

Raman Tuning

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Overview of Raman Tuning

Raman Tuning Algorithm calculates and sets the different pump power values across five Raman pumps to obtain the target Raman Gain on a span. Raman tuning runs in both directions of the span independently at the node level. Raman tuning requires communication between peer nodes. Hence, OSC communication between the two nodes is a prerequisite for Raman Tuning.

Raman tuning algorithm uses the following parameters to calculate the pump powers necessary to achieve the target Raman gain.

- Fiber type
- Fiber length
- Loss on the fiber at each pump wavelength
- Loss on the fiber at the signal wavelength

If you configure a span length value, Raman tuning uses this value.

Raman tuning is disabled by default. Raman tuning is enabled if automatic link bring up is enabled. You can manually trigger Raman tuning if necessary. initiates the tuning process under the following circumstances:

- During the initial link bring up
- After a fiber cut
- After a power cycle event
- After a line card cold reload event
- After a DFB shut or unshut event
- After an OTS controller shut or unshut event on near end or far end node
- After modification of span length configuration

Raman tuning is traffic impacting. When Raman tuning is in progress, the amplifier on the far end of the span is turned off to block traffic. The Optical Safety Remote Interlock (OSRI) feature allows turning off the amplifier on the peer node for Raman tuning. Only the OSC is active on the link while Raman tuning is in progress.

At the LINE-TX port on the far end of the span, the dedicated Raman probe (DFB) is combined with the transmitted optical channels. The DFB laser at 191.1 THz is used to perform a link continuity check on the Raman span for optical safety. The DFB laser is used during Raman tuning.

At the LINE-RX port, five wavelengths between 1424 nm and 1495 nm are inserted in the counter propagating direction of the signal to provide amplification using the Raman effect for both C and L band optical channels.

The system triggers Raman tuning when a link goes down and comes back up. After completing Raman tuning successfully, soft reloads, RP reloads, Raman OSRI change, and Raman Force APR change do not retrigger Raman tuning.

The following table lists and describes the different Raman Tuning Status.

Raman Tuning Status	Description
WORKING – MEASUREMENT	The algorithm is measuring the span loss on the link.
WORKING – CALCULATION	The algorithm is calculating the gain target and required pump powers.
WORKING – OPTIMIZATION	The algorithm is optimizing the pump powers.
TUNED	Raman tuning is complete.
BLOCKED	The system is unable to perform Raman tuning. This status can occur because the link is down or the system detected high Raman Back Reflection.
DISABLED	Raman tuning is disabled.

Raman tuning works in the following three modes:

- Auto mode: Raman tuning defines the target gain and sets the pump powers and DFB VOA attenuation to achieve the target gain overwriting user configuration.
- Gain mode: User defines the gain target and Raman tuning sets the pump powers and DFB VOA attenuation to achieve the target gain.
- Manual mode: User disables Raman tuning and manually configures the Raman pumps and DFB VOA attenuation.

Note

- If Raman back reflection (BR) is high, Raman tuning turns the Raman pumps off and goes into blocked state. High BR can damage the optics. When you clear the high BR and BR is at acceptable levels, the system triggers Raman tuning and turns the Raman pumps on.
- If a Raman span has a span loss value less than 14 dB, Raman tuning goes into the BLOCKED state. performs a span loss check at system startup to verify if you can use Raman amplification effectively on the span.

View Raman Tuning Status

You can view the Raman tuning status using **show olc raman-tuning** command. The following sample is an output of the **show olc raman-tuning** command.

```
RP/0/RP0/CPU0:ios#sh olc raman-tuning
Tue Mar 21 06:11:36.944 UTC

Controller : Ots0/0/0/0
Raman-Tuning Status : TUNED
Tuning Complete Timestamp : 2023-03-20 07:54:00
Estimated Max Possible Gain : 19.8 dB
Raman Gain Target : 16.0 dB
Gain Achieved on Tuning Complete : 15.7 dB
```

You can view the Raman tuning status for individual controllers using **show olc raman-tuning controller ots r/s/i/p** command. The following sample is an output of the **show olc raman-tuning controller ots** *r/s/i/p* command.

```
RP/0/RP0/CPU0:ios#sh olc raman-tuning controller ots 0/0/0/0
Tue Mar 21 06:13:26.535 UTC

Controller : Ots0/0/0/0
Raman-Tuning Status : TUNED
Tuning Complete Timestamp : 2023-03-20 07:54:00
Estimated Max Possible Gain : 19.8 dB
Raman Gain Target : 16.0 dB
Gain Achieved on Tuning Complete : 15.7 dB
```

You can view detailed Raman tuning status using **show olc raman-tuning details** command. The following sample is an output of the **show olc raman-tuning details** command.

```
RP/0/RP0/CPU0:ios#show olc raman-tuning details
Tue Mar 21 06:27:13.302 UTC

Controller : Ots0/0/0/0
Raman-Tuning Status : TUNED
Tuning Complete Timestamp : 2023-03-20 07:54:00
Estimated Max Possible Gain : 19.8 dB
Raman Gain Target : 16.0 dB
Gain Achieved on Tuning Complete : 15.7 dB
Last Run Fail Reason : [ Peer node is unreachable ]
Last Run Fail Timestamp : 2023-03-19 12:20:37
Last Successful Tuning Gain : 15.7 dB
Last Successful Tuning Timestamp : 2023-03-20 07:54:00
```

