Configuring the Card Mode

This chapter lists the supported configurations and the procedures to configure the card mode on the line cards.

Note Unless otherwise specified, “line cards” refers to 1.2T and 1.2TL line cards.

1.2T and 1.2TL Line Cards

The following section describes the supported configurations and procedures to configure the card modes on the line cards.

Card modes

A card mode is a configuration option for line cards that

- determines which trunk and client ports operate together,
- controls whether trunk rates are set globally or independently, and
- defines how client ports are mapped to trunk ports.

Each line card includes two trunk ports (0 and 1) and twelve client ports (2 through 13). You can configure each line card in one of two modes.

Muxponder mode

Both trunk ports (0 and 1) are configured with the same trunk rate. Client-to-trunk mapping is sequential and enables all client ports to use the combined bandwidth of the trunks efficiently.

Muxponder slice mode

Each trunk port (0 and 1) is configured independently, allowing different trunk rates for each. The client to trunk mapping is fixed. Client ports 2 through 7 map to trunk 0, and client ports 8 through 13 map to trunk 1.

Sub 50G configuration

A Sub 50G configuration is a line card setup that

- enables data transmission rates below 50 Gbps or coupled mode on muxponder line cards,
- allows flexible port assignments and mapping for various supported data rates, and
- imposes specific requirements and operational restrictions when configured.

Standard port configurations for Sub 50G data rates

You can configure Sub 50G or coupled mode on the line card only when operating in muxponder mode. This table shows the supported port configurations for various data rates.

Table 1: Port configuration for supported data rates

Trunk data rate (per trunk)	Total configured data rate	Card support	Trunk ports	Client ports for trunk 0 (100G)	Shared client port (50G per trunk)	Client ports for trunk 1 (100G)
50G	100G	1.2T, 1.2TL	0, 1	-	2	-
150G	300G	1.2T, 1.2TL	0, 1	2	3	4
250G	500G	1.2T , 1.2TL	0, 1	2, 3	4	5, 6
350G	700G	1.2T , 1.2TL	0, 1	2, 3, 4	5	6, 7, 8
450G	900G	1.2T	0, 1	2, 3, 4, 5	6	7, 8, 9, 10
550G	1.1T	1.2T	0, 1	2, 3, 4, 5, 6	7	8, 9, 10, 11, 12

Alternate port configurations (split client port mapping)

From Release 7.5.2, 1.2T and 1.2TL line cards support an alternate port configuration for Sub 50G (split client port mapping), which you configure using CLI. This table shows the alternate port mapping for the supported data rates:

Operational considerations

In all x50G configurations, client traffic on the middle port is affected by ODUK-BDI and LF alarms after a **power cycle** or **link flap** on the trunk side. This issue occurs when two network lanes operate in coupled mode and move from low to high power. To resolve this, create a new frame at the near-end or far-end by performing a **shut** or **no shut** of the trunk ports.

Restrictions for coupled mode configurations

These restrictions apply to coupled mode configuration:

- Both trunk ports must be configured with the same bits-per-symbol or baud rate and must be sent over the same fiber and direction.
- Chromatic dispersion values must be configured identically for both trunk ports.
- When trunk internal loopback is configured, it must be set for both trunk ports. Configuring internal loopback on only one trunk results in traffic loss.
- A fault on a trunk port of a coupled pair may cause errors on all clients, including those running only on the unaffected trunk port.

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Supported Data Rates

The following data rates are supported on the line card.

In R7.0.1, you can configure the client port to OTU4 only in the muxponder mode. In R7.1.1 and later releases, you can configure the client port to OTU4 in both the muxponder and muxponder slice modes. In muxponder slice mode, both the slices must be configured with either OTU4 or 100GE Ethernet client rates in R7.1.1. In R7.2.0, a mixed configuration of OTU4 and 100GE is supported in the muxponder slice mode. LLDP drop, L1 encryption, and AINS are not supported on the OTU4 configuration.

The following table displays the client and trunk ports that are enabled for the muxponder configuration.

Trunk Data Rate	Card Support	Client Data Rate (100GE, OTU4)	Trunk Ports	Client Ports
100	1.2T, 1.2TL	100GE, OTU4	0, 1	2, 3
200	1.2T, 1.2TL	100GE, OTU4	0, 1	2, 3, 4, 5
300	1.2T, 1.2TL	100GE, OTU4	0, 1	2, 3, 4, 5, 6, 7
400	1.2T, 1.2TL	100GE, OTU4	0, 1	2, 3, 4, 5, 6, 7, 8, 9
500	1.2T	100GE, OTU4	0, 1	2, 3, 4, 5, 6, 7, 8, 9, 10, 11
600	1.2T	100GE, OTU4	0, 1	2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13

The following table displays the client and trunk ports that are enabled for the muxponder slice 0 configuration.

Trunk Data Rate	Card Support	Client Data Rate	Trunk Ports	Client Ports
100	1.2T, 1.2TL	100GE, OTU4	0	2
200	1.2T, 1.2TL	100GE, OTU4	0	2, 3
300	1.2T, 1.2TL	100GE, OTU4	0	2, 3, 4

Trunk Data Rate	Card Support	Client Data Rate	Trunk Ports	Client Ports
400	1.2T, 1.2TL	100GE, OTU4	0	2, 3, 4, 5
500	1.2T	100GE, OTU4	0	2, 3, 4, 5, 6
600	1.2T	100GE, OTU4	0	2, 3, 4, 5, 6, 7

The following table displays the client and trunk ports that are enabled for the muxponder slice 1 configuration.

Trunk Data Rate	Card Support	Client Data Rate	Trunk Ports	Client Ports
100	1.2T, 1.2TL	100GE, OTU4	1	8
200	1.2T, 1.2TL	100GE, OTU4	1	8, 9
300	1.2T, 1.2TL	100GE, OTU4	1	8, 9, 10
400	1.2T, 1.2TL	100GE, OTU4	1	8, 9, 10, 11
500	1.2T	100GE, OTU4	1	8, 9, 10, 11, 12
600	1.2T	100GE, OTU4	1	8, 9, 10, 11, 12, 13

All configurations can be accomplished by using appropriate values for client bitrate and trunk bitrate parameters of the **hw-module** command.

The following table displays the trunk parameter ranges for the 1.2T card.

