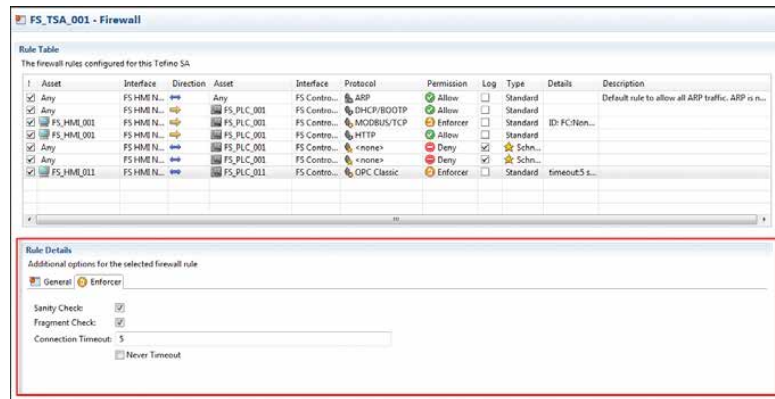


Figure 65: OPC Classic enforcer rule table

- Select the "General" tab. Set rate and burst limits as required.
- Select the "Enforcer" tab and configure the rule as follows.
- To have the Tofino SA check that the connection establishment messages are properly formed and follow the RPC specification, select "Sanity Check: "
- To have the Tofino SA check to see if the connection establishment messages have been fragmented, select "Fragment Check: "
- Set the "Connection Timeout: " in seconds. This is the amount of time the Tofino SA will wait for an OPC connection after a port has been requested.
- To have the Tofino SA wait indefinitely, select the "Never Timeout" check box. Rather than performing a DCOM object request each time they connect to an object, some OPC clients perform the object request solely on the first connection. They then re-use the same TCP port number without performing a new object request on subsequent connections to that OPC data object. Use the "Never Timeout" option so that the firewall doesn't drop subsequent connections.
- Click the Save icon in the toolbar.

7.3.3 Creating IEC104 Enforcer Firewall Rule

The Tofino Security Appliance (Tofino SA) implements an IEC104 Loadable Security Module (LSM) which enables Deep Pack Inspection (DPI) firewall capabilities for IEC104 traffic. The IEC104 traffic is allowed to flow between master station (client) / substation (server) device pairs and only correctly formatted IEC104 packets are allowed.

Tofino Configurator provides a user with the capability to specify various IEC104 application layer parameter options and formatting. Two assets are created- M104 for the master station and S104 for the substation.

Use the steps below to add an IEC104 Enforcer firewall rule.

- Click the “Firewall” icon to open the Firewall screen and to create a firewall rule.
- Click the “Create Rule” button to open the New Firewall Rule Wizard.
- Select the type of rule and click the “Next” button to open the Assets panel.
- Click “+” to the left of Common Industrial in the “Protocol” pop-up and select “IEC104/TCP” (the icon with orange circular badge).
- Select “Enforcer” in the Permission panel on the right side of the “Protocol” pop up.
- Click the “Finish” button to complete the IEC104 rule configuration. The Tofino Configurator shows the firewall rule table with the newly configured IEC104 Enforcer rule highlighted.
- Click the “Enforcer” tab in the “Rule Details” panel to view the detailed configuration.

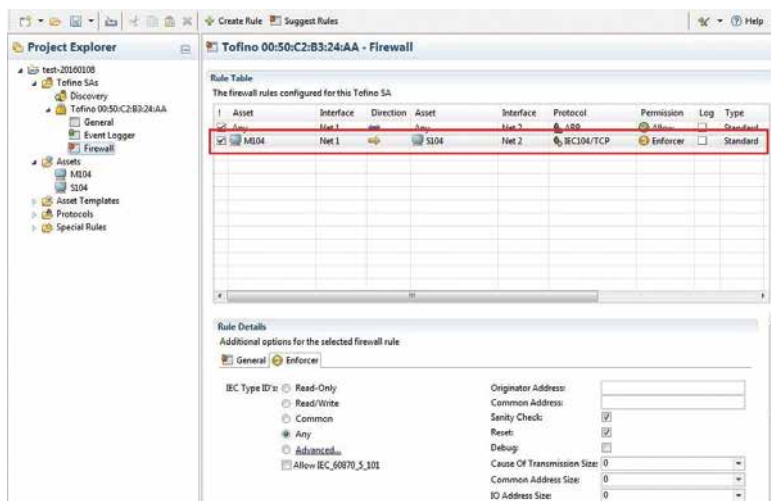


Figure 66: IEC104 enforcer rule table

The table below depicts parameter options setting of the IEC104 Enforcer screen.

Parameter		Description
1	Type ID	Defines the allowed type IDs of incoming IEC104 packets. Only packets with type IDs selected in TC will be allowed. TC offers different options to group type IDs for the ease of selection. Refer to Table 2 for details
2	Originator Address	Identifies the devices from which packets originated. Only packets with specified originator addresses will be allowed. If this field is empty, then any originator address is allowed. Valid vales are comma separated integer listfrom 0-255.
3	Common Address	Identifies the devices to which a packet is destined. Only packets with specified common address will be allowed. If this field is empty, then any common address is allowed. Valid values are comma separated integer list from 0-255 when common address size is 1 byte, or from 0-65635 when common address size is 2.
4	Sanity Check	When checked, this Boolean flag enables the enforcer to perform sanity check on packets. These sanity checks ensure packets adhere the protocol specification.
5	Reset	When checked, this Boolean flag tells the enforcer to send TCP reset messages to both parties of the connection when DPI on an IEC104 packet failed.
6	Debug	When checked, this Boolean flag turns on the debugging of the enforcer.
7	Cause of Transmission Size (COT)	The three size parameters define the variation of respective fields of packets. The enforcer performs DPI based on these settings. The default value of COT size is 2. When 1 is selected, the originator address field is grayed out, meaning there is no originator address in the packets. Valid values are 1 or 2 where the latter is the most commonly used.
8	Common Address Size	Valid values are 1 or 2 where the latter is the most commonly used.
9	IO Address Size	Valid values are 1, 2 or 3 where the last one is the most commonly used.

Table 1: IEC104 Parameter Setting

The table below provides the information about the Type ID options.

IEC Type ID Option		Description
1	Read Only	1, 3, 5, 7, 9, 11, 13, 15, 20, 21, 30-40, 100-102, 107.
2	Read /Write	1, 3, 5, 7, 9, 11, 13, 15, 20, 21, 30-40, 45-51, 58-64, 70, 100-102, 107.
3	Common	1, 3, 5, 7, 9, 11, 13, 15, 20, 21, 30-40, 45-51, 58-64, 70, 100-103, 105, 107, 110-113, 120-127.
4	Any	When selected, the user can use any type IDs from the drop-down list.
5	Advanced	When selected, the user can use any type IDs from the drop-down list, plus select one of the above three option.
6	Allowed	2, 4, 6, 8, 10, 12, 14, 16-19, 104, 106.
7	IEC_60870_5_101	<p>The type IDs in this list are those defined in IEC101 specification which may or may not be used by newer devices. This option can be checked along with one of the above five options. The effect is to merge the two options.</p> <p>Example 1: If Read Only and Allowed IEC_60870_5_101 are selected, then the final list of type IDs will be: 1, 3, 5, 7, 9, 11, 13, 15, 20, 21, 30-40, 100-102, 107, 2, 4, 6, 8, 10, 12, 14, 16-19, 104, 106.</p> <p>Example 2: Select Common with IEC_60870_5_101 checked will have all type IDs defined.</p>

Table 2: Type ID Options

7.3.4 Creating an EtherNet/IP Enforcer Rule

The EtherNet/IP Enforcer LSM is an advanced Deep Packet Inspection firewall for the EtherNet/IP protocol. It is specifically designed to increase the level of security on CIP explicit messaging network traffic. It allows you to filter traffic based on specific CIP objects or services and the validity of the EtherNet/IP messages.

The EtherNet/IP Enforcer can also be configured to inspect PCCC messages that are encapsulated within CIP objects. This is useful when securing communications to PLC-5 or MicroLogix controllers.

To perform EtherNet/IP Deep Packet Inspection on CIP and PCCC messages, select the Enforcer option on the applicable firewall rules.

NOTE

To create and apply an EtherNet/IP Enforcer rule, the EtherNet/IP Enforcer LSM needs to be licensed for activation in your Tofino SA. Without a license for the LSM, you can create trial Enforcer rules in the Eaton Tofino Configurator; however, you will be unable to load them into the Tofino SA.

Some control products, such as older Rockwell PLCs, may be configured to use protocols like CSPv4 (rather than EtherNet/IP) for Ethernet-based communications. You can enable these messages to pass through the firewall without Deep Packet Inspection.

The EtherNet/IP Enforcer helps secure CIP Class 3 explicit messages. Enforcer firewall rules do not process CIP implicit messages such as I/O communications. If you are setting up a firewall that filters implicit messages, you can either pass this type of traffic through the firewall according to stateful layer 3 and 4 filters or block it.

CAUTION !

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- To create firewall rules to manage implicit messages, select **EtherNet/IP (CIP) Implicit Msg.**
- To allow PCCC traffic embedded in CIP EtherNet/IP to pass through the firewall, select the **EtherNet/IP (CIP) Explicit Msg** protocol on the applicable firewall rules and then select the **Allow Embedded PCCC** option on the Enforcer tab.
- To allow PCCC traffic embedded in the CSPv4 protocol to pass through the firewall, select the **Rockwell CSP** protocol on the applicable firewall rules.
- Before deploying the firewall, test your settings by sending both implicit and explicit messages, and verify that your configuration is correct.

Failure to follow these instructions can result in injury or equipment damage.

Open the General settings page for the Tofino SA you are configuring. Check that the “ Firewall LSM” and “EtherNet/IP Enforcer LSM” options are selected in the Loadable Security Modules list.

Open the Firewall settings page and click “ Create Rule”.

Work through the New Firewall Rule Wizard to define a firewall rule with the following settings:

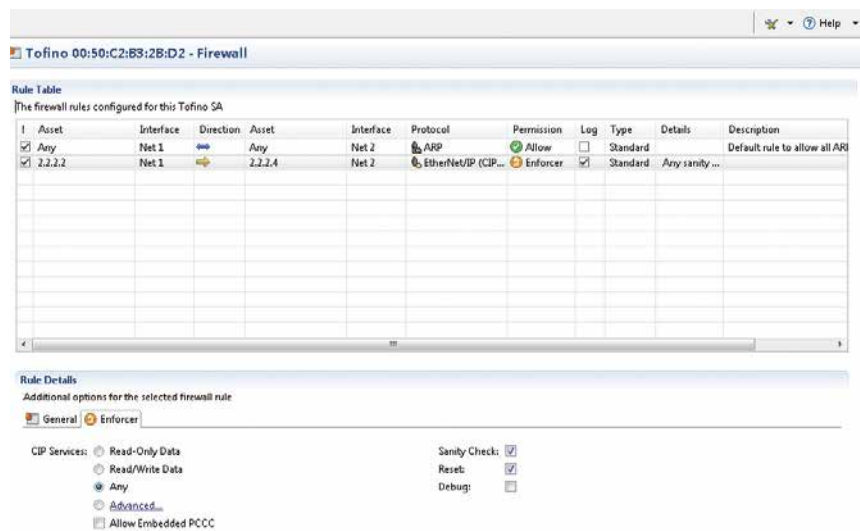
- On the Rule Type page, select “Standard rule.” Click “Next”.
- On the Assets page, create a firewall rule between two assets. Set the direction so that it is FROM the EtherNet/IP Client TO the EtherNet/IP Server. The Bidirectional option is not an appropriate selection for the EtherNet/IP Enforcer LSM. Click “Next”.
- On the Protocol page, expand the “Common Industrial” folder and select “EtherNet/IP (CIP) Explicit Msg”.
- In the Permission section, select “Enforcer”.

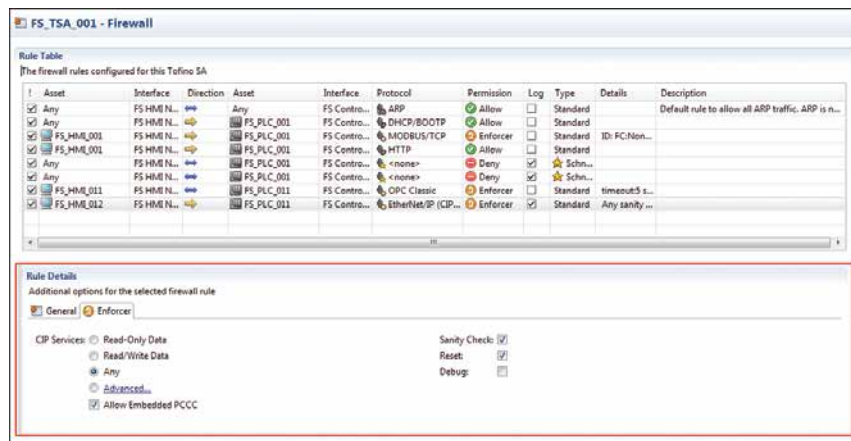
NOTE

If you select “Allow” or “Deny”, the Tofino SA allows to pass (“Allow”) or stops from passing (“Deny”) the EtherNet/IP traffic between the two assets accordingly without reference to the EtherNet/IP Enforcer.

The “Enforcer” option inspects and filters the traffic using Deep Packet Inspection.

- To create a log each time the rule is triggered, select the “Enable Logging” check box.
- Click “Finish”. The Eaton Tofino Configurator creates the Enforcer firewall rule and adds it to the table. Configure the firewall settings in the following Rule Details section.





Select the “General” tab. Set rate and burst limits as required.

Select the “Enforcer” tab and configure the rule as follows.

Select the appropriate option for CIP Services. The options are:

- Read-Only Data: CIP services that are data read commands are permitted.
- Read/Write Data: CIP services that are data read or data write commands are permitted.
- Any: All CIP services are permitted.
- Advanced: Opens a new window where you add CIP objects and services. Select the Add CIP Filter button (+) to open the Add CIP Object window. From the drop-down list, select a CIP object and then select the CIP services codes that you want to allow. Add a comment, if desired. You can add as many CIP objects as needed to one firewall rule.
To include specific types of CIP Services, select “Also Include CIP Services” and then select the appropriate option: “Read-Only Data” or “Read/Write Data”. Click “OK”.
- Allow Embedded PCCC: This is useful when securing network traffic to PLC-5 and MicroLogix controllers.
- To have the Tofino SA inspect PCCC messages that are embedded within EtherNet/IP, select “Allow Embedded PCCC”. This is useful when securing network traffic to PLC-5 and MicroLogix controllers.

NOTE

You can use the Tofino SA in test mode to determine if an option issuitable for your application.

CAUTION !

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Select the **EtherNet/IP Debug** option only when you are using the product in a test environment.

Failure to follow these instructions can result in injury or equipment damage.

- To have the Tofino SA validate that the EtherNet/IP command layer adheres to the ODVA specification, select “Sanity Check: “. Validation includes length checking proper protocol version, option field values, and correct IP address usage. If the “Allow Embedded PCCC” option has been selected, the PCCC messages will also be inspected to determine if they adhere to the PCCC protocol definitions.
- To have the Tofino SA send a TCP reset packet to both EtherNet/IP devices when it blocks a message, select “Reset: “. This can keep a session from locking up on certain EtherNet/IP products.
- To have the Tofino SA include an ASCII text string as a payload in a TCP reset packet, select “Debug: “. The string will explain the reason why the message was dropped by the Tofino SA. To view the text, capture network traffic with a tool such as Wireshark. Use this option solely during testing. Clear this check box during regular operations as it may expose security details to potential attackers.
- Click the Save icon in the toolbar.

7.3.4.1 Ethernet IP Wild Card Feature

You can allow/disallow any CIP services for all the class objects by using the wild card (asterisk *) option. The wild card works with all the services like “Read-Only Data” or with separate multiple class objects and services combinations.

Service codes entered under wild card are applied on all class objects. There are basically to reduce the human efforts.

Advanced EtherNet/IP CIP Service Filtering

CIP Object
Add/Edit CIP Objects, Add Wild Card CIP Service Codes

CIP Object	CIP Service	Comment
(0x01) Identity	(0x05) Reset	
(0x01) Identity	(0x0E) Get Attribute Single	
(0x01) Identity	(0x10) Set Attribute Single	
(0x01) Identity	(0x11) Find Next Object Instance	

☐ Also Include CIP Services:
☒ Read-Only Data
☐ Read/Write Data

Wild Card CIP Service Codes: 0x01,0x03,0x04,0x0d,0x0f,0x0e

OK Cancel

Figure 67: EtherNet/IP wild card feature

NOTE

If you select a class object with a same service code that is present as a wild card, the system gives priority to the wild card and considers it for all class objects.

7.3.5 Creating a DNP3 Enforcer Rule

The Tofino Security Appliance (Tofino SA) implements a DNP3 Loadable Security Module (LSM) which enables Deep Pack Inspection (DPI) firewall capabilities for DNP3 traffic. The DNP3 traffic is allowed to flow between master/slave device pairs and only correctly formatted DNP3 traffic is allowed. This includes checking the common header byte fields, packet lengths, and DNP3 CRC values.

For each master/slave device pair, there is a provision to specify which DNP3 application layer message types or function codes will be allowed for request and response traffic.

DNP3 Enforcer rules are unidirectional, mapping from the client/master to the server/slave device.

Use the steps below to add a DNP3 Enforcer firewall rule.

- In the Project Explorer view, expand the Tofino SA and click “Firewall”
- Right-click the empty line below the ARP rule and select “Create Rule.” The “New Firewall Rule Wizard” opens.
- Click the “Next” button to open the Assets panel.
- Select the assets involved in the firewall rule and click the “Next” button.
- Click “+” to the left of Common Industrial in the “Protocol” pop-up and select “DNP3” (the icon with orange circular badge).

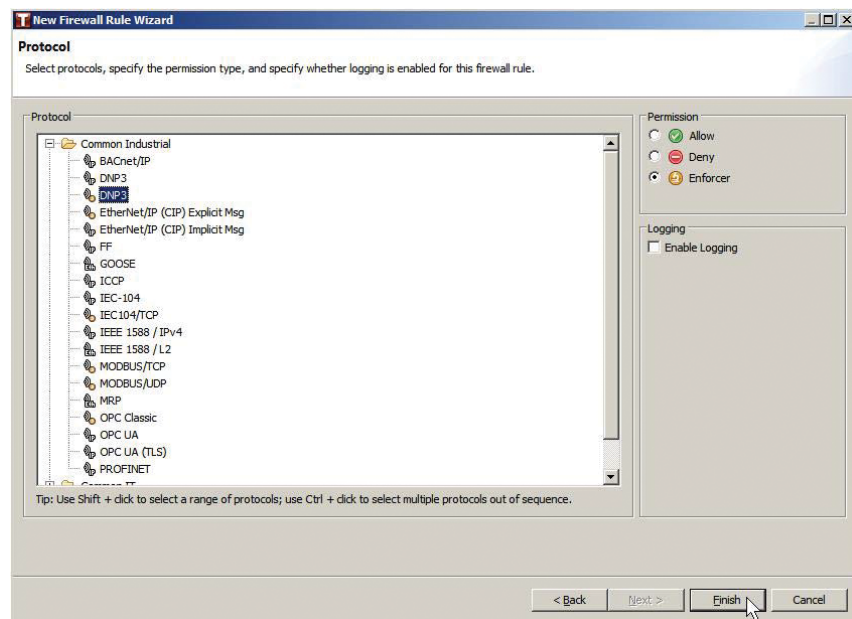


Figure 68: Select DNP3 protocol

- Select “Enforcer” in the Permission panel on the right side of the “Protocol” pop up.
- Click the “Finish” button to complete the rule configuration. The Tofino Configurator shows the firewall rule table with the newly configured DNP3 Enforcer rule highlighted.

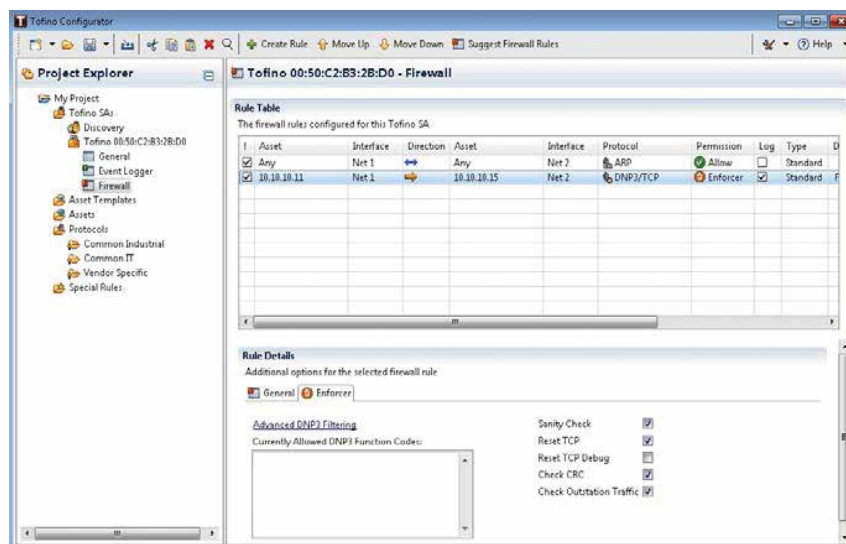


Figure 69: DNP3 Enforcer rule is selected

- Click the “Enforcer” tab in the “Rule Details” panel to view the detailed configuration

Meaning of DNP3 Enforcer Check Boxes:

- **Sanity Check** - Enables sanity checking and validation of DNP3 packets. This can be disabled if one of the sanity checks is causing a problem for valid network traffic.
- **Reset TCP** - Enables the generation of a TCP reset packet on both Tofino ports when a DNP3 packet is dropped by the Enforcer.
- **Reset TCP Debug** - Enables the generation of a debug message when a TCP reset is sent by the Enforcer.
- **Check CRC** - Enables the computation and verification of CRCs in both DNP3 Data Link Layer Headers and Application Layer messages. The overhead of computing and checking the CRCs is not as large as might be expected. Even for heavily loaded systems, toggling this flag may not result in a detectable change in performance.
- **Check Outstation Traffic** - Enables the checking of packets originating at an outstation. Packets originating at a master are always checked when the Enforcer is active.

NOTE

If this flag is not enabled, packets originating at an outstation will not trigger any of the sanity checks mentioned in these requirements.

NOTE

For more information on DNP3 objects, read the chapter “Advanced Topic: DNP3 Objects”.

NOTE

Below “Select DNP3 Application Layer Query/Response Function Codes” link, you can view selected DNP3 function codes in the quick view box. This box is not editable.

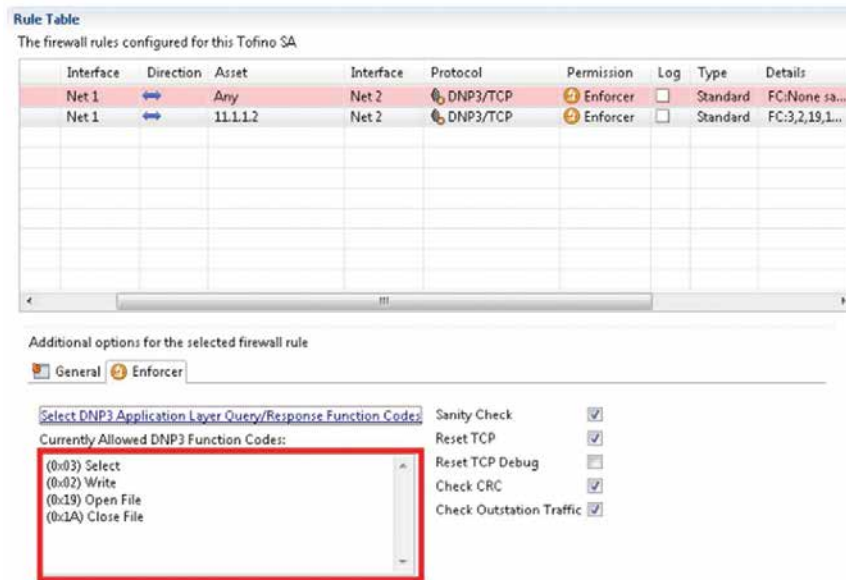


Figure 70: DNP3 quick view box

7.3.6 Creating a GOOSE Enforcer Rule

The Tofino Security Appliance (Tofino SA) implements a GOOSE (Generic Object Oriented Substation Event) Loadable Security Module (LSM) which enables Deep Pack Inspection (DPI) firewall capabilities for GOOSE traffic.

The GOOSE traffic is one of the mapped standards of IEC 61850 protocol and is engineered for configuration of Intelligent Electronic Devices for electrical substation automation systems to be able to communicate with each other.

Use the steps below to add a GOOSE PDU Enforcer firewall rule.

- In the Project Explorer view, expand the Tofino SA and click “Firewall”.
- Right-click the empty line below the ARP rule and select “Create Rule”. The “New Firewall Rule Wizard” opens.
- Click the “Next” button to open the Assets panel.
- Select the assets involved in the firewall rule and click the “Next” button.
- Click “+” to the left of Common Industrial in the “Protocol” pop-up and select “GOOSE PDU”.