You can view detailed Raman tuning status for individual controllers using **show olc raman-tuning details controller ots r/s/i/p** command. The following sample is an output of the **show olc raman-tuning details controller ots** *r/s/i/p* command.

```
RP/0/RP0/CPU0:ios#show olc raman-tuning details controller Ots 0/0/0/0
Tue Mar 21 06:27:58.213 UTC

Controller : Ots0/0/0/0
Raman-Tuning Status : TUNED
Tuning Complete Timestamp : 2023-03-20 07:54:00
Estimated Max Possible Gain : 19.8 dB
Raman Gain Target : 16.0 dB
Gain Achieved on Tuning Complete : 15.7 dB
Last Run Fail Reason : [ Peer node is unreachable ]
Last Run Fail Timestamp : 2023-03-19 12:20:37
Last Successful Tuning Gain : 15.7 dB
Last Successful Tuning Timestamp : 2023-03-20 07:54:00
```

To view the individual Raman pump information and other parameters, use the **show controllers ots** *r/s/i/p* **raman-info** command.

```
RP/0/RP0/CPU0:ios#show controllers ots 0/0/0/0 raman-info
Fri Apr  1 06:40:33.849 UTC

          Alarm Status:
          -------------
          Detected Alarms: None


          Alarm Statistics:
          -----------------
          RAMAN-AUTO-POW-RED = 0
          RAMAN-1-LOW-POW = 0
          RAMAN-2-LOW-POW = 0
          RAMAN-3-LOW-POW = 0
          RAMAN-4-LOW-POW = 0
          RAMAN-5-LOW-POW = 0
          RAMAN-1-HIGH-POW = 1
          RAMAN-2-HIGH-POW = 0
          RAMAN-3-HIGH-POW = 0
          RAMAN-4-HIGH-POW = 0
          RAMAN-5-HIGH-POW = 0

          Parameter Statistics:
          ---------------------
          Raman Safety Control mode = auto
          Raman Osri = OFF
          Raman Force Apr = OFF
          Composite Raman Power = 886.60 mW

          RAMAN Pump Info:
          ----------------------
          Instance        Wavelength(nm)  Power(mW)
           1               1424.00                 257.60
           2               1438.00                 255.10
           3               1457.00                 71.60
           4               1470.00                 127.50
           5               1495.00                 170.10



          Configured Parameters:
          -------------
          Raman Safety Control mode = auto
          Raman Osri = OFF
          Raman Force Apr = OFF

          RAMAN Pump Info:
          ----------------------
          Instance        Power(mW)
           1               45.00
           2               40.00
           3               40.00
           4               40.00
           5               35.00
```

Note In the previous output, there are two sections for Raman Pump Info that show different values. The first Raman Pump Info section displays operational data (current pumps power values). The second Raman Pump Info section displays Raman Pump Power configuration. In this case, the default pump powers are displayed. Use the **raman-tx-power** *pump***value***value* command to configure individual Raman pump powers.

The Raman tuning application locks the OTDR scan at both fiber ends before the tuning starts, and releases the lock after the tuning completes. Therefore, when you try to start the OTDR scan when Raman tuning is running, your request gets rejected. The following example explains the OTDR start request rejection. The OTDR scan request that has been rejected already does not run automatically after the lock is released, so you have to create a new request to start the OTDR again.

Configure Raman Tuning

The following configurations are available for Raman Tuning:

Disable Raman Tuning

You can disable Raman tuning for a controller. Use the following commands to disable Raman tuning.

configure

optical-line-control

controller ots *Rack/Slot/Instance/Port*

raman-tuning disable

commit

end

The following is a sample configuration that disables Raman tuning.

```
RP/0/RP0/CPU0:ios#configure
RP/0/RP0/CPU0:ios(config)#optical-line-control
RP/0/RP0/CPU0:ios(config-olc)#controller ots 0/0/0/0
RP/0/RP0/CPU0:ios(config-olc-ots)#raman-tuning disable
RP/0/RP0/CPU0:ios(config-olc-ots)#commit
RP/0/RP0/CPU0:ios(config-olc-ots)#end
```

Enable Raman Tuning

You can enable Raman tuning for a controller. Use the following commands to enable Raman tuning.

configure

optical-line-control

controller ots *Rack/Slot/Instance/Port*

raman-tuning enable

commit

end

The following is a sample configuration that enables Raman tuning.

```
RP/0/RP0/CPU0:ios#configure
RP/0/RP0/CPU0:ios(config)#optical-line-control
RP/0/RP0/CPU0:ios(config-olc)#controller ots 0/0/0/0
RP/0/RP0/CPU0:ios(config-olc-ots)#raman-tuning enable
RP/0/RP0/CPU0:ios(config-olc-ots)#commit
RP/0/RP0/CPU0:ios(config-olc-ots)#end
```

Configure Raman Gain Target

You can manually set the desired Raman gain target. Use the following commands to set the Raman gain target.