Trunk Payload	FEC	Min BPS	Max BPS	Min GBd	Max GBd
50G	15%	1	1.3125	24.0207911	31.5272884
50G	27%	1	1.4453125	24.0207911	34.7175497
100G	15%	1	2.625	24.0207911	63.0545768
100G	27%	1	2.890625	24.0207911	69.4350994
150G	15%	1.3203125	3.9375	24.0207911	71.6359689
150G	27%	1.453125	4.3359375	24.0207911	71.6749413
200G	15%	1.7578125	5.25	24.0207911	71.7420962
200G	27%	2	4.40625	31.51	69.43
250G	15%	2.1953125	6	26.2727403	71.8059237
250G	27%	2.4140625	6	28.9312914	71.9068991
300G	15%	2.6328125	6	31.5272884	71.8485385
300G	27%	2.8984375	6	34.7175497	71.8681352
350G	15%	3.0703125	6	36.7818364	71.8790086

Trunk Payload	FEC	Min BPS	Max BPS	Min GBd	Max GBd
350G	27%	3.3828125	6	40.503808	71.8404724
400G	15%	3.5078125	6	42.0363845	71.9018782
400G	27%	3.8671875	6	46.2900663	71.8197392
450G	15%	3.9453125	6	47.2909326	71.9196757
450G	27%	4.34375	6	52.0763245	71.9327648
500G	15%	4.3828125	6	52.5454806	71.93392
500G	27%	4.8281250	6	57.8625828	71.9068991
550G	15%	4.8203125	6	57.8000287	71.9455787
550G	27%	5.3125	6	63.6488411	71.88575
600G	15%	5.2578125	-	-	71.9552971

The following table displays the trunk parameter ranges for the 1.2TL card.

Trunk Payload	FEC	Min BPS	Max BPS	Min GBd	Max GBd
100G	15%	1	2.625	24.0207911	63.0545768
100G	27%	1	2.890625	24.0207911	69.4350994
150G	15%	1.3203125	3.9375	24.0207911	71.6359689
150G	27%	1.453125	4.3359375	24.0207911	71.6749413
200G	15%	2	4	31.5272884	63.0545768
200G	27%	2	4.40625	31.51664088	69.43509943
250G	15%	2.1953125	4.5	35.0303204	71.8059237
250G	27%	2.4140625	4.5	38.5750552	71.9068991
300G	15%	2.6328125	4.5	42.0363845	71.8485385
300G	27%	2.8984375	4.5	46.2900662857142	71.86813526
350G	15%	3.0703125	4.5	49.0424486	71.8790086
350G	27%	3.3828125	4.5	54.0050773	71.8404724
400G	15%	3.5078125	4.5	56.0485127	71.9018782
400G	27%	3.8671875	4.5	61.72008838	71.81973921

To configure the BPS, see Configuring the BPS, on page 11.

Configuring the Card Mode

You can configure the line card in the module (muxponder) or slice configuration (muxponder slice).

To configure the card in the muxponder mode, use the following commands.

configure

hw-module location *location* **mxponder client-rate {100GE** | **OTU4}**

hw-module location *location* **mxponder trunk-rate** {**50G** | **100G150G** | **200G** | **250G** | **300G** | **350G** | **400G** | **450G** | **500G** | **550G** | **600G** }

commit

To configure the card in the muxponder slice mode, use the following commands.

configure

hw-module location *location* **mxponder-slice** *mxponder-slice-number* **client-rate { 100GE|OTU4}**

hw-module location *location* **mxponder-slice trunk-rate** { **100G** | **200G** | **300G** | **400G** | **500G** | **600G** }

commit

Examples

The following is a sample in which the card is configured in the muxponder mode with a 550G trunk payload.

```
RP/0/RP0/CPU0:ios#config
Tue Oct 15 01:24:56.355 UTC
RP/0/RP0/CPU0:ios(config)#hw-module location 0/1 mxponder client-rate 100GE
RP/0/RP0/CPU0:ios(config)#hw-module location 0/1 mxponder trunk-rate 550G
RP/0/RP0/CPU0:ios(config)#commit
```

The following is a sample in which the card is configured in the muxponder mode with a 500G trunk payload.

```
RP/0/RP0/CPU0:ios#config
Sun Feb 24 14:09:33.989 UTC
RP/0/RP0/CPU0:ios(config)#hw-module location 0/2 mxponder client-rate OTU4
RP/0/RP0/CPU0:ios(config)#hw-module location 0/2 mxponder trunk-rate 500G
RP/0/RP0/CPU0:ios(config)#commit
```

The following is a sample in which the card is configured in the muxponder slice 0 mode with a 500G trunk payload.

```
RP/0/RP0/CPU0:ios#config
RP/0/RP0/CPU0:ios(config)#hw-module location 0/1 mxponder-slice 0 client-rate 100GE
RP/0/RP0/CPU0:ios(config)#hw-module location 0/1 mxponder-slice 0 trunk-rate 500G
RP/0/RP0/CPU0:ios(config)#commit
```

The following is a sample in which the card is configured in the muxponder slice 1 mode with a 400G trunk payload.

```
RP/0/RP0/CPU0:ios#config
RP/0/RP0/CPU0:ios(config)#hw-module location 0/1 mxponder-slice 1 client-rate 100GE
RP/0/RP0/CPU0:ios(config)#hw-module location 0/1 mxponder-slice 1 trunk-rate 400G
RP/0/RP0/CPU0:ios(config)#commit
```

The following is a sample in which the card is configured with mixed client rates in the muxponder slice mode.

```
RP/0/RP0/CPU0:ios#configure
Mon Mar 23 06:10:22.227 UTC
RP/0/RP0/CPU0:ios(config)#hw-module location 0/1 mxponder-slice 0 client-rate OTU4 trunk-rate
 500G
RP/0/RP0/CPU0:ios(config)#hw-module location 0/1 mxponder-slice 1 client-rate 100GE trunk-rate
 500G
RP/0/RP0/CPU0:ios(config)#commit
```

