Maximize Spectral Efficiency on Optical Links Using Cisco Automated Subsea Tuning, Release 2.1

First Published: 2021-05-31

Business Challenge of Manual Optimization of Submarine Optical Links

During field installations, the manual optimization of submarine optical links for maximum spectral efficiency is a cumbersome and time-consuming process. The process involves a manual tuning of the line cards by searching for an optimal combination of line rates, BPS, and channel spacing.

The Cisco Automated Subsea Tuning (Cisco AST) overcomes this challenge. Cisco AST is a cloud hosted microservices-based software application. Cisco AST determines the spectral efficiency of the optical links automatically by using real time data obtained from devices at both ends of the optical link.

In a system that uses Cisco NCS 1004 devices, Cisco AST automatically tunes the NCS 1004 transponder that is connected to any DWDM line system by using real-time performance information, to optimally use the subsea cable capabilities. This tuning is done during field installation of the system and also during re-optimization of the links in future.

Cisco AST collects network data and analyses, executes the tuning algorithm, and deploys the configuration in the system.

This solution is beneficial for customers who use Cisco's optical submarine network systems. By using Cisco AST during device installations, they can maximize their link capacity, and so reduce their operational cost.

Install Cisco AST on a Centralized Server

The Cisco AST application is delivered as a bundled tar file signed by Cisco, to ensure the authenticity of the package. The tar file contains the following files and folders:

- A shell script (ciscoAir.sh) to install on a CentOs machine

- A docker-compose file (docker-compose.yml) referring to the images in the local repository with a version tag

- An images folder (`images`) that has images of Cisco AST microservices in a tar file with the file format tar.gz.

- A docker-installation folder (`docker_installation`) that has docker-ce rpms and docker-compose installation file

- A signature file (<PkgName>.signature)

You will receive a product information document containing the signature verification key, through eDelivery, after you purchase and download the tar file.

When it is executed with the appropriate commands, the script performs installation, start, and stop processes of the application.

Before you begin

You must have the following:

- VM with minimum 16GB RAM, eight Core CPU with CentOs v7.6, and a storage of at least 50GB

- Docker version 19.03.2, build 6a30dfc (The install script installs this version of docker if it is not found on the VM).

- Docker-compose version 1.24.1, build 4667896b (The install script installs this version of docker compose if it is not found on the VM).

- Check the firewall rules on the VM or server where you install the Cisco AST, to ensure that HTTPS port 443 is open.

The following table lists the supported browser versions:

Table 1: Supported Browser Versions

Browser	Latest Version	Minimum Browser Version
Google Chrome	81.0.4044.122	72.0.3626
Mozilla Firefox	75.0	68.6.0esr version
Microsoft Edge	81.0.416.64	44.18362.449.0

Procedure

Step 1 To install the Cisco AST application, perform the following steps:

a) Download the cisco-air-<*version*>.tar.gz from Cisco Commerce Workspace (CCW) tool to your VM.

```
[root@air-devm-1 package_test]# ls -l

Total 42224144

-rw-r—r--. 1 root root 4325523238

[root@air-devm-1 package_test]#
```

b) Extract the tar file in the installation directory.

```
[root@air-devm-1 package_test]# tar -xvf cisco-air-<ver>.tar.gz

ciscoAIR.sh

pkgs.tar.gz
```

After you extract the package, the contents of the tar file are unpacked. Verify that the unpacked contents include the signature file.

c) Copy the key available in the information document into a file. Save the file to the installation folder on the server and run the installation script with the key filename as one of the arguments:

```
./ciscoAir.sh -o install -t clean -m offlinemode -k <public_key_file>
```

This ensures that the installation happens only if the image signature is verified.

d) Install the application using the script available in the extracted tar file.

```
[root@air-devm-1 package_test]# sudo./ciscoAIR.sh

2020-02-12 11:58:37 Invalid arg Operation type cannot be empty Exiting

Usage: ./ciscoAIR.sh -o <install|start|stop> -t <update|clean> -m <offlinemode>

Usage: ./ciscoAIR.sh -o install -t clean -m offlinemode

Usage: ./ciscoAIR.sh -o install -t update -m offlinemode

-m offlinemode will install from included tar

User need to enter username and password when prompted which will be used for application
 login

[root@air-devm-1 package_test]#
```

The installation requires several minutes, because it extracts and loads the required images required from the bundled packages tar file.

```
[root@air-devm-1 package_test]# sudo./ciscoAIR.sh -o install -t clean -m offlinemode
```

- **-o Install -t clean -m offlinemode**—Installs the unpacked tarfile on the host machine cleaning any previously installed images.

- **-o Install -t update -m offlinemode**—Installs the unpacked tarfile on the host machine without cleaning any previously installed images.

- **-o start**—Starts the stopped Cisco AST services simultaneously. It requires a previous installation to run this command. If the Cisco AST services are already up, this command option execution does not perform any action.

- **-o stop**—Stops Cisco AST services currently running on the host machine.

```
Starting install

Starting installation. This could take several minutes to load the images

removed 'airInstall.log'

2020-02-12 11:59:23 Extracting tar filepkgs.tar.gz

docker-compose.yml

images/
```

The script prompts you to provide your own web server certificate at the time of installation. You must copy this certificate in the installation location where the docker-compose file is available at the folder path `certs/air-ui`.

During the installation procedure, the script prompts you to provide a user name and password. You must use this credential to log in to the Cisco AST application.

```
2020-02-12 12:19:19 Load image completed

Please enter Username: demo-user

Please enter Password (Min 8 chars):
```

Note The username must be alphanumeric, and can include hyphens and underscores. The password length must be in the range of 8–12 characters.

If the installation is successful, the following message appears:

```
2020-02-12 12:21:10 Installation Success

[root@air-devm-1 package_test]#
```

If the installation is not successful, share the log file (airInstall.log) that is generated in the installation folder with the Cisco support team to troubleshoot installation issues.

Note   When you perform a clean installation again on the same VM, the script does not again prompt you for the username and password. The same username and password that you had provided earlier persists.

After successful installation, start the application.

Note   To enable the IPv6 devices to onboard Cisco AST, ensure that you check the following:

- Verify that VM has a network interface with a valid and routable IPv6 address.