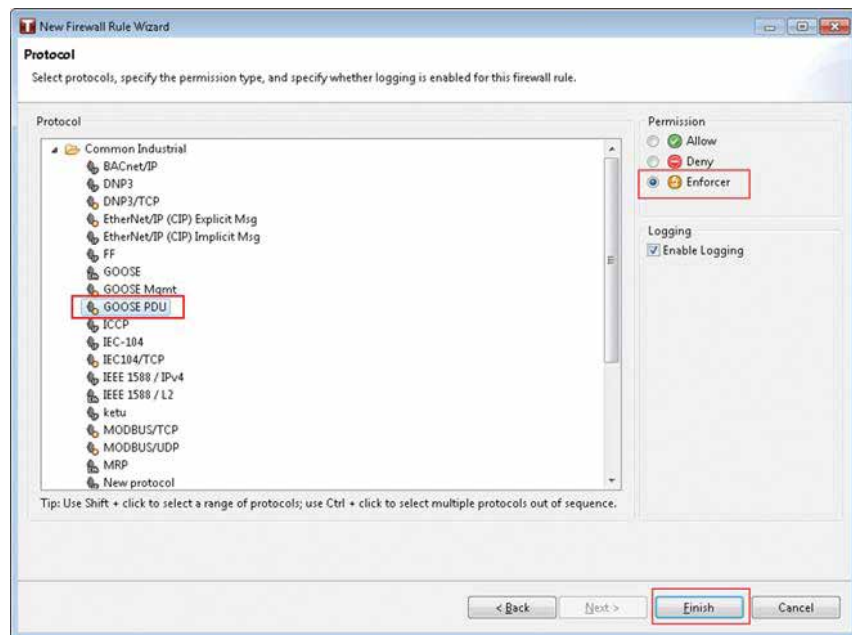


Figure 71: Select GOOSE PDU protocol

- Select “Enforcer” (the icon with orange circular badge) in the Permission panel on the right side of the “Protocol” pop up.
- Click the “Finish” button to complete the rule configuration. The Tofino Configurator shows the firewall rule table with the newly configured GOOSE PDU Enforcer rule highlighted.

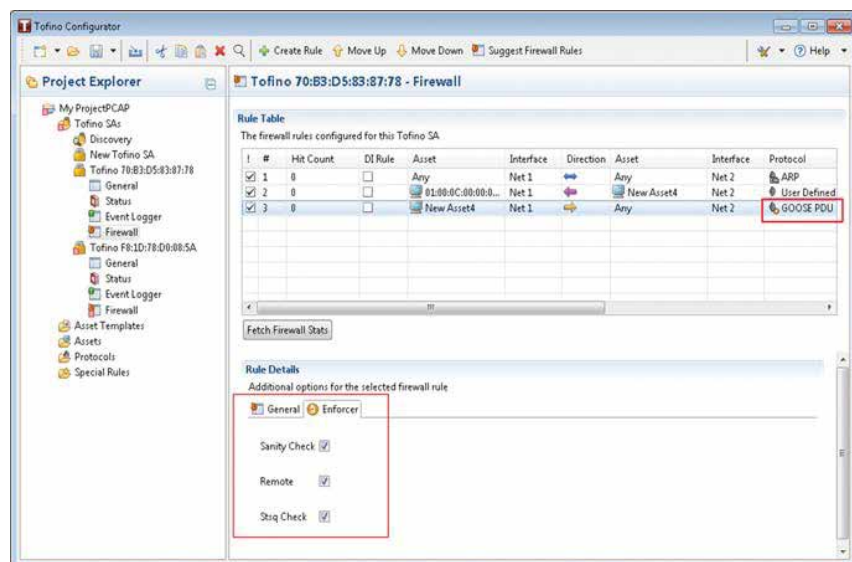


Figure 72: GOOSE PDU Enforcer is selected

- Click the “Enforcer” tab in the “Rule Details” panel to view the detailed configuration

Details of GOOSE PDU Enforcer check boxes:

- Sanity Check: The enforcer performs a sanity check on PDU data length and field value.
- Remote: In both types of packet, there is a "src_location" parameter indicating the packet source is remote (IED) or local (protected IED), if this flag is checked, it means the system needs to check that the packet source is remote else it treats the packet to be local.
- St (state) and sq (sequence) Check: The enforcer performs a sequencing check on incoming PDU packets if the flag is set to be true. The enforcer performs the following checks on packets with the same application id.
 - if an incoming packet has an smaller st number than the previous packet's, then the packet is regarded as old packet and marked as DROPPED.
 - if an incoming packet has an st number more than one greater than the previous packet's, then the packet is consider too new and an ALERT syslog message is generated.
 - if an incoming packet has the same st number as the previous packet's, but has a smaller sq number than the last packet's, then the packet is regarded as old packet and marked as DROPPED.
 - if an incoming packet has the same st number as the previous packet's, but has a sq number more than one greater than the last packet's , then the packet is regarded as too new and an ALERT syslog message is generated.
 - if an incoming packet has a time stamp older than the previous packet's, then the packet is regarded as old packet and marked as DROPPED.

7.4 Editing Firewall Rules

The Rule Table on the Firewall page displays the firewall rules created for the selected Tofino SA. You can make changes directly on this page: in the table and in the Rule Details section. You can also change the order in which the rules are evaluated.

- In the Project Explorer view, expand the Tofino SA you want to work with and click “ Firewall”. The Firewall page displays the rules created for this Tofino SA.

	Asset	Interface	Direction	Asset	Interface	Protocol	Permission	Log	Type
<input checked="" type="checkbox"/>	Any	FS_HME_NL	→	Any	FS_Centro...	ARP	Allow	<input type="checkbox"/>	Stand
<input checked="" type="checkbox"/>	Any	FS_HME_NL	→	FS_PL_C_001	FS_Centro...	DHCP/BOOTP	Allow	<input type="checkbox"/>	Stand
<input checked="" type="checkbox"/>	FS_HME_001	FS_HME_NL	→	FS_PL_C_001	FS_Centro...	MODBUS/TCP	Enforce	<input type="checkbox"/>	Stand
<input checked="" type="checkbox"/>	FS_HME_001	FS_HME_NL	→	FS_PL_C_001	FS_Centro...	HTTP	Allow	<input type="checkbox"/>	Stand
<input checked="" type="checkbox"/>	Any	FS_HME_NL	→	FS_PL_C_001	FS_Centro...	<none>	Deny	<input checked="" type="checkbox"/>	Sci
<input checked="" type="checkbox"/>	Any	FS_HME_NL	→	FS_PL_C_001	FS_Centro...	<none>	Deny	<input checked="" type="checkbox"/>	Sci

Figure 73: Firewall rule table

- The check box in this column indicates if the rule is active (selected). When the check box is not selected, the rule will not be loaded into the firewall. This allows you to create rules in advance to activate later. It also allows you to quickly deactivate rules for testing without having to delete them.
- Asset (first of two): An asset or address that the rule applies to. Certain protocols require a specific address type or a predefined address.
- Interface: The Tofino SA interface where the first asset or address is found.
- Direction: The direction a session is initiated. There are three possible options: right, left, and bidirectional.
- Asset (second of two): An asset or address that the rule applies to. Certain protocols require a specific address type or a predefined address.
- Interface: The Tofino SA interface where the second asset or address is found.
- Protocol: The protocol defined when the firewall rule was created. The Protocols folder contains a list of available protocols.
- Permission: What the firewall does with a packet based on the defined rules. There are three options:
 - Allow: The Tofino SA will allow traffic matching the rule to pass.
 - Deny: The Tofino SA will stop traffic matching the rule from passing.
 - Enforcer: The Tofino SA will further inspect and filter the traffic using Deep Packet Inspection. This option is available for protocols that have Enforcer LSMs installed.

- Type: The type selected when the firewall was created: Standard or Special.
- Standard: These rules are designed to allow or deny specific protocols passing through the firewall. They allow the user to set the source, destination, direction, and permission for traffic of a particular protocol type.
- Special: These rules are highly complex and go beyond allowing and denying traffic. For example, a Special Rule could be used to block a subset of a particular type of traffic. The available Special Rules can be viewed in the Special Rules folder.
- Log: A check box indicating if logging is enabled for the rule.

NOTE

By default, the Tofino SA will log denied packets that do not match any of the rules in the firewall table. Similarly, if you enable logging on a rule (the permission may be Allow or Deny), packets matching the rule will be logged. Conversely, if logging is disabled on a rule, no log events will be created for packets matching this rule. A common use for this option is to help stop nuisance alarms from blocking broadcast traffic.

- Details: A short form summary of special firewall rule details. The information in this column comes from the Rule Details section.
- Description: A text field where the controls engineer can add a comment about the rule.
- Click the cell you want to edit and make the necessary change in the table. Depending on the cell selected, you will be able to do the following:
 - Change the state of a check box
 - Select an entry in a list
 - Open a dialog box and select from a list of appropriate values
 - Enter text

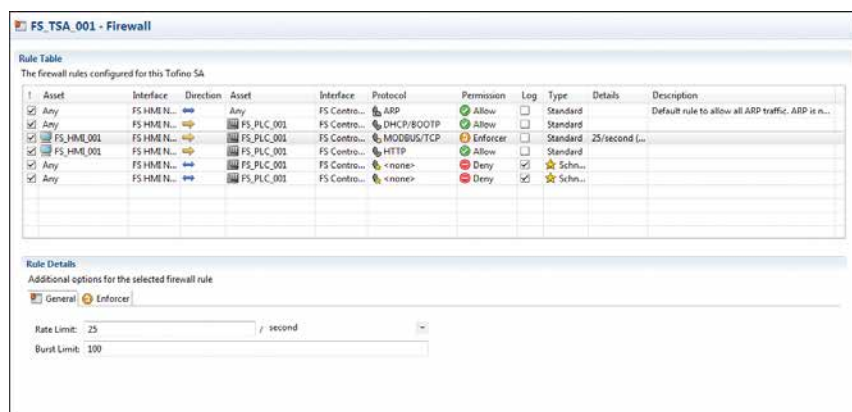


Figure 74: Select the rule to be edited

- On the General and Enforcer tabs in the Rule Details section, update the settings as necessary for the currently selected rule in the table.
- Reorder the rules as necessary. Packets will be inspected sequentially beginning at the top of the table. Select a rule and position it by clicking “ Move Up” and “ Move Down” in the toolbar.
- Check the title bar above the rule table for messages. You will be prompted if a rule is incorrect or if an additional rule is required.
- Click the Save icon in the toolbar.

7.5 How Automatic Rule Generation Works

The Eaton Tofino Configurator offers the ability to automatically generate rules based on the rule profiles associated with a given asset. For example, if a workstation uses the protocol HTTP as a client (i.e., it initiates the communications to an HTTP server), the New Firewall Rule Wizard can use this information to automatically create HTTP rules for the asset to allow it to talk to the server.

When the option to automatically generate rules is selected, the Eaton Tofino Configurator will perform a series of checks based on the rule profiles of the assets selected earlier in the wizard:

- If one of the assets has rule profiles and the other has no rule profiles, then the rule profiles from the asset with rule profiles will be used to create rules.
- If both of the assets have rule profiles, the automatic rule generator will create one rule for every protocol the assets have in common. If the assets have no protocols in common, a message will display and no rules will be created. Similarly, no rules will be created if the assets have a protocol in common, but are either both clients or both servers.
- Finally, since two assets may have different rule profile settings for the same protocol, the Eaton Tofino Configurator will use a series of priorities to determine what the final rule should be. The following table shows how these conflicts are resolved.

If a field is required to match and the rule profiles of the two assets do not match on that field, then no rule will be created. If the fields do match, then the value of that field will be used for the new rule to be created.

If a field is indicated as not having to match, then the priority describes how the value of the field in the resulting firewall rule is determined. For example, if the assets have different values for the Rate Limit, then the lowest rate limit will have priority and will be used in the resulting firewall rule. Alternatively if the two rule profiles both have comments that are different, the automatic rule generator will combine the comments in the resulting rule.

Field	Are rule profile values required to match?	If values do not match, priority is given to:	Notes
Special Rule Type	Yes		Special Rules that lock assets cannot be used for rule profiles.
Assets	N/A		
Protocol	Yes		
Direction	See Notes		Rule direction is decided based on the relationship of Server and Client settings for both profiles.
Permission	See Notes		If one profile is set to Allow and the other is set to Enforcer, Enforcer is the resulting permission.
Log	No	Enabled	
Rate Limit	No	Lowest	If one asset has no Rate Limit defined, the Rate Limit of the other asset is used.
Burst Limit	No	Lowest	If one asset has no Burst Limit defined, the Burst Limit of the other asset is used.
Enforcer Details	No	Refer to Modbus and EtherNet/IP sections in this table	If one profile has an Enforcer detail and the other does not, the existing Enforcer detail will be assigned to the rule.
Description	No	Both	The rule profile descriptions from both assets are combined.
Modbus			
Function Codes	No	The most restrictive group takes precedence	Read Only (most restrictive) < Read/Write < Programming/OFS < Advanced < Any (least restrictive). <ul style="list-style-type: none"> If both assets have Advanced Function Codes, see the Modbus Advanced Filters section in this table.
Unit ID	Yes		Unit IDs common to both assets will be used.
Sanity Check	No	Enabled	
State Check	No	Enabled	
Exception	No	Enabled	
Reset	No	Enabled	

Continued

Table 2: Automatically generated rules

Field	Are rule profile values required to match?	If values do not match, priority is given to:	Notes
Modbus Advanced Filters			
Function Code	Yes		Function Codes common to both assets will be used.
Range	Yes		Ranges for Function Codes common to both assets will be used.
Comment	No	Both	The comments from both assets are combined.
EtherNet/IP			
CIP Services	No	The most restrictive group takes precedence	Read Only Data (most restrictive) < Read/Write Data < Advanced < Any (least restrictive) <ul style="list-style-type: none"> If both assets have Advanced CIP Services, see the EtherNet/IP Advanced Filters section in this table.
Sanity Check	No	Enabled	
Reset	No	Enabled	
Debug	No	Enabled	
EtherNet/IP Advanced Filters			
Object	Yes		Objects common to both assets will be used.
Service	Yes		Services common to both assets will be used.
Comment	No	Both	The comments from both assets are combined.
OPC Classic			
Sanity Check	No	Enabled	
Fragment Check	No	Enabled	
Connection Timeout	No	Lowest	A checked Never Timeout is considered the highest connection timeout setting.

Table 2 (continued): Automatically generated rules

7.6 Using Tofino Test Mode to Validate Firewall Rules

You can operate the Tofino SA in two modes: Test and Operational.

Running in Test mode allows the Tofino SA to fully process network messages and generate event logs without actually blocking network traffic. This is a non-invasive way to check the impact that the firewall rules will have when put in Operational mode. Use Test mode to confirm that the Tofino SA is configured correctly.

- In the Project Explorer view, expand the Tofino SA you want to work with and click "General." The main view displays the general settings for the selected Tofino SA.
- In the Status section, select "Test" as the mode.
- On the Firewall page create firewall rules based on the known network traffic patterns and desired security.
- Load the resulting configuration into the Tofino SA (see "Applying and Verifying Configurations").
- Let the Tofino SA process network traffic for a period of time (typically 24 hours or longer).
- Using a syslog server, or the USB Save feature and log viewing software (see "Retrieving Log Files"), review the log messages generated by the Tofino SA to determine if there are instances of either of the following:
 - Packets marked to be dropped that you think should be allowed
 - Packets marked to be dropped that you think should be dropped without being logged (i.e., nuisance alarms)
- If either of these are noted, adjust the firewall rules accordingly and repeat this task.
- Once no unwanted log messages are being generated, return to the General settings page, set the mode to "Operational," and load the final configuration into the Tofino SA.

7.7 Firewall Rules for Grouped Assets

Given a situation where you want to create rules for six different assets lying in two different folders. You need to create six separate rules for each asset.

Now think of a solution where you can create all six rules in one go along with all the possible combinations (one-to-one or one-to-many.)

TC allows you to create one firewall rule for multiple assets. TC create rules only for the assets that exist in the selected folders. Tofino SA is configured. Follow these steps to create a rule for grouped assets.

- In the Project Explorer view, expand the Tofino SA you want to work with and click " Firewall."

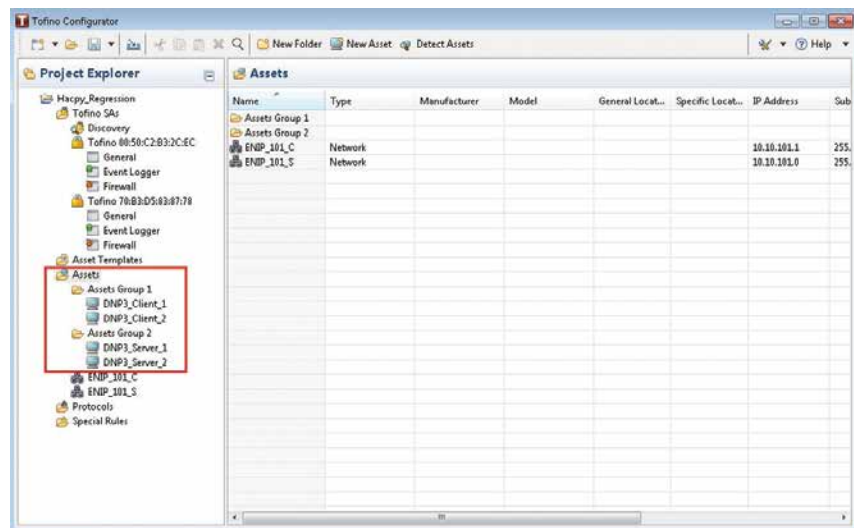


Figure 75: Firewall rule table

- Click "Create Rule" in the toolbar.
The New Firewall Rule Wizard opens.

Rule Type

Select the type of firewall rule you want to create.

☒ Standard rule

☐ Select a special rule type from the list below:

★ Tofino Rapid Network Recovery

Figure 76: Select the rule type

- Select the type of rule you want to create: standard or special. If you are creating a special rule, you also select a rule type from the list provided. Click "Next".
- Define the assets involved in the firewall rule and click "Next".

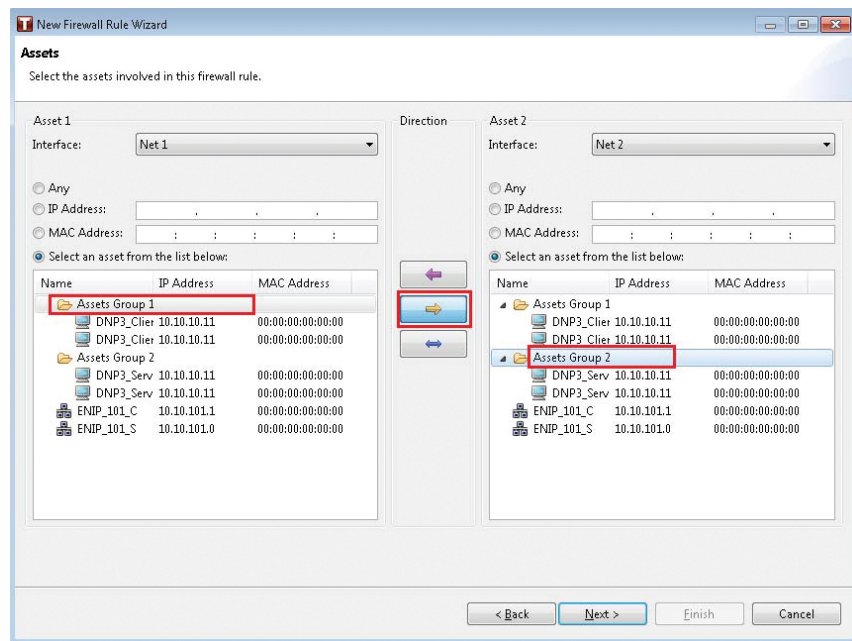


Figure 77: Select assets from the list

For each asset you:

- Select the interface where the asset or address is found.
- Specify the asset or address that the rule applies to. You can enter a specific address or select from a list of known assets. You can also specify that the rule applies to any asset.
- Set the direction to indicate which asset can establish the connection. The options are left, right, and bidirectional. In the above screenshot, it is bidirectional.
- Define the rule protocols for the selected assets.

When the selected assets have no rule profiles associated with them, the Protocol page appears where you can manually create the rule profiles.

However, when one or both of the assets selected is associated with a rule profile, a prompt appears. You can either choose the existing profile or can manually create the firewall rules.

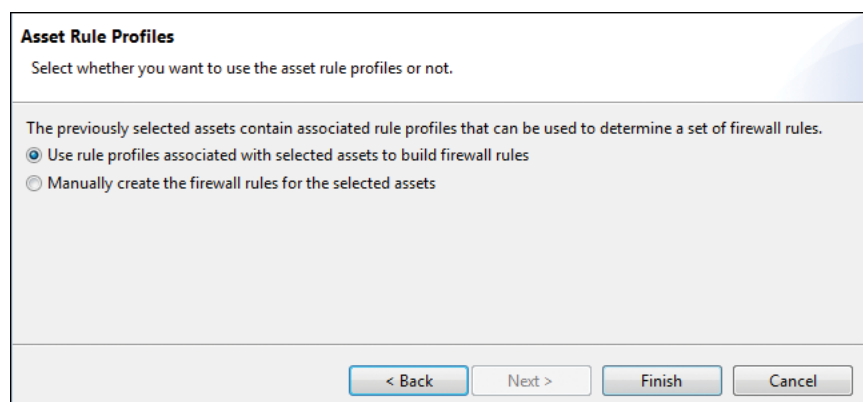


Figure 78: Assets rule profile

- If prompted, select how you want to create the firewall rules and click “Finish”.

When you choose to manually create the rule profiles, you are directed to the Protocol page.

When you choose to use the existing rule profiles, the Eaton Tofino Configurator checks both of the assets for protocols listed in their rule profiles. The automatic rule generator then creates one rule for every protocol that the two assets have in common. The New Firewall Rule Wizard closes and the rules created display in the table on the Firewall page.

If the assets have no protocols in common, no rules are generated. Similarly, if they have protocols in common but are both clients or are both servers, no rules are generated. In these cases, a message informs you of the situation and you need to define the protocols manually on the Protocol page.

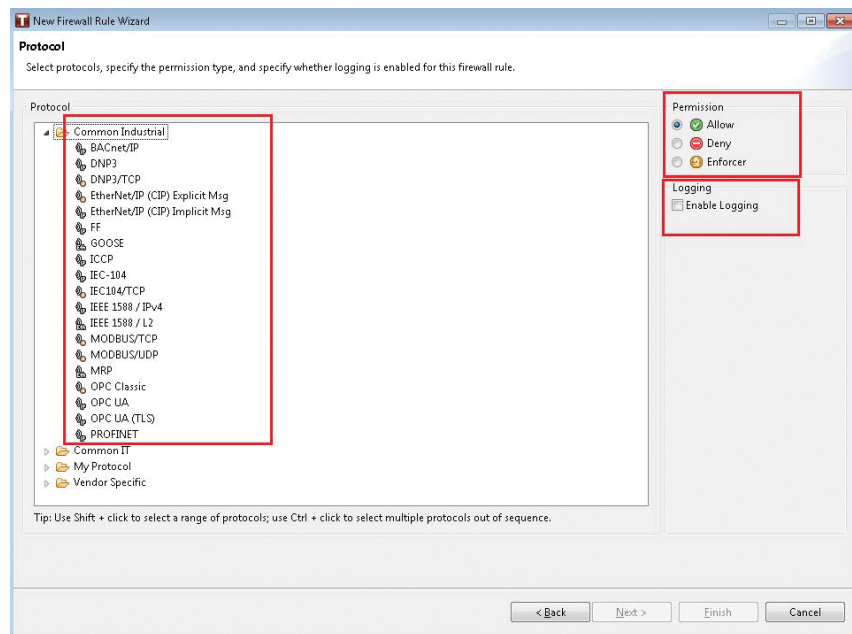


Figure 79: Select the protocol, specify the permissions, and enable logging

- To create rules manually on the Protocol page, expand the folders and select the protocols you want to use for the asset rules. Use SHIFT+click to select a range of protocols; use CTRL+click to select multiple protocols out of sequence. A rule is created for each protocol selected.
- Set the permission. This tells the firewall what to do with a packet that matches the rule: allow it to pass (“Allow”) or stop it from passing (“Deny”). The “Enforcer” option inspects and filters the traffic using Deep Packet Inspection. This option is appropriate solely for the Enforcer protocols.
- To create a log each time the rule is triggered, select the “Enable Logging” check box.
- Click “Finish”.

- Finish configuring the firewall details in the Rule Details section. Many firewall rules allow you to adjust advanced settings, such as traffic rate limiting. Additional settings for the selected rule are displayed in one or more tabs below the rules table. The Details column in the rules table displays a summary of these advanced settings. For more information on setting these rule details, see “Firewall Rate Limiting” and the appropriate sections on Enforcer rules: “Creating a Modbus TCP Enforcer Rule,” “Creating an OPC Classic Enforcer Rule,” “Creating IEC104 Enforcer Firewall Rule,” “Creating an EtherNet/IP Enforcer Rule,” “Creating a DNP3 Enforcer Rule” “Creating a GOOSE Enforcer Rule”
- Manually reorder the rules as necessary.
- Click the Save button in the toolbar.

7.8 Statistics of Firewall Rules

Eaton Tofino Configurator now displays the packet count statistics to indicate which rules are getting hit and which ones are not. This helps you to know about the present rules that never hit by any matching traffic due to several reasons such as:

- Presence of a more generic rule (or superset rule) above the unused rule.
- Presence of a permit all or deny all rule above the unused rule.
- Change in network topology (such as IP addresses or ports) making the rule redundant.
- Change in traffic profile causing the rule to be never hit.

The Eaton Tofino Configurator allows you to have a hit count corresponding to each firewall rule. This counter displays the number of many packets that were hit for that rule at TSA side.

To do so, TC provides you a button named “**Fetch Firewall Stats**” to fetch the firewall stats for all the rules present in rule table for a specific TSA.