Verifying the Card Configuration

```
RP/0/RP0/CPU0:ios#show hw-module location 0/2 mxponder
Fri Mar 15 11:48:48.344 IST

Location:             0/2
Client Bitrate:       100GE
Trunk  Bitrate:       500G
Status:               Provisioned
LLDP Drop Enabled:    FALSE
Client Port            Mapper/Trunk Port   CoherentDSP0/2/0/0  CoherentDSP0/2/0/1
                    Traffic Split Percentage

HundredGigECtrlr0/2/0/2  ODU40/2/0/0/1               100                   0
HundredGigECtrlr0/2/0/3  ODU40/2/0/0/2               100                   0
HundredGigECtrlr0/2/0/4  ODU40/2/0/0/3               100                   0
HundredGigECtrlr0/2/0/5  ODU40/2/0/0/4               100                   0
HundredGigECtrlr0/2/0/6  ODU40/2/0/0/5               100                   0
HundredGigECtrlr0/2/0/7  ODU40/2/0/1/1                 0                 100
HundredGigECtrlr0/2/0/8  ODU40/2/0/1/2                 0                 100
HundredGigECtrlr0/2/0/9  ODU40/2/0/1/3                 0                 100
HundredGigECtrlr0/2/0/10 ODU40/2/0/1/4                 0                 100
HundredGigECtrlr0/2/0/11 ODU40/2/0/1/5                 0                 100
```

The following is a sample ouput of the coupled mode configuration where the shared client port is highlighted.

```
RP/0/RP0/CPU0:ios#show hw-module location 0/1 mxponder
Tue Oct 15 01:25:57.358 UTC

Location:             0/1
Client Bitrate:       100GE
Trunk  Bitrate:       550G
Status:               Provisioned
LLDP Drop Enabled:    FALSE
Client Port           Mapper/Trunk Port    CoherentDSP0/1/0/0 CoherentDSP0/1/0/1
                  Traffic Split Percentage

HundredGigECtrlr0/1/0/2    ODU40/1/0/0/1             100                   0
HundredGigECtrlr0/1/0/3    ODU40/1/0/0/2             100                   0
HundredGigECtrlr0/1/0/4    ODU40/1/0/0/3             100                   0
HundredGigECtrlr0/1/0/5    ODU40/1/0/0/4             100                   0
HundredGigECtrlr0/1/0/6    ODU40/1/0/0/5             100                   0
HundredGigECtrlr0/1/0/7    ODU40/1/0/0/6              50                  50
HundredGigECtrlr0/1/0/8    ODU40/1/0/1/1               0                 100
HundredGigECtrlr0/1/0/9    ODU40/1/0/1/2               0                 100
HundredGigECtrlr0/1/0/10   ODU40/1/0/1/3               0                 100
HundredGigECtrlr0/1/0/11   ODU40/1/0/1/4               0                 100
HundredGigECtrlr0/1/0/12   ODU40/1/0/1/5               0                 100
```

The following is a sample ouput of all the muxponder slice 0 configurations.

```
RP/0/RP0/CPU0:ios#show hw-module location 0/1 mxponder-slice  0
Fri Mar 15 06:04:18.348 UTC

Location:             0/1
```

```
Slice ID:             0
Client Bitrate:       100GE
Trunk  Bitrate:       500G
Status:               Provisioned
LLDP Drop Enabled:    FALSE
Client Port                     Mapper/Trunk Port          CoherentDSP0/1/0/0
                                Traffic Split Percentage

HundredGigECtrlr0/1/0/2         ODU40/1/0/0/1                      100
HundredGigECtrlr0/1/0/3         ODU40/1/0/0/2                      100
HundredGigECtrlr0/1/0/4         ODU40/1/0/0/3                      100
HundredGigECtrlr0/1/0/5         ODU40/1/0/0/4                      100
HundredGigECtrlr0/1/0/6         ODU40/1/0/0/5                      100
```

The following is a sample ouput of all the muxponder slice 1 configurations.

```
RP/0/RP0/CPU0:ios#show hw-module location 0/1 mxponder-slice 1
Fri Mar 15 06:11:50.020 UTC

Location:             0/1
Slice ID:             1
Client Bitrate:       100GE
Trunk  Bitrate:       400G
Status:               Provisioned
LLDP Drop Enabled:    TRUE
Client Port                     Mapper/Trunk Port          CoherentDSP0/1/0/1
                                Traffic Split Percentage

HundredGigECtrlr0/1/0/8         ODU40/1/0/1/1                      100
HundredGigECtrlr0/1/0/9         ODU40/1/0/1/2                      100
HundredGigECtrlr0/1/0/10        ODU40/1/0/1/3                      100
HundredGigECtrlr0/1/0/11        ODU40/1/0/1/4                      100
```

The following is a sample ouput of the muxponder slice 1 configuration with client configured as OTU4.

```
RP/0/RP0/CPU0:ios#sh hw-module location 0/0 mxponder-slice 1

Wed Mar 11 13:59:11.073 UTC

Location:             0/0
Slice ID:             1
Client Bitrate:       OTU4
Trunk  Bitrate:       200G
Status:               Provisioned
Client Port                     Peer/Trunk Port            CoherentDSP0/0/0/1
                              Traffic Split Percentage
OTU40/0/0/8                     ODU40/0/0/1/1                      100
OTU40/0/0/9                     ODU40/0/0/1/2                      100
```

The following is a sample to verify the mixed client rate configuration in the muxponder slice mode.

```
RP/0/RP0/CPU0:ios#show hw-module location 0/1 mxponder
Mon Mar 23 06:20:22.227 UTC

Location:             0/1
Slice ID:             0
Client Bitrate:       OTU4
Trunk  Bitrate:       500G
Status:               Provisioned
Client Port                     Peer/Trunk Port            CoherentDSP0/1/0/0
                                Traffic Split Percentage

OTU40/1/0/2                     ODU40/1/0/0/1                      100
OTU40/1/0/3                     ODU40/1/0/0/2                      100
```

```
OTU40/1/0/4                    ODU40/1/0/0/3                     100
OTU40/1/0/5                    ODU40/1/0/0/4                     100
OTU40/1/0/6                    ODU40/1/0/0/5                     100


Location:             0/1
Slice ID:             1
Client Bitrate:       100GE
Trunk  Bitrate:       500G
Status:               Provisioned
LLDP Drop Enabled:    FALSE
ARP Snoop Enabled:    FALSE
Client Port                    Mapper/Trunk Port          CoherentDSP0/1/0/1
                               Traffic Split Percentage

HundredGigECtrlr0/1/0/8        ODU40/1/0/1/1                       100
HundredGigECtrlr0/1/0/9        ODU40/1/0/1/2                       100
HundredGigECtrlr0/1/0/10       ODU40/1/0/1/3                       100
HundredGigECtrlr0/1/0/11       ODU40/1/0/1/4                       100
HundredGigECtrlr0/1/0/12       ODU40/1/0/1/5                       100
```