- Execute the following command:

  ```
  sudo ip6tables -t nat -A POSTROUTING -o <ipv6-interface-name> -j MASQUERADE
  ```

  Example:

  ```
  sudo ip6tables -t nat -A POSTROUTING -o eth0 -j MASQUERADE
  ```

- Verify that Cisco AST connects to IPv6 devices.

You can also add this command to a startup script residing at (`/etc/rc.local`) to make it persistent across reboot.

Step 2   To start the Cisco AST application, enter the following command:

```
[root@air-devm-1 package_test]# sudo./ciscoAIR.sh -o start

Starting start

Starting the application, will take few minutes for the application to come up

2020-02-12 12:21:10 Executing Docker-compose UP
```

This command starts all the relevant containers. This could take up to two minutes to start the application and bring up all the services.

Step 3   Go to **https://<host-name>** and login to the application.

Step 4   (Optional) To stop the Cisco AST application, enter the following command:

```
[root@air-devm-1 package_test]# sudo./ciscoAIR.sh -o stop

Starting stop

2020-02-12 16:30:07 Executing Docker-compose down
```

Cisco AST Limitations

The following limitations apply:

1. You must have root access to the server on which you install the Cisco AST application. The server infrastructure must be secure for uninterrupted functioning of the Cisco AST application.

2. You can access Cisco AST application by using only the user credentials provided during the installation. Multiple users can use the same credentials to access the application simultaneously. We recommend to store the password safely because it cannot be recovered.

Note The user has an admin role. User credentials must be shared with only those users who will use the Cisco AST application.

3. When selecting the device pairs in a tuning project, ensure that you select only the physically connected ports of the near-end and far-end devices. Otherwise, the tuning results become unpredictable.

4. Cisco AST does not perform the gRPC Remote Procedure Call server authentication because the certificates installed on the NCS1004 devices for gRPC connection may not be uniform.

5. By default, the slot 1 is allocated for pairing the devices. Because NCS1004 has two carriers for each slot, the tuning fails if you proceed with the default number of slots. Therefore, we recommend you to select a minimum of two slots for tuning.

6. Cisco AST generates a confirmation code after you enter the authorization code when you update the license. You must enter the confirmation code in the CSSM portal. If you do not enter the confirmation code in the CSSM portal, then the confirmation information about the updated license is not stored in the CSSM portal. When you update or remove the license in the CSSM portal, it prompts you for the confirmation code again. You can locate the confirmation code which was not captured earlier, in the Technical Support Logs for entry in the CSSM portal.

7. Ensure that you do not stop or restart the Cisco AST services, while installing, updating, or returning the Cisco AST licenses. Otherwise, it may lead to unknown license reservation states and behavior.

Log into the Cisco AST Web Interface

Use this task to log into the Cisco AST web interface (Cisco AST instance).

Procedure

Step 1 In the browser URL field, enter the IP address or hostname where Cisco AST is installed.

The login page appears.

Step 2 Enter the username and password.

You must use the credentials that you chose during the installation. You can change the password later.

Step 3 Click **Sign In**.

The home page appears with the main menu in the left panel. By default, the **Smart Software Licensing** page is displayed.

The following table describes the task you can perform in the home page.

Table 2: Cisco AST Home Page Menu

Menu	Description
Devices	Onboard the devices to be tuned. See Onboard Devices to Cisco AST, on page 9.
Projects	Create and tune a project. See Tune Devices Using Cisco AST, on page 11.
Admin	View the audit logs. See Troubleshoot Cisco AST Issues Using Logs, on page 34.
License	Reserve license, update reservation, and return the license. See Manage Licenses in Cisco AST Using Smart Licensing , on page 6.
Login	Sign out of the application and change the password.

Step 4 (Optional) To change the password, perform the following steps:

a) Click the icon in the bottom-left of the page and select **Change Password**.

A dialog box appears.

b) Enter the **Current Password**, **New Password**, and **Confirm Password**.

c) Click **Save**.

Manage Licenses in Cisco AST Using Smart Licensing

Smart Licensing is a cloud-based, standardized licensing platform that simplifies and streamlines the management of your software licenses from one centralized website. For more information, see Cisco Smart Software Licensing.

Cisco AST is an offline-based licensed software application. You can use Cisco AST in evaluation mode for 90 days; this mode supports tuning of eight ports of NCS1004 devices.

Cisco AST supports only Specific License Reservation (SLR), which is an offline mode of license consumption. There are two categories of licenses.

- Right to Use (RTU)—License to use the software.

- Right to manage (RTM)—License to perform tuning on the ports.

You can run Cisco AST in subscription mode by purchasing and adding the following entitlements to your virtual account in Cisco Smart Software Manager (CSSM).

Table 3: License Entitlements

Entitlement	Product tag
S-OAS-AIR-LIC	OAS Automatic Inline Retuner Software RTU
S-OAS-AIR-RTM-TXP1	OAS Automatic Inline Retuner NCS 1004 1.2T TXP port RTM

In order to be compliant, you must reserve one RTU license and multiple RTM licenses for each instance of the Cisco AST installation. If you have reserved only RTM licenses, but not RTU licenses, then the product becomes noncompliant.

The reserved RTM licenses are utilized for a tuning project until tuning is in progress. When you confirm the tuning result either by selecting Accept, Reject, or Revert, the RTM licenses are automatically released back to the reserved pool of licenses for that Cisco AST instance. You can reuse the released RTM licenses for other projects.

Reserve Licenses for Cisco AST

Use this task to reserve licenses for Cisco AST.

Before you begin

Procedure

Step 1	Click the icon in the left panel.
Step 2	Click **Reserve License**.
	The **License Reservation Request** dialog box appears.
Step 3	Click **Copy to Clipboard** to copy the reservation code or Click **Save as file** to save the code to a file.
Step 4	Login to CSSM Portal using the Cisco provided username and password.
Step 5	Choose your smart account from the **Virtual Account** drop-down list.
Step 6	Click the **License** tab.
Step 7	Click **License Reservation**.
	The system displays the **Smart License Reservation** wizard.
Step 8	On the **Enter Request Code** tab, paste the reservation request code that you have generated or upload the file where the code is saved, and click **Next**.
Step 9	On the **Select Licenses** tab, check the **Reserve a specific License** check box.
	The system displays the list of surplus licenses available in your virtual account.
Step 10	Enter the number of licenses that you want to reserve for the RTU and RTM licenses, in the **Reserve** field.
	You must select at least one RTU license.
Step 11	Click **Next**.
Step 12	On the **Review and Confirm** tab, click **Generate Authorization Code**.
	The system displays the Authorization Code that is generated.
Step 13	Click **Copy to Clipboard** to copy the code or download it as a file.
Step 14	In the Cisco AST UI, Click **Continue** in the **License Reservation Request** dialog box.
Step 15	Click **Enter Reservation Authorization Code**.