Follow these steps to fetch the firewall stats:

- In the Project Explorer view, expand the Tofino SA you want to work with and click “ Firewall”

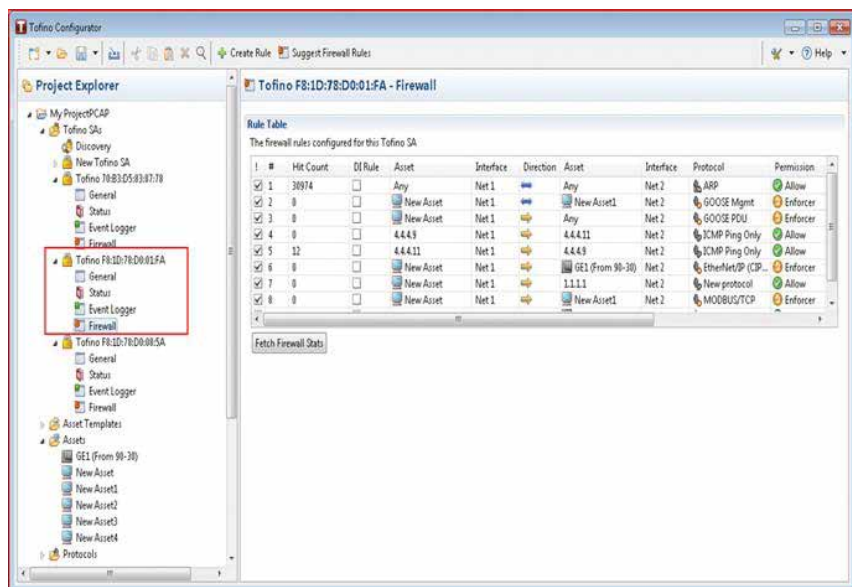


Figure 80: TSA Firewall page

- Click on Fetch Firewall Stats button.

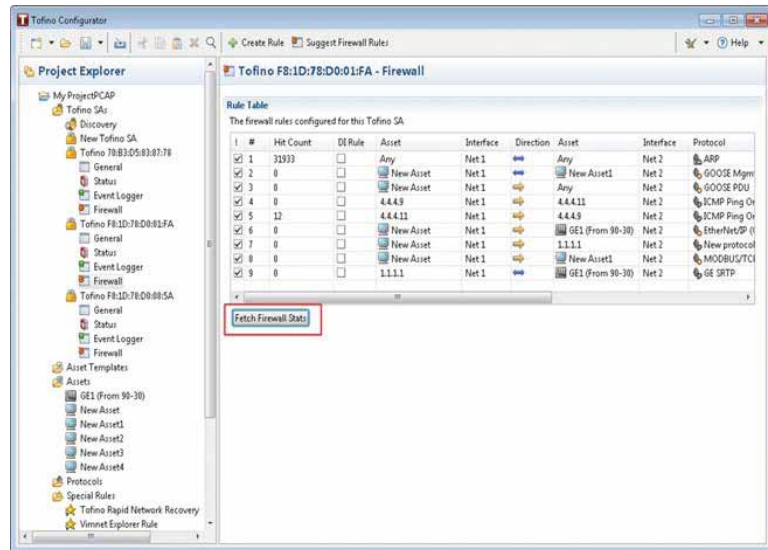


Figure 81: Fetch firewall statistics

- Now, TC fetches the stats for every rule and show the counter value. All these values are shown under Hit Counter column for respective rules.

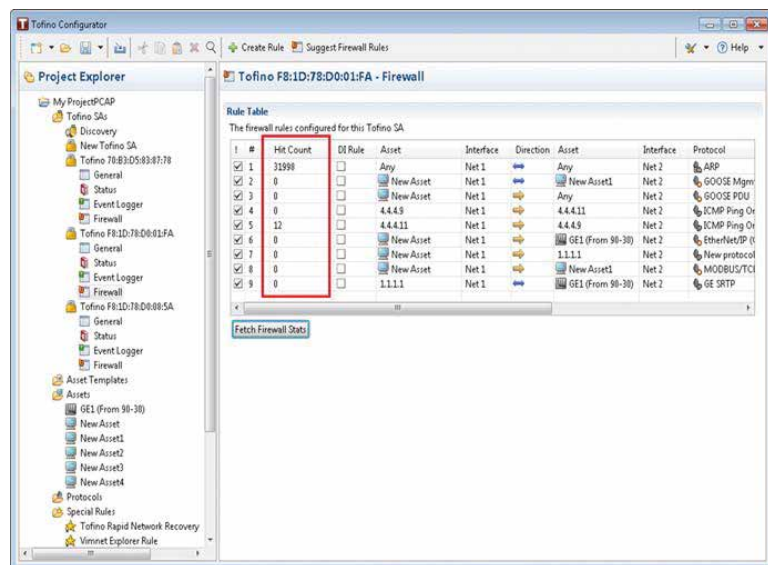


Figure 82: Showing hit counter

Here are some facts:

- Firewall Stat Counter value is saved if you navigate to other pages in the project explorer.
- Firewall Stat Counter default value is 0 for every rule. But when you open a project in TC, the counter value is default till the time you fetch new values.

NOTE

The counter value for a rule is not saved in the project file

7.9 Digital Input Rules

Eaton Tofino Configurator has an option to provide the rule sets when the Digital Input (DI) is physically active on a Tofino SA. On TC side too, the DI rules are send only if the “DI Active” option is checked.

On the General section, check the “DI Active” check-box:

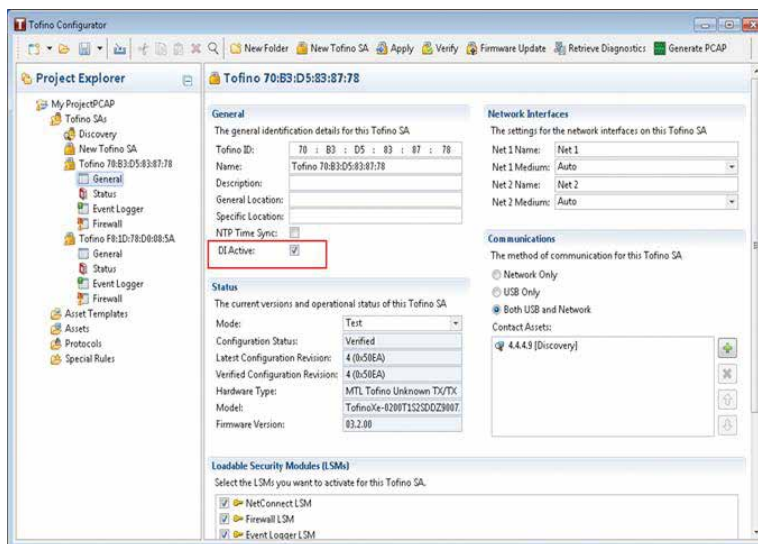


Figure 83: Digital Input check-box

It is mandatory to check the DI Active box in General section else TC won't be able to send DI rules to TSA. In addition to this, DI should be enabled on TSA too to apply DI related configuration.

Now on Firewall section of a TSA, click on the desired DI Rule check-box to be chosen as a DI rule.

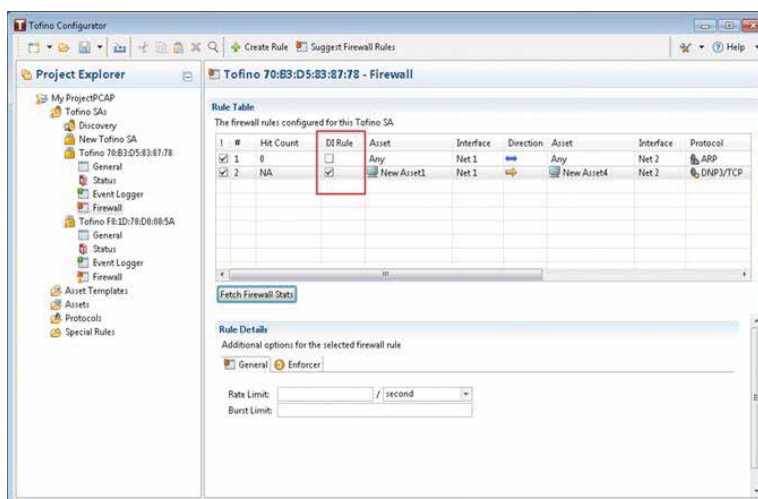


Figure 84: DI rule of a TSA

When you enable DI Rule check-box, Eaton Tofino Configurator pushes the additional DI rule sets while applying configuration to a TSA. If you disable the DI Rule check-box, TC now removes the DI rules from the configuration.

8 EVENT LOGGING

The Event Logger LSM is a security module used to provide external alarm and event logging for the Tofino SA to a syslog server. It offers two methods for saving event logs:

- Via the syslog protocol to forward Tofino SA exception events to a remote syslog server
- Saving exception events to the long-term memory in the Tofino SA for offloading via USB storage device

8.1 Setting up the Event Logger

Configure the Event Logger page to specify the type of events you want to collect in the log files and how you want to store the files.

NOTE

To activate event logging, the Event Logger LSM needs to be licensed for activation in your Tofino SA. Without a license for the LSM, you can create a trial logging configuration in the Eaton Tofino Configurator; however, you will be unable to load them into the Tofino SA.

- Open the General settings page for the Tofino SA you are configuring. Confirm that the “ Event Logger LSM” is selected in the Loadable Security Modules list.
- In the Project Explorer view, click “ Event Logger” beneath the Tofino SA you are working with.

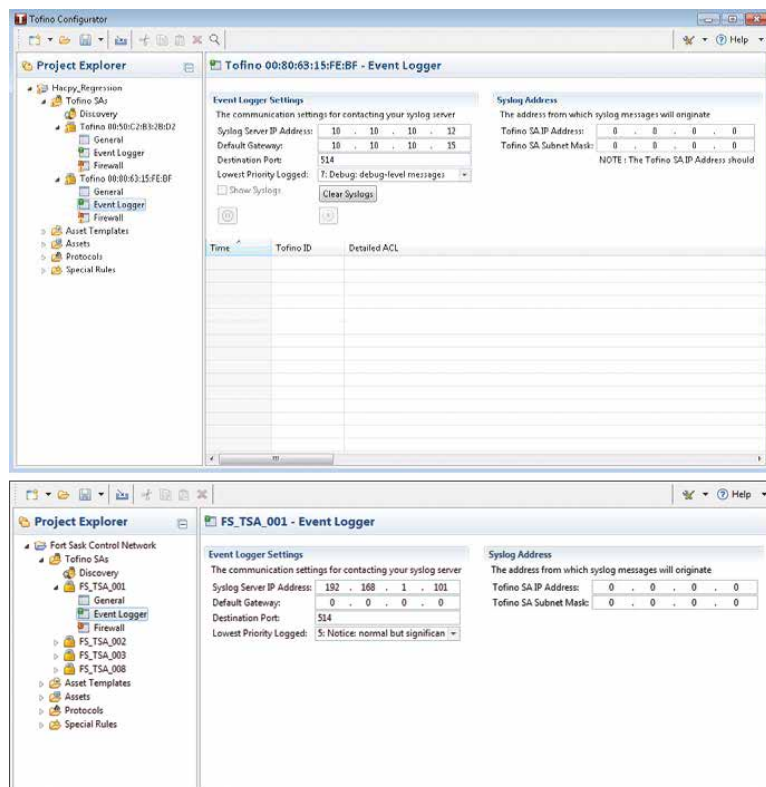


Figure 85: Syslog event logger

Fill the fields in the Event Logger Settings section to specify the information to be captured and where the files should be stored.

- **Syslog Server IP Address:** This is the address of the syslog server where syslog events/logs are logged. To disable the remote syslog feature, set this field to zeros.
- **Default Gateway:** This is the IP address of the forwarding router on the network where the Tofino SA is located. This is required when the syslog server is on a different network than the Tofino SA. If you are not using the syslog feature, or if the Tofino SA and the syslog server are on the same subnet, set this field to zeros.
- **Destination Port:** This is the UDP port number your syslog server is listening for log messages on (usually port 514). The range of this port is 0 to 65535. To disable the syslog feature, leave this field blank. The port number remains intact with global settings.
- **Lowest Priority Logged:** This is the cut-off as to the lowest logging level you would like the Tofino SA to record. Setting the priority to 0 would result in just the emergency events being recorded while setting the priority to 7 would result in every detected event with smaller or equal priority being recorded. The default setting is 5.
- Click the “show syslogs” checkbox.
 - > This checkbox is enabled only when the TC system host acts as | syslog server where Tofino SA sends the logs.
 - > The populated logs are sorted at least on the basis of Tofino ID. There are options to sort the logs on the basis of other fields.
- Use the “Clear Syslogs” button to clear the screen.

Lowest Priority Message to be Logged		Explanation
0	Emergency: system is unusable	Not used by the Tofino SA.
1	Alert: action must be taken immediately	A physical change to the system occurred, such as a detected power supply failure or interface disconnection. This can also indicate the detected loss of a process on the firewall.
2	Critical: critical conditions	An event occurred that could modify the operation of the firewall, such as a new configuration being loaded.
3	Error: error conditions	The firewall and/or an Enforcer dropped a network packet.
4	Warning: warning conditions	Not used by the Tofino SA.
5	Notice: normal but significant condition	Not used by the Tofino SA.
6	Informational: informational messages	The Event Logger LSM generated a periodic event message.
7	Debug: debug-level messages	Not used by the Tofino SA.

Table 3: Lowest Priority Message to be Logged setting options for the Event Logger

The following table shows the priority settings for a selection of event logs generated by the Tofino SA.

Event Type	Syslog Level
Network Interface Up/Down	1
Power Failure or Power Recovery	1
License Expiration	1
TC Configuration Load Attempted	2
Tofino Mode Change	2
Firewall Packet Allow/Deny	3
Modbus Enforcer Allow/Deny	3
EtherNet/IP Enforcer Allow/Deny	3
OPC Enforcer Allow/Deny	3
Event Log Periodic Message	6

To record when packets are denied by the Firewall and Enforcer modules, set the "Lowest Priority Logged: " value to 3 or higher.

- Complete the fields in the Syslog Address section to indicate the address from which syslog messages will originate.
- Tofino SA IP Address: This address is used exclusively for syslog reporting. The Tofino SA will not respond to traffic directed to this address.
- Tofino SA Subnet Mask: The subnet mask is used by the Tofino SA in conjunction with the IP address to identify if the syslog server is on the same subnet as the Tofino SA. A subnet mask is a 32-bit number that is notated by using four numbers from 0 to 255, separated by periods. Typically subnet masks use either 255 or 0 for each number (such as 255.255.255.0) but other numbers can appear in special cases.
- Click the Save icon in the toolbar.

NOTE

Keep in mind that the Tofino SA does not require an IP address to communicate to a remote syslog server. The Tofino SA uses special stealth technology to communicate without having an IP address. The syslog server will see the messages coming from the address you entered as the Tofino SA IP Address. If nothing is specified in Tofino SA IP Address i.e. by default syslog server will see the messages coming from 169.254.2.2.

8.2 Retrieving Log Files

When the Event Logger is configured to save to the Tofino SA's long-term memory, you use a USB storage device to retrieve the log files.

- Power on the Tofino SA for at least one minute.
- Insert the USB storage device into the USB port.
- Press the Save Load Reset button once. The Save/Load LED will illuminate in green. After a few seconds the Mode, Save/Load, and Reset LEDs will flash in green in a left to right sequence to indicate the USB Save is in progress.
- When the flashing sequence stops, remove the USB storage device. If the save was successful the Tofino SA LEDs will revert to the state they were in prior to the save action.

NOTE

For more details on the USB Save function, see "Transferring Data from Your Tofino SA via USB" on page 100.

- Insert the USB device into a computer.
- Open the storage device to locate and view the file containing the logs.

The logs will be stored in eventlogger_<tofino id>.zip, which is compressed.

When an Event Logger file reaches 4 MB in size, it is rotated. The rotated files are numbered and appear as eventlogger_<tofino id>.X.zip, where X is the number of the file. This number increases by 1 each time a new rotated file is created; up to 20 rotated files are saved. Upon reaching eventlogger_<tofino id>.20.zip, the first rotated file (eventlogger_<tofino id>.1.zip) is removed and eventlogger_<tofino id>.21.zip is created.

- Extract the files using an extraction tool, such as 7-zip.
- Open the log files using a syslog viewer or WordPad. The file is more clearly formatted in WordPad.

Following is an example of a log file opened with WordPad.



8.3 Viewing Syslogs

Use the “Show Syslogs” checkbox to view the logs at syslog sent by Tofino SA (TSA). This is applicable only when Eaton Tofino Configurator (TC) Host System is configured as a syslog server. All the events are reported in the Event Logger section of the discovered Tofino SA.

- Open the General settings page for the Tofino SA you have discovered. Confirm that the “Event Logger LSM” is selected in the Loadable Security Modules list.
- In the Project Explorer view, click “Event Logger” beneath the Tofino SA.
- Complete the fields in the Event Logger Settings section to provide the syslog server IP address with the port where the TSA sends the syslog.
User can specify the lowest priority to be logged. For details about priority messages to be logged, refer to Setting up the Event Logger section for a detailed description of each field.
- Complete the fields in the Syslog Address section to indicate the address from which syslog messages will originate.
- Click the “show syslogs” checkbox.
- This checkbox is enabled only when the TC system host acts as syslog server where Tofino SA sends the logs.
- The populated logs are sorted at least on the basis of Tofino ID. There are options to sort the logs on the basis of other fields.
- Use the “Clear Syslogs” button to clear the screen.
- Press the “Pause” button to stall the logs generation process.
- Press the “Play” button to resume the logs generation process.

NOTE

The system refreshes the logs automatically without the need of any manual intervention. The auto refresh interval is of 5 seconds.

NOTE

In Event Logger section, the logs of selected Tofino SA are listed only. Select a specific Tofino SA to see the list of its logs coming to the port.

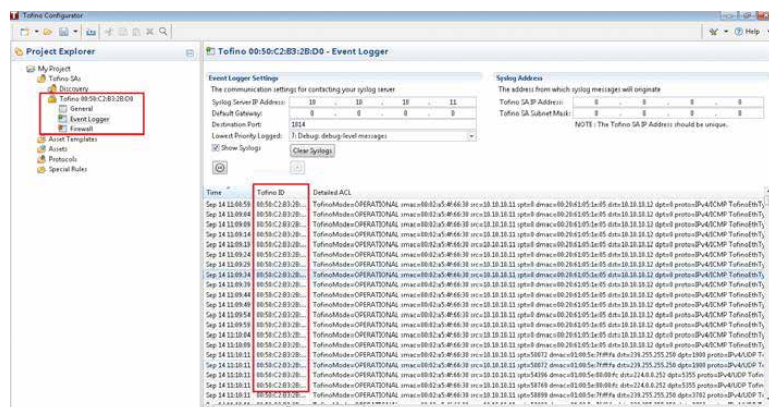


Figure 86: Viewing Syslog

8.3.1 Suggesting Rules From Event Logger View

Follow these steps to suggest rules from the event log view:

- In the Project Explorer view, expand the Tofino SA and click “ Event Logger”.

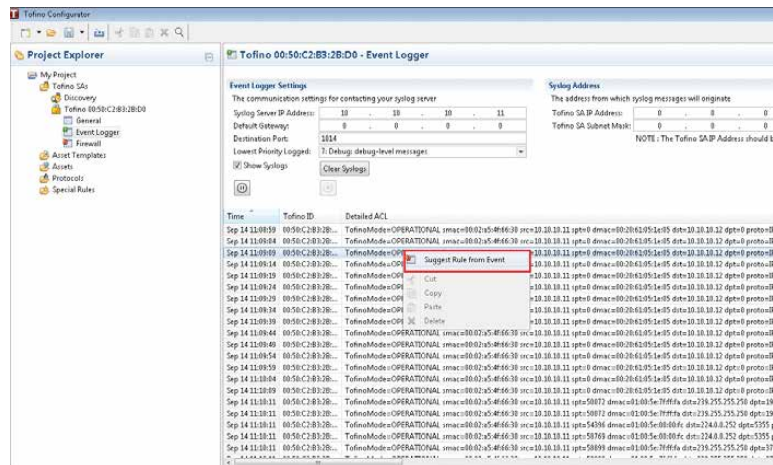


Figure 87: Rule Suggestion From Event Logger

- Right-click on the log on which you want to apply a rule and then select “Suggest Rule from Event” option. Rule corresponding to that log gets generated provided it should be a valid rule.
- Select the suggested firewall rule(s)1 to be added to the specific Tofino SA.
 1. The suggest firewall rules is currently supported for IPv4 traffic only.

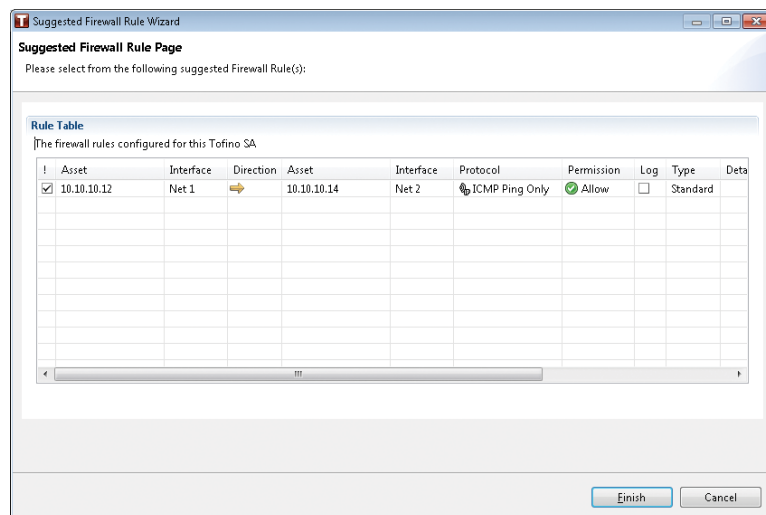


Figure 88: Suggested firewall rule page

- Click on “Finish” button.
The selected rule(s) display under the Firewall “Rule Table”

NOTE

The system does not suggest duplicate rules for the Tofino SA that already exist in firewall rule table.

9 APPLYING AND VERIFYING CONFIGURATIONS

Once your Tofino SAs are configured in the Eaton Tofino Configurator, these configurations need to be transferred to the Tofino SAs in the field. This is a two step process:

- Transfer the configuration to the Tofino SAs
- Verify the configuration

The Eaton Tofino Configurator can communicate with the Tofino SAs in the field in two ways:

- Over the network
- Via encrypted files on a USB storage device

To communicate with a Tofino SA over the network, you need a license for the NetConnect Loadable Security Module (LSM), which you activate for the Tofino SA.

To communicate with a Tofino SA over the network, select either “Network Only” or “Both USB and Network” as the communication setting on the General page.

9.1 Applying a Tofino SA Configuration

To configure a Tofino SA in the field, you apply the configuration settings in the Eaton Tofino Configurator to the matching Tofino SA device. The Apply action builds an encrypted configuration that you transfer to the Tofino SA in one of two ways: over the network or via encrypted files on a USB storage device.

When you set up a Tofino SA to communicate over the network, you apply the configuration directly to the Tofino SA in the field. When you set up a Tofino SA to communicate via USB, you apply the configuration to a USB storage device and then transfer the configuration manually to the matching Tofino SA.

Regardless of how you transfer the configuration, you will receive a set of files back from the Tofino SA that you can verify in the Eaton Tofino Configurator.

You can apply a configuration if the following conditions are met:

- The Tofino SA configuration is valid.
- The Eaton Tofino Configurator is licensed properly and the correct LSM licenses exist to support the LSMs being configured.
- You have write access to the project file.
- Any changes to the project have been saved.

The write access requirement helps to keep users without sufficient privileges from modifying Tofino SAs in the field.

The final requirement reduces the possibility that the configurations being transferred to the Tofino SAs in the field are different from the configurations in the project file.

- To list the Tofino SAs in this project, click “General” in the Project Explorer view.
- Select the Tofino SAs that you want to create configurations for. Use SHIFT+click to select a range of devices; use CTRL+click to select multiple devices out of sequence.
Selecting a folder also selects the Tofino SAs within that folder.
You can create multiple Tofino SA configurations at once. If transferring configurations via USB, you can store them on a single USB device.

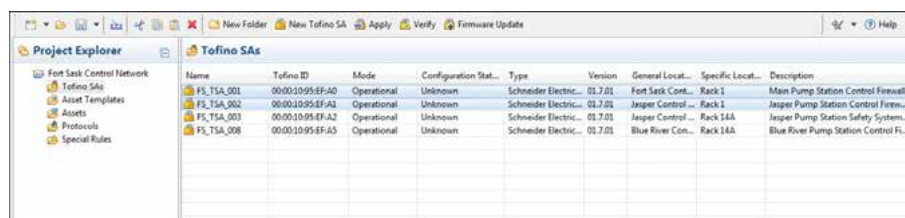


Figure 89: Select Tofino SA to apply configuration

- Click “ Apply” in the toolbar.
The Apply Configuration dialog box opens.

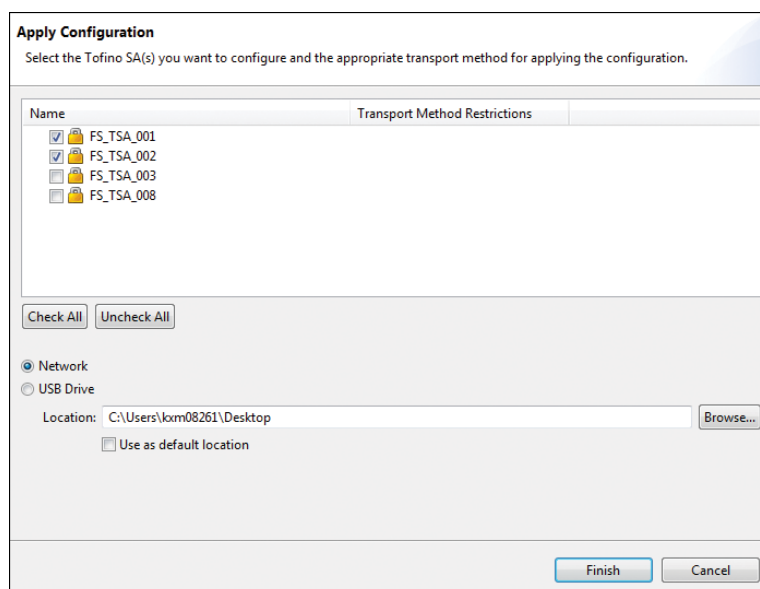


Figure 90: Apply configuration

- Confirm that the Tofino SAs that you want to configure are selected in the list.
- Select the method you want to use to transfer the configuration to the Tofino SA: “ Network” or “ USB Drive”.

