DCP-404

Technical Description

dcp-release-12.0.1

Contents

1 Introduction

This manual provides the technical description for DCP-404. The DCP-404 is a muxponder card in the DCP-series that can be mounted in DCP-2 chassis.

1.1 General

The DCP-404 is a muxponder with 4x100G clients and one 400G line. This card will take one slot in a DCP-2 chassis.

Figure 1. *Front view of DCP-404 plug-in unit.*

The client side use QSFP28 pluggables and support 4x100GBE. Different options of QSFP28 pluggables can be used, e.g. SR4, LR4, CWDM4, ER4, ZR4. See chapter Technical data for supported formats and pluggables.

The line side use coherent 400G OpenZR+ DWDM QSFP-DD pluggables.

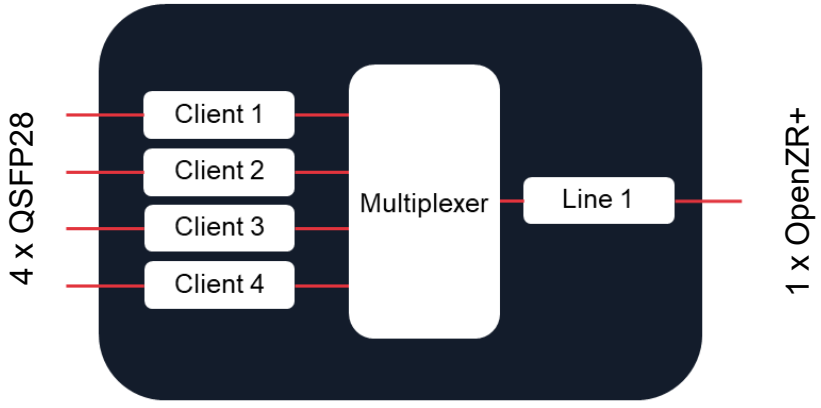


Figure 2. *Functional diagram for DCP-404.*

The line side can be configured to use different bit rates and modulation formats. The following multiplexing combinations are supported in R8.0.1:

- 4 x 100G using 400G-16QAM on the line
- 3 x 100G using 300G-8QAM on the line
- 2 x 100G using 200G-QPSK on the line
- 1 x 100G using 100G-QPSK on the line
- 1 x 100G using 100G-QPSK with stair case FEC on the line

1.2 In commercial confidence

The manual is provided in commercial confidence and shall be treated as such.

1.3 Document Revision History

Revision	Date	Description of changes
8.1.1 A	2023-07-05	First version for R8.1.1 user manual Added info about fan speed and boot loader
8.1.2 A	2023-08-09	Updated alarm list
8.1.3 A	2023-10-06	Added clarification on the 0 setting for BIP threshold. Removed info about fan speed and boot loader
8.1.4 A	2023-10-12	No update
8.1.4 B	2023-10-23	Updated text about hi temp shutdown. Added 200G 16QAM application Updated text about fan replacement
8.1.5 A	2023-11-01	No update
8.1.6 A	2023-11-17	Updated severity on eMMC failure alarm
8.1.7 A	2024-01-10	Added text about FW bug that will stop FEC counters
9.0.1 A	2024-01-22	Added chapter about G.826 PM reports Added support for TQD017-TUNC-SO and grey optics for the line side.
10.0.1 A	2024-07-01	Updated chapter about encryption Added support for settable dispersion range Added support for 400G ER Lite transceivers Added G.826 alarms, client fault alarms and encryption alarms
10.0.2 A	2024-09-05	Added support for TQD027
11.0.1 A	2024-12-12	Fiber intrusion function added
12.0.1 A	2025-06-24	Added a chapter about dynamic update of certified transceiver list Added support for 400G ULH, TQD029-TUNC-SO