Use the following command to clear alarm statistics on the optics or coherent DSP controller.

clear counters controller *controllertype R/S/I/P*

The following is a sample in which the alarm statistics are cleared on the coherent DSP controller.

```
RP/0/RP0/CPU0:ios#show controller coherentDSP 0/1/0/0
Tue Jun 11 05:15:12.540 UTC

Port                                        : CoherentDSP 0/1/0/0
Controller State                            : Up
Inherited Secondary State                   : Normal
Configured Secondary State                  : Normal
Derived State                               : In Service
Loopback mode                               : None
BER Thresholds                              : SF = 1.0E-5  SD = 1.0E-7
Performance Monitoring                      : Enable

Alarm Information:
LOS = 1 LOF = 1 LOM = 0
OOF = 1 OOM = 1 AIS = 0
IAE = 0 BIAE = 0        SF_BER = 0
SD_BER = 2      BDI = 2 TIM = 0
FECMISMATCH = 0 FEC-UNC = 0
Detected Alarms                             : None

Bit Error Rate Information
PREFEC  BER                                 : 8.8E-03
POSTFEC BER                                 : 0.0E+00

TTI :
        Remote hostname                     : P2B8
        Remote interface                    : CoherentDSP 0/1/0/0
        Remote IP addr                      : 0.0.0.0

FEC mode                                    : Soft-Decision 15

AINS Soak                                   : None
AINS Timer                                  : 0h, 0m
AINS remaining time                         : 0 seconds
RP/0/RP0/CPU0:ios#clear counters controller coherentDSP 0/1/0/0
Tue Jun 11 05:17:07.271 UTC
All counters are cleared
```

```
RP/0/RP0/CPU0:ios#show controllers coherentDSP 0/1/0/1
Tue Jun 11 05:20:55.199 UTC

Port                                          : CoherentDSP 0/1/0/1
Controller State                              : Up
Inherited Secondary State                     : Normal
Configured Secondary State                    : Normal
Derived State                                 : In Service
Loopback mode                                 : None
BER Thresholds                                : SF = 1.0E-5  SD = 1.0E-7
Performance Monitoring                        : Enable

Alarm Information:
LOS = 0 LOF = 0 LOM = 0
OOF = 0 OOM = 0 AIS = 0
IAE = 0 BIAE = 0        SF_BER = 0
SD_BER = 0      BDI = 0 TIM = 0
FECMISMATCH = 0 FEC-UNC = 0
Detected Alarms                               : None

Bit Error Rate Information
PREFEC  BER                                   : 1.2E-02
POSTFEC BER                                   : 0.0E+00

TTI :
        Remote hostname                       : P2B8
        Remote interface                      : CoherentDSP 0/1/0/1
        Remote IP addr                        : 0.0.0.0

FEC mode                                      : Soft-Decision 15

AINS Soak                                     : None
AINS Timer                                    : 0h, 0m
AINS remaining time                           : 0 seconds
```

Regeneration Mode

In an optical transmission system, 3R regeneration helps extend the reach of the optical communication links by reamplifying, reshaping, and retiming the data pulses. Regeneration helps to correct any distortion of optical signals by converting it to an electrical signal, processing that electrical signal, and then retransmitting it again as an optical signal.

In Regeneration (Regen) mode, the OTN signal is received on a trunk port and the regenerated OTN signal is sent on the other trunk port of the line card and the other way round. In this mode, only the trunk optics controller and coherentDSP controllers are created.

Configuring the Card in Regen Mode

The supported trunk rates for the different cards are:

To configure regen mode on 1.2T, 1.2TL, and 2-QDD-C cards, use the following commands:

configure

hw-module location *location*

regen

trunk-rate *trunk-rate*

commit

exit

Example

Verifying the Regen Mode

The following is a sample to verify the regen mode.

show hw-module location *location* **regen**

```
RP/0/RP0/CPU0:ios#show hw-module location 0/0 regen
Mon Mar 25 09:50:42.936 UTC

Location:             0/0
Trunk  Bitrate:       400G
Status:               Provisioned
East Port              West Port
CoherentDSP0/0/0/0      CoherentDSP0/0/0/1
```

The terms, East Port and West Port are used to represent OTN signal regeneration at the same layer.

Configuring the BPS

You can configure the Bits per Symbol (BPS) to 3.4375 to support 300G trunk configurations on 75 GHz networks using the following commands:

configure

controller optics *R/S/I/P* **bits-per-symbol 3.4375**

commit

The following is a sample in which the BPS is configured to 3.4375.

```
RP/0/RP0/CPU0:ios#configure
Wed Mar 27 14:12:49.932 UTC
RP/0/RP0/CPU0:ios(config)#controller optics 0/3/0/0 bits-per-symbol 3.4375
RP/0/RP0/CPU0:ios(config)#commit
```

Viewing BPS and Baud Rate Ranges

To view the the BPS for a specific range use the following command:

show controller optics *R/S/I/P* **bps-range** *bps-range* **| include** *data-rate* **| include** *fec-type*

```
RP/0/RP0/CPU0:ios#show controllers optics 0/3/0/0 bps-range 3 3.05 | include 300G | include
 SD27
Thu Mar 28 03:01:39.751 UTC
300G            SD27            3.0000000       69.4350994
300G            SD27            3.0078125       69.2547485
300G            SD27            3.0156250       69.0753320
300G            SD27            3.0234375       68.8968428
300G            SD27            3.0312500       68.7192736
300G            SD27            3.0390625       68.5426174
300G            SD27            3.0468750       68.3668671
```

To view the baud for a specific range use the following command:

show controller optics *R/S/I/P* **baud-rate-range** *baud-range* **| include** *data-rate* **| include** *fec-type*

```
RP/0/RP0/CPU0:ios#show controllers optics 0/3/0/0 baud-rate-range 43 43.4 | include 300G |
 include SD27
Thu Mar 28 03:12:36.521 UTC
300G            SD27            4.8046875       43.3545986
300G            SD27            4.8125000       43.2842178
300G            SD27            4.8203125       43.2140651
300G            SD27            4.8281250       43.1441394
300G            SD27            4.8359375       43.0744397
300G            SD27            4.8437500       43.0049648
```

Configuring the Trunk Rate for BPSK

From R7.2.1 onwards, you can configure trunk rates of 50G, 100G, and 150G to support Binary Phase-Shift Keying (BPSK) modulation. The BPSK modulation enables information to be carried over radio signals more efficiently.