NOTE

You may be unable to change the transport method specified in this dialog box. The Communications section on the General settings page determines how the Eaton Tofino Configurator can communicate with the Tofino SA in the field.

- When the transport method is set to “ USB Drive”, insert a USB device and click “Browse...”. Select the location you want to save the configuration to.
Click the “Use as default location” check box to save the selected location as the default for the next time you perform this action.

NOTE

You can save the configuration directly to the USB device, or you can save it to a location on your computer and transfer it to the USB device at another time. The configuration file is saved as a .tcf file.

- Click “Finish”.
If you transferred the configuration data over the network, the Eaton Tofino Configurator displays a results page indicating whether or not the transfer was successful. Read the “Validation Mechanism for Firewall Rules” section for more information.
- Click “OK” to close this dialog box. When the transfer is successful, verification files for each Tofino SA configured will be returned to the Eaton Tofino Configurator.
If you transferred the configuration data to a USB device, you need to manually load that data into the Tofino SA. Proceed to the task “Loading Your Tofino SA via USB”.


NOTE

You can select multiple devices to push configurations in parallel. On completion, a result dialog shows the summary of all successful and failed devices correctly. The devices, which are updated, have the applied rulesets. The failed devices stick to previously persisted rule-sets.

NOTE

The Tofino SA will pass network traffic freely during the initial configuration or when its configuration is being updated. Firewall rules take effect after completion of the initial configuration or update of the Tofino SA so that network operations are not affected before the full rule set can be applied. A typical configuration transfer will finish in approximately 30 seconds.

9.1.1 Loading Your Tofino SA via USB

	WARNING
	<p>UNINTENDED EQUIPMENT OPERATION</p> <p>Follow these configuration loading steps carefully.</p> <ul style="list-style-type: none">• Power on the Tofino SA for at least one minute.• Insert the USB storage device containing the prepared files into the USB port.• Press the Save Load Reset button twice. The Save/Load LED will illuminate in yellow. After a few seconds the Mode, Save/Load, and Reset LEDs will flash in yellow in a right to left sequence to indicate the USB Load is in progress.• When the flashing sequence stops remove the USB storage device. <p>Failure to follow these instructions can result in death, serious injury, or equipment damage.</p>

The Save Load Reset button on the Tofino SA provides three functions depending on the number of times it is pressed.

- Once: Saves diagnostics files and log files to a USB storage device.
- Twice: Transfers configuration files from a USB storage device.
- Three times: Performs a factory reset and returns the Tofino SA back to its default state as shipped from the factory.

You use the USB Load function to transfer configuration files generated by the Eaton Tofino Configurator and firmware updates to a Tofino SA in the field. This is the second part of a two-step process. Before you load the Tofino SA, transfer the desired data to the USB storage device. See the appropriate topic to perform this first step:

- “Applying a Tofino SA Configuration”
- “Upgrading Your Tofino SA”

NOTE
The ACA22-USB storage device has been tested by Tofino and is therefore recommended. For ordering ACA22-USB, see “Accessories” in the Installation Guide.

The following version 2.0 USB storage devices are known to work: Kingston Data Traveler, SanDisk Cruzer, Sony Microvault, Lexar, and Hirschmann ACA21-USB. Other brands and models may work, but have not been tested. Only USB devices formatted as FAT or FAT32 are compatible. The Tofino SA Fault LED will flash twice when it detects an invalid storage device.

If the load was successful, the Tofino SA's Fault LED will be off.

Following a successful USB Load function, five or more files should be stored on your USB storage device for each Tofino SA loaded (<tofino id> is replaced with the actual ID of the Tofino SA):

- <tofino id>_tc_data
Verification data indicating if the configuration was successful or not (see “Verifying a Tofino SA Configuration”)
- <tofino id>_diagnostics.txt
Diagnostics information on the Tofino SA (see “Tofino SA Diagnostics” on page 141)
- eventlogger_<tofino id>.zip and eventlogger_<tofino id>.X.zip
Event logs from the Tofino SA in a compressed file (see “Setting up the Event Logger” on page 86)
- <tofino id>_kernel_evt.enc
Encrypted kernel diagnostics information (solely for factory troubleshooting use)
- <tofino id>_diagnostics.enc
Encrypted module diagnostics information (solely for factory troubleshooting use)
- <tofino id>_configuration.txt
Configuration data listing the LSMs licensed for this Tofino SA

NOTE

The Tofino SA will pass network traffic freely during the initial configuration or when its configuration is being updated. Firewall rules take effect after completion of the initial configuration or update of the Tofino SA so that network operations are not affected before the full rule set can be applied. A typical configuration transfer will finish in approximately 30 seconds.

9.1.2 Validation Mechanism for Firewall Rules

Previously, while applying the firewall rule configuration, TC copies the script and verifies the hash, it never used to check if all rules are executed correctly. TC now has validation mechanism in place which ensures all firewall rules are executed/installed correctly.

All firewall rules are validated after configuration push on the basis of count. The Count is matching the number of rules inserted at TC and number of executed/inserted rules at TSA. If the count does not match, the validation fails. You will see the validation result as following.

If the validation is successful:

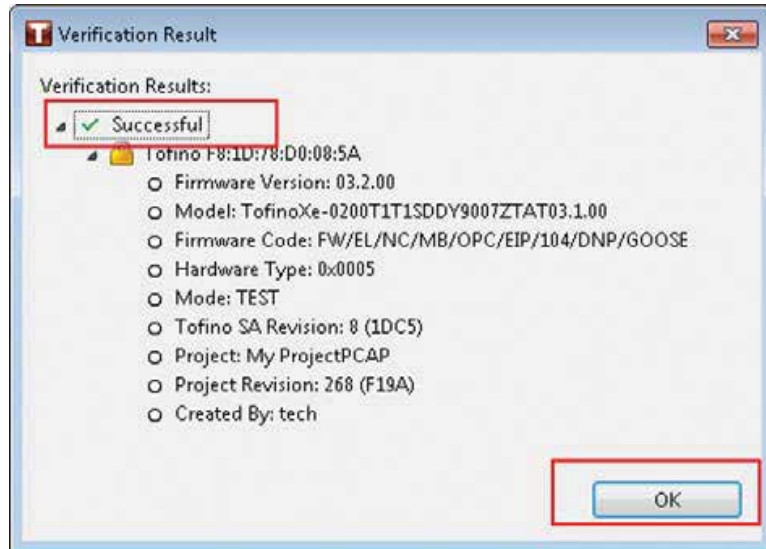


Figure 91: Validation successful

In case, the validation fails:

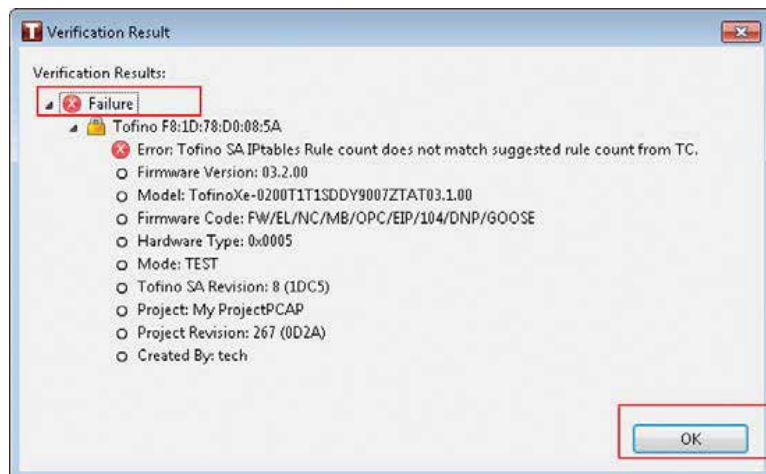


Figure 92: Validation failure

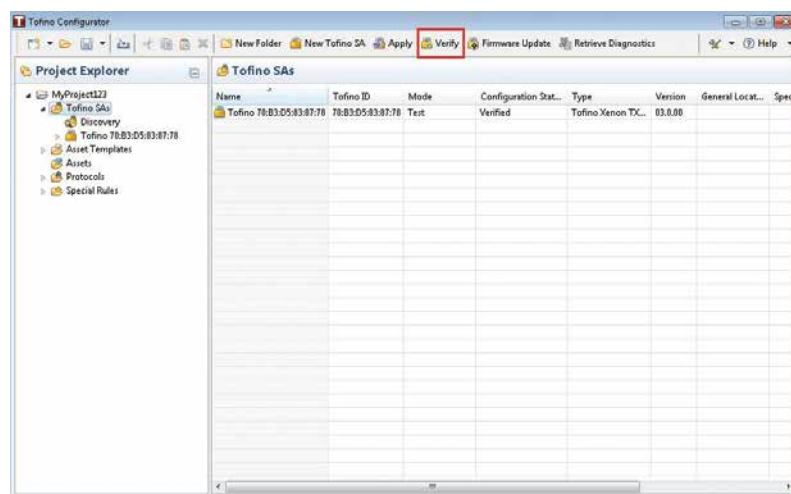
From the above messages, you will be able to know the exact reason behind the failure of the rule validation.

9.2 Verifying a Tofino SA Configuration

To record and verify the configuration of one or more Tofino SAs in the field, use the Verify action. This retrieves the configuration transfer reports sent over the network or from a USB storage device.

When you configure the Tofino SAs over the network, the verification files are automatically returned to the Eaton Tofino Configurator. When you transfer the configurations or perform firmware updates via USB, the verification files reside on the USB storage device that was used to transfer the configuration or upgrade the Tofino SAs.

- To list the Tofino SAs in this project, click “Tofino SAs” in the Project Explorer view.
- Select the Tofino SAs you want to verify. Use SHIFT+click to select a range of devices; use CTRL+click to select multiple devices out of sequence.



- Click “Verify” in the toolbar.
The Verify Loaded Configuration dialog box opens.

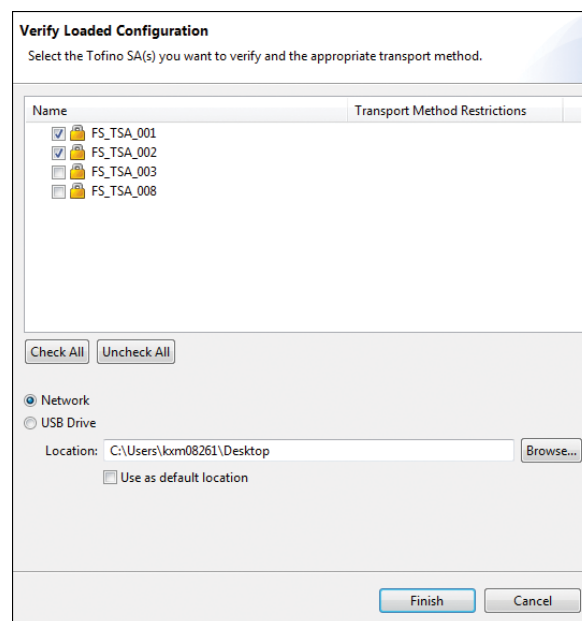


Figure 93: Verify loaded configuration

- Confirm that the Tofino SAs you want to verify are selected in the list.
- Select the method you want to use to transfer the configuration to the Tofino SA: “ Network” or “ USB Drive”.

NOTE

You may be unable to change the transport method specified in this dialog box. The Communications section on the General settings page determines how the Eaton Tofino Configurator can communicate with the Tofino SA in the field.

- When the transport method is set to “ USB Drive”, insert into your computer the USB storage device that you used to load the configuration onto the Tofino SA in the field. Click “Browse...” and select the USB drive location.
Click the “Use as default location” check box to save the selected location as the default for the next time you perform this action.
- Click “Finish”.
The verification data will be displayed and logged by the Eaton Tofino Configurator.

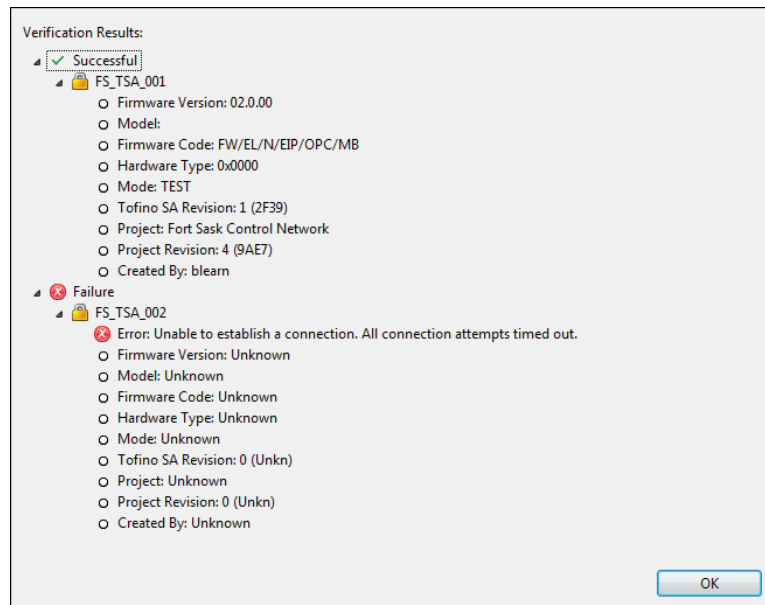


Figure 94: Verify the results

The Verified Configuration Revision, Hardware Type, and Firmware Version for the verified Tofino SAs will be updated in the project file. You can view the verification information on the General settings page for each Tofino SA.

9.3 Transferring Data from Your Tofino SA via USB

The Save Load Reset button on the Tofino SA provides three functions depending on the number of times it is pressed.

- Once: Saves diagnostics files and log files to a USB storage device.
- Twice: Transfers configuration files from a USB storage device.
- Three times: Performs a factory reset and returns the Tofino SA back to its default state as shipped from the factory.

You use the USB Save function (pressing the button once) to copy diagnostics and validation files from the Tofino SA to the USB storage device. You can then validate these files using the Verify function in the Eaton Tofino Configurator or you can send them to technical support for analysis.

NOTE

Performing a USB Load (see “Loading Your Tofino SA via USB”) automatically executes a USB Save in order to record the results of the transfer and the status of the Tofino SA after the transfer is finished. If you transferred configuration files via USB, you will not need to perform a USB Save to retrieve the files required for verification. They will already be on the USB storage device.

- Power on the Tofino SA for at least one minute.
- Insert the USB storage device into the USB port.
- Press the Save Load Reset button once. The Save/Load LED will illuminate in green. After a few seconds the Mode, Save/Load, and Reset LEDs will flash in green in a left to right sequence to indicate the USB Save is in progress.
- When the flashing sequence stops, remove the USB storage device. If the save was successful the Tofino SA LEDs will revert to the state they were in prior to the saving action.

NOTE

The ACA22-USB storage device has been tested by Tofino and is therefore recommended. For ordering ACA22-USB, see “Accessories” in the Installation Guide.

The following version 2.0 USB storage devices are known to work: Kingston Data Traveler, SanDisk Cruzer, Sony Microvault, Lexar, and Hirschmann ACA21-USB. Other brands and models may work, but have not been tested. Only USB devices formatted as FAT or FAT32 are compatible. The Tofino SA Fault LED will flash twice when it detects an invalid storage device.

Following a successful USB Save function, five or more files should be stored on your USB storage device for the Tofino SA (<tofino id> is replaced with the actual ID of the Tofino SA):

- <tofino id>_tc_data
Verification data indicating if the configuration was successful or not (see “Verifying a Tofino SA Configuration” on page 98)
- <tofino id>_diagnostics.txt
Diagnostics information on the Tofino SA (see “Tofino SA Diagnostics” on page 141)
- eventlogger_<tofino id>.zip and eventlogger_<tofino id>.X.zip
Event logs from the Tofino SA in a compressed file (see “Setting up the Event Logger” on page 86)
- <tofino id>_kernel_evt.enc
Encrypted kernel diagnostics information (solely for factory troubleshooting use)
- <tofino id>_diagnostics.enc
Encrypted module diagnostics information (solely for factory troubleshooting use)
- <tofino id>_configuration.txt
Configuration data listing the LSMs licensed for this Tofino SA

9.4 Retrieving Diagnostics File via Network

Use the “Retrieve Diagnostics” button to retrieve diagnostic files via network. The information is saved in an encrypted file to be used by the Tech Support to help diagnose any problems. This is equivalent to the USB save diagnostic data that can be physically retrieved from the Tofino SA. The user sends these files to L1, L2, or L3 support to read.

- Click “Tofino SA” in the Project Explorer view.
- Click the “Retrieve Diagnostics” button and save the project file prior to retrieving the diagnostics.
- Select the Tofino SAs to retrieve USB Diagnostics and click the “Next” button.

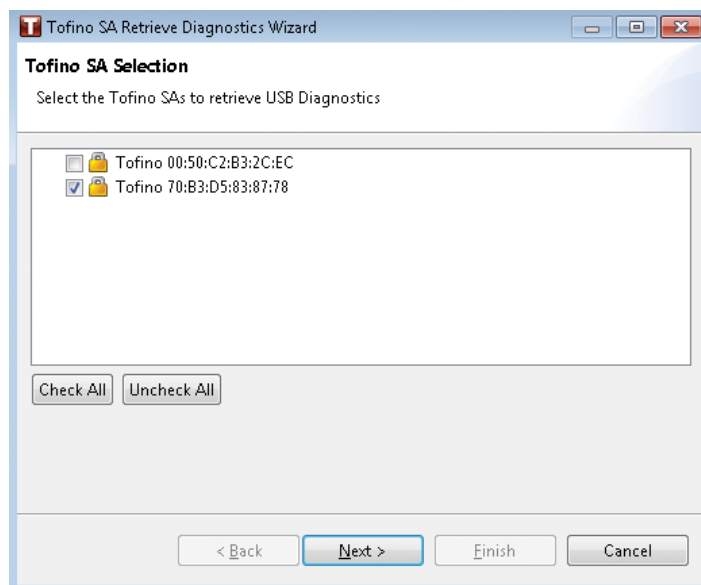


Figure 95: Select the Tofino SA

- Locate the directory to save the Diagnostic file and click the “OK” button.

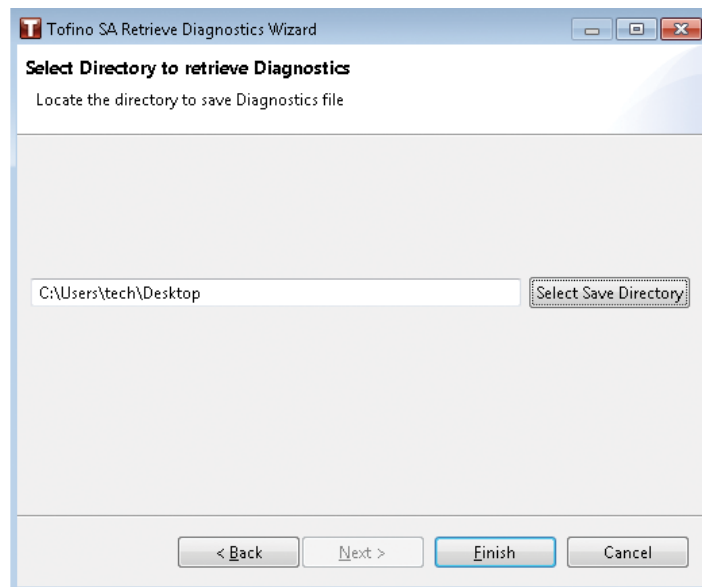


Figure 96: Browse the directory to save file

- Click the “Finish” button.
A confirmation message displays that the diagnostics was successfully retrieved.

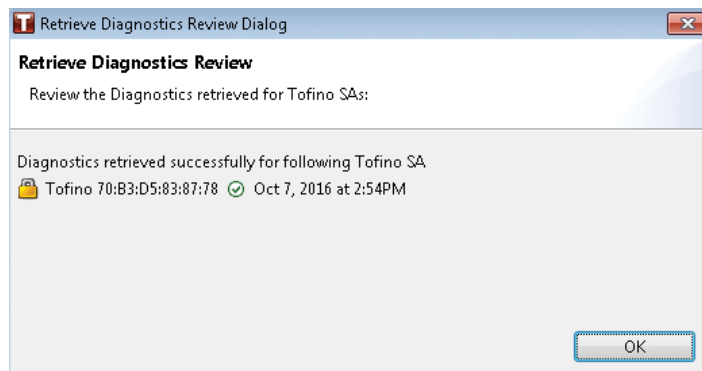


Figure 97: Review the diagnostics

10 ADVANCED TOPIC: PROTOCOLS

In the Eaton Tofino Configurator, protocols define the particular services that are communicated between devices on the network. For example, the use of web traffic on a network would use the Hyper Text Transport Protocol (HTTP) for communications between a web server and a web client. Similarly, an HMI might use the Modbus/TCP protocol to communicate to a PLC.

The Eaton Tofino Configurator comes with a number of predefined protocols that are common to many industrial systems. However, in special cases you may want to create new protocols for specific types of equipment or situations.

By selecting a protocol in the Project Explorer view, you can do the following:

- Create a new protocol
- Create a folder
- View and edit the protocol's details
- Delete a protocol

The factory defined protocols cannot be edited, cut, or deleted.

10.1 Creating a Protocol

Create new protocols for specific types of equipment or situations where one of the predefined protocols does not meet your needs.

In addition to creating a protocol manually, you can copy and paste an existing protocol to create a new one. However, this does not run the wizard. To make the protocol unique, you need to edit the details manually.

When creating your own protocols, you may want to organize them in folders. Use the New Folder feature in the toolbar to create the folder hierarchy.

- In the Project Explorer view, expand "Protocols" and click the folder where you want the new protocol to reside.
Click "Protocols" to create the protocol at the top level.
- Click " New Protocol" in the toolbar.
Alternately, open the New menu in the toolbar and click " Protocol".
The New Protocol wizard opens.

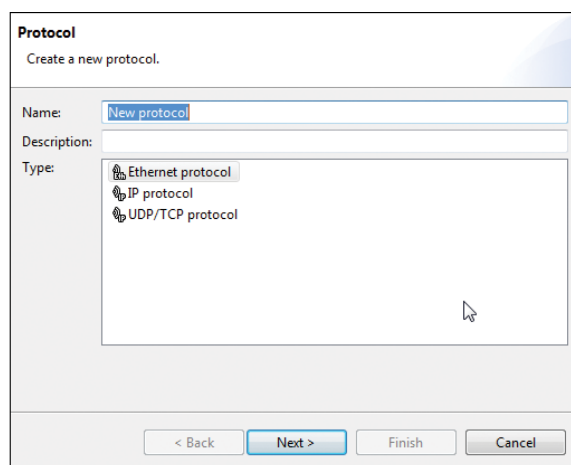


Figure 98: Create a new protocol

- Enter a name and description for the protocol, and select the type. Click “Next”.
On the second page of the wizard you enter specific details for the protocol. This page varies depending on the type of protocol selected.

Figure 99: Create a new protocol

- Complete the fields as appropriate for your protocol. For a detailed description of these fields, see “Editing Protocols” below.
- Click “Finish”.
The new protocol appears in the Project Explorer view.

10.2 Editing Protocols

Selecting a protocol in the Project Explorer view allows you to view and edit its current settings. This includes general information and specific parameters. The information displayed in the Protocol Details view varies depending on the type of protocol selected.

The factory defined protocols cannot be edited, cut, or deleted.

In the Project Explorer view, click the protocol you want to edit.

Edit the protocol settings as necessary. The available fields may include:

- **Protocol Name:** A name or identifier that uniquely identifies the protocol. Remember that each protocol needs to have a unique name to avoid confusion.
- **Description:** A text field solely for reference. This can be used to describe the function of this protocol.
- **Protocol Type:** The general classification of this protocol. The classification determines the fields available for input (UDP, TCP, IP or EtherNet).
- **Ports:** The ports used by this protocol. Use commas to separate individual port numbers and dashes to separate a range of port numbers. For example, if the protocol uses the TCP ports 5000 through 5004, they can be entered as either 5000, 5001, 5002, 5003, 5004 or 5000-5004. Exclusively use the numbers 0 through 9 and commas and dashes.

- IP Protocol: The IP protocol number in hexadecimal format.
- EtherNet Type: The EtherNet type number in hexadecimal format. For more information see: <http://www.iana.org/assignments/ethernet-numbers/ethernetnumbers.xml>
- Click the Save icon in the toolbar.

Following are three typical protocols of different types.