Step 16   In the **Enter Reservation Authorization Code** dialog box, paste the authorization code, or upload the file where the authorization code is saved.

Step 17   Click **Install**.

After successful installation, the following message appears:

Authorized and Reserved

Update License Reservation

When you want to reserve RTM licenses to tune more ports, you can update the reserved licenses.

Procedure

Step 1   Log in to the CSSM portal using the Cisco-provided username and password.

Step 2   Click the **Inventory** tab.

Step 3   From the **Virtual Account** drop-down list, select your smart account.

Step 4   From the **Product Instances** tab, for the Cisco AST instance, click the **Actions** tab and choose **Update Reserved Licenses**.

Step 5   On the **Select Licenses** tab, check the **Reserve a specific License** check box, and update the number of licences.

Step 6   Click **Next**.

Step 7   On the **Review and Confirm** tab, click **Generate Authorization Code**.

The system displays the authorization code that is generated in the **Authorization Code** tab.

Step 8   Click **Copy to Clipboard** to copy the code or download it as a file.

Step 9   Login to Cisco AST. See Log into the Cisco AST Web Interface, on page 5.

Step 10   Click the   icon.

Step 11   Click **Update Reservation**.

Step 12   Paste the authorization code copied from the CSSM or upload the file where the code is saved.

Step 13   Click **Install**.

After the successful installation, the following message appears:

Authorized and Reserved

Cisco AST generates a confirmation code to be updated in the CSSM portal.

Step 14   Click **Copy to Clipboard**.

Step 15   Log in to the CSSM portal.

Step 16   Click the **Inventory** tab.

Step 17   From the **Virtual Account** drop-down list, choose your virtual account.

Step 18   Click the **Product Instances** tab.

The list of product instances available is displayed.

Step 19	Click the required Cisco AST instance to expand the same.
	The **Overview** window is displayed.
Step 20	From the **Actions** drop-down list, choose **Enter Confirmation Code**.
	The **Enter Confirmation code** window is displayed.
Step 21	In the **Reservation Confirmation Code** field, paste the confirmation code.
	The confirmation code is updated on CSSM.

Return Licenses

Use this task to return the license reservation for Cisco AST.

Before you begin

Procedure

Step 1	Click the icon in the left panel.
Step 2	Click **Return License**.
Step 3	Click **Continue** in the **Return License Conformation** dialog box, to confirm.
	The **License Reservation Return Code** dialog box appears.
Step 4	Click **Copy to Clipboard** to copy the reservation code or click **Save as file** to save the code in a file.
Step 5	Log in to CSSM portal.
Step 6	Click the **Inventory** tab. From the **Virtual Account** drop-down list, select your smart account.
Step 7	In the **Product Instances** tab, for the Cisco AST instance, click **Actions** drop-down menu and choose **Remove**.
Step 8	When prompted, paste the return code, and click **Remove product Instance**.
	The Registration Status becomes UNIDENTIFIED in the Cisco AST user interface and the application returns back to the evaluation mode.

Onboard Devices to Cisco AST

Cisco AST does not discover the NCS 1004 devices automatically. You must onboard the devices that need to be tuned before initiating a tuning process.

Cisco AST supports the following data rates:

- Trunk Side: 100G, 150G, 200G, 250G, 300G, 350G, and 400G

• Client Side: 100GE client automatic configuration only

OTU4 client requires a manual configuration.

Manage Devices

Use this task to add devices into the inventory and edit the device details.

Before you begin

Procedure

Step 1 To add the devices manually for onboarding, follow these steps:

a) Click **Devices** in the left panel.

b) Click **New**.

c) Enter the device details that are needed to connect to the device and perform actions, such as get Inventory, set configuration, and get operational data.

Ensure that you enter valid a username and password of the device to enable Cisco AST to connect to the device.

d) Click **Save**.

The new device is onboarded and added to the **Devices** table. Cisco AST validates the connection with the onboarded device.

The **Name** column includes name, image, device connection status, and an icon indicating the connection status.

   • Green—Device is connected.

   • Yellow—Device is waiting to be connected.

   • Red—Device is disconnected.

   Cisco AST does not automatically reconnect a disconnected device. Select the disconnected device and click **Reconnect**.

   If the device is reachable, the device gets reconnected and the status changes to connected.

e) Repeat Steps b through d to add additional devices.

Step 2 To view the device inventory, follow these steps:

a) Click **Devices** in the left panel.

b) Select the device that you want to edit and click **Edit** or click the device name under the **Name** column.

c) Click the **Inventory** tab.

If the device is reachable, the live inventory details of the device appear.

Step 3 To change the device details of the onboarded device, follow these steps.

a) Click **Devices** in the left panel.

b) Select the device that you want to edit and click **Edit** or click the device name under the **Name** column.

Step 4   c)   Modify the device details as required.

       d)   Click **Save and Close**.

Step 4   To delete an onboarded device, follow these steps:

a)   Click **Devices** in the left panel.

b)   Select the device that you want to delete.

c)   Click **Delete**.

d)   Confirm the deletion.

     The selected device gets deleted.

> **Note**   You cannot delete a device that is part of the tuning project.

Projects

A project represents a container of the following information needed for the tuning process:

- Devices involved in the tuning process

- Device pairing process

- A set of input parameters that can be adjusted to modify the tuning behavior

A project is a persistent entity. Both input parameters and tuning results are stored in the database and available for future operations.

Furthermore, the project represents a single tuning instance, and therefore parallel tuning can be performed on different project instances.

Tune Devices Using Cisco AST

Table 4: Feature History

Feature Name	Release Information	Feature Description
Support to display margin values in the preview panel	Cisco AST Release 2.1	In the Tune page, the SNR margin and Q margin values are displayed for channels that are tuned, based on the project granularity.
Support for user confirmation before reading the SNR margin after channel equalization	Cisco AST Release 2.1	After the tuning workflow is complete, if SNR and Q margin values are lower than the target margin value, then these values are displayed in red and the whole line item is denoted with a red dot.