You can configure trunk rates for BPSK using CLI, NetConf YANG, and OC models.

The following table list the 50G, 100G, and 150G trunk rates with the supported BPSK modulation:

Trunk Rate	BPSK Modulation
50G	1 to 1.4453125
100G	1 to 2.890625
150G	1.453125 to 4.3359375

To configure the trunk rate for BPSK modulation, enter the following commands:

configure

hw-module location *location* **mxponder**

trunk-rate {50G | 100G | 150G}

commit

The following example shows how to configure trunk rate to 50G:

```
RP/0/RP0/CPU0:(config)#hw-module location 0/0 mxponder
RP/0/RP0/CPU0:(config-hwmod-mxp)#trunk-rate 50G
RP/0/RP0/CPU0:(config-hwmod-mxp)#commit
```

Viewing the BPSK Trunk Rate Ranges

To view the trunk rate configured for the BPSK modulation, use the following **show** commands:

```
RP/0/RP0/CPU0:ios(hwmod-mxp)#show hw-module location 0/0 mxponder

Tue Feb 25 11:13:41.934 UTC


Location:             0/0
Client Bitrate:       100GE
Trunk  Bitrate:       50G
Status:               Provisioned
LLDP Drop Enabled:    FALSE
ARP Snoop Enabled:    FALSE
```

```
Client Port                     Mapper/Trunk Port          CoherentDSP0/0/0/0
CoherentDSP0/0/0/1
                                Traffic Split Percentage


HundredGigECtrlr0/0/0/2         ODU40/0/0/0                             50
      50


RP/0/RP0/CPU0:ios#show controllers optics 0/0/0/0
Thu Mar  5 07:12:55.681 UTC

Controller State: Up

Transport Admin State: In Service

Laser State: On

LED State: Green

 Optics Status

         Optics Type:  DWDM optics
         DWDM carrier Info: C BAND, MSA ITU Channel=61, Frequency=193.10THz,
         Wavelength=1552.524nm

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


         LOS/LOL/Fault Status:

         Alarm Statistics:

         -------------
         HIGH-RX-PWR = 0            LOW-RX-PWR = 2
         HIGH-TX-PWR = 0            LOW-TX-PWR = 0
         HIGH-LBC = 0               HIGH-DGD = 0
         OOR-CD = 0                 OSNR = 0
         WVL-OOL = 0                MEA  = 0
         IMPROPER-REM = 0
         TX-POWER-PROV-MISMATCH = 0
         Laser Bias Current = 0.0 %
         Actual TX Power = 1.97 dBm
         RX Power = 1.58 dBm
         RX Signal Power = 0.60 dBm
         Frequency Offset = 386 MHz

         Performance Monitoring: Enable

         THRESHOLD VALUES
         ----------------

         Parameter                High Alarm  Low Alarm  High Warning  Low Warning
         -----------------------  ----------  ---------  ------------  -----------
         Rx Power Threshold(dBm)          4.9      -12.0           0.0          0.0
         Tx Power Threshold(dBm)          3.5      -10.1           0.0          0.0
         LBC Threshold(mA)                N/A        N/A          0.00         0.00

         Configured Tx Power = 2.00 dBm
         Configured CD High Threshold = 180000 ps/nm
         Configured CD lower Threshold = -180000 ps/nm
         Configured OSNR lower Threshold = 0.00 dB
```

```
        Configured DGD Higher Threshold = 180.00 ps
        Baud Rate =  34.7175521851 GBd
        Bits per Symbol = 1.0000000000  bits/symbol
        Modulation Type: BPSK
        Chromatic Dispersion -9 ps/nm
        Configured CD-MIN -180000 ps/nm  CD-MAX 180000 ps/nm
        Polarization Mode Dispersion = 0.0 ps
        Second Order Polarization Mode Dispersion = 125.00 ps^2
        Optical Signal to Noise Ratio = 34.60 dB
        SNR = 20.30 dB
        Polarization Dependent Loss = 0.20 dB
        Polarization Change Rate = 0.00 rad/s
        Differential Group Delay = 2.00 ps
        Filter Roll Off Factor : 0.100
        Rx VOA Fixed Ratio : 15.00 dB
        Enhanced Colorless Mode : 0
        Enhanced SOP Tolerance Mode : 0
        NLEQ Compensation Mode : 0
        Cross Polarization Gain Mode : 0
        Cross Polarization Weight Mode : 0
        Carrier Phase Recovery Window : 0
        Carrier Phase Recovery Extended Window : 0


AINS Soak               : None
AINS Timer              : 0h, 0m
AINS remaining time     : 0 seconds
```

OTN-XP Card

The following section describes the supported configurations and procedures to configure the card modes on the line card.