UDP/TCP Protocol

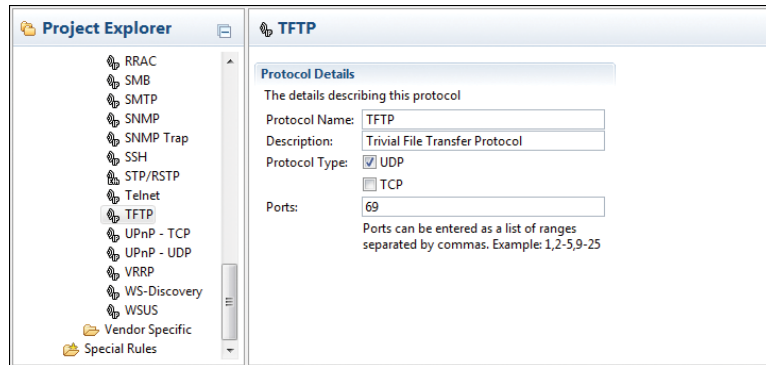


Figure 100: UDP/TCP protocol

IP Protocol

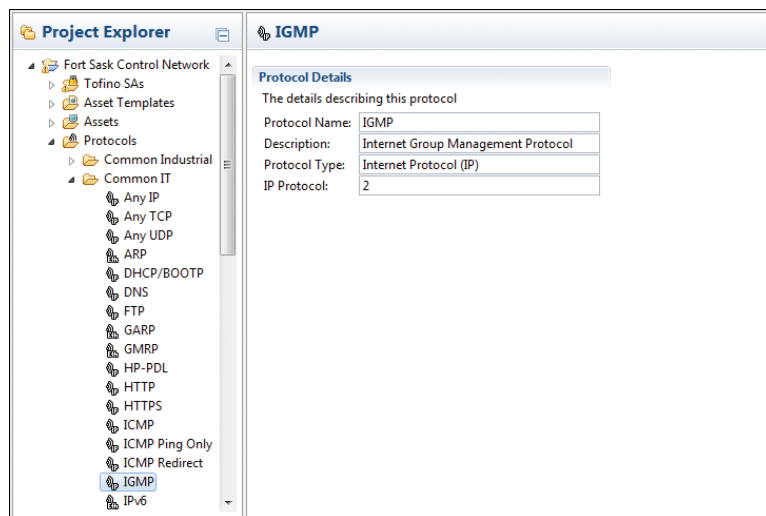


Figure 101: IP protocol

Ethernet Protocol

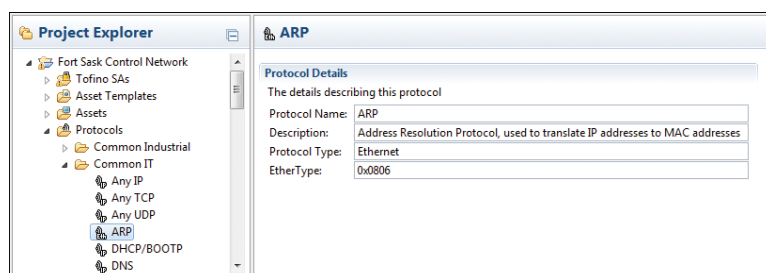


Figure 102: Ethernet protocol

10.3 Deleting a Protocol

Delete a protocol if you no longer need it in the current project. The factory defined protocols cannot be edited, cut, or deleted.

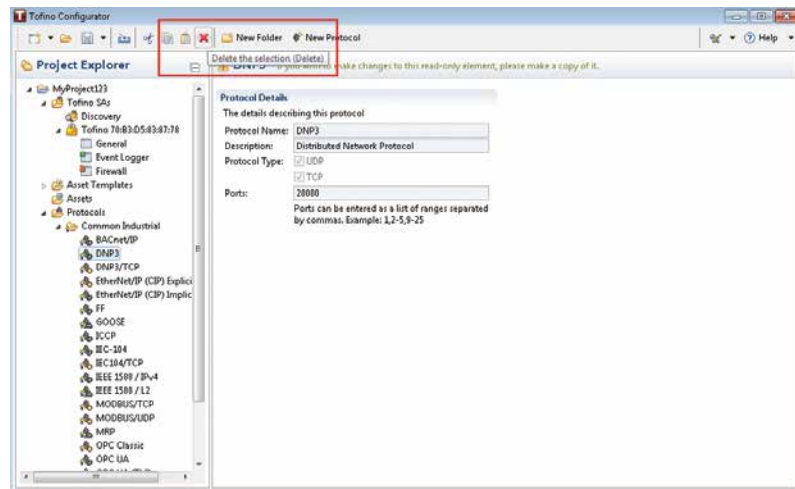


Figure 99: Create a new protocol

- In the Project Explorer view, click the protocol you want to delete.
- View the details to verify that this is the protocol you want to delete.
- Click the Delete icon in the toolbar.

If the selected protocol is referenced in a firewall rule, you will receive a message with two options. You can choose to cancel the deletion, or delete the protocol and fix the resulting errors later.

When you choose to delete the protocol, a message prompts you to confirm the action. Click "OK" to proceed. Canceling the deletion at this prompt will not reinstate the protocol in any firewall rules or assets from which it was removed.

11 ADVANCED TOPIC: IMPORTING TEMPLATES AND SECURITY PROFILES

The Eaton Tofino Configurator allows you to import predefined objects that can be used as building blocks for your security design. The following types of objects can be imported:

- Asset templates
- Protocols
- Special rules
- Security profiles

Importing asset templates, protocols, or special rules allows you to update existing definitions or add new ones to your project. Importing new versions of asset templates, protocols, or special rules will not automatically update the rules in your firewalls.

Security profiles are predefined combinations of asset templates, special rules, and protocol definitions, bundled into a single security profile file (.tsp). They allow you to import the related objects needed to help secure PLCs, DCS, and other devices against published vulnerabilities as a single file.

NOTE

If the asset templates or the security profiles in an imported file reference protocols or special rules, these will be imported during the import operation.

To import a predefined object follow these steps:

- Click the Import icon in the toolbar.
- Select the type of object you would like to import. Click “Next”
- Click “Browse...” Locate and select the object file.
- Click “Finish”.

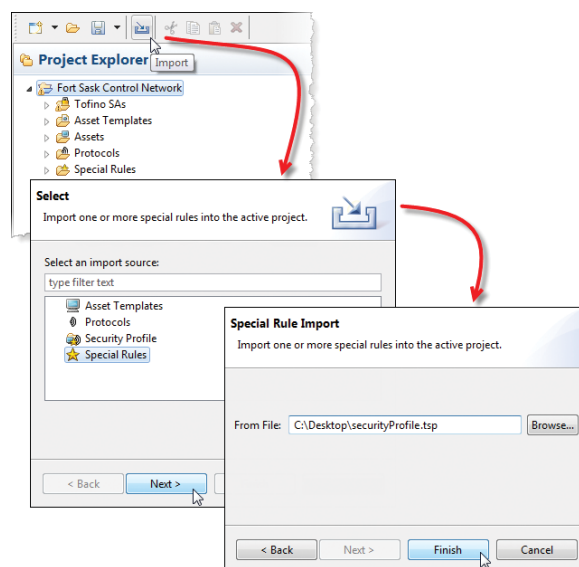


Figure 104: Import a predefined object

12 ADVANCED TOPIC: EATON TOFINO CONFIGURATOR SETTINGS

You can update and customize the following aspects of your Eaton Tofino Configurator:

- Licensing See “Adding LSM Licenses” below.
- User permissions See “Managing User Logging, Access, and Privileges” on the opposite page.
- Program settings and preferences See “Customizing Program Settings and Preferences” on page 112.

12.1 Adding LSM Licenses

The Eaton Tofino Configurator allows you to manage licenses for the Loadable Security Modules (LSMs) used in the Tofino SAs. This is a multistep process that involves exporting a project summary file to the Tofino Customer Portal; assigning the desired LSM licenses to the Tofino SAs in your project; and creating, downloading, and importing a license grant file into the project.

- Have your License Activation Key ready.
To locate the key, open the Preferences menu and select Licensing > View Licenses. Record the license key and click “Finish” to close the dialog box.
- Open the Preferences menu and select Licensing > Export Project Summary File....
- Name the project summary file and save it to a location on your computer.
- Open your browser and navigate to the Tofino Customer Portal (<http://www.tofinosecurity.com/licensing>).
- Log in to your account or click “New User” to create an account.
- In the portal, perform the following three steps:
 - Navigate to the Projects page and click “New Project”
 - Upload the project summary file (.psf).
 - Navigate to the License Grants page and create a license grant file for the project.

For assistance in the Tofino Customer Portal, click the help button in the upper right corner of the page for information specific to that page.

- In the Eaton Tofino Configurator, open the Preferences menu and select Licensing > Import License Grant File....

The License Grant Results dialog box lets you know the upgrade is complete. It indicates the upgrade was successful or lists any errors encountered.

The new LSM licenses will be loaded to the Tofino SA(s) automatically the next time a configuration is transferred.

12.2 Managing User Logging, Access, and Privileges

The Eaton Tofino Configurator is designed to give users the flexibility to tailor the security controls on the Eaton Tofino Configurator projects to their needs. It uses functionality built into the software, along with the Windows File Management system, to control user access to each Tofino project and log user activities.

There are three possible levels of access:

- View-Only Access
- Configuration Access
- Administration Access

The following table details the functionality available in the Eaton Tofino Configurator for each level of user permission.

Functionality	View-Only Access	Configuration Access	Administration Access
Open Project	Yes	Yes	Yes
Save Project	No	Yes	Yes
Save As Project	No	No	Yes
Read from Tofino SAs	Yes	Yes	Yes
Configure Tofino SAs	No	Yes	Yes
Change Project LAK or Password	No	No	Yes
Change Project File Location	No	No	Yes
Change Audit File Settings	No	No	Yes

Table 5: Available functionality by user permission level

These levels are enforced using a combination of techniques which are described in “Managing Access to a Project” and “Managing User Activity Logging and Privileges within a Project”.

12.2.1 Managing Access to a Project

The core method to control access to a project is based in the Eaton Tofino Configurator protection settings. This allows a combination of passwords, License Activation Keys (LAKs), and encryption to help secure the project files. The protection settings on the main project page in the Eaton Tofino Configurator control who has access to the project.

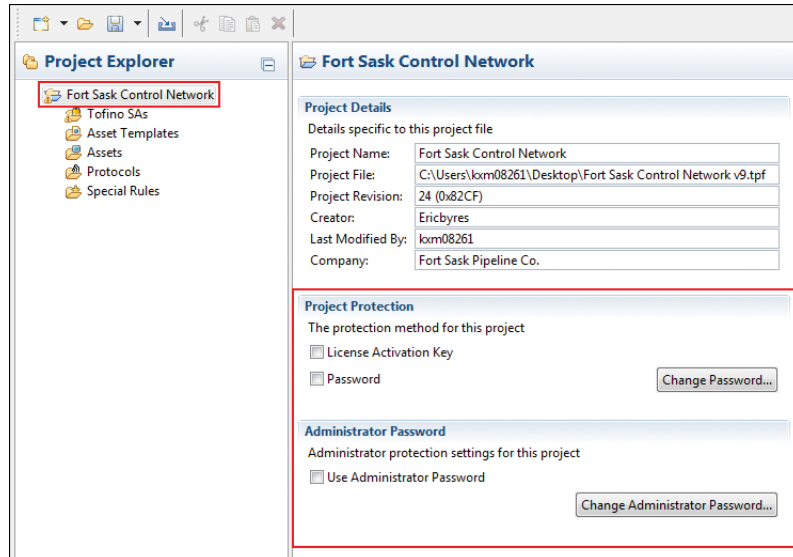


Figure 105: Project properties

There are three options for controlling access to your project:

- **Project Protection: License Activation Key**
When the “License Activation Key” option is selected, the project file is encrypted when saved. Each time the project file is opened, the system confirms that the Eaton Tofino Configurator is using the same LAK that it had when the project was created. If the LAK is different, then the file cannot be decrypted. This is a low level of security, but it restricts computers that are running other copies of Eaton Tofino Configurator software from viewing or modifying your projects—provided that the LAK is not shared outside the company.
- **Project Protection: Password**
When the “Password” option is selected, the project file is encrypted when saved. Each time the project file is opened, the user will be prompted for the project password. If the password entered is incorrect, then the file cannot be decrypted or opened. This is a higher level of security, as it restricts unauthorized users from viewing or modifying your projects.
- **Administrator Password**
When the “Use Administrator Password” option is selected, the user is unable to make administrative changes to the project file, such as changing the Project Protection settings, attempting to move the project file to a new location, or modifying audit log settings. When activated, users attempting to make these changes are prompted for the administrative password.

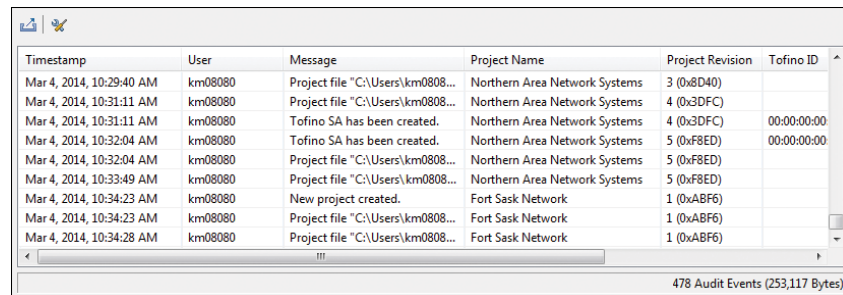
These three options can be used simultaneously. For the highest level of project security, activate all three options and use different passwords for the Project Protection and the Administrator passwords.

To help stop unwanted access to the project file, limit the distribution of the Administrator Password.

12.2.2 Managing User Activity Logging and Privileges within a Project

User Identification and User Privileges for the Eaton Tofino Configurator are based on the Windows Account Management system. The Eaton Tofino Configurator continuously checks the active account name on the computer running the Eaton Tofino Configurator software, as well as the Windows access rights to the project file. It then uses this information to log user activity and determine whether a user is permitted to configure a project or solely view it.

To accurately log user activity, each user should be required to have a unique user account on the computer where the Eaton Tofino Configurator is located. When a user makes key changes to a project, the Windows user name for the active account will be recorded in the audit logs.



Timestamp	User	Message	Project Name	Project Revision	Tofino ID
Mar 4, 2014, 10:29:40 AM	km08080	Project file "C:\Users\km08080..."	Northern Area Network Systems	3 (0x8D40)	
Mar 4, 2014, 10:31:11 AM	km08080	Project file "C:\Users\km08080..."	Northern Area Network Systems	4 (0x3DFC)	
Mar 4, 2014, 10:31:11 AM	km08080	Tofino SA has been created.	Northern Area Network Systems	4 (0x3DFC)	00:00:00:00
Mar 4, 2014, 10:32:04 AM	km08080	Tofino SA has been created.	Northern Area Network Systems	5 (0xF8ED)	00:00:00:00
Mar 4, 2014, 10:32:04 AM	km08080	Project file "C:\Users\km08080..."	Northern Area Network Systems	5 (0xF8ED)	
Mar 4, 2014, 10:33:49 AM	km08080	Project file "C:\Users\km08080..."	Northern Area Network Systems	5 (0xF8ED)	
Mar 4, 2014, 10:34:23 AM	km08080	New project created.	Fort Sask Network	1 (0xABF6)	
Mar 4, 2014, 10:34:23 AM	km08080	Project file "C:\Users\km08080..."	Fort Sask Network	1 (0xABF6)	
Mar 4, 2014, 10:34:28 AM	km08080	Project file "C:\Users\km08080..."	Fort Sask Network	1 (0xABF6)	

478 Audit Events (253,117 Bytes)

Figure 106: Audit logs

To limit access to project functions by giving users View-Only (i.e., Read Only) or Configuration (i.e., Read/Write) permissions, the system administrator should set Windows user permission on either the Tofino Project File (.tpf) or on the folder in which the project file is located. The Eaton Tofino Configurator then limits access to project functionality to View-Only (Read Only) or Configuration (Read/Write) permissions based on these file or folder permissions.

For example, if a user's account is given read-only access to the folder where a project file is stored, then the Eaton Tofino Configurator will also give the user read-only access to project tasks. These settings extend beyond basic file management: they can keep an unauthorized user from loading a new configuration into the Tofino SA.

The file permissions can be set as follows:

- Locate the folder on your computer where the project file (.tpf) resides. This can be on the local computer or a file server.
- Right click the folder or the project file, and select "Properties"
- Navigate to the Security tab.
- Set the advanced permissions for a specific user or group.

Confirm that View-Only users are not included in any Windows permission groups that allow Full Control, Modify, or Write access. Also, check that View- Only users do not have administrative rights in the project or on the computer that would allow them to change either the project file permissions or file locations.

Refer to the Windows documentation for details on setting user permissions.

12.3 Customizing Program Settings and Preferences

The Preferences command allows you to view and edit preferences that are not project specific.

- Open the Preferences menu and click “Preferences.” The Preferences dialog box opens. These are the categories listed in the
 - Audit
 - Help
 - Project
 - Syslog Port

- **Audit Preferences**

The Audit page allows you to set the maximum size of the audit file and specify where it is stored.

- Click “Audit” in the side panel.

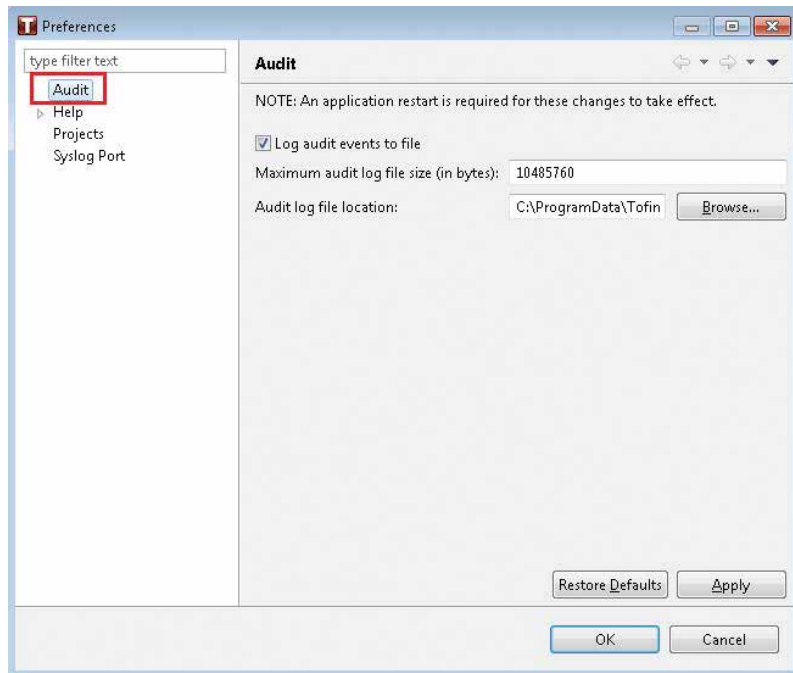


Figure 107: Audit Preferences

- Click the “Log audit events to file” check box to enable logging.
- Specify the maximum size of the log file in bytes.
- Click “Browse...” and select where you want to store the log files.
- Click “Apply” to save the settings.

- **Help Preferences**

The Help page allows you to select how Eaton Tofino Configurator help content is displayed on your computer. For example, you can select whether the help is displayed in a Eaton Tofino Configurator window or in an external browser.

- Click “Help” in the side panel.

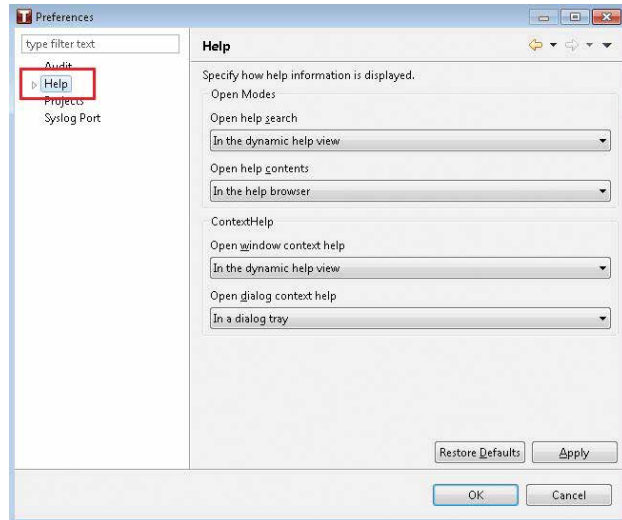


Figure 108: Help preferences

- Select from the lists to indicate how you want to display the help content.
- To save the settings, click “Apply”.

You can also incorporate help topics from remote servers into the local help system.

- Open the “ Help” item in the side panel and click “Content”.

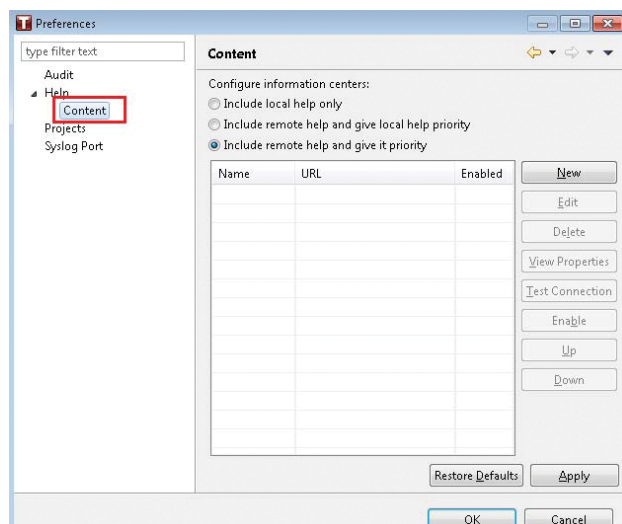


Figure 109: Content preferences

- Configure the remote servers you want to include content from.
- To save the settings, click “Apply”.

- **Project Preferences**

The Projects page allows you to set a default project to open automatically when you start the Eaton Tofino Configurator.

- Click “Projects” in the side panel.

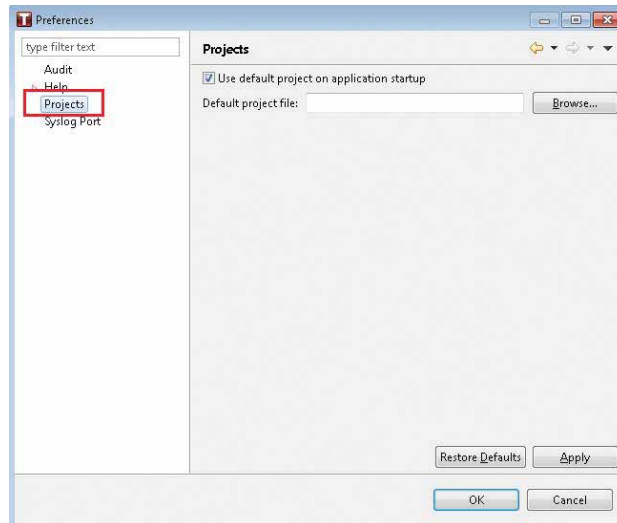


Figure 110: Project preferences

- To enable the default project feature, click the “Use default project on application startup” check box.

NOTE
If a default project is specified but this check box is disabled, the project will not open on start-up.

- Click “Browse”. Locate and select the project you want to open automatically on start-up.
- To save the settings, click “Apply”.

- **Syslog Port Preferences**

The Syslog Port page allows you to make the Syslog port dynamically global in Eaton Tofino Configurator.

All Event Logger Details page for a specific TSA fetches the logs if the port set for TSA matches the port set under global settings.

- Click “Syslog Port” on the side panel.

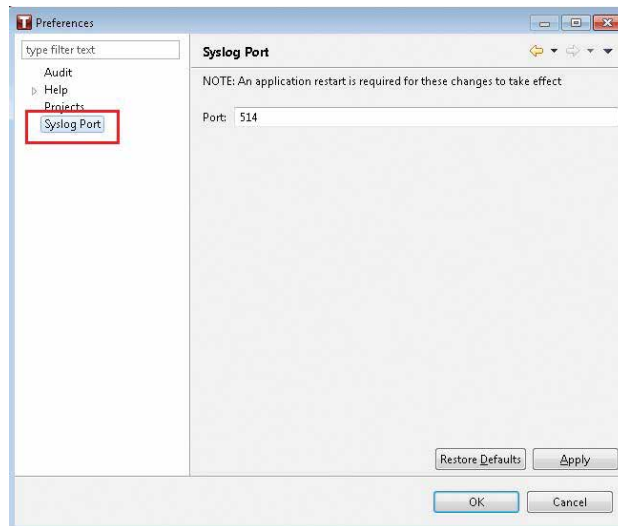


Figure 111: Syslog port preferences

- To set a global syslog port, enter a port number.

NOTE

You need to restart the application for these changes to be effective.

- To save the settings, click “Apply”.

13 **ADVANCED TOPIC: IMPORTING TEMPLATES AND SECURITY PROFILES**

By default, the DNP3 Enforcer allows the object groups mentioned in the IEEE 1815-2012 specification, section 12.2.2 Parsing guideline tables, except for those dealing with security objects mentioned in Table 12-62. This section is for the users who want to disable portions of the specs recommendation or add custom objects.

You can defeat attacks against DNP3 by parsing object information in request and response white lists. This requires a list of valid group/variation/function code/qualifier code combinations and the length of each object.

When verifying a DNP3 object is valid in a particular request/response message, four object parameters must be checked:

- Group
- Variation
- Function code
- Qualifier code

All four must match a definition in the white list for the object to be allowed in a message. Any message with one or more non-allowed objects is dropped. Each of the parameters is specified as follows:

- **Group:** DNP3 objects are divided into groups based on the object's use or type. Examples include: "group 0: device attribute objects" and "group 1: binary input static objects". The group is specified using the group name with value number="n", where n is the group number.
- **Variation:** DNP3 objects are further divided into variations of objects within a group. For objects in group 1, binary inputs, examples include: "variation 1: packed format" and "variation 2: with flags". The list of variations allowed in a group is specified as a list defined inside the body of the group. Variations can either be defined singly using value number="n" or as an interval using values start="s" and end="e", which specifies all variations on the interval [s,e] are allowed.