Feature Name	Release Information	Feature Description
Support for warning message when user exceeds the bandwidth allocation	Cisco AST Release 2.1	In the Properties page, when the values for parameters such as mapping granularity, start frequency, stop frequency, and so on, exceed the allocated bandwidth, an error message displays. Ensure that you enter the correct values.

The tuning workflow is an end-to-end process that starts from creating a project and ends at verifying the final configuration for deployment. The following flow diagram depicts the tuning workflow.
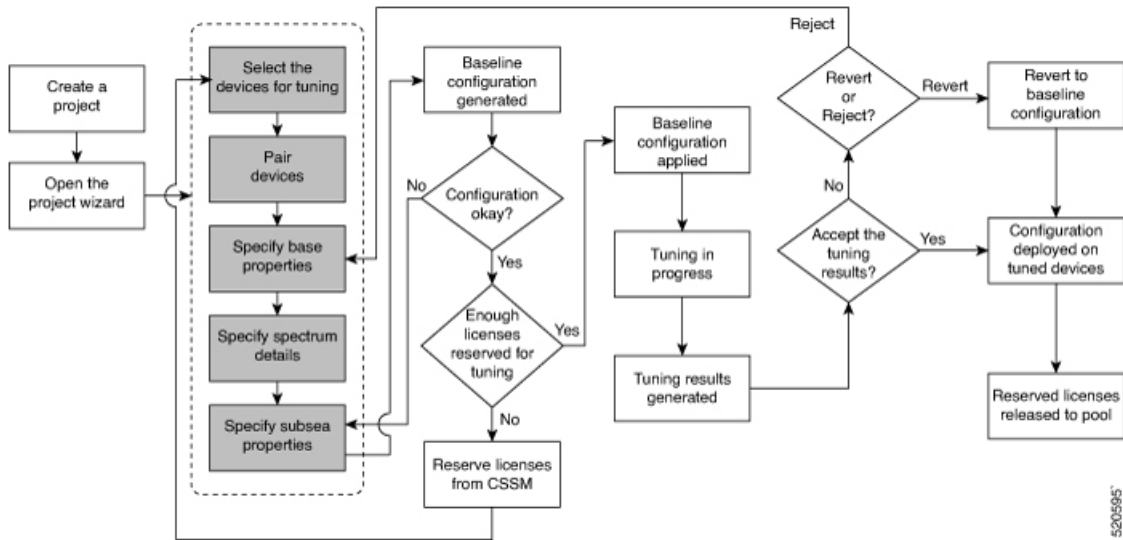
Warning   The tuning workflow is based on a procedure that requires the power-off of the channels along the workflow and during the final configuration. This can affect the stability of the link and impact any existing channel that shares the same spectrum.

Table 5: Tuning Workflow

Workflow Sequence	Detailed Steps

Create a Project	1. Click **Projects** on the left panel.
	
	2. To create a new project, follow these steps:
	
	  a. Click **New**.
	
	    The **New Project** dialog box appears.
	
	  b. Enter the **Project Name** and choose the **Near-End Location** and **Far-End Location**.
	
	    Cisco AST filters the devices to be tuned based on the location chosen. Therefore, the devices belonging to other locations cannot be tuned.
	
	3. From Cisco AST Release 2.1, you can also import a project baseline configuration using a template in the Excel format (for example, *project.xlsx*). For more information, see Import Project Baseline Configuration Using Template, on page 20.
	
	4. To edit a project, follow these steps:
	
	  a. Choose the project and click **Edit**.
	
	  b. Modify the required parameters in the **Edit Project** dialog-box.
	
	  c. Click **Save**.
	
	5. To delete a project, use the following steps:
	
	  a. Choose the project that you want to delete.
	
	  b. Click **Delete**.

Open the Project Wizard	1. Click **Projects** in the left panel. 2. Click the name of the project that you want to tune. The project wizard opens.
Select	Select the devices for pairing: 1. Choose the Near-End Device and Far-End-Device from the drop-down lists. 2. Choose the Number of Slots to be connected between the selected devices. The chosen number of slots is the maximum available slots for both devices in a pair. 3. Click **Add** or the + icon next to the pair to add more device pairs. 4. To delete a pair from the project, click the delete icon next to the pair. 5. Click **Continue**.

Workflow Sequence	Detailed Steps
Pair	Pair the near-end and far-end devices. 1. Choose the slots to be paired from the **Slot** drop-down lists for both the devices. You can also cross-connect the slots belonging to the same device pair. For example, you can choose slot 0 for the near-end device and slot 3 for the far-end device. 2. You can exclude a pair from tuning, using the **Include** toggle button. 3. Click **Continue**. The devices are paired. If the pairing is successful, a green line appears between the paired devices; otherwise, a red line appears.
Properties	Set properties for the base configuration. For more information, see Base Configuration Properties, on page 22. The default values for the properties appear. 1. Modify the values as required. You can also upload the properties from a file (.csv) that is available in your system. 2. Click **Continue**. **Note** When the values for parameters such as mapping granularity, start frequency, stop frequency, and so on, exceed the allocated bandwidth, an error message displays. Ensure that you enter the correct values.
Spectrum	Specify the forbidden regions of the spectrum if necessary. 1. Choose the Blocking Spectrum N Start Frequency, the Blocking Spectrum N Stop Frequency, and the Width of the spectrum. 2. Click **Continue**. The subsea configuration values that are derived from the properties are displayed.
Subsea	Modify the subsea configuration values if needed. 1. Choose the pair whose subsea parameters you want to edit. 2. Click **Edit**. The **Sub-Configuration** dialog box displays the default values. 3. Modify the subsea configurations. For more information, see Subsea Configuration Parameters, on page 30. 4. Click **Okay**. 5. Click **Continue**.

Workflow Sequence	Detailed Steps

Configuration	1. Verify the configuration values for tuning.
	
	Cisco AST builds the baseline configuration based on the carrier properties provided. The baseline configuration is the starting point for subsequent tuning.
	