LC Mode on OTN-XP Card

When you install the OTN-XP card in the Cisco NCS 1004 chassis, it is in the POWERED_ON state. The **LCMODE is not configured for line card** alarm is present on the card and the LED status is AMBER.

```
sysadmin-vm:0_RP0# show platform
Thu Mar  26 21:38:07.305 UTC+00:00
Location  Card Type              HW State      SW State      Config State
--------------------------------------------------------------------------------
0/0       NCS1K4-LC-FILLER       PRESENT       N/A           NSHUT
0/1       NCS1K4-OTN-XP          POWERED_ON    N/A           NSHUT
0/RP0     NCS1K4-CNTLR-K9        OPERATIONAL   OPERATIONAL   NSHUT
0/FT0     NCS1K4-FAN             OPERATIONAL   N/A           NSHUT
0/FT1     NCS1K4-FAN             OPERATIONAL   N/A           NSHUT
0/FT2     NCS1K4-FAN             OPERATIONAL   N/A           NSHUT
0/PM0     NCS1K4-AC-PSU          OPERATIONAL   N/A           NSHUT
0/SC0     NCS1004                OPERATIONAL   N/A           NSHUT

sysadmin-vm:0_RP0# show alarms brief system active
Thu Mar  26 21:38:34.394 UTC+00:00

------------------------------------------------------------------------------
Active Alarms
------------------------------------------------------------------------------
Location          Severity      Group           Set time            Description
------------------------------------------------------------------------------
```

```
0                major         environ         03/26/20 20:23:11   Power Module redundancy
 lost.
0                critical      environ         03/26/20 20:23:29   Fan: One or more LCs
missing, running fans at max speed.
0/1              not_alarmed   shelf           03/26/20 21:38:26   LCMODE is not configured
 for line card
sysadmin-vm:0_RP0#
```

```
sysadmin-vm:0_RP0# show led location 0/1
Thu Mar  26 21:39:05.101 UTC+00:00
============================================================
Location  LED Name                       Mode          Color
============================================================
0/1
          0/1-Status LED                 WORKING       AMBER
sysadmin-vm:0_RP0#
```

You must select a datapath mode by configuring the LC mode. OTN-XP does not have a default LC mode. After the LC mode is configured using the CLI,the card transitions to the OPERATIONAL state, the alarm clears, and the LED status turns to GREEN.

The LC modes supported on the OTN-XP card are:

- 10G-GREY-MXP

Note 100G-TXP LC mode is not supported.

Only one LC mode can be configured on the OTN-XP card at a time. When the LC mode is changed using the CLI, the **LCMODE changed, delete the datapath config and reload line card** alarm is present on the card and the DP FPD is in disabled state. To clear the alarm and enable the DP FPD, delete the the existing datapath configuration and reload the line card to apply the new LC mode to make the card operational.

If a LC mode requires a different FPGA configuration, and the package is not available, the **OTN_XP_DP_FPD_PKG is missing, please install the package to proceed** alarm is present on the card. To clear the alarm, install the OTN_XP_DP_FPD_PKG file. After the package installation is complete, the required FPGA image is copied from the OTN_XP_DP_FPD_PKG file to the card, the card is automatically reloaded, and the card becomes operational.

Note The LC mode configuration is a shared plane configuration. The configuration does not enter the preconfigured state when the line card is not available.

Configuring the LC Mode

Note

- Ensure the OTN_XP_DP_FPD_PKG file is installed before configuring the LC mode.
- When you insert an OTN-XP line card having a lower FPD version, you must configure a LC mode which is supported on the software release that the line card is loaded with. You cannot upgrade the FPD of a line card if you configure a LC mode supported only in a higher software release.

To configure the LC mode on the OTN-XP card, use the following commands:

configure

lc-module location *location* **lcmode** *mode*

commit

Example

To view the LC modes available on the OTN-XP card, use the following command:

```
RP/0/RP0/CPU0:ios#sh lc-module location 0/0 lcmode all
Wed Sep 29 14:41:51.487 UTC
States: A-Available     R-Running       C-Configured

Node    Lcmode_Supported    Owner    Options(State)                HW_Ver
-------------------------------------------------------------------------------
0/0     Yes                 None     10G-GREY-MXP (A)               3.0
                                     4x100G-MXP-400G-TXP (A)        2.0
```

The following is a sample in which the OTN-XP card is configured in the 10G-GREY-MXP mode.

```
RP/0/RP0/CPU0:ios#configure
Thu Mar 26 21:40:51.495 UTC
RP/0/RP0/CPU0:ios(config)#lc-module location 0/1 lcmode 10G-GREY-MXP
RP/0/RP0/CPU0:ios(config)#commit
```

Verifying the LC Mode Configuration

The following is a sample output of a successful 10G-GREY-MXP LC mode configuration after which the card transitions to the OPERATIONAL state, the alarm clears, and the LED status turns to GREEN.

```
RP/0/RP0/CPU0:ios(config)#do show platform
Thu Mar 26 21:41:17.206 UTC
Node              Type                         State             Config state
-------------------------------------------------------------------------------
0/0               NCS1K4-LC-FILLER             PRESENT           NSHUT
0/1               NCS1K4-OTN-XP                OPERATIONAL       NSHUT
0/RP0/CPU0        NCS1K4-CNTLR-K9(Active)      IOS XR RUN        NSHUT
0/FT0             NCS1K4-FAN                   OPERATIONAL       NSHUT
0/FT1             NCS1K4-FAN                   OPERATIONAL       NSHUT
0/FT2             NCS1K4-FAN                   OPERATIONAL       NSHUT
0/PM0             NCS1K4-AC-PSU                OPERATIONAL       NSHUT
0/SC0             NCS1004                      OPERATIONAL       NSHUT
RP/0/RP0/CPU0:ios(config)#do show alarms brief system active
Thu Mar 26 21:41:29.641 UTC

------------------------------------------------------------------------------------
Active Alarms
------------------------------------------------------------------------------------
Location        Severity     Group            Set Time                    Description



------------------------------------------------------------------------------------
0               Major        Environ          03/26/2020 20:23:11 UTC     Power Module
redundancy lost.


0               Critical     Environ          03/26/2020 20:23:29 UTC     Fan: One or more
LCs missing, running fans at max speed.

RP/0/RP0/CPU0:ios(config)#end
RP/0/RP0/CPU0:ios#show lc-module location 0/1 lcmode all
Thu Mar 26 21:41:58.780 UTC
```

```
States: A-Available     R-Running       C-Configured

Node    Lcmode_Supported    Owner    Options(State)                HW_Ver
-------------------------------------------------------------------------------
0/1     Yes                 CLI      10G-GREY-MXP (R/C)             3.0
                                     4x100G-MXP-400G-TXP (A)        2.0
RP/0/RP0/CPU0:ios#show lc-module location 0/1 lcmode
Thu Mar 26 21:42:18.997 UTC

Node    Lcmode_Supported    Owner    Running                Configured
-------------------------------------------------------------------------------
0/1     Yes                 CLI      10G-GREY-MXP           10G-GREY-MXP
RP/0/RP0/CPU0:ios#admin
Thu Mar 26 21:42:38.525 UTC

root connected from 192.0.2.3 using ssh on sysadmin-vm:0_RP0
sysadmin-vm:0_RP0# show led location 0/1
Thu Mar  26 21:42:45.337 UTC+00:00
============================================================
Location  LED Name                      Mode         Color
============================================================
0/1
          0/1-Status LED                WORKING      GREEN
```