NOTE
Variation 0 (zero) has a special meaning. In requests it means the outstation can choose the format (variation) for the objects in the response. Responses never contain objects of variation 0. Also, all objects with variation 0 are defined with length="none" (see below).

- **Function code:** For each group and variation combination, an allowed function code(fc) must be defined. The fc appears in the body of the variation. Several values are defined here:
 - The number="n" attribute defines the function code number allowed. This is the only required attribute. Note that if multiple function codes are allowed for a given variation, the style used is to create separate, duplicate variation tags for each separate function code.
 - The name="NAME" attribute defines an optional text name for the function code. This attribute is available to make the XML more readable, and the encoded name may be used in error messages, etc.

The attribute is not used in white list decisions and may include spaces or other special characters.

- The length="l" attribute defines an optional length for the object. It is used in computing object set lengths when parsing objects in messages. The length is a string delimited by double quotes. A complete list of valid length strings is:
 - If no length attribute is given, or "none" is specified, the object values will appear in request/response messages.
 - An integer length encoded as a string, e.g., "4".
 - If the second byte of the object's data contains the length of the remaining portion of the data, this is specified by "byte_2".
 - Packed, single-bit values are padded out to the next byte boundary if the count of values is not a multiple of 8. The length is specified by "Ceiling(N/8)".
 - Packed, double-bit values are padded out to the next byte boundary if the count of values is not a multiple of 4. The length is specified by "Ceiling(N/4)".
 - The variation of the object encodes the length of the object. This is specified by "variation".
 - For objects with qualifier code 5B, the object count is specified by the 1-byte range value. Each object's length is encoded in a 2-byte prefix. This is specified by "QC_5B".
 - Objects with qualifier code 5B as above but with an object count limited to one (1) by the DNP3 specification are treated as a special case. This is specified by "QC_5B_count_1".
- **Qualifier code:** For each group, variation, and function code combination, a list of allowed qualifier codes (qc) must be defined by using a list of one or more qc inside the body of the function code. Each qc is used to define a single allowed qualifier code. The qualifier code is an 8-bit value defining the object prefix code and range specifier code for the object(s) in a DNP3 message.

You can perform these given actions on DNP3 objects present in a DNP3 enforcer:

- "Update DNP3 objects for DNP3 enforcer"
- "Update Request/Response"

13.1 Update DNP3 objects for DNP3 enforcer

You can update the default DNP3 objects for a DNP3 enforcer.

Follow these steps to update DNP3 enforcer:

- In Rule Detail section, click on Enforcer tab.

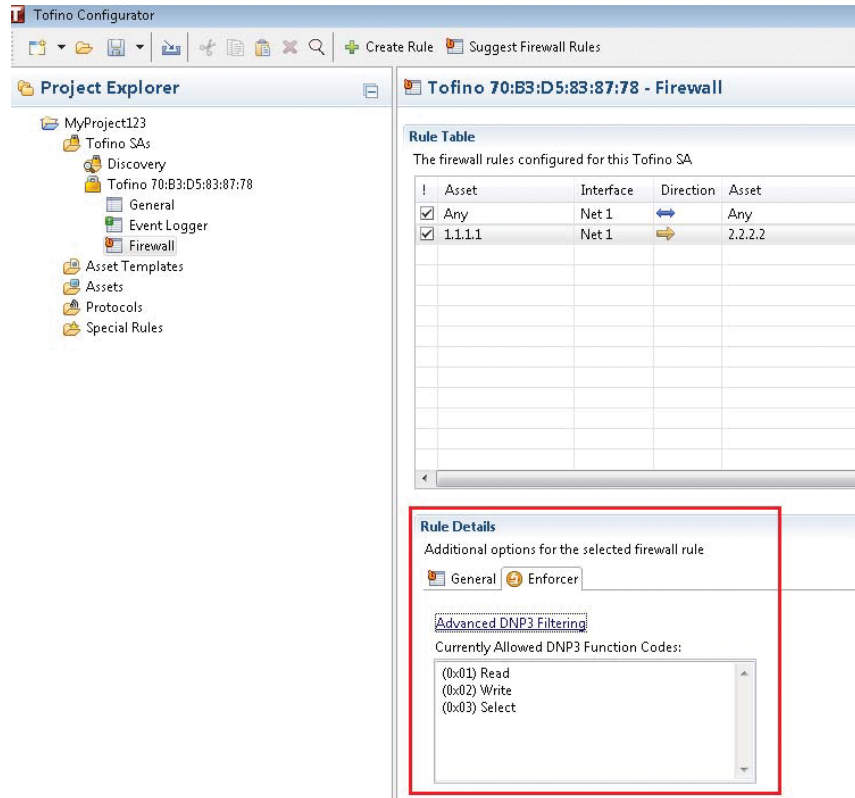


Figure 112: Rule details

- Click on Advanced DNP3 Filtering. The “DNP3 Application Layer Query/Response Function Code Filtering” appears.

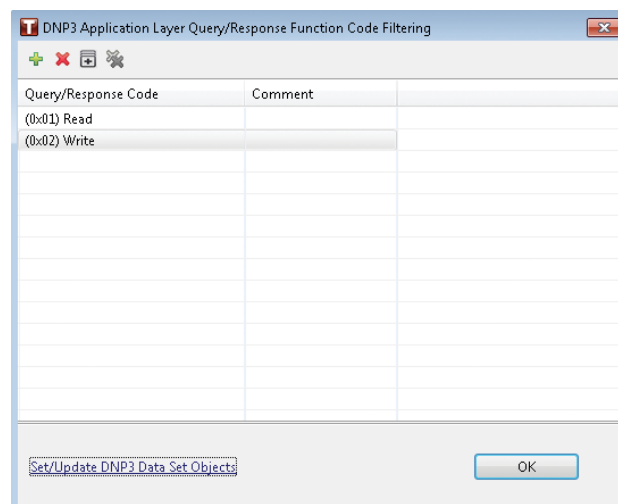


Figure 113: DNP3 Application Layer Query/Response Function Code Filtering

- Click on green + button. The “Add DNP3 Application Query/Response Function Code” dialog box appears.

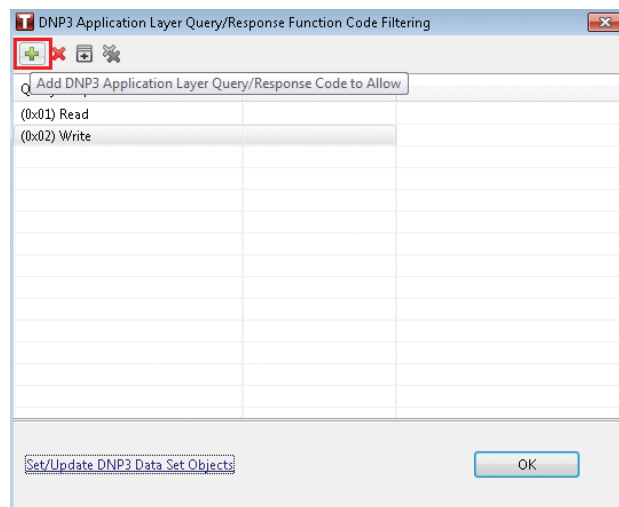


Figure 114: Add DNP3 Application Query/Response Function Code

- Click on “Application Layer Function Code” drop down list.

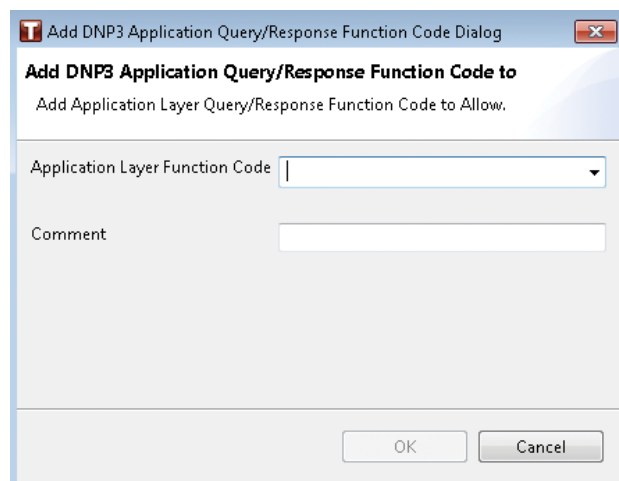


Figure 115: Add DNP3 Application Query/Response Function Code Dialog

- Select the function code you want to add.
- Add comment to this function.
- Click the OK button.

You can see the newly added function in Query/Response Code list.

13.2 Update Request/Response

You can update either Request or Response of a default DNP3 white list.

By updating Request/Response of objects means, you can:

- Add/delete groups from either response or request white lists.
- Add/delete variations from groups.
- Add/delete functions from variations
- Add/delete qualifier codes

13.2.1 Add/delete groups from request/response

You can add a new or delete an existing group for request/response. Eaton Tofino Configurator provides a group number when you create a new group.

To add a new group to either request or response, follow these steps:

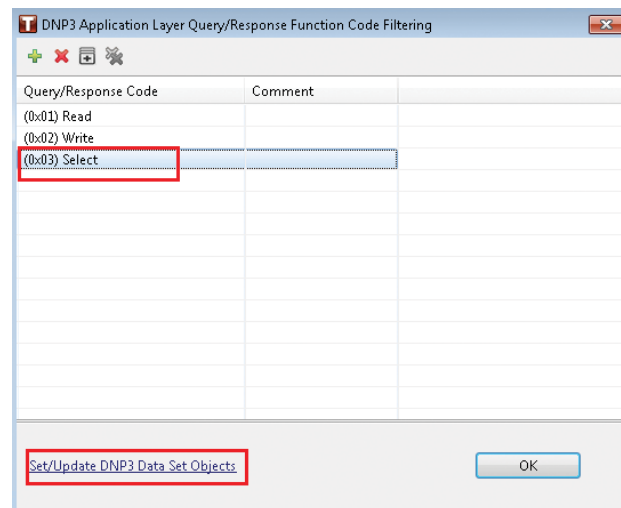


Figure 116: Set/Update DNP3 Data Set Objects

- Select a Query/Response code.
- Click on Set/Update DNP3 Data Set Objects link.
- The Object list appears. Right-click on either Request or Response.

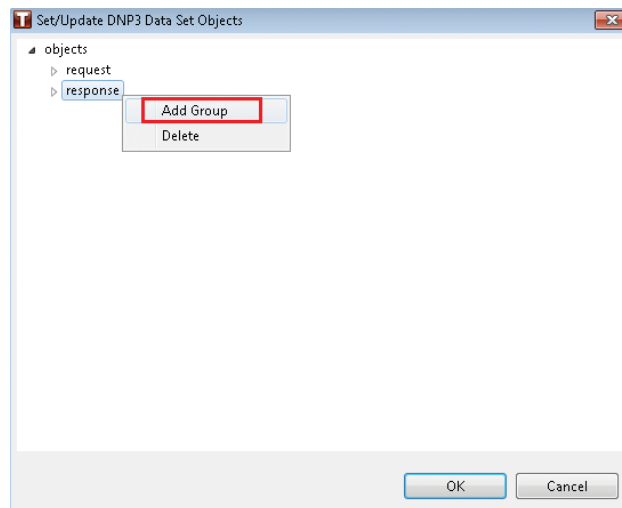


Figure 117: Add Group

- Click on Add Group option. A small window appears.

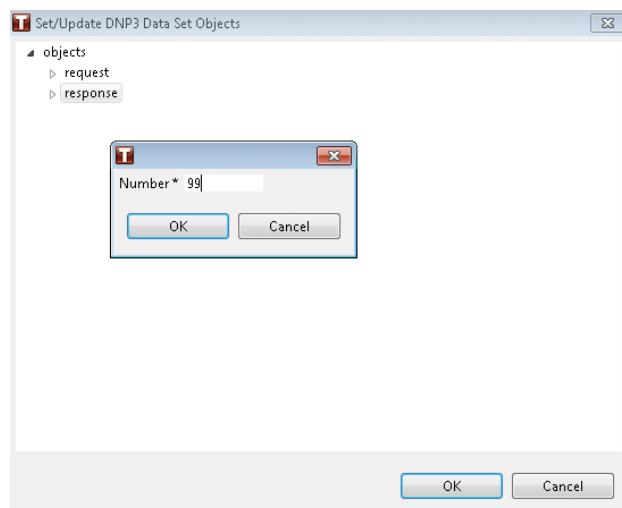


Figure 118: Add group number

- Click on OK button.
- The newly added group is now added to the list.

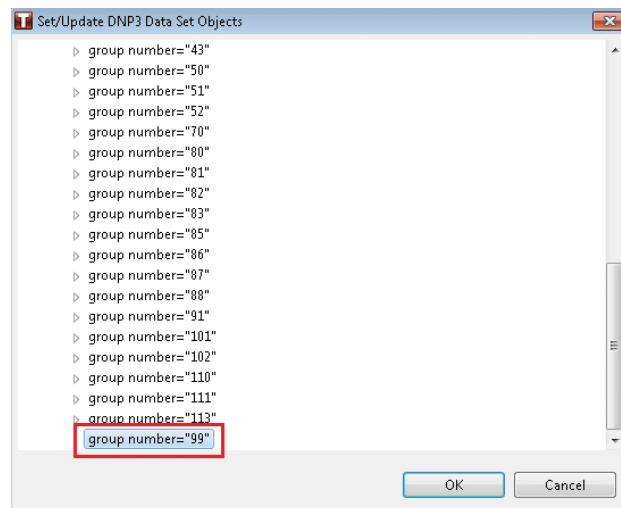


Figure 119: Newly added group

To delete an existing group from request/response, follow these steps:

- Right-click on the group you want to delete.

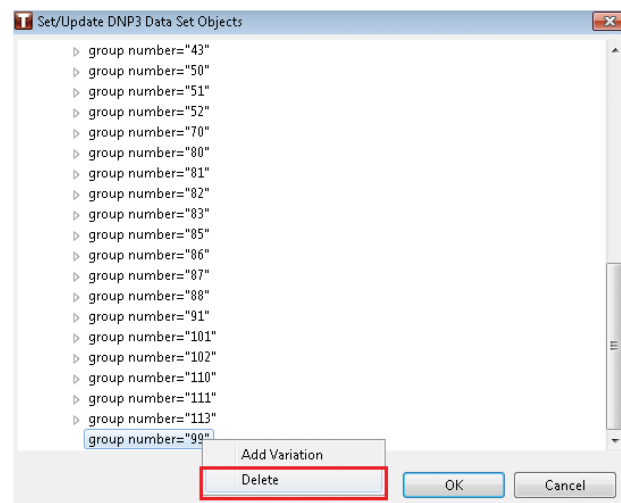


Figure 120: Delete a group

- Click on Delete option. The group is now deleted.

13.2.2 Add/delete variations from groups

You can add a new or delete an existing variations to groups. This variation can be a number or a range of numbers.

To add variations from group(s), follow these steps:

- Right-click on a group in which you want to add variation.

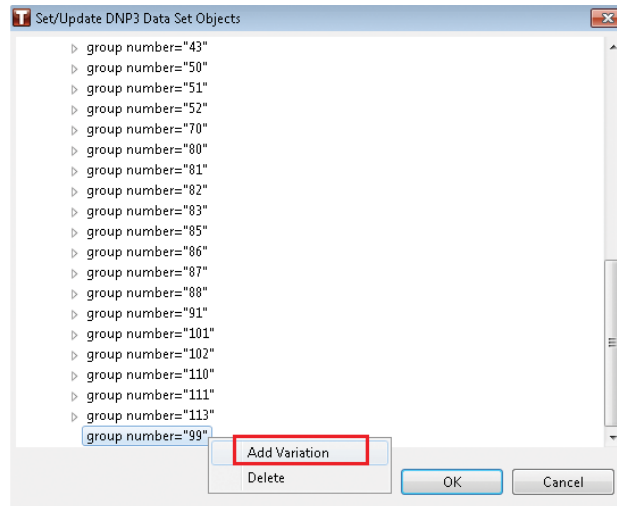


Figure 121: Add variation to a group

- Enter Start and End numbers of variation.

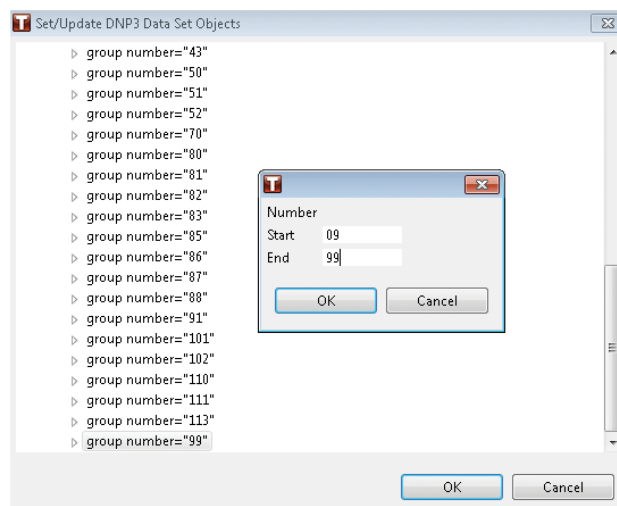


Figure 122: Enter start and end numbers

- Click on OK button. Variation range is added to a group.

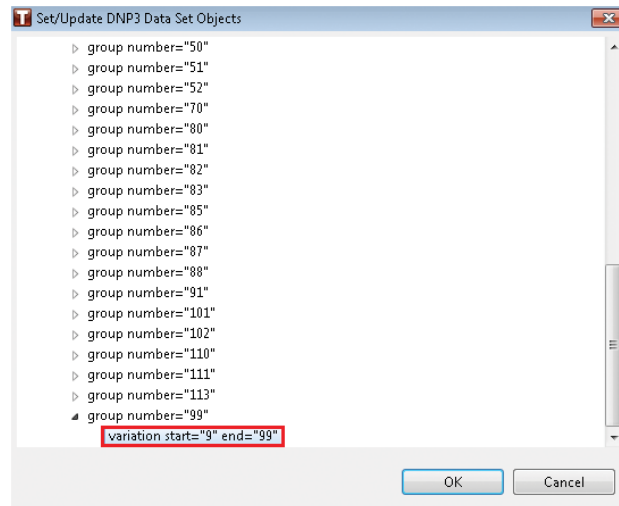


Figure 123: Variation is added to a group

To delete an existing variations from group(s), follow these steps:

- Right-click on a variation you want to delete.

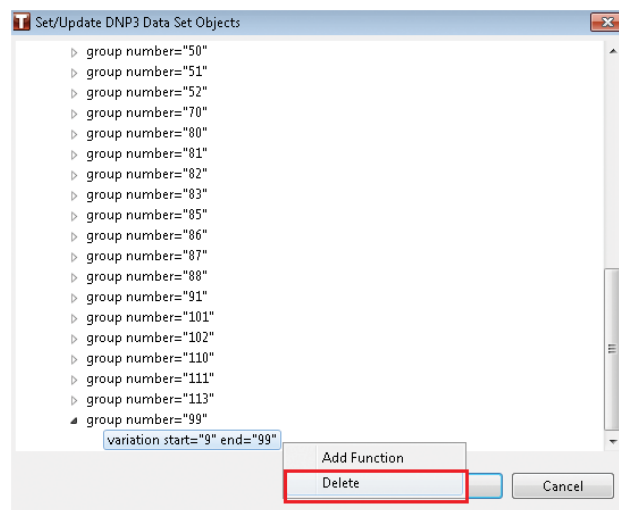


Figure 124: Delete variation

- Select Delete option. The variation is now deleted.

13.2.3 Add/delete function codes for variation

You can add a new or delete an existing functions to variations. These functions are numbers.

To add a new function to variation, follow these steps:

- Right-click on a variation in which you want to add function.

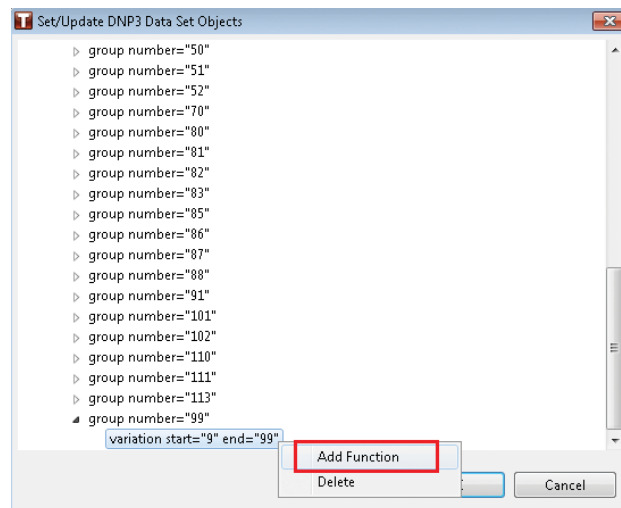


Figure 125: Add function

- Select Add Function option. A small window appears.

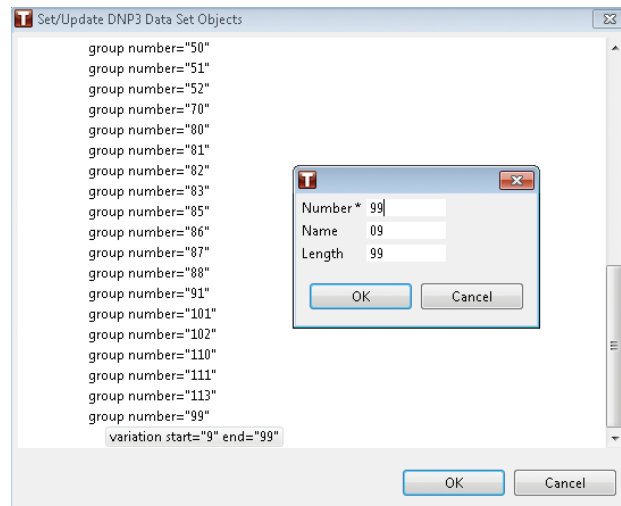


Figure 126: Add function to a variation

- Enter Number, Name and Length of a function.
- Click the OK button. The new function is added to a variation now.

To delete an existing function from variation, you need to go one step up. You delete the variation in order to delete a function associated with that variation.

13.2.4 Add/delete qualifier codes

You can add a new or delete an existing qualifier codes from a function. These qualifier are multiple hexadecimal values.

To add a qualifier code, follow these steps:

- Right-click on a function in which you want to add qualifier.

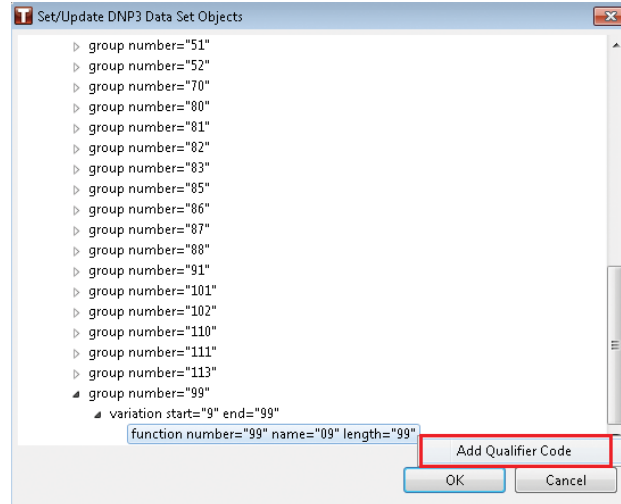


Figure 127: Add qualifier to a function

- A small window appears. Enter qualifier code in it.

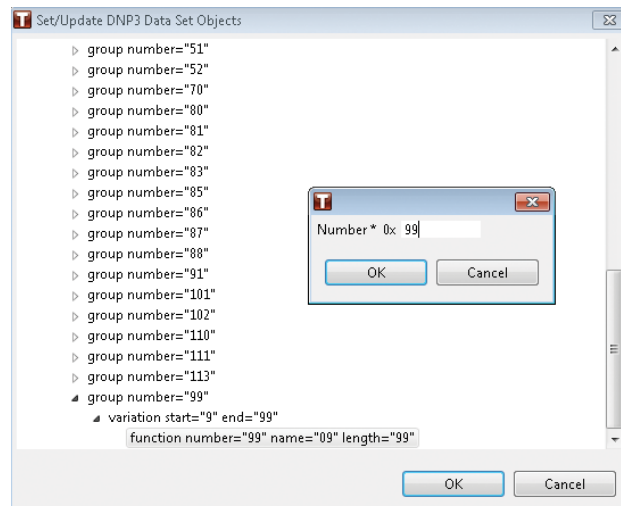


Figure 128: Enter qualifier code

- Click the OK button. The qualifier code is now added to the function.

To delete a qualifier code, follow these steps:

- Right-click on the qualifier you want to delete.

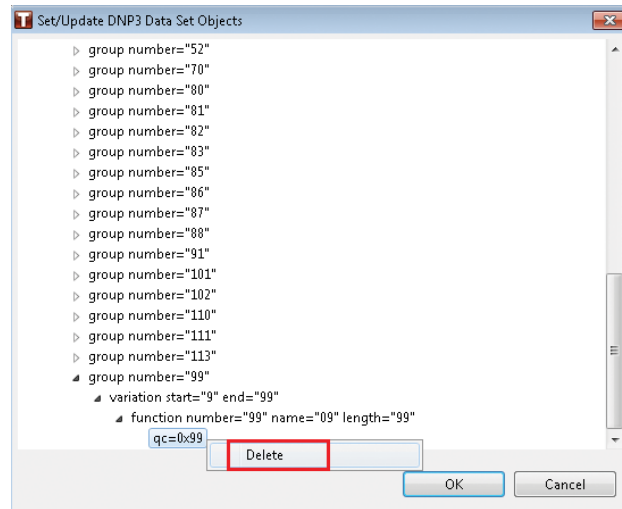


Figure 129: Delete qualifier

- Select the Delete option. The selected qualifier is now deleted.