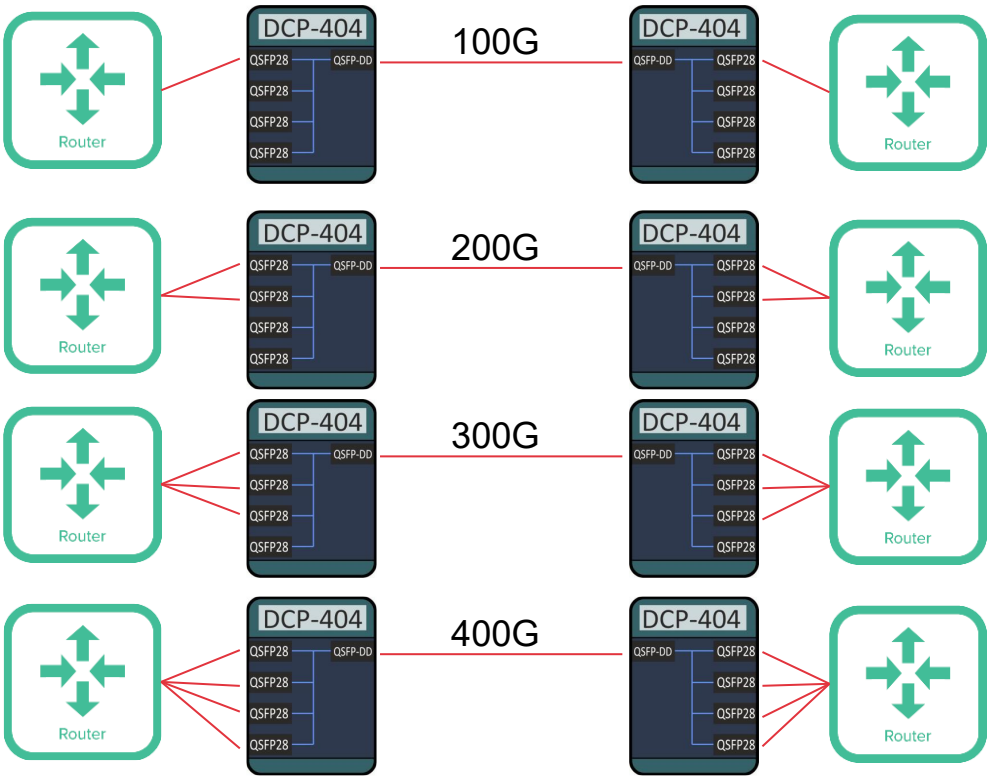
2 Applications

The DCP-404 can work as a 100G transponder in 1x100G mode or as a muxponder with the modes 2x100G, 3x100G and 4x100G. The line side use coherent DWDM pluggables and can be transported over dark fiber or any 400G capable line system, including:

- DCP-F
- DCP-R
- DCP-M

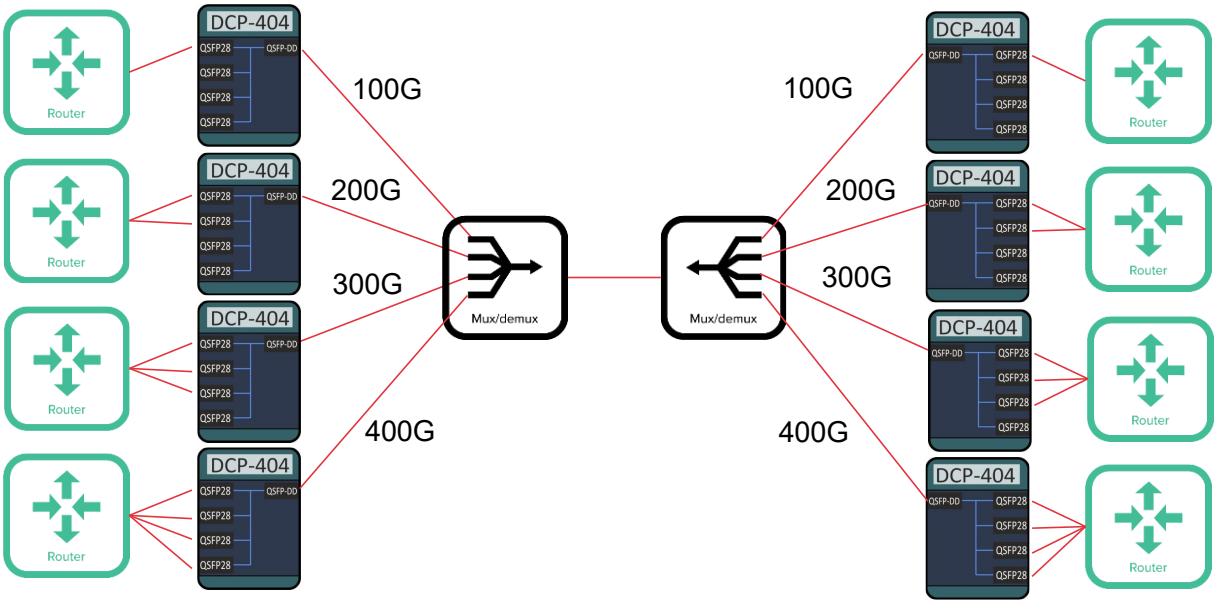
2.1 Transport over dark fiber

DCP-4 can be used over dark fiber without filters for distance extension or for multiplexing up to 4x100G on same wavelength. Maximum distance and attenuations can be found in the data sheets for the supported coherent DWDM QSFP-DD pluggables.



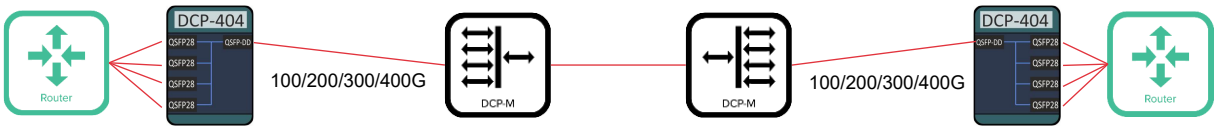
2.2 Transport over passive DWDM filters

It is possible to run DCP-404 over passive DWDM filters.
Note that the bandwidth, BW, is different for different signal formats. Therefore it is important to select a DWDM filter that is wide enough to support the required BW.
For 100G QPSK the 3dB BW is around 35GHz so 100G can be used in systems with 50GHz channel spacing and 3dB filter BW of >40GHz.
For 200G QPSK, 300G 8QAM and 400G 16QAM the 3dB BW is around 60GHz so they can be used in systems with 100GHz spacing and 3dB filter BW of >72.5GHz.
Several filters in Smartoptics H-series are 400G capable and have 3dB BW >72.5GHz.



2.3 Transport over DCP-M

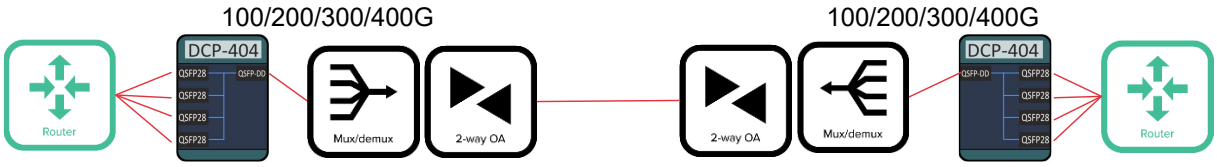
DCP-404 can be used over DCP-M systems. All DCP-M systems with 40ch filters are possible to use. However, the DCP-M units optimized for PAM4 have tunable dispersion compensation with limited BW. This means that high baud rate signals like 200G QPSK and 400G 16QAM will get filter penalty due to channel narrowing effects in those units. This will limit the maximum reach. For best reach and performance for DCP-404 it is recommended to use DCP-M40-C-ZR+ that is optimized for coherent signals.



2.4 Transport over DCP-F

It is possible to use DCP-F line system to transport 400G signals from DCP-404. It is important to select filters with BW that can support wide 400G signals.
The PPM DCM modules are channelized and have limited bandwidth so it is recommended to limit the total number of PPM DCM that 400G signals should pass. If dispersion

compensation is necessary, it is recommended to use continuous DCMs based on fiber gratings.



2.5 Transport over DCP-R

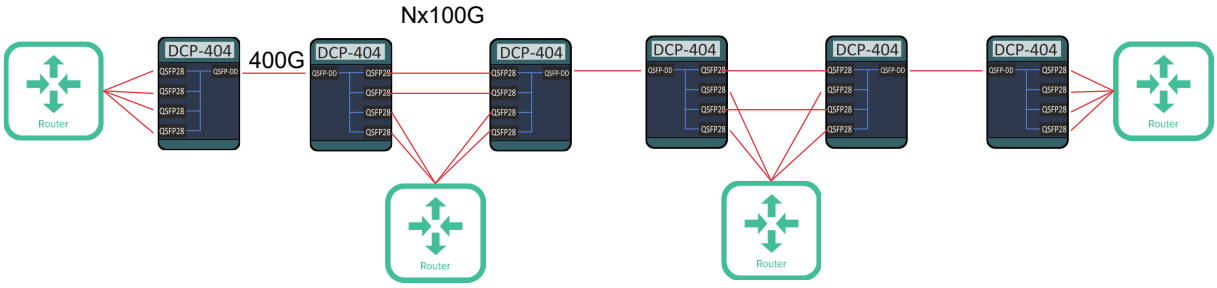
The DCP-R family is built to support coherent DWDM signals with different bit rates and signal format. The integrated 40ch filters have 3dB BW of 80GHz so signals up to 400G can be supported. Note that 400G QSFP-DD are available in low power and high power versions. The output power from the low power 400G QSFP-DD is quite low and it is not certain that any legacy ROADM system can handle that. DCP-R is built with this in mind so that low loss filters and WSS ports are used. It is possible to use both low and high power QSFP-DDs in DCP-R.

2.6 Transport over third party line system

It is possible to use DCP-404 as an alien traffic unit that is connected to a third-party line system. In this case it is important to make sure that the third-party line system is 400G ready so that it can support the output power from 400G coherent DWDM QSFP-DD and the wide spectral width.
Note that 400G QSFP-DD are available in low power and high power versions. High power versions may be needed in third party line systems.
See manual “Design Rules” for more information about the specific parameters.

2.7 ADM configuration

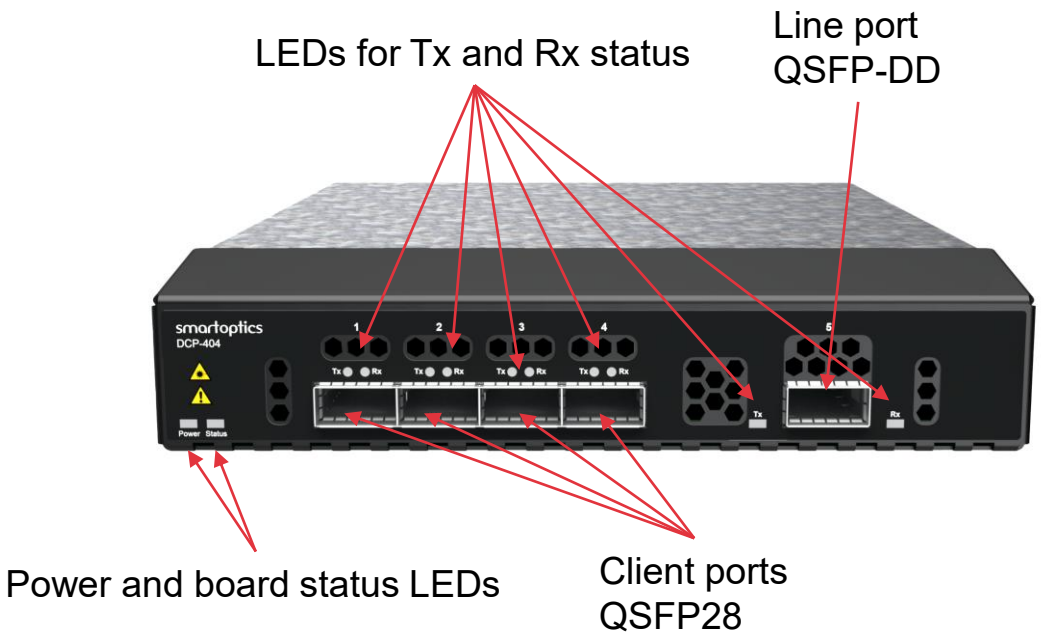
It is possible to patch client signals from one DCP-404 card to another up to 8 times. This is only tested with LR4 clients. The patching of clients makes it possible to create ADM configurations. In this case two DCP-404 cards are used in the intermediate ADM nodes. For each client signal it is possible to select if it should drop or continue. Note that there is no cross-connection functionality on the card so the cross connections are static and decided by patch cords connections.


Nx100G
DCP-404
400G
DCP-404
DCP-404
DCP-404
DCP-404
DCP-404
Router
Router
Router
Router

3 Functional description

3.1 Front layout

The front layout of DCP-404 is quite simple and it is dominated by the QSFP28 ports for the clients and the QSFP-DD port for the line. The front also contains some LEDs.



Traffic LEDs for Tx and Rx ports can show Green or Yellow light.
Green means OK.
Yellow means that there is a warning or alarm.

The LED for board status can show Green or Red light.
Green means OK.
Red means that there is a critical or major active alarm.

3.1.1 Traffic LEDs

The traffic LED's are used to indicate the status of the traffic.

Rx Off	Not receiving any light.
Rx Fault (yellow)	Receiving light but with alarm (loss of lock).
Rx On (green)	Receiving light and lock on the signal.
Tx Off	Tx is disabled.
Tx Fault (yellow)	An active alarm on the transmitter side (e.g Tx Faulty).
Tx On	Transmitting and no active alarm.

Traffic case		Traffic LED function	
Rx	Tx	Rx	Tx
Off	Off		
Off	Fault		
Off	On		
Fault	Off		
On	Off		
On	Fault		
On	On		
Fault	Fault		

3.1.2 Status LED

The status LED is Red during startup (both warm start and cold start).

When the software is up and running it shall reflect the highest severity of the module.

Green No active alarms.

Red At least 1 active Critical or Major alarm.

3.2 Client port configuration

The client side can support QSFP28 pluggables that follows the QSFP28 MSA and that have power class 7 (max 5W power consumption). Each of the 4 client ports can be configured individually with different settings and pluggables independently of the other ports.

The line side QSFP-DD functionality will define what signal formats that can be used on the client side. In this release only 100GbE is supported.

Different options of QSFP28 pluggables can be used, e.g. SR4, LR4, CWDM4, ER4, ZR4.

It is also possible to use single lane 100G optics, e.g. FR, DR, LR, FRx, LRx.

See chapter Technical Specifications for supported formats and pluggables.
FEC can be enabled or disabled on the client port.

All client ports have the possibility to use third party QSFP28 as long as they have supported formats and follow the QSFP28 MSA.

3.3 Line port configuration

The line side can support coherent DWDM QSFP56-DD pluggables with up to max 24W power consumption. The line port can be configured and activated independently from the client ports.

From release 9.0.1 it is also possible to use grey QSFP-DD transceivers on the line side.

3.3.1 Frequency settings and channel plan

It is possible to set the central frequency for the Tx laser from 191.30 THz to 196.10 THz in steps of 6.25GHz or 50GHz. The granularity will depend on the selected grid spacing. It is possible to select 6.25GHz or 50GHz grid spacing.

Same frequency that is used on the Tx port is then automatically used on the Rx side as well. It is not possible to have different frequencies on the transmitter and receiver.
The default central frequency on all tunable QSFP-DD is 193.10 THz.

3.3.2 Settable output power

Most coherent DWDM transceiver have a VOA integrated on the Tx port. This parameter can be set from R8.0.

3.3.3 Settable loss threshold

DCP-404 will use the loss threshold advertised by the QSFP-DD, but it is also possible to change this threshold manually by using the CLI commands “useLosOverride” and “ losThreshold”. See CLI manual for more info.

3.3.4 Settable alarm thresholds for low and high input power

DCP-404 will use the alarm thresholds for low and high input power advertised by the QSFP-DD, but it is also possible to change those thresholds manually by using the CLI commands “rxPowerAlarmThreshold”, “highRxThreshold” and “lowhRxThreshold”. See CLI manual for more info.

3.3.5 Traffic modes

DCP-404 supports different line rate and modulation settings. The parameter “Traffic Mode” will determine number of clients and the bit rate for the line side.
In R8.1.4 following traffic modes are available:

- mux:4x100G-400G
- mux:3x100G-300G
- mux:2x100G-200G

- mux:1x100G-100G
- mux:1x100G-100GscFEC
- mux:2x100G-200G16QAM

The default setting for each traffic mode is shown in the table below:

Traffic mode	Client signals	Line bit rate (Gb/s)	Modulation	Baud rate (Gbaud)	FEC
mux:4x100G-400G	4x100GBE	400	DP-16QAM	60	OFEC
mux:3x100G-300G	3x100GBE	300	DP-8QAM	60	OFEC
mux:2x100G-200G	2x100GBE	200	DP-QPSK	60	OFEC
mux:1x100G-100G	1x100GBE	100	DP-QPSK	30	OFEC
mux:1x100G-100GscFEC[1]	1x100GBE	100	DP-QPSK	30	SC-FEC
mux:2x100G-200G16QAM[2]	2x100GBE	200	DP-16QAM	30	OFEC

Table 1. Default modulation and bit rates for different traffic modes

[1]Some versions support Staircase FEC, but not all QSFP-DDs.
[2]Some versions support 200G 16QAM application, but not all QSFP-DDs.

The CD limits and sensitivity power limits will be set dynamically depending on which application code that is used.

For 100G it is possible to use 400G versions SO-TQSFPDD4CCZRP, TQD013-TUNC-SO, TQD014-TUNC-SO and FTCD3323R1PCL-** or the dedicated 100G versions DP01QSDD-ZT1-001, TQD011-TUNC-SO.

3.3.6 Pulse shaping

The pulse shaping parameter will determine the spectral shape of the signal and it will affect the bandwidth, roll-off factor and output power. It is possible to set the parameter “Pulse shaping” to enable or disable. Default is enable. When pulse shaping is enabled the signal has smaller spectral width, smaller roll-off factor and lower output power. The roll-off factor is about 0.2 when pulse shaping is enabled and around 0.4 when it is disabled. Disabling pulse shaping can increase the Tx power up to 3dB for the bit rates 200G, 300G and 400G on SO-TQSFPDD4CCZRP.

3.3.7 Settable dispersion range

The DSPs inside coherent QSFP-DDs can compensate for chromatic dispersion in a defined range. For each transceiver there is a default value for the min and max chromatic

dispersion. From R10.0.1 it is possible to change those values within the specification of the transceiver.

Settable dispersion range is supported on DCP-404 with following coherent QSFP-DDs:

SO-TQSFPDD4CCZRP, TQD011-TUNC-SO, TQD013-TUNC-SO, TQD017-TUNC-SO

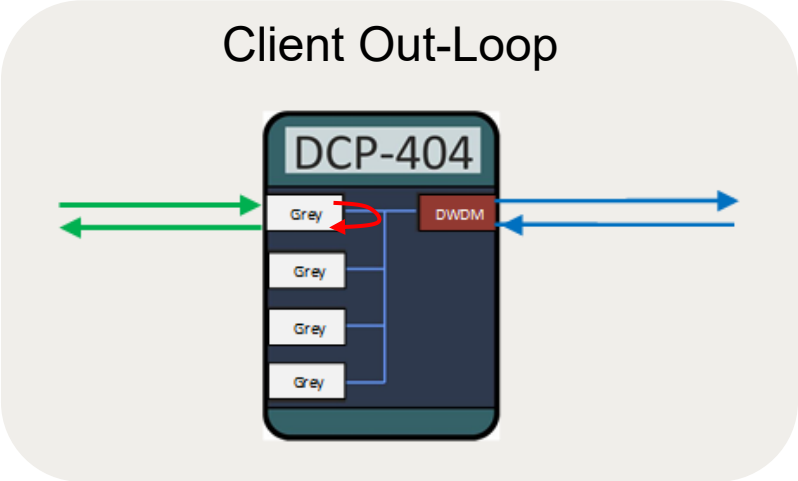
3.4 Loop back

Two different loop back settings are possible for the client side. A warning will be raised during the time that a port is configured in loop back mode.

In this release it is only the client loopback that is implemented, but line side loopback is considered for later releases.

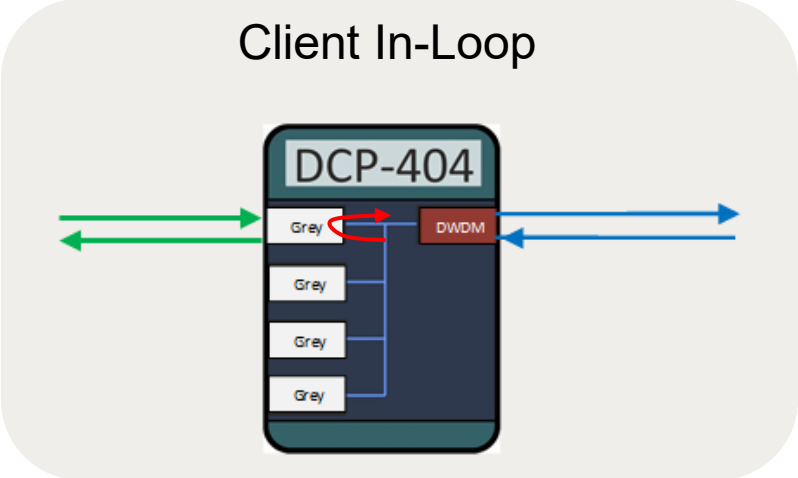
3.4.1 Client Out-loop

The client out-loop can be used to loop the signal back to the client equipment or to a test instrument connected on the client port. The loop is mainly done on the ports of the ASIC sitting after the QSFP28. No real data processing is done inside the ASIC for the looped signal.



3.4.2 Client In-loop

The client in-loop can be used to loop the signal back to the line side without using a patch cord on the client side. In this case the signal will be processed through the electronics in the DCP-404 before it is looped back to the line side.



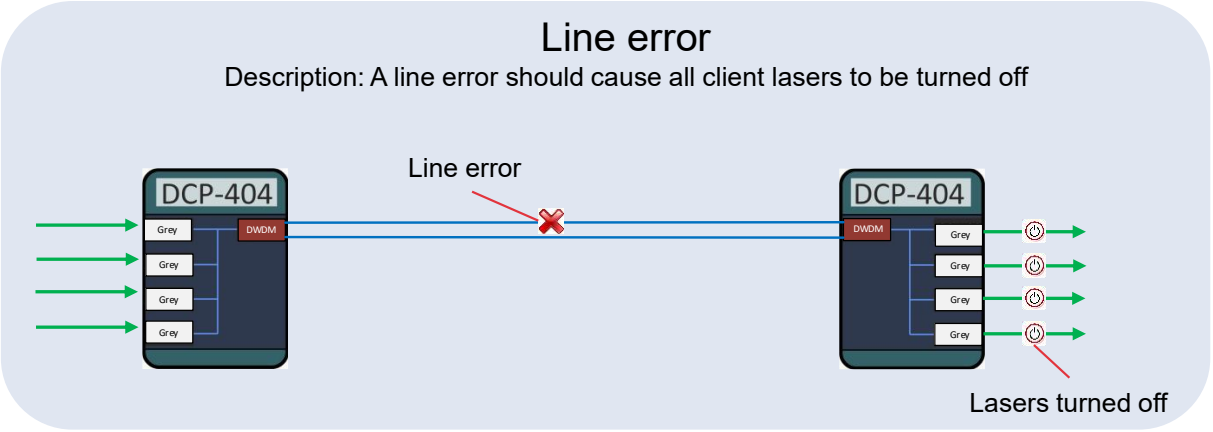
3.5 Link loss forwarding

Link loss forwarding is a setting that can be enabled or disabled via CLI commands. Link loss forwarding can be disabled by setting client laser