Example

The following is a sample in which the LC mode is changed from 10G-GREY-MXP to the 4x100G-MXP-400G-TXP mode. In this sample, the datapath configuration is deleted and the card is reloaded to apply the new LC mode.

```
RP/0/RP0/CPU0:ios#show lc-module location all lcmode
Thu Sep 30 10:19:29.853 UTC

Node    Lcmode_Supported    Owner    Running                Configured
-------------------------------------------------------------------------------
0/0     Yes                 CLI      10G-GREY-MXP           10G-GREY-MXP
0/1     No                  N/A      N/A                    N/A
0/2     No                  N/A      N/A                    N/A
0/3     No                  N/A      N/A                    N/A


RP/0/RP0/CPU0:ios#configure
Thu Sep 30 10:19:32.818 UTC
Current Configuration Session  Line       User     Date                      Lock
00001000-000051f7-00000000     vty1       root     Wed Sep 29 15:26:00 2021
RP/0/RP0/CPU0:ios(config)#no lc-module location 0/0 lcmode 10g-GREY-MXP
RP/0/RP0/CPU0:ios(config)#commit
Thu Sep 30 10:20:34.086 UTC
RP/0/RP0/CPU0:ios(config)#do show alarms brief system active
Thu Sep 30 10:20:52.950 UTC

------------------------------------------------------------------------------------
Active Alarms
------------------------------------------------------------------------------------
Location        Severity     Group            Set Time                  Description



------------------------------------------------------------------------------------
0/PM0           Major        Environ          09/29/2021 14:41:59 UTC    Power Module Output
```

```
 Disabled


0               Major        Environ          09/29/2021 14:42:15 UTC    Power Module
redundancy lost.


0               Critical     Environ          09/29/2021 14:42:25 UTC    Fan: One or more
LCs missing, running fans at max speed.


0/0             NotAlarmed   Shelf            09/30/2021 10:20:34 UTC    LCMODE changed,
delete the datapath config and reload line card




RP/0/RP0/CPU0:ios#configure
Thu Sep 30 10:21:41.281 UTC
Current Configuration Session  Line       User     Date                       Lock
00001000-000051f7-00000000     vty1       root     Wed Sep 29 15:26:00 2021
RP/0/RP0/CPU0:ios(config)#no hw-module location 0/0
RP/0/RP0/CPU0:ios(config)#commit
Thu Sep 30 10:21:49.982 UTC
RP/0/RP0/CPU0:ios(config)#

RP/0/RP0/CPU0:ios#show platform
Thu Sep 30 10:22:08.482 UTC
Node              Type                         State             Config state
--------------------------------------------------------------------------------
0/0               NCS1K4-OTN-XP                OPERATIONAL       NSHUT
0/2               NCS1K4-LC-FILLER             PRESENT           NSHUT
0/3               NCS1K4-LC-FILLER             PRESENT           NSHUT
0/RP0/CPU0        NCS1K4-CNTLR-K9(Active)      IOS XR RUN        NSHUT
0/FT0             NCS1K4-FAN                   OPERATIONAL       NSHUT
0/FT1             NCS1K4-FAN                   OPERATIONAL       NSHUT
0/FT2             NCS1K4-FAN                   OPERATIONAL       NSHUT
0/PM0             NCS1K4-AC-PSU                OPERATIONAL       NSHUT
0/SC0             NCS1004                      OPERATIONAL       NSHUT
RP/0/RP0/CPU0:ios#
RP/0/RP0/CPU0:ios#admin
Thu Sep 30 10:23:55.937 UTC
Last login: Thu Sep 30 04:32:57 2021 from 192.0.2.3
root connected from 192.0.2.3 using ssh on sysadmin-vm:0_RP0
sysadmin-vm:0_RP0# hw-module location 0/0 reload
Thu Sep  30 10:24:17.938 UTC+00:00
Reloading the module will be traffic impacting if not properly drained. Continue to Reload
 hardware module ? [no,yes] yes
result Card graceful reload request on 0/0 succeeded.
sysadmin-vm:0_RP0#show platform
Thu Sep  30 10:25:16.876 UTC+00:00
Location  Card Type               HW State      SW State      Config State
--------------------------------------------------------------------------------
0/0       NCS1K4-OTN-XP           POWERED_ON    N/A           NSHUT
0/2       NCS1K4-LC-FILLER        PRESENT       N/A           NSHUT
0/3       NCS1K4-LC-FILLER        PRESENT       N/A           NSHUT
0/RP0     NCS1K4-CNTLR-K9         OPERATIONAL   OPERATIONAL   NSHUT
0/FT0     NCS1K4-FAN              OPERATIONAL   N/A           NSHUT
0/FT1     NCS1K4-FAN              OPERATIONAL   N/A           NSHUT
0/FT2     NCS1K4-FAN              OPERATIONAL   N/A           NSHUT
0/PM0     NCS1K4-2KW-AC           OPERATIONAL   N/A           NSHUT
0/SC0     NCS1004-K9              OPERATIONAL   N/A           NSHUT

sysadmin-vm:0_RP0#exit
```

```
RP/0/RP0/CPU0:ios#show lc-module location all lcmode
Thu Sep 30 10:29:08.183 UTC

Node    Lcmode_Supported    Owner    Running                Configured
-------------------------------------------------------------------------------
0/0     Yes                 None     Not running            Not configured
0/1     No                  N/A      N/A                    N/A
0/2     No                  N/A      N/A                    N/A
0/3     No                  N/A      N/A                    N/A

RP/0/RP0/CPU0:ios#show platform
Thu Sep 30 10:29:36.075 UTC
Node              Type                         State             Config state
-------------------------------------------------------------------------------
0/0               NCS1K4-OTN-XP                POWERED_ON        NSHUT
0/2               NCS1K4-LC-FILLER             PRESENT           NSHUT
0/3               NCS1K4-LC-FILLER             PRESENT           NSHUT
0/RP0/CPU0        NCS1K4-CNTLR-K9(Active)      IOS XR RUN        NSHUT
0/FT0             NCS1K4-FAN                   OPERATIONAL       NSHUT
0/FT1             NCS1K4-FAN                   OPERATIONAL       NSHUT
0/FT2             NCS1K4-FAN                   OPERATIONAL       NSHUT
0/PM0             NCS1K4-AC-PSU                OPERATIONAL       NSHUT
0/SC0             NCS1004                      OPERATIONAL       NSHUT
RP/0/RP0/CPU0:ios#
RP/0/RP0/CPU0:ios#configure
Thu Sep 30 10:29:57.997 UTC
Current Configuration Session  Line       User     Date                       Lock
00001000-000051f7-00000000     vty1       root     Wed Sep 29 15:26:00 2021
RP/0/RP0/CPU0:ios(config)#lc-module location 0/0 lcmode 4x100G-MXP-400G-TXP
RP/0/RP0/CPU0:ios(config)#commit
Thu Sep 30 10:30:11.312 UTC
RP/0/RP0/CPU0:ios(config)#end
RP/0/RP0/CPU0:ios#show lc-module location all lcmode
Thu Sep 30 10:40:56.480 UTC

Node    Lcmode_Supported    Owner    Running                Configured
-------------------------------------------------------------------------------
0/0     Yes                 CLI      4x100G-MXP-400G-TXP    4x100G-MXP-400G-TXP
0/1     No                  N/A      N/A                    N/A
0/2     No                  N/A      N/A                    N/A
0/3     No                  N/A      N/A                    N/A

RP/0/RP0/CPU0:ios# RP/0/RP0/CPU0:ios#show  platform
Thu Sep 30 10:41:25.093 UTC
Node              Type                         State             Config state
-------------------------------------------------------------------------------
0/0               NCS1K4-OTN-XP                OPERATIONAL       NSHUT
0/2               NCS1K4-LC-FILLER             PRESENT           NSHUT
0/3               NCS1K4-LC-FILLER             PRESENT           NSHUT
0/RP0/CPU0        NCS1K4-CNTLR-K9(Active)      IOS XR RUN        NSHUT
0/FT0             NCS1K4-FAN                   OPERATIONAL       NSHUT
0/FT1             NCS1K4-FAN                   OPERATIONAL       NSHUT
0/FT2             NCS1K4-FAN                   OPERATIONAL       NSHUT
0/PM0             NCS1K4-AC-PSU                OPERATIONAL       NSHUT
0/SC0             NCS1004                      OPERATIONAL       NSHUT
RP/0/RP0/CPU0:ios#
```