14 ADVANCED TOPIC: PCAP GENERATION

Tofino SA allows you to collect a Packet CAPture (PCAP) from the Eaton Tofino Configurator. The PCAP file helps you to debug the captured packets on tools like Wireshark.

Follow this instruction of Tofino SA wizard to generate PCAP:

- Select a Tofino SA from which you want to collect PCAP.

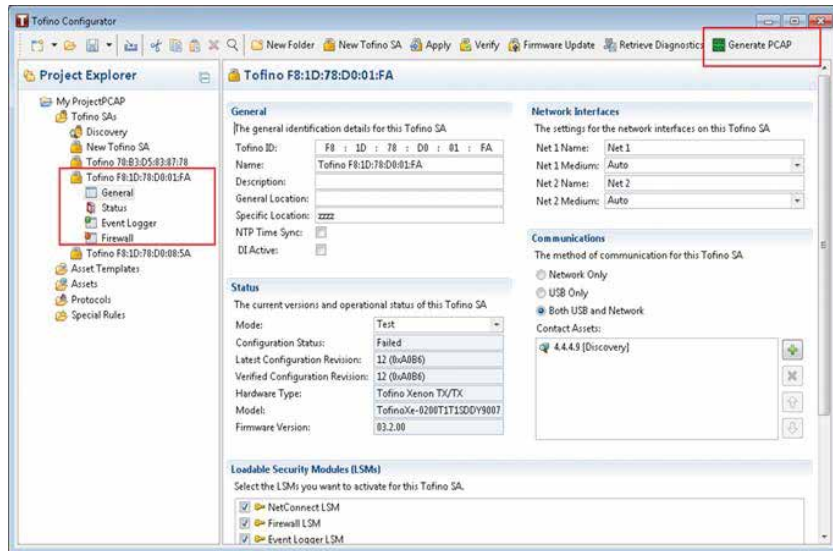


Figure 130: Generate PCAP for a TSA

- Select the Generate PCAP option from top menu bar. You can also right click on General in Project Explorer view and select “Generate PCAP” option.
- The Tofino SA PCAP generation wizard starts.

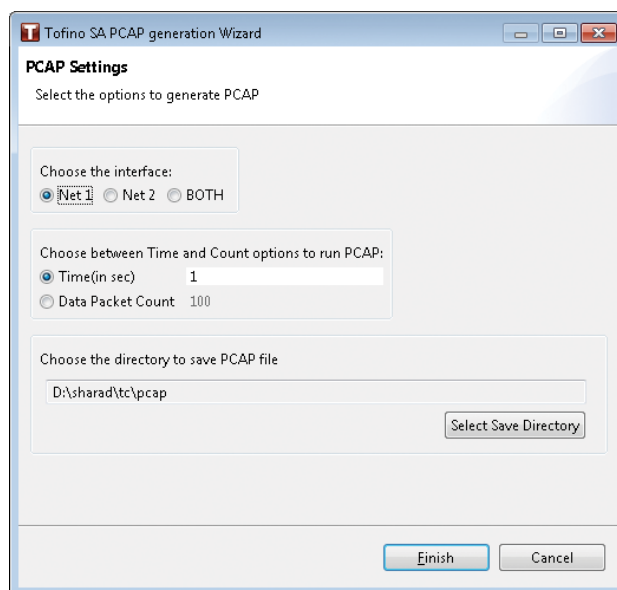


Figure 131: PCAP wizard

Choose the interface for data packet capture: Interface 1, Interface 2 or Both. In the case of "Both" - TC builds a PCAP listed on the bridge interface, in which both Net 1 and Net 2 are a part of. It generates a single file.

Eaton Tofino Configurator allows to capture the packets for TSA either with max number of count (1000) or for a maximum allowed time (300 seconds). TC also has a cap of 1MB file size irrespective of time or counts.

- Click "Finish": TC saves the PCAP file at the desired location. You will be prompted with a dialog box for the confirmation.

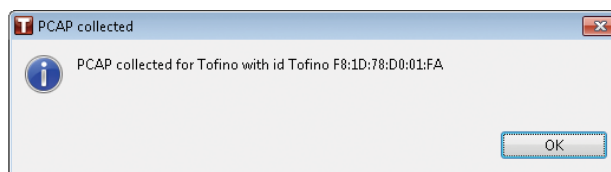


Figure 132: PCAP file confirmation

PCAP generation is a background process and can be collected for multiple TSAs at the same time.

15 TC AND CCM INTEGRATION

Configuration Compliance Manager (CCM) from Tripwire scans to discover and audit system configurations. CCM uses both active and passive scanning. You receive highly detailed information on the configurations of your systems, applications, firewalls, routers and switches.

CCM is integrated with Tofino devices via an interface exposed by Eaton Tofino Configurator (TC). This helps CCM to gather data from Tofino devices. TC then starts an output of data stream. This stream contains the dumped configuration required by the CCM.

The salient features of TC and CCM integration are:

- TC starts in CCM mode - You can start TC in headless mode for CCM with either of these two commands:
 - `Path_of_tofinoConfigurator.exe ccm path_project.tpf`
 - `Path_of_tofinoConfigurator.exe ccm path_project.tpf | more`
- TC started in CCM mode dumps the same configuration for all TSAs that is present in the project file.
- If TC in CCM mode receives an error while connecting to a TSA, it dumps the same error with reason on the output stream and moves onto the next TSA to dump configurations.
- TC throws an error message on the output stream if you receive a corrupt file or wrong/no password is provided.
- The data dumped by TC to read TSA file is in non encrypted form.

16 CONVERTING CMP LICENSE TO A TC LICENSE

Perform the steps below to convert your CMP license to a TC license.

- Export your CMP database and take note of the location you selected where it was saved by CMP.
- Login to the Customer Portal to access the "Import CMP Project" page.
- Click the "Browse" button to locate the CMP Database backup file and click the "Upload" button.

NOTE
New licenses created are part of "ImportCMPDB" project and are attached to a reserved TC LAK. For a CMP license, the number of TC license created are equal to the number of hardware instances attached to the CMP license.

- If the conversion process is successful, you will be redirected to the "Project" tab that shows the created licenses. Otherwise, an error message displays with an error code. Contact the customer support for help to deal with the error.
- Navigate to the "Licenses" tab to check the newly created TC licenses, after a successful license migration.

NOTE
The submitting user is set as the LAK's account activator which is attached to the newly created licenses.

- Navigate to the "Hardware" tab to pair the created licenses to the specific Tofino hardware device.

NOTE
Skip this step if the CMP license creates the hardware during the conversion process.

- Navigate to the "Grant" tab to generate the grants file to import the licenses into your TC.

17 UPGRADING YOUR TOFINO SA

There are two ways to upgrade your Tofino SA device:

- Over the network
- Via encrypted files on a USB storage device

The information you receive with your upgrade will indicate the proper method for your Tofino SA.

To communicate with a Tofino SA over the network, you need a license for the NetConnect Loadable Security Module (LSM), which you activate for the Tofino SA.

To communicate with a Tofino SA over the network, select either “Network Only” or “Both USB and Network” as the communication setting on the General page.

NOTE

You can select multiple Tofino devices to do firmware update in parallel, this process runs in parallel for multiple devices. On completion, a result dialog shows the summary for all failed and successful devices. After Parallel Firmware Update, all successfully devices have the updated Firmware while failed ones stick to the previous version.

17.1 Upgrading over the Network

Perform your Tofino SA upgrade over the network when your device is licensed and activated to use the NetConnect LSM.

Perform your Tofino SA upgrade over the network when your device is configured to use the NetConnect LSM.

- In the Project Explorer view, click “Tofino SAs”
- To open the Tofino SA Update Wizard, click “Firmware Update” in the toolbar.

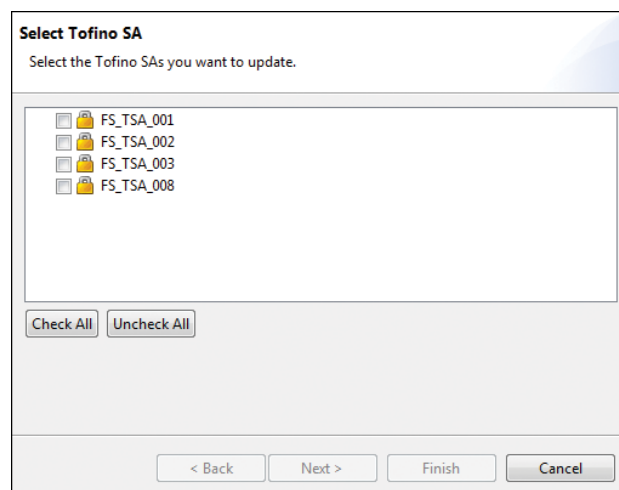


Figure 133: Select Tofino SA

- Select the Tofino SAs that you want to update and click “Next”. Selecting a folder also selects the Tofino SAs within that folder.
- Click “Browse...” Locate and select the .tfo upgrade file provided to you.
- Click “Finish”: The Eaton Tofino Configurator displays a confirmation dialog box.
- To proceed with the update, click “Yes”. The Verification Results dialog box lets you know the verification is complete. It indicates the upgrade was successful or lists any errors detected.
- Click “OK” to close this window.

NOTE

The purpose of firmware updates is to bring previously purchased Tofino SAs to the latest software level. This update does not enable or license new LSMs on Tofino SA hardware. To activate new LSMs, see “Adding LSM Licenses”.

17.2 Upgrading via USB

Upgrade a Tofino SA to the latest software version using the firmware update software downloaded from the Eaton portal on www.tofinosecurity.com. You will use a USB storage device to load these files to the Tofino SA. The USB device needs to be empty before you begin this task.

- Place the upgrade files on a suitable USB storage device.
- Follow the steps described in “Loading Your Tofino SA via USB”.
- Once the USB Load is complete, confirm that it was successful by performing a USB verification as described in “Verifying a Tofino SA Configuration”. The Verification Results dialog box lets you know the verification is complete. It indicates the upgrade was successful or lists any errors detected.
- Click “OK” to close this window.

NOTE

The purpose of firmware updates is to bring previously purchased Tofino SAs to the latest software level. This update does not enable or license new LSMs on Tofino SA hardware. To activate new LSMs, see “Adding LSM Licenses”.

18 REFERENCE: FIELD DESCRIPTIONS

The topics in this section provide detailed field descriptions to help you edit and maintain your project.

18.1 Tofino SA Fields

The screenshot displays the Tofino SA configuration window. The title bar reads 'Tofino 00:50:C2:B3:2B:D2'. The interface is divided into several sections:

- General:** Fields for Tofino ID (00 : 50 : C2 : B3 : 2B : D2), Name (Tofino 00:50:C2:B3:2B:D2), Description, General Location, Specific Location, and NTP Time Sync (unchecked).
- Status:** Fields for Mode (Operational), Configuration Status (Verified), Latest Configuration Revision (6 (0x49A)), Verified Configuration Revision (6 (0x49A)), Hardware Type (Tofino Xenon TX/TX), Model (TofinoXe-0200T1T1SDZ9000ZTAT02.2.00), and Firmware Version (02.2.00).
- Network Interfaces:** Fields for Net 1 Name (Net 1), Net 1 Medium (Auto), Net 2 Name (Net 2), and Net 2 Medium (Auto).
- Communications:** Radio buttons for Network Only, USB Only, and Both USB and Network (selected). A Contact Assets field shows 5.5.5.13 [Discovery].
- Loadable Security Modules (LSMs):** A list of checkboxes for NetConnect LSM, Firewall LSM, Event Logger LSM, Modbus TCP Enforcer LSM, OPC Classic Enforcer LSM, and EtherNet/IP Enforcer LSM, all of which are checked.

Figure 134: Tofino SA fields

General

The General section provides identification information for the selected Tofino SA.

- **Tofino ID:** The ID number found on the right hand side of the Tofino SA's face. This number is used to confirm that the configuration is loaded into the correct Tofino SA.
If you don't know the Tofino ID of your appliance you can enter a temporary ID of 00:00:00:00:00:XX, where XX is any two digit number. This lets you configure the Tofino SA without the actual ID number. However, you will receive a message indicating that you need to enter a correct Tofino ID in order to apply the configuration to a Tofino SA.
- **Tofino ID:** The ID number from the lower front of the Tofino SA's face. This number is used to confirm that the configuration is loaded into the correct Tofino SA. Enter it accurately.
If you don't know the Tofino ID of your appliance you can enter a temporary ID of 00:00:00:00:00:XX, where XX is any two digit number. This lets you configure the Tofino SA without the actual ID number. However, you will receive a message indicating that you need to enter a correct Tofino ID in order to apply the configuration to a Tofino SA.
- **Name:** Insert a name or identifier that uniquely identifies the Tofino SA. (e.g., Jasper Pump Station Tofino or JP-TFN-001). Each Tofino SA needs to have a unique name for clarity and ease of deployment.
- **Description:** A text field that can be used to describe the function of this Tofino SA.
- **General Location:** A text field for reference.
- **Specific Location:** A text field for reference.

- **NTP Time Sync:** A check box indicating the Tofino SA uses Network Time Protocol messages to calibrate its internal clock. When selected, the Tofino SA intercepts NTP packets that pass through it and calibrate its clock to the information in the packet. This applies a more accurate timestamp to the messages in log files. When not selected, the Tofino SA time is set when information is loaded to the appliance via a USB device or over the network.

Network Interfaces

The Network Interfaces section displays the network interface settings for the selected Tofino SA.

- **Net 1 Name:** A name or identifier that describes the upper Ethernet port on the Tofino SA. For example, you could name it after the network it connects to (such as Business Network) or it could be named by function (such as Untrusted).
- **Net 1 Medium:** This sets the interface settings on the upper Ethernet port. The Tofino SA supports auto-negotiation of both Ethernet ports, meaning the Tofino SA's connection and transmission parameters are negotiated automatically with the switch or device it is attached to. Depending on the media type in the Tofino SA, you can manually set the Ethernet ports to the following:
 - Auto (auto-negotiate)
 - 10baseT-HD (Twisted pair, 10 Mb/s, half duplex)
 - 10baseT-FD (Twisted pair, 10 Mb/s, full duplex)
 - 100baseTX-HD (Twisted pair, 100 Mb/s, half duplex)
 - 100baseTX-FD (Twisted pair, 100 Mb/s, full duplex)

The default value is Auto.

- **Net 2 Name:** A name or identifier that describes the lower Ethernet port on the Tofino SA. For example, you could name it after the network it connects to (such as Control Network) or you could name it by function (such as Trusted).
- **Net 2 Medium:** This sets the interface settings on the lower Ethernet port. The Tofino SA supports auto-negotiation of both Ethernet ports, meaning the Tofino SA's connection and transmission parameters are negotiated automatically with the switch or device it is attached to. Depending on the media type, you can also manually set the Ethernet ports to:
 - Auto (auto-negotiate)
 - 10baseT-HD (Twisted pair, 10 Mb/s, half duplex)
 - 10baseT-FD (Twisted pair, 10 Mb/s, full duplex)
 - 100baseTX-HD (Twisted pair, 100 Mb/s, half duplex)
 - 100baseTX-FD (Twisted pair, 100 Mb/s, full duplex)

The default value is Auto.

Status

The Status section provides status and version information for the selected Tofino SA.

- Mode: You can set the Tofino SA to one of two modes:
 - Test: The Tofino SA is fully functional and processes traffic but will not drop any network traffic. You can use this mode to test if the Tofino SA is correctly configured before you use it to filter control system traffic.
For more information on using Test mode, see “Using Tofino Test Mode to Validate Firewall Rules.”
 - Operational: The Tofino SA provides full-packet processing and protection.
- Configuration Status: This is the current status of the actual Tofino SA in the field, as determined by the last verification:
 - Unconfigured: The configuration has either not been loaded onto the Tofino SA or has not been verified.
 - Verified: A configuration was successfully loaded onto the Tofino SA and the Verify command was run to read the results back into Eaton Tofino Configurator.
 - Failed: The last attempt to apply a configuration to this Tofino SA was unsuccessful.
- Latest Configuration Revision: The number of the current version of this Tofino SA's configuration in this project file, along with a specially calculated hash code to reduce the chance of accidental duplication of revision numbers. The configuration revision number is incremented each time you modify the settings of the Tofino SA and the project is saved. This is calculated separately from the Project Revision number by the Eaton Tofino Configurator.
- Verified Configuration Revision: The number of the last version of this Tofino SA's configuration. This value is returned from the Tofino SA when you verify its configuration. There is also a specially calculated hash code to reduce the chance of accidental duplication of revision numbers. If the Verified Configuration Revision is different than the Latest Configuration Revision, then the Tofino SA in the field may contain an outdated configuration.
- Hardware Type: This field is updated by the Verify command based on the Tofino type reported by the Tofino SA.
- Model: This field is updated by the Verify command based on the model reported by the Tofino SA
- Firmware Version: This field is updated by the Verify command based on the firmware version reported by the Tofino SA.

Communications

The Communications section displays the chosen method of communication for the selected Tofino SA.

- You can specify whether you want to transfer configuration data to the Tofino SA device over the network or with a USB device. If you do not have a license for the NetConnect LSM, choose “USB Only”.
You can specify whether you want to transfer configuration data to the Tofino SA device over the network or with a USB device.

- The Contact Assets list displays the assets the Eaton Tofino Configurator will use to communicate with the Tofino SA in the field. A Tofino SA doesn't have its own IP address. The Eaton Tofino Configurator uses a contact asset's address in order to contact and communicate with (send packets to) the Tofino SA. This does not impact the other devices on the network, but it makes the Tofino SA almost impossible for hackers to detect. You manually specify the contact devices for each Tofino SA.

You can define multiple contact assets for a Tofino SA. You can select any device or IP address in the network as a contact device. However, for successful communication, the contact device must be on the other side of the Tofino SA from the Eaton Tofino Configurator.

NOTE

If your Eaton Tofino Configurator is installed on a laptop that will be moved between various locations, select contact assets on opposite sides of the Tofino SA. This gives you a valid path for communicating between the Eaton Tofino Configurator and the Tofino SA, regardless of where you are on the network. Managed switches make great contact assets.

Each Tofino SA in your project maintains a list of contact assets. These assets can be one of three types:

- The IP address of a contact asset found with the Discovery function
- A specific IP address
- An existing asset

You can add any number of assets to this list but at least one needs to be on the other side of the Tofino SA from the Eaton Tofino Configurator. The Eaton Tofino Configurator will attempt to establish communication with the Tofino SA using the first asset in the list and then move onto the next until a successful connection is established. Use the arrow buttons to the right of the list to reorder the assets to make the connection process faster.

The Eaton Tofino Configurator may be located anywhere in the network, as long as it is able to communicate with the Tofino SAs that it manages. If any routers or firewalls are located between the Eaton Tofino Configurator and a Tofino SA in the network, then configure each router/firewall device to allow the Eaton Tofino Configurator traffic to pass through these devices.

The Eaton Tofino Configurator uses both TCP and UDP traffic to manage Tofino SAs. There are three types and directions of traffic that pass between the Eaton Tofino Configurator and Tofino SAs:

- TCP Port 6689: Eaton Tofino Configurator to Tofino SA
- UDP Port 6689: Eaton Tofino Configurator to Tofino SA
- UDP Port 6689: Tofino SA to Eaton Tofino Configurator

Loadable Security Modules (LSMs)

The Loadable Security Modules (LSMs) section displays the LSMs active for the selected Tofino SA.

- A key icon to the left of the LSM indicates that the Tofino SA is licensed to use that LSM. The check box to the left of the LSM indicates that this LSM has been activated. If you activate an LSM that is not licensed, you can configure the features associated with this (unlicensed) LSM. However, if you do this, you need to purchase a license for that LSM to successfully apply the Tofino SA configuration to the Tofino SA device.

18.2 Asset and Asset Template Fields

The screenshot shows a configuration window for an asset named 'FS_HMI_001'. It is divided into three main sections: General, Communications, and Rule Profiles.

General
The general settings for this asset

Name: FS_HMI_001
Type: Computer
Description: Main Pump Station HMI #1
Manufacturer: Schneider
Model: CitectSCADA
General Location: Main Pump Station Control Room
Specific Location: Right Desk
Asset Tag: 675849-23

Communications
The communication settings for this asset

IP Address: 192 . 168 . 1 . 15
Subnet Mask: 255 . 255 . 255 . 0
MAC Address: 00 : 00 : 00 : 00 : 00 : 00

Rule Profiles
The rule profiles associated with this asset

Protocol	Type	Server	Client	Permission	Log	Details	Description
MODBUS/TCP	Standard	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/> Allow	<input type="checkbox"/>		
DHCP/BOOTP	Standard	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/> Allow	<input type="checkbox"/>		
ICMP Ping Only	Standard	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/> Allow	<input type="checkbox"/>		
HTTP	Standard	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/> Allow	<input type="checkbox"/>		

Buttons: + Add Rule Profile... X

Figure 135: Asset template fields

General

The General section contains the basic settings for an asset.

- Name: The name or identifier that uniquely identifies the asset. (e.g., Jasper Pump Station PLC or JP-PLC-001). Each asset needs to have a unique name to avoid confusion.
- Type: The asset type. Asset types include:
 - Computer
 - Controller
 - Device
 - Network
 - Network Equipment
 - Broadcast
 - Multicast
- Description: A text field describing the function of this asset.
- Manufacturer: The make or company that manufactured or sold this asset (e.g., Schneider Electric).
- Model: The model of this asset (e.g., Quantum).
- General Location: A text field for reference.
- Specific Location: A text field for reference.
- Asset Tag: A user-defined field for corporate asset tags.

Communications

The Communications section contains the settings related to the Tofino SA's communication settings.

- **IP Address:** This is the IP address of the asset. In order for the firewall rules to operate properly, check that the address is correct.
- **Subnet Mask:** The subnet mask is used by the Tofino SA in conjunction with the IP address to identify the computers or devices that are part of a local or subnetwork. A subnet mask is a 32-bit number that is notated by using four numbers from 0 to 255, separated by periods. Typically subnet masks use either 255 or 0 for each number (such as 255.255.255.0) but other numbers can appear in special cases.
- **MAC Address:** This is the Ethernet MAC or physical address of the asset. This is an optional field so can be left blank. However, if you are creating rules for non-IP protocols, such as GOOSE, then enter a MAC address.

Rule Profiles

When you create an asset you can also specify the protocols that this asset typically uses, along with how you want those protocols managed. For example, you can specify whether the asset uses a protocol as a client (i.e., it initiates the communications) or as a server (i.e., it responds to requests from clients). The New Firewall Rule Wizard can use this information to automatically create rules for the asset. For more information on how rule profiles are used in automatic rule generation see.

The Rule Profiles section contains a table that lists the rule profiles associated with an asset. You can set the following options for any rule profile.

- **Protocol:** A list of protocols that this asset can use for network communications.

NOTE
If you select an application layer protocol, such as Modbus or HTTP, lower layer protocols (such as EtherNet, TCP, and IP) are automatically included.

- **Type:** The type of protocol:
 - Standard firewall rules are designed to allow or deny specific protocols passing through the firewall.
 - Special Rules are highly complex rules that go beyond simple allow or deny. For more information see "Creating Firewall Rules".
- **Server:** Selecting this check box indicates that the asset acts as a server and responds to requests from clients. For example, a web server or a Modbus slave device (such as a PLC) would be selected as a server.
- **Client:** Selecting this check box indicates that the asset acts as a client and initiates requests to servers. For example, a web browser or a Modbus client device (such as an HMI) would be selected as a client. Protocols can be set as both client and server on an asset if appropriate. For example, a computer may contain both web server software and web browser software and thus could be designated as both an HTTP client and an HTTP server.

- **Permission:** What the firewall does with a packet based on the defined rules. There are three options:
 - **Allow:** The Tofino SA will allow traffic matching the rule to pass.
 - **Deny:** The Tofino SA will stop traffic matching the rule from passing.
 - **Enforcer:** The Tofino SA will further inspect and filter the traffic using Deep Packet Inspection settings. This option is available for protocols such as Modbus, EtherNet/IP and OPC Classic that have Enforcer LSMs installed.
- **Log:** A check box for setting logging on the rule.

NOTE
<p>By default, the Tofino SA will log denied packets that do not match any of the rules in the firewall table. Similarly, if you check the Log option on a rule (the permission may be Allow or Deny), packets matching the rule will be logged. Conversely, if you uncheck the Log option on a rule, no log events will be created for packets matching this rule. A common use for this option is to help stop nuisance alarms when blocking broadcast traffic.</p>

- **Details:** A short form summary of special rule profile details, such as RO for Modbus Read-Only.
- **Description:** This field is available as a convenience so the controls engineer can add a comment about the rule profiles.

19 TROUBLESHOOTING

The topics in the Troubleshooting chapter address common questions that may arise while using the Eaton Tofino Configurator.

19.1 Tofino SA Diagnostics

The Tofino SA has the capability to save diagnostics files to a USB storage device for troubleshooting purposes. You can view these files with a standard text editor or send them to technical support for analysis.

To create these files you need to perform a USB Save.

- Power on the Tofino SA for at least one minute.
- Insert the USB storage device into the USB port.
- Press the Save Load Reset button once. The Save/Load LED will illuminate in green. After a few seconds the Mode, Save/Load, and Reset LEDs will flash in green in a left to right sequence to indicate the USB Save is in progress.
- When the flashing sequence stops, remove the USB storage device.
- If the save was successful the Tofino SA LEDs will revert to the state they were in prior to the saving action.
- Send copies of these files to technical support for analysis.

NOTE

The ACA22-USB storage device has been tested by Tofino and is therefore recommended. For ordering ACA22-USB, see "Accessories" in the Installation Guide.

The following version 2.0 USB storage devices are known to work: Kingston Data Traveler, SanDisk Cruzer, Sony Microvault, Lexar, and Hirschmann ACA21-USB. Other brands and models may work, but have not been tested. Only USB devices formatted as FAT or FAT32 are compatible. The Tofino SA Fault LED will flash twice when it detects an invalid storage device.

- **Interpreting Diagnostics Files**

If the USB Diagnostics Save is successful there will be files on the USB storage device similar to this (<tofino id> is replaced with the actual ID of the Tofino SA):

- <tofino id>_tc_data
Verification data indicating if the configuration was successful or not (see "Verifying a Tofino SA Configuration" on page 98)
- <tofino id>_diagnostics.txt
Diagnostics information on the Tofino SA
- eventlogger_<tofino id>.zip and eventlogger_<tofino id>.X.zip
Event logs from the Tofino SA in a compressed file (see "Setting up the Event Logger" on page 86)
- <tofino id>_kernel_evt.enc
Encrypted kernel diagnostics information (solely for factory troubleshooting use)
- <tofino id>_diagnostics.enc
Encrypted module diagnostics information (solely for factory troubleshooting use)
- <tofino id>_configuration.txt
Configuration data listing the LSMs licensed for this Tofino SA I

f you examine the file ending in .txt using a standard text editor, such as WordPad, you should see something like the following:

```
=====
2  Tofino Version information:
3    Tofino Firmware version: Tofino Linux: 1.7.0
4  Tofino Hardware Info:
5    Hardware : Hirschmann EAGLE20 Development Platform
6    Processor : XScale-IXP42x Family rev 2 (v5b)
7    Flash Type: P-Flash
8    Tofino ID: 00:80:63:73:77:649
=====
10 Network Statistics
11   unsecured IF ifconfig
12 eth0      Link encap:Ethernet  HWaddr 00:80:63:73:77:64
13           inet6 addr: fe80::280:66ff:fe04:652c/64 Scope:Link
14           UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
15           RX packets:2776 errors:0 dropped:0 overruns:0 frame:0
16           TX packets:3900 errors:0 dropped:0 overruns:0 carrier:0
17           collisions:0 txqueuelen:100
18           RX bytes:419084 (409.2 KiB)  TX bytes:586268 (572.5 KiB)
19
20   secured IF ifconfig
21 eth1      Link encap:Ethernet  HWaddr 00:80:63:73:77:65
22           inet6 addr: fe80::280:66ff:fe04:652d/64 Scope:Link
23           UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
24           RX packets:15 errors:0 dropped:0 overruns:0 frame:0
25           TX packets:716 errors:0 dropped:0 overruns:0 carrier:0
26           collisions:0 txqueuelen:100
27           RX bytes:846 (846.0 B)  TX bytes:95002 (92.7 KiB)
28
29   unsecured IF Settings
30 Basic registers of MII PHY #0: 1000 782d 0013 7a11 01e1 45e1
31 0005 6001.
32 The autonegotiated capability is 01e0.
33 The autonegotiated media type is 100baseTx-FD.
34 Basic mode control register 0x1000: Auto-negotiation enabled.
35 You have link beat, and everything is working OK.
36 Your link partner advertised 45e1: Flow-control 100baseTx-FD
37 100baseTx 10baseT-FD 10baseT, w/ 802.3X flow control.
38 End of basic transceiver information.
39
40   secured IF Settings
41 Basic registers of MII PHY #1: 1000 782d 0013 7a11 01e1 45e1 0005
42 6001.
43 The autonegotiated capability is 01e0.
44 The autonegotiated media type is 100baseTx-FD.
45 Basic mode control register 0x1000: Auto-negotiation enabled.
46 You have link beat, and everything is working OK.
47 Your link partner advertised 45e1: Flow-control 100baseTx-FD
48 100baseTx 10baseT-FD 10baseT, w/ 802.3X flow control.
49 End of basic transceiver information.
50
=====
48 Memory
49      total      used      free      shared      buffers      cached
50 Mem:    62952    17952    45000         0        140        9060
51 -/+ buffers/cache:    8752    54200
52 Swap:      0         0         0
53 -----
54 MemTotal:    62952 kB
55 MemFree:    44992 kB
56 Buffers:      140 kB
57 Cached:     9060 kB
58 SwapCached:    0 kB
59 Active:     9288 kB
60 Inactive:    1996 kB
```

```

61 SwapTotal:      0 kB
62 SwapFree:       0 kB
63 Dirty:          0 kB
64 Writeback:      0 kB
65 AnonPages:      2100 kB
66 Mapped:         1744 kB
67 Slab:           3176 kB
68 SReclaimable:   752 kB
69 SUnreclaim:     2424 kB
70 PageTables:     260 kB
71 NFS_Unstable:   0 kB
72 Bounce:         0 kB
73 WritebackTmp:   0 kB
74 CommitLimit:    31476 kB
75 Committed_AS:   5200 kB
76 VmallocTotal:   958464 kB
77 VmallocUsed:    33436 kB
78 VmallocChunk:   917500 kB
79

```

```

=====
80 Flash
81 Filesystem      Size      Used Available Use% Mounted on
82 rootfs          31.5M      8.1M      23.4M  26% /
83
=====

```

```

=====
Tofino Version information:
Tofino Firmware version: Tofino Linux: 01.7.01
Tofino Hardware Info:
Hardware : Schneider Connexium Development Platform
Processor : XScale-IXP42x Family rev 2 (v5b)
Firmware Revision Number: r10440
Tofino ID: 00:80:63:B3:20:08
=====
Network Statistics
Port 1 - IF ifconfig
eth0 Link encap:Ethernet Hwaddr 00:80:63:B3:20:08
      UP BROADCAST MULTICAST MTU:1500 Metric:1
      RX packets:0 errors:0 dropped:0 overruns:0 frame:0
      TX packets:0 errors:0 dropped:0 overruns:0 carrier:0
      collisions:0 txqueuelen:100
      RX bytes:0 (0.0 B) TX bytes:0 (0.0 B)

Port 2 - IF ifconfig
eth1 Link encap:Ethernet Hwaddr 00:80:63:B3:20:09
      UP BROADCAST MULTICAST MTU:1500 Metric:1
      RX packets:0 errors:0 dropped:0 overruns:0 frame:0
      TX packets:0 errors:0 dropped:0 overruns:0 carrier:0
      collisions:0 txqueuelen:100
      RX bytes:0 (0.0 B) TX bytes:0 (0.0 B)

Port 1 - IF Settings
Basic registers of MII PHY #0: 1000 7809 0040 61e4 01e1 0000 0004 2001.
Basic mode control register 0x1000: Auto-negotiation enabled.
Basic mode status register 0x7809 ... 7809.
Link status: not established.
End of basic transceiver information.

Port 2 - IF Settings
Basic registers of MII PHY #1: 1000 7809 0040 61e4 01e1 0000 0004 2001.
Basic mode control register 0x1000: Auto-negotiation enabled.
Basic mode status register 0x7809 ... 7809.
Link status: not established.
End of basic transceiver information.
=====
Memory
=====


|                    | total | used  | free  | shared | buffers | cached |
|--------------------|-------|-------|-------|--------|---------|--------|
| Mem:               | 63008 | 21312 | 41696 | 0      | 3840    | 7772   |
| -/+ buffers/cache: |       | 9700  | 53308 |        |         |        |
| Swap:              | 0     | 0     | 0     |        |         |        |


=====
MemTotal: 63008 kB
MemFree: 41704 kB
Buffers: 3840 kB
Cached: 7772 kB
SwapCached: 0 kB
Active: 11116 kB
Inactive: 3172 kB
SwapTotal: 0 kB
SwapFree: 0 kB
Dirty: 4 kB
Writeback: 0 kB
AnonPages: 2692 kB
Mapped: 1724 kB
Slab: 3656 kB
SReclaimable: 1504 kB
SUnreclaim: 2152 kB
PageTables: 320 kB
NFS_Unstable: 0 kB
Bounce: 0 kB
WritebackTmp: 0 kB
CommitLimit: 31504 kB
Committed_AS: 6064 kB
VmallocTotal: 958464 kB

```

The files ending in .enc are encrypted files and should be sent to product technical support.

The eventlogger_<tofino id>.zip and eventlogger_<tofino id>.X.zip files are compressed files that contain log files created by the Event Logger LSM. After you extract the log files you can open and view them with any event management system or text editor.

19.2 Firewall Not Blocking Traffic

If the Tofino Firewall LSM does not appear to be blocking traffic that you think it should, first check the following:

- The Tofino Firewall LSM status (Is the Firewall LSM activated?)
See “Editing a Tofino SA” on page 25.
- The mode of the Tofino SA (Is the Tofino SA in Operational mode?)
The Tofino SA's Mode LED should be on steady.
- Does the configuration of the Tofino SA really match what is stored on the Eaton Tofino Configurator?
If in doubt, verify the Tofino SA configuration (see “Verifying a Tofino SA Configuration” on page 98).

Next, check the rules on the Tofino SA's firewall details view for the following (see “Editing Firewall Rules” on page 74)

- Are the device IP addresses correct?
- Are the protocols and direction correct?
- Are there conflicting rules? For example, does the Tofino SA have an Allow All rule as well as a protocol-specific rule?
- Was the connection between devices established before the rule was loaded? The Tofino SA will not break established connections between two devices. If you think the connection was made before the rule was loaded, try breaking the connection by restarting one of the devices.

19.3 USB Storage Device Recommendations

If you are experiencing difficulties doing USB Loads or USB Saves, check to see if you are using a version 2.0 USB storage device. USB storage devices that are version 1.1 are not compatible and will not work with the Tofino SA. The Tofino SA Fault LED will flash twice (indicating invalid USB storage device), if it detects a version 1.1 USB storage device.

The ACA22-USB storage device has been tested by Tofino and is therefore recommended. For ordering ACA22-USB, see "Accessories" in the Installation Guide.

The following version 2.0 USB storage devices are known to work: Kingston Data Traveler, SanDisk Cruzer, Sony Microvault, Lexar, and Hirschmann ACA21-USB. Other brands and models may work, but have not been tested.

Only USB devices formatted as FAT or FAT32 are compatible.

No. of Flashes	During Load Sequence	During Save Sequence
1	The USB port is disabled Check the Communications setting on the General page. The method of communication should be "USB Only" or "Both USB and Network."	
2	No USB memory device is connected to the USB connection, or the file system of the memory device is not formatted as FAT or FAT32.	No USB memory device is connected to the USB connection, or the file system of the memory device is not formatted as FAT or FAT32.
3	The files on the USB memory device are invalid.	The device was unable to create any diagnostic files. Please contact your technical support.
4	The device was unable to encrypt the configuration files. It is possible that the files were damaged during the copying operation. Repeat the copying operation. If the condition persists, please contact your technical support.	The device was unable to encrypt the diagnostic files. Please contact your technical support.
5	The device was unable to load the files. It is possible that the files were damaged during the copying operation. Repeat the copying operation. If the condition persists, please contact your technical support.	The device was unable to copy the encrypted diagnostic files to the USB memory device. It is possible that the memory device is full.
6	The device was unable to deactivate the USB connection. Please contact your technical support.	The device was unable to deactivate the USB connection. Please contact your technical support.
7		The file system of the device does not have enough memory capacity to save the files temporarily before they are copied to the USB memory device. Please contact your technical support.

Table 6: Fault LED Activity During Load/Save

19.4 Factory Resetting Your Tofino SA

To reset the Tofino SA back to its default state as shipped from the factory, you can perform a Factory Reset.

- Confirm that power is applied to the Tofino SA and it has completed its start-up initialization.
- Press and release the Save Load Reset button 3 times. On the first press the Save/Load LED illuminates in green; on the second press the Save/Load LED illuminates in yellow; and on the third press the Reset LED illuminates in yellow with the Save/Load LED off. After a few seconds the Mode, Save/Load, Reset, and Fault LEDs flash simultaneously while the factory reset is being performed.

Once the factory reset is complete, the LEDs will turn off. This indicates that the Tofino SA is passive and passing traffic without filtering.

If the Mode LED is green, either flashing or solid, repeat this task. If the LEDs are different than described in this task, contact technical support.

19.5 Special Rules

Special Rules are complex rules that go beyond allow or deny. For example, a Special Rule could be used to block a subset of a particular type of traffic. They often have specific permission, protocol, and direction attributes embedded within them. You can view the available Special Rules in the “Special Rules” folder in the Project Explorer view. You use special rules solely in exceptional cases.

19.5.1 Tofino Rapid Network Recovery

Tofino Security Appliances are often utilized in networks that have high availability requirements. Therefore, these networks use redundancy protocols—such as the RSTP (Rapid Spanning Tree Protocol) or other comparable protocols—to achieve redundant connections. Many of these protocols detect device or media errors based on the loss of the physical network link between adjacent devices (e.g., two Ethernet switches). Without further configuration, a Tofino SA will not pass link status information from one of its network ports to the other port. Therefore, it may interrupt or block the correct detection of a device or connectivity loss by a redundancy protocol.

To allow the Tofino SA to forward link status information between its two network ports, create a rule in its firewall configuration that has the special rule type Tofino Rapid Network Recovery.

NOTE

Even with the Tofino Rapid Network Recovery special rule configured, each Tofino SA adds a small time span to the overall recovery time of the network. Also, when a Tofino SA loses the physical link to both of its network ports simultaneously, the first network port to be reconnected will experience a short link-up before taking down the network link again.

When utilizing a Tofino SA with the Tofino Rapid Network Recovery special rule, test the network recovery time in your installation prior to commissioning. Also check that the redundancy protocol utilized can cope with a possible short link-up on one network port of the Tofino SA.

19.6 The Discovery Feature is Not Finding Tofino SAs

The Discovery feature lets you scan IP address ranges to locate new and existing Tofino SA devices on your network. If you are performing scans and not discovering Tofino SAs that you know are on the network, try the following suggestions.

- Reset the scan settings and create a new scan.
- Verify that both interfaces of the Tofino SA are connected to networks or devices. Also check that at least one device on the port opposite the port connected to the Eaton Tofino Configurator has an IP address in the range you have selected to scan.
- If any routers or firewalls are located between the Eaton Tofino Configurator and a Tofino SA on the network, check that each router/firewall device is configured to allow the Eaton Tofino Configurator traffic to pass through it. For more details, see "Communications".
- Check that the Tofino SAs you are trying to discover are new Tofino SAs direct from the factory or existing Tofino SAs that have been factory reset.

In these cases, the Mode light on the Tofino SA will be off. To help stop attackers from using a stolen copy of the Eaton Tofino Configurator to discover a Tofino SA, the Tofino SAs configured by one project database cannot be discovered by a Eaton Tofino Configurator using a different project.

19.7 Unable to Open a Project File

Tofino project files are secured using state of the art cryptography to reduce the chance of unauthorized people accessing them and the Tofino SAs they control. As a result, you may experience situations where you are unable to open a project file. Here are some reasons why this may occur.

- When opening a project file you are asked for a password. This indicates that the project is password protected. Provide the correct password to proceed.
- When opening a project file you are informed that your License Activation Key (LAK) is different from the one used to save the project you are trying to open.
This indicates that the License Activation Key (LAK) protection has been turned on for the project and the project you are trying to open was created with Eaton Tofino Configurator software licensed with a different LAK than your current software. To address this, use the same Eaton Tofino Configurator that was used to save the project.
- When opening a project file you are asked for a Project Administrator Password.
This indicates that the project is protected by an Administrator Password. The project file has been moved from its original location to its current location. Provide the administrator password to proceed.
- When opening a project file from the list of recent projects, you are informed that the selected project cannot be found.
This indicates that the project has been moved. Click "Open Project..." to locate and open the correct project file (.tfp).

To help avoid being locked out of a project, back up your project files regularly and record all passwords in a suitable password management system.

19.8 Eaton Tofino Configurator Error Logging

Eaton Tofino Configurator supports creating a error log file while performing an operation. Imagine a scenario where a project file gets corrupt while saving and nothing is logged explicitly. These logs become very helpful to debug all occurrences of errors that may arise.

Here are some salient features of error logging:

- It occurs when TC fails to save or load a project file.
- TC creates the log files on the same path of its installation (user dir/logs). Each file has a maximum size of 5000 KB.
- TC also creates maximum four backup files when a file is rolled over.
- Each log file is saved by a timestamp, has a details of error message, and the plugin details where an error has occurred.

ACL	Access Control List: List of rules specifying access privileges to network resources.
ARG	Assisted Rule Generation: a feature that helps you create firewall rules for the purpose of helping to protect devices on your network. This feature comes with the Secure Asset Management LSM.
Asset	The objects used to represent the devices (or groups of devices) installed in your control system. They can be broken down into seven categories: Computers, Controllers, Devices, Networks, Networking equipment, Broadcast and Multicast.
CCM	Tripwire's Configuration Compliance Manager (CCM) utilizes active and passive scanning to discover and audit configurations.
Children	A child node is one that is connected under another node (known as its parent).
CIP	Common Industrial Protocol: CIP is an open standard for industrial network technologies. It is supported by an organization called Open DeviceNet Vendor Association (ODVA).
CSP	Client Server Protocol: An Allen-Bradley protocol used to communicate to PLCs over TCP/IP.
DCOM	Distributed Component Object Model: This is an extension to the Component Object Model that Microsoft made to support communication among objects on different computers across a network.
DCS	Distributed Control System: A Distributed Control System allows for remote human monitoring and control of field devices from one or more operation centers.
DMZ	Demilitarized Zone: A small network inserted as a neutral zone between a trusted private network and the outside untrusted network.
DNP3	Distributed Network Protocol 3: A protocol used between components in process automation systems.
DNS	Domain Name System: A distributed database system for resolving human readable names to Internet Protocol addresses.
DPI	Deep Packet Inspection.
EtherNet/IP™	An industrial control protocol defined by the Open DeviceNet Vendors Association (ODVA).
Firewall	A set of security schemes that helps prevent unauthorized persons or devices from gaining access to protected nodes on a network. A firewall essentially works as a control point that blocks invalid connections to nodes behind the firewall while allowing trusted communications to pass through unaffected.
FTP	File Transfer Protocol.
GOOSE	Generic Object Oriented Substation Events.
GUI	Graphical User Interface: Graphical, as opposed to textual, interface to a computer.
HMI	Human Machine Interface: This interface enables the interaction of human and machine.
HTML	HyperText Markup Language: The authoring software language used on the Internet's World Wide Web.
HTTP	HyperText Transfer Protocol: The protocol used to transfer Web documents from a server to a browser.
HTTPS	HyperText Transfer Protocol over SSL: A protocol that uses encryption to transfer Web documents from a server to a browser.
IDS	Intrusion Detection System: A system to detect suspicious patterns of network traffic.

IP	Internet Protocol: The standard protocol used on the Internet that defines the datagram format and a best-effort packet delivery service.
IT	Information Technology: The development, installation and implementation of business computer systems and their applications.
LAN	Local Area Network: A network that interconnects computers in a limited area such as a home, office, laboratory or factory.
LDAP	Lightweight Directory Access Protocol: Protocol to access directory services.
LSM	Loadable Security Module: Software plug-ins providing security services, such as Firewall, Intrusion detection system (IDS), and Diagnostics.
Modbus	A communications protocol designed by Modicon Incorporated for use with its PLCs.
MySQL	A relational database management system (RDBMS) that runs as a server providing multi-user access to a number of databases.
NETBEUI	NetBIOS Extended User Interface: An enhanced version of the NetBIOS protocol.
NetBIOS	Network Basic Input Output System: A de facto IBM standard for applications to use to communicate over a LAN.
NTP	NetworkTime Protocol.
OFS	OPC Factory Server: Data server software.
OLE	Object Linking and Embedding: A precursor to COM, allowing applications to share data and manipulate shared data.
OPC	OLE for Process Control: A standard based on OLE, COM and DCOM for accessing process control information on Microsoft Windows systems.
Parent	A parent node is one that has nodes connected to it (known as children).
PCN	Process Control Network: A communications network used to transmit instructions and data to control devices and other industrial equipment.
PLC	Programmable Logic Controller: A PLC is a small dedicated computer used for controlling industrial machinery and processes.
Protocol	A convention or standard that controls or enables the connection, communication, and data transfer between two computing endpoints. In its simplest form, a protocol can be defined as the rules governing the syntax, semantics, and synchronization of communication. Protocols may be implemented by hardware, software, or a combination of the two. At the lowest level, a protocol defines the behavior of a hardware connection.
RPC	Remote Procedure Call: A standard for invoking code residing on another computer across a network.
SA	Security Appliance: An industrially hardened security appliance designed to be installed in front of individual and/or networks of HMI, DCS, PLC or RTU control devices that require protection.
SCADA	Supervisory Control And Data Acquisition: A system for industrial control consisting of multiple Remote Terminal Units (RTUs), a communications infrastructure, and one or more Control Computers.
SNMP	Simple Network Management Protocol: A protocol used to manage devices such as routers, switches and hosts.

SQL	A database computer language designed for managing data in relational database management systems.
SSL	Secure Socket Layer: A de facto standard for encrypted communications created by Netscape Incorporated.
Syslog	A standard for logging event messages.
TCP	Transmission Control Protocol: A transport level protocol that provides a connection-oriented stream service.
TFTP	Trivial File Transfer Protocol.
Tofino Configurator™	Configuration software for configuring the Tofino security appliances.
Tofino Security Appliance	An industrially hardened security appliance designed to be installed in front of individual and/or networks of HMI, DCS, PLC or RTU control devices that require protection.
UDP	User Datagram Protocol: Connectionless network transport protocol.
URL	Uniform Resource Locator: The address of a resource on the Internet.
USB	Universal Serial Bus: a specification to establish communication between devices and a host controller (usually personal computers); in the context of this document, it refers to USB-based flash drives used to transfer files.
XML	eXtensible Markup Language: A general-purpose markup language for creating special purpose markup languages that are capable of describing many different kinds of data.

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AUSTRALIA

MTL Instruments Pty Ltd,
10 Kent Road, Mascot, New South Wales, 2020, Australia
Tel: +61 1300 308 374 Fax: +61 1300 308 463
E-mail: mtlsalesanz@eaton.com

BeNeLux

MTL Instruments BV
Ambacht 6, 5301 KW Zaltbommel
The Netherlands
Tel: +31 (0) 418 570290 Fax: +31 (0) 418 541044
E-mail: mtl.benelux@eaton.com

CHINA

Cooper Electric (Shanghai) Co. Ltd
955 Shengli Road, Heqing Industrial Park
Pudong New Area, Shanghai 201201
Tel: +86 21 2899 3817 Fax: +86 21 2899 3992
E-mail: mtl-cn@eaton.com

FRANCE

MTL Instruments sarl,
7 rue des Rosiéristes, 69410 Champagne au Mont d'Or
France
Tel: +33 (0)4 37 46 16 53 Fax: +33 (0)4 37 46 17 20
E-mail: mtlfrance@eaton.com

GERMANY

MTL Instruments GmbH,
Heinrich-Hertz-Str. 12, 50170 Kerpen, Germany
Tel: +49 (0)22 73 98 12-0 Fax: +49 (0)22 73 98 12-2 00
E-mail: csckerpen@eaton.com

INDIA

MTL India,
No.36, Nehru Street, Off Old Mahabalipuram Road
Sholinganallur, Chennai- 600 119, India
Tel: +91 (0) 44 24501660 /24501857 Fax: +91 (0) 44 24501463
E-mail: mtlindiasales@eaton.com

ITALY

MTL Italia srl,
Via San Bovio, 3, 20090 Segrate, Milano, Italy
Tel: +39 02 959501 Fax: +39 02 95950759
E-mail: chmninfo@eaton.com

JAPAN

Cooper Industries Japan K.K.
Unizo Nogizaka Bldg. 7th Floor, 8-11-37, Akasaka, Minato-ku,
Tokyo, Japan 107-0052
Tel: +81 (0)3 6434 7890 Fax: +81 (0)3 6434 7889
E-mail: mtl-jp@eaton.com

NORWAY

Norex AS
Fekjan 7c, Postboks 147,
N-1378 Nesbru, Norway
Tel: +47 66 77 43 80 Fax: +47 66 84 55 33
E-mail: info@norex.no

RUSSIA

Cooper Industries Russia LLC
Elektrozavodskaya Str 33
Building 4
Moscow 107076, Russia
Tel: +7 (495) 981 3770 Fax: +7 (495) 981 3771
E-mail: mtlrussia@eaton.com

SINGAPORE

Cooper Crouse-Hinds Pte Ltd
100G Pasir Panjang Road, Interlocal Centre
#07-08 Singapore 118523
Tel: +65 6645 9888 Fax: +65 6645 9811
E-mail: sales.mtlsing@eaton.com

SOUTH KOREA

Cooper Crouse-Hinds Korea
7F, Parkland Building 237-11 Nonhyun-dong Gangnam-gu,
Seoul 135-546, South Korea.
Tel: +82 6380 4805 Fax: +82 6380 4839
E-mail: mtl-korea@eaton.com

UNITED ARAB EMIRATES

Cooper Industries/Eaton Corporation
Office 205/206, 2nd Floor SJ Towers, off. Old Airport Road,
Abu Dhabi, United Arab Emirates
Tel: +971 2 44 66 840 Fax: +971 2 44 66 841
E-mail: mtlgulf@eaton.com

UNITED KINGDOM

Eaton Electric Limited,
Great Marlings, Butterfield, Luton
Beds LU2 8DL
Tel: +44 (0)1582 723633 Fax: +44 (0)1582 422283
E-mail: mtlenquiry@eaton.com

AMERICAS

Cooper Crouse-Hinds MTL Inc.
3413 N. Sam Houston Parkway W.
Suite 200, Houston TX 77086, USA
Tel: +1 800-835-7075 Fax: +1 866-298-2468
E-mail: mtl-us-info@eaton.com