configure

optical-line-control

controller ots *Rack/Slot/Instance/Port*

raman-tuning raman-gain-target *value*

commit

end

You can configure Target Raman Gain of 8.0 to 25.0 dB in multiples of 0.1 dB. The following is a sample configuration that configures the Raman gain target to 18 dB.

```
RP/0/RP0/CPU0:ios#configure
RP/0/RP0/CPU0:ios(config)#optical-line-control
RP/0/RP0/CPU0:ios(config-olc)#controller ots 0/0/0/0
RP/0/RP0/CPU0:ios(config-olc-ots)#raman-tuning raman-gain-target 180
RP/0/RP0/CPU0:ios(config-olc-ots)#commit
RP/0/RP0/CPU0:ios(config-olc-ots)#end
```



Note If you use ALC to calibrate your Raman links, you must configure Raman gain target in multiples of 1 dB.

Configure Raman Pump Powers

You can set the Raman pump powers manually. Use the following commands to set the pump powers.

configure

controller ots *Rack/Slot/Instance/Port*

raman-tx-power *pump***value***value*

commit

end

The following is a sample configuration that sets the pump power of the first Raman pump to 211 mW.

```
RP/0/RP0/CPU0:ios#configure
RP/0/RP0/CPU0:ios(config-olc)#controller ots 0/0/0/0
RP/0/RP0/CPU0:ios(config-olc-ots)#raman-tx-power 1 value 21100
RP/0/RP0/CPU0:ios(config-olc-ots)#commit
RP/0/RP0/CPU0:ios(config-olc-ots)#end
```

Configure DFB VOA Attenuation

Raman tuning algorithm changes the DFB VOA to adjust the DFB Tx power depending on the span loss. The following table lists the DFB TX power for different span loss ranges.

Span Loss	DFB TX Power
14-25 dB	-5 dB
25-33 dB	0 dB
>33 dB	5 dB

Use the following commands to configure DFB VOA attenuation when Raman Tuning is disabled and you want to configure the DFB manually.

configure

controller dfb *Rack/Slot/Instance/Port*

tx-voa-attenuation *value*

commit

end

The following is a sample configuration that sets the DFB VOA attenuation to 10 dB.

```
RP/0/RP0/CPU0:ios#conf
Wed Jul  6 04:45:47.720 UTC
RP/0/RP0/CPU0:ios(config)#controller dfb 0/0/0/0
RP/0/RP0/CPU0:ios(config-Dfb)#tx-voa-attenuation 100
RP/0/RP0/CPU0:ios(config-Dfb)#commmit
RP/0/RP0/CPU0:ios(config-Dfb)#end
```

Initiate Raman Tuning

You can trigger Raman tuning manually. Use the following exec command to trigger Raman tuning.

olc start-raman-tuning controller ots *Rack/Slot/Instance/Port*

The following is a sample configuration that initiates Raman tuning.

```
RP/0/RP0/CPU0:ios#olc start-raman-tuning controller ots 0/0/0/0
```

Raman Tuning with OTDR Lock

Table 1: Feature History

Feature Name	Release Information	Description
Raman Tuning with OTDR Lock	Cisco IOS XR Release 7.10.1	If the OTDR scan and Raman tuning are performed on the same fiber simultaneously, the OTDR reports unexpected results. In this release, a check is being implemented to prevent both operations from running simultaneously. The Raman tuning application imposes an OTDR lock at both ends of the fiber before the process starts and releases the same after the tuning is completed.

The OTDR scan and Raman tuning cannot be simultaneously executed on the same fiber. To resolve this issue, Raman tuning application locks the OTDR at both ends of the fiber before the tuning process starts and releases the lock after the tuning completes.

If the OTDR scan is in progress, the lock request is rejected and the Raman tuning application retries every minute to acquire the OTDR lock. The Raman tuning starts only when OTDR scan lock is acquired at both ends of the fiber. If the Raman tuning application is running, user request to start OTDR scan is rejected.

The following sample shows the blocked status of the Raman Tuning due to OTDR running in remote node.

```
RP/0/RP0/CPU0:ios#show olc raman-tuning
Tue Feb 28 10:32:12.648 UTC

Controller                       : Ots0/0/0/0
Raman-Tuning Status              : BLOCKED
Blocked Reason Details           : [ Raman peer response OSRI ON/OTDR LOCK ON failure ]
Tuning Complete Timestamp        : N/A
Estimated Max Possible Gain      : N/A dB
Raman Gain Target                : N/A dB
Gain Achieved on Tuning Complete : N/A dB
```

The following sample shows the blocked status of the Raman Tuning due to OTDR running in local node.

```
P/0/RP0/CPU0:ios#sh olc raman-tuning
Tue Feb 28 10:39:18.055 UTC
Controller                       : Ots0/0/0/0
Raman-Tuning Status              : BLOCKED
Blocked Reason Details           : [ Raman local OTDR LOCK ON failure ]
Tuning Complete Timestamp        : N/A
Estimated Max Possible Gain      : N/A dB
Raman Gain Target                : N/A dB
Gain Achieved on Tuning Complete : N/A dB
```