	2. Click **Continue and Apply** if you agree with the baseline configuration, else click **Back** to modify the properties and the subsea configuration.
	
	Note
	    • While deleting a channel, ensure that you replace the spectral slot with the same noise value. Retaining the spectral range outside the bandwidth that is allocated to the project that is completely occupied prevents link instability and enables you to maintain the channel power at a constant.
	
	    • You must manually configure the proper channel plan on the terminal equipment.
	
	3. Click **Apply** to confirm the tuning process.
	
	If the number of licenses that are reserved is enough to tune the number of ports selected, Cisco AST proceeds with the tuning. Otherwise, you must reserve sufficient licenses and begin the tuning workflow.
	
	The tuning process begins by applying the baseline configuration. You can view the progress of the tuning process. After the tuning process is complete, you can view the tuning results. It is a set of measurements that are performed on the tuned devices after applying the configuration.

Workflow Sequence	Detailed Steps
Tune	The upper area of the **Tune** page displays histogram graphs and the lower area displays a table that reports configuration and status information for each interface of the tuned devices.
	The histogram graphs gives a clear indication of power trends and margin distributions. Transmit power scale is displayed on the right side of the graph. Margin scale is on the left side. On the top-left corner, you have toggle buttons to switch between the variables on the horizontal and vertical axes. You can choose one of the following combinations:
	• Frequency versus SNR-Margins
	• Frequency versus Q-Margin
	• Wavelength versus SNR-Margins
	• Wavelength versus Q-Margin
	The SNR margin and Q margin values are displayed for channels that are tuned based on the project granularity.
	Perform one of the following depending on whether you accept the tuning results:
	1. Click **Reject** to reject the final configuration.
	Cisco AST removes the actual deployed configuration from the devices, and the project moves to the draft state. You can start again from selecting the devices for pairing.
	2. Click **Revert** to revert to the baseline configuration.
	3. Click **Accept** to accept this configuration and click **Apply** to move the project to final tuned state.
	Cisco AST removes the actual configuration running, deploys the final configuration on the device, performs measurements, and generates the report.
	4. Click **Restart** to restart the tuning process from specifying the base properties.
	5. (Optional) Click **Export Report** to export the reports in the CSV format.
Done	The project moves to the **Done** state.
	Note　　If SNR and Q margin values are lower than the target margin value, then these values are displayed in red and the whole line item is denoted with a red dot.
	Click **Refresh** to reload the values.
	Click **Restart** to restart the tuning process from specifying the base properties.

Project Baseline Configuration Template

The project baseline configuration template should be in the Excel sheet format containing four sheets. Ensure that you create the template in the following sheet in order to prevent warnings or errors.

- Near-end location

- Far-end location

- Project Properties

- Blocking Spectrum

You can also export the base line configuration of a successfully tuned project, which can be imported into another project. See Export Project Baseline Configuration as a Template, on page 21.

Near-end and Far-end Locations

The near-end and far-end location device details are taken using the **show run** command executed from the device. Use the same details to fill the sheets.

The near-end location is the first sheet and the far-end location is the second sheet, and names of these sheets can differ based on locations.

The first row of the near-end and far-end location sheets should contain the device name that is onboarded already. The remaining rows of the sheets should contain the hardware module and controller configuration details. The near-end and far-end location sheets can have multiple device details.

Sample sheet for the Near-end Location
dev2
hw-module location 0/0
mxponder
trunk-rate 200G
client-rate 100GE
!
controller Optics0/0/0/0
cd-min -1001
cd-max 1000
transmit-power 29
dwdm-carrier 100MHz-grid frequency 191.41075
bits-per-symbol 1.9375
enh-colorless-mode 3
enh-sop-tol-mode 3
nleq-comp-mode 2
cross-pol-gain-mode 4
cross-pol-weight-mode 4
cpr-win-mode 4
cpr-ext-win-mode 8

Sample sheet for the Near-end Location
rx-voa fixed-ratio 1700
rx-voa-target-power -7
filter-roll-off-factor 0.074
!

Sample sheet for the Far-end Location
dev1
hw-module location 0/1
mxponder
trunk-rate 200G
client-rate 100GE
!
controller Optics0/0/0/1
cd-min -1001
cd-max 1000
transmit-power 29
dwdm-carrier 100MHz-grid frequency 191.4856
bits-per-symbol 1.9375
enh-colorless-mode 3
enh-sop-tol-mode 3
nleq-comp-mode 2
cross-pol-gain-mode 4
cross-pol-weight-mode 4
cpr-win-mode 4
cpr-ext-win-mode 8
rx-voa fixed-ratio 1700
rx-voa-target-power -7
filter-roll-off-factor 0.074

Sample sheet for the Far-end Location
!

Project Properties

The project properties sheet (third Excel sheet) should contain the project name and parameters with values. These parameters are mandatory. Ensure that the sheet name is **Project Properties**.

✎

Note For Mapping granularity, the maximum value is 2.

Table 6: Sample Project Properties Sheet

Project Name	Test
mappingGranularity	2
SNRmarginTarget (dB)	1
SNRmarginTargetTol (dB)	0.05
StartFrequency (THz)	191.3250
StopFrequency (THz)	196.1250
ChannelPowerRule	Derived
Max Channel Power (dBm)	3
Max Channel BW (GHz)	72
OLS Add-Drop Constraints	Limited
OLS Add-Drop Module Max Output Power (dBm)	15
Number of Ports per OLS Add-Drop Module	8
Number Of OLS Add-Drop Module	12
GridGranularity (GHz)	6.25
FilteringGuardband (GHz)	6.25
IsOpenConfigSupported	FALSE

Blocking Spectrum

The Blocking Spectrum, the first header row denotes the start and end positions. The following rows can have spectrum values for the start and end positions. Ensure that the sheet name is **BlockingSpectrum**.

Table 7: Sample Blocking Spectrum Sheet

START POSITION [THZ]	END POSITION [THZ]
191.3375	191.34375
191.34375	191.35
191.35	191.35625
191.3625	191.36875

Import Project Baseline Configuration Using Template

Table 8: Feature History

Feature Name	Release Information	Feature Description
Import Project Baseline Configuration Using Template	Cisco AST Release 2.1	You can import a project baseline configuration in Excel format (for example, *project.xlsx*) using a template. The Excel sheet contains near-end and far-end router details such as hardware and controller configuration, project properties, and blocking spectrum start and end positions.

You can import a project baseline configuration using a template in the Excel format (for example, *project.xlsx*).

The Excel sheet contains near-end and far-end router details such as hardware and controller configuration, project properties, and blocking spectrum start and end positions.

The project base configuration parameters that are supported are:

- Channel Power Rule
- Max Channel Power
- Max Channel bandwidth
- Max Data Rate
- SNR Margin Target
- SNR Margin Target Tol
- Start Frequency
- Stop Frequency
- Blocking Spectrum and Start Frequency

Use this task to import the project baseline configuration using an Excel template.

Before you begin

Procedure

Step 1	Click **Projects** on the left panel.
	The Projects page displays.
Step 2	Click **Import Project Configuration**.
	The **Import xlsx file** dialog box appears.
Step 3	Click **Browse** and select the Excel file containing the details of the baseline configuration.
Step 4	(Optional) On the **Projects** page, check the **Deploy Imported Baseline Configuration** check box.
	This enables you to deploy the baseline configuration automatically on the system.
Step 5	Click **Upload**.
	The project is created in the Draft stage.
Step 6	In the **Projects** page, click the Project link.
	The project properties page displays. The values of the project properties are not editable except SNR Margin Target and SNR Margin Target Tol. Click **Next**.
Step 7	In the **Spectrum** page, Click **Continue**.
	The values of the spectrum parameters are not editable and you cannot add a new spectrum.
Step 8	In the **Subsea** page, Click **Continue**.
	The subsea parameters are editable.
Step 9	In the **Configuration** page, Click **Continue & Apply**.
Step 10	In the **Tune** page, the tuning starts.
	The configuration that is provided in the template is applied.
Step 11	The project moves to the **Tuned** stage.

Export Project Baseline Configuration as a Template

Table 9: Feature History

Feature Name	Release Information	Feature Description
Export Project Baseline Configuration Using Template	Cisco AST Release 2.1	You can export the baseline configuration of a successfully tuned project in the Excel format as a template.

You can export the baseline configuration of a tuned project that is completed successfully, in the Excel format as a template, at the end of the shrinking operation. The shrinking operation is performed after you click **Accept** and the tuning is completed. This shrinking operation enables the channels to be put closer to each other in such a way to save space for other channels, and enhance the data capacity of the system. This Excel file can be imported into another project.

Use this task to export the project baseline configuration as an Excel template.

Before you begin

Procedure

Step 1	Click **Projects** on the left panel.
	The Projects page displays.
Step 2	Click the name of the successfully tuned project from which you want to export the baseline configuration.
Step 3	Click **Export Baseline Configuration**.
	Save the baseline configuration as a template.
Note	The exported file preserves name of the imported project. When you reimport the file, ensure that you rename the existing project or the name of the project in the exported file, because Cisco AST does not accept two projects with the same name.

Base Configuration Properties

Table 10: Feature History

Feature Name	Release Information	Feature Description
Support for 100G and 150G data rate	Cisco AST Release 2.1	Cisco AST supports 100 and 150 Gbps for maximum line rate for optimization (max data rate). The minimum value that is supported for the max data rate parameter is reduced to 100 Gbps.

The following table describes the various properties that you have to provide for the baseline configuration.

Table 11: Base Configuration Properties

Parameter	Description	Minimum	Maximum	Default	Unit
Channel Power Rule	Selects the option for defining the power spectral density (PSD) at the OLS Add-Drop Module input. The available options are: • Manual: In Manual mode, the input PSD is directly set as the RequiredPSD. • Derived: In Derived mode, the input PSD is derived from the Max Channel Power and the Max Channel BW. In both modes, Cisco ASTpreserves the minimum average value of PSD that must be warranted over the link during the tuning process.	Manual, Derived	Manual, Derived	Derived	N/A
Max Channel Power	Maximum Channel Power of the Transponder output in dBm.	–20	23	+3dBm	dBm
Max Channel BW	Maximum Channel BW of the Transponder in GHz.	1	5000	72	GHz

Parameter	Description	Minimum	Maximum	Default	Unit
Max Data Rate	Maximum line rate where Cisco AST searches for optimization. If this value is equal to the Min Data Rate, the search is performed only on the selected line rate. The valid values are 100, 150, 200, 250, 300, 350, and 400. Maximum line rate depends on the choice of the minimum line rate and the mapping granularity. **System Default Mode** In case of the system default mode (blind mode) that uses the most reliable baseline configuration for tuning of the channels (without importing the configuration), the following options are allowed: • Option 1—With the mapping granularity of 1 or 2 (serial mode) (see Mapping Granularity), if the minimum line rate is 100G, then the maximum line rate must be of the same value. • Option 2—With the mapping granularity of 1 or 2, if the minimum line rate is 150G, then the maximum line rate can be anything up to 400G. • Option 3—The whole range of line rates (from 100G to 400G) can be used only if the mapping granularity is set equal to 3 (parallel mode). In this case, a transmission power issue and crosstalk may occur. **Imported Baseline Configuration** For imported baseline configuration, the tuning is performed based on the following features: • The line rates reported in the imported file cannot be changed when Cisco AST is running. • The tuning and shrinking of the channels are performed only by using the line rates reported in the imported file. Any further change at different data rates would require a new import file with the updated line rates.	100 [1] 200 [2]	400	300	Gb/s

Parameter	Description	Minimum	Maximum	Default	Unit
Min Data Rate	Minimum line rate where Cisco AST searches for optimization. If this value is equal to the max Data Rate, the search is performed only on the selected line rate. The valid values are 100, 150, 200, 250, 300, 350, and 400.	200	400	200	Gb/s
SNR Margin Target	Minimum SNR margin that must be warranted.	0	20	1	dB
SNR Margin Target Tol	SNR margin tolerance that limits the SNR margin target between a maximum and minimum SNR margin target range. The actual SNR margin tolerance comprises two values: Actual SNR Margin Tolerance = Input Unequalization + Measure Error. This parameter considers the maximum difference in the value of input channels PSD between any two adjacent channels that can impact the SNR margin target search.	0	10.00	0.05	dB
Required PSD	Minimum value of PSD that must be warranted at the OLS Add-Drop Module input in dBm/GHz.	–40	–15	-16	dBm/GHz
Start Frequency	Minimum frequency of the bandwidth allocated to the project. This field is mandatory.	191.3250	196.1250	191.3250	THz
Stop Frequency	Maximum frequency of the bandwidth allocated to the project. This field is mandatory.	191.3250	196.1250	196.1250	THz
Blocking Spectrum N Start Frequency	Minimum frequency of the forbidden bandwidth "N" to be used in the project.	191.3250	196.1250	191.3250	THz
Blocking Spectrum N Stop Frequency	Maximum frequency of the forbidden bandwidth "N" to be used in the project.	191.3250	196.1250	191.3250	THz

Parameter	Description	Minimum	Maximum	Default	Unit
Width	Width of the Blocking Spectrum N starting from the Blocking Spectrum N Start Frequency of the forbidden bandwidth "N" to be used in the project. It is automatically derived by the tool after setting Blocking Spectrum N Start Frequency and Blocking Spectrum N Stop Frequency. **Note** The blocking spectrum is created when the slices of spectrum are added progressively based on the grid granularity. This operation requires that the order of creating each blocking spectrum must reflect the order that is present in the frequency domain. For example, if two different blocking spectra are created in two different spectral zones, then the blocking spectrum of the lowest frequency must be created first, and the second blocking spectrum of higher frequency must be created later.	N/A	N/A	N/A	THz

Parameter	Description	Minimum	Maximum	Default	Unit
Mapping Granularity	Desired resolution of the tuning spectral map. The number shows how many carriers are used as probe for the tuning. (For example, when you select the value of mapping granularity as 3, one out of three carriers is used as a probe to perform the tuning.) This parameter also affects the interpolation granularity providing a flat region for every probe used for the tuning. **Note** You can set the value of the granularity, based on which the baseline configuration is applied with respect to revert action. You can set the following values for the Granularity: • Granularity is 1—The baseline configurations applied before the tuning and after the revert action, have homogenous carrier frequency configurations. The tuning goes in serial mode. • Granularity is 2—The baseline configurations applied before the tuning and after the revert action, have homogenous carrier frequency configurations. The tuning goes in serial mode. • Granularity is 3—The baseline configurations applied before the tuning and after the revert action, are different. The tuning goes in parallel mode. **Note** If the baseline is imported, only granularities 1 and 2 are allowed. The whole set of granularity values (1, 2, and 3) is allowed in blind mode only.	1	3	3	N/A

Parameter	Description	Minimum	Maximum	Default	Unit
OLS Add-Drop Constraints	Selects the type of SLTE implemented and affects the baseline generation. The available options are: • Limited—The Number Of Ports for each OLS Add-Drop Module is limited by the Required PSD. • Unlimited—No limitations are considered.	Limited, Unlimited	Limited, Unlimited	Unlimited	
OLS Add-Drop Module Max Output Power	Maximum Output Power of the OLS Add-Drop Module in dBm. This parameter is used in Limited mode to calculate the Maximum Number Of Ports for each OLS Add-Drop Module provisionable with the required PSD.	–20.00	23.00	12 for Limited	dBm

Parameter	Description	Minimum	Maximum	Default	Unit
Number Of Ports per OLS Add-Drop Module	Number of ports currently connected to the OLS Add-Drop Module device. This parameter is used ONLY in the Limited Mode to check if the Number Of Ports per OLS Add-Drop Module are enough to support the Required minimum required PSD at its input. If the result is higher than the Required minimum PSD, the application proceeds with the configuration; otherwise, it warns you that the Number Of Ports per OLS Add-Drop Module exceeds the maximum number compared to the worst case. The application also provides: • The maximum number of channels allowed with the current PSD: This is calculated according to the following formula: Number Of Ports per OLS Add-Drop Module $\leq$ [10^(OLS Add-Drop Module Max Output Power(dBm)/10)]/{72(GB)*[10^(Input PSD(dBm/GHz)/10)]}. • The minimum required input PSD to be set in the Manual Mode to allow usage of the current number of channels: The minimum required input PSD (in dBm/GHz) is derived according to the following formula: Input PSD(dBm/GHz) $\leq$ 10*log10{ [10^(OLS Add-Drop Module Max Output Power(dBm)/10)]/[Number Of Ports per OLS Add-Drop Module*72(GB)]}. You can preserve the current Number Of Ports per OLS Add-Drop Module by setting the Required PSD parameter in the Manual Mode according to the value of PSD.	1	150	12 for Limited	N/A
Number Of OLS Add-Drop Module	Number of Mux/Demux devices used to aggregate the carriers. A Filtering Guardband (GBf) is required between each of them in order to avoid any filtering impairment.	1	20	8 for Limited	N/A

Parameter	Description	Minimum	Maximum	Default	Unit
Grid Granularity	Value of the slice width of the Wavelength Selective Switch (WSS) units. The total width of any group of channels (Media Channel (MCH) or equivalent) is multiple of this parameter.	1	100	6.25 for Limited and 12.5 GHz for Unlimited	GHz
Filtering Guard band	Value of the wasted BW due to filtering impairment at the edge of the MCH. Each MCH has one filtering guard band at each edge. (Two in total.) GBs is considered for each side. The Modulation GB (GBm) describes the value of GB that must be observed among the channels, within the same MCH. In general, GBf is ≥ 0 GHz. When carriers are combined into an MCH, the different GBs are combined to obtain the MCH required bandwidths.	0	100	6.25 for Limited	GHz

[1] Starting with Cisco AST 2.1, the minimum data rate is 100.
[2] For releases earlier than Cisco AST 2.1, the minimum data rate is 200.

Subsea Configuration Parameters

Table 12: Feature History

Feature Name	Release Information	Feature Description
Change in default value support for Carrier Phase Recovery Window Mode (cpr-win-mode)	Cisco AST Release 2.1	The default value that is supported for the Carrier Phase Recovery Window Mode is increased from 1 to 4.

The following table explains the subsea configuration parameters.

Parameter	Description	Min	Max	Default	Unit
cd-max	Maximum chromatic dispersion.	–350000	+350000	+1000	ps/nm
cd-min	Maximum chromatic dispersion.	–350000	+350000	–1000	ps/nm
cpr-ext-win-mode	Carrier phase recovery extended window mode. The range is 1–9. Choose the value depending on the number of symbols. It can support up to 288 symbols for subsea and long-haul transmission over large dispersion and large effective area fiber.	1	9	8	N/A

Parameter	Description	Min	Max	Default	Unit
cpr-win-mode	Carrier Phase Recovery Window Mode. The range is 1–4. Choose the value depending on the number of symbols. It can support up to 75 symbols for terrestrial regional, long-haul propagation over G.655 fiber type (small core diameter, low dispersion), or older submarine cable optimized for direct detect modulation.	1	4	1[3] 4[4]	N/A
cross-pol-gain-mode	Carrier Phase Recovery Cross Polarization Gain Mode. The optimal value for subsea and long-haul transmission over large dispersion and large effective area fiber is in the range of 3–6. The optimal value for terrestrial regional, long-haul propagation over G.655 fiber type (small core diameter, low dispersion), or older submarine cable optimized for direct detect modulation, is 0.	0	15	4	N/A
cross-pol-weight-mode	Carrier Phase Recovery Cross Polarization Weight Mode. The optimal value for subsea and long-haul transmission over large dispersion and large effective area fiber is in the range of 3–6. The optimal value for terrestrial regional or long-haul propagation over G.655 fiber type (small core diameter, low dispersion) or older submarine cable optimized for direct detect modulation, is in the range of 2–4.	1	7	4	N/A
enh-colorless-mode	Enhanced Colorless Mode. In colorless Rx deployment, you must not set this parameter to Mode 0. The colorless interference penalty depends on many conditions; hence we recommend choosing mode 1–3 for each wavelength, by and determining the mode that provides the lowest BER. Typically, the edge channels (of a wavelength group) require only Mode 1, whereas the channels in the middle of each group need Mode 2 or 3. In Colored Rx deployment, set this parameter to Mode 0.	1	3	3	N/A

Parameter	Description	Min	Max	Default	Unit
enh-sop-tol-mode	Enhanced Second Order Polarization (SOP) Tolerance Mode. In subsea deployment, we recommend setting this parameter to Mode 3 for enhanced sensitivity. In subsea, the polarization state is minimal, and you can use a reduced tracking rate to improve linear sensitivity. This bit can only be enabled in Low-Power state. In terrestrial network with aerial fiber deployment, if the cable is optical ground wire (OPGW) and deployed in regions with potential lightning activity, we recommend setting this parameter to Mode 1. This setting slightly degrades back-to-back sensitivity but enables DSP to track much faster SOP events. In those types of deployments, we recommend using the highest baud rate possible and a payload rate that is less than or equal to 400G.	1	3	3	N/A
filter-roll-off-factor	Root Raised Cosine (RRC) Filter Roll-Off Factor. In subsea, the goal is to maximize overall cable capacity. Therefore, you must pack as many wavelengths as you can on the fiber pair, with minimal spectral gaps between the channels. We recommend using transmitter RRC pulse shape with roll-off factor of 0.07 to 0.085. This change can be made while in high-power state. Reducing the Tx roll-off factor usually generates a small back-to -back sensitivity penalty. However, in deployment, a reduced roll-off factor reduces the effect of neighboring channel interference.	0	1	0.074 (in steps of 0.001, length of string must be 5)	N/A

Parameter	Description	Min	Max	Default	Unit
nleq-comp-mode	Configures the nonlinear compensation functionality and optimizes best performance over propagation. For +D system with high dispersion large effective area fiber, set the value to the following value: • 1 for high baud rate (60Gbaud - 72Gbaud) • 2 for lower baud rates (30Gbaud > 55Gbaud) Similarly, for small effective area and low dispersion fiber, set the value to the following value, to provide better performance with longer distance and higher accumulated dispersion: • 3 for high baud rate (60Gbaud -> 72Gbaud). • 4 for lower baud rates (30Gbaud -> 55Gbaud).	1	4	2	N/A
rx-voa-mode	Receive variable optical attenuation mode. The available options are: • fixed-ratio • target-power			fixed-ratio	
rx-voa-fixed-ratio	Receive Ratio of Optical Attenuation. • In colorless deployment, choose 17dB as the ratio. • In colored deployment, choose 15dB as the ratio. .	1	17	17	dB
rx-voa-target-power	Receive Target Power. • In colorless deployment, choose 7dBm as the target power. • In colored deployment, choose 5dBm as the target power.	−19	+3	−7	dBm

[3] For releases earlier than Cisco AST 2.1, the default value is 1.
[4] Starting with Cisco AST 2.1, the default value is 4.

Troubleshoot Cisco AST Issues Using Logs

You can troubleshoot any issues that you may encounter while using the Cisco AST application by reviewing the data available in the following logs:

Table 13: Cisco AST Logs

Logs	Description
Tech-Support Logs (for issues with licensing process)	The Smart Agent integrated with Cisco AST provides logs information regarding the licensing process. • Click the License icon in the left panel. The **Smart Software Licensing** page appears. • Click **View** under **Tech-Support Logs**. You can view the log information related to the licensing process. • Click **Save as File** to save the logs to a text format. You can share the file with the Cisco support team to troubleshoot any issues in the licensing process.
Tuner Intermediate Logs	You can troubleshoot the issues in a tuning project based on the tuner intermediate logs, such as the configuration data fetched and applied in the tuning process. • Click **Projects** in the left panel. • Under the **Logs** column, click the log icon corresponding to a project. • Click **Open** or **Download** to view or download the tuner intermediate logs.

Logs	Description
Audit Logs	Audit logs display a historical record of events performed by users in the Cisco AST application. • Click **Admin** in the left panel. • Click **Audit Logs**. A table listing the type of events, description of the events, timestamps, and the user who triggered the events appears. • To filter the events, choose the **Start Date** and the **End Date**, and select the type of events from the **Select Log Event** drop-down list. • Click **Export** to download the audit log details in a compressed format (zip file) to your local system.
Troubleshooting Logs	The troubleshooting page is a centralized logging area that includes entire logs related to the services and components of a tuner project. • Click **Troubleshooting** in the left panel. • Click **Download** to download the logs in a CSV file format. • Click **View** to view service logs in the Kibana dashboard. Kibana is an open-source analytics and visualization platform. For information about Kibana, see https://www.elastic.co/products/kibana. You can filter the logs and download it from the Kibana page.