Muxponder Configuration on OTN-XP Card

The OTN-XP card has two trunk ports and 12 client ports. The muxponder configuration supports two slices, 0 and 1. You can configure mxponder-slice 0, mxponder-slice 1, or both. Each mxponder-slice supports 10 client interfaces.

Table 2: Feature History

Feature Name	Release Information	Description
400 TXP or MXP modes with CFP2 DCO for OTN-XP Card	Cisco IOS XR Release 7.3.1	On the OTN-XP card, you can configure a single 400GE or 4x100G payload that is received over the client port as a 400G signal over DWDM on the line side. The card improves efficiency, performance, and flexibility for customer networks allowing 400GE or 4x100G client transport over 400G WDM wavelength. Commands modified: • **controller coherentDSP** • **show controller coherentDSP**

Table 3: Hardware Module Configuration with Client to Trunk Mapping

Hardware Module Configuration	Line Card Mode	Client Port Rate	Client to Trunk Mapping	Trunk Rate
10G Grey Muxponder	10G-GREY-MXP	OTU2, OTU2e, or 10 GE	Mxponder-slice 0—Client ports 4, 5, and 2 are mapped to the trunk port 0. Mxponder-slice 1—Client ports 7, 6, and 11 are mapped to the trunk port 1. Each client port consists of four lanes, 1, 2, 3, and 4. The lanes 3 and 4 can only be configured for ports 2 and 11. It is not mandatory to configure all 10 client lanes for a slice.	100G

Configuring the Muxponder Mode for 10G Grey Muxponder

Note The LC mode must be configured to 10G-GREY-MXP on the OTN-XP card before you perform this configuration.

To configure the OTN-XP card in the muxponder mode, use the following commands:

configure

hw-module location *location* **mxponder-slice** *mxponder-slice-number*

trunk-rate 100G

client-port-rate *client-port-number* **lane** *lane-number* **client-type { 10GE | OTU2 | OTU2e}**

commit

Example

The following is a sample in which the OTN-XP card is configured with mixed client rates in the mxponder-slice 0 mode.

```
RP/0/RP0/CPU0:ios#config
Tue Apr 21 09:21:44.460 UTC
RP/0/RP0/CPU0:ios(config)#hw-module location 0/1 mxponder-slice 0
RP/0/RP0/CPU0:ios(config-hwmod-mxp)#trunk-rate 100G
RP/0/RP0/CPU0:ios(config-hwmod-mxp)#client-port-rate 2 lane 3 client-type OTU2
RP/0/RP0/CPU0:ios(config-hwmod-mxp)#client-port-rate 2 lane 4 client-type OTU2
RP/0/RP0/CPU0:ios(config-hwmod-mxp)#client-port-rate 4 lane 1 client-type 10GE
RP/0/RP0/CPU0:ios(config-hwmod-mxp)#commit
```

Verifying the Muxponder Configuration

The following is a sample to verify the muxponder configuration in the OTN-XP card.

```
RP/0/RP0/CPU0:ios#show hw-module location 0/1 mxponder
Tue Apr 21 09:26:12.308 UTC

Location:             0/1
Slice ID:             0
Client Bitrate:       MIXED
Trunk  Bitrate:       100G
Status:               Provisioned
LLDP Drop Enabled:    FALSE
ARP Snoop Enabled:    FALSE
Client Port   Mapper/Trunk Port    Peer/Trunk Port    OTU40/0/0/0
              Traffic Split Percentage
OTU20/0/0/2/3            NONE          ODU20/0/0/0/2/3       100
OTU20/0/0/2/4            NONE          ODU20/0/0/0/2/4       100
TenGigECtrlr0/0/0/4/1 ODU2E0/0/0/0/4/1       NONE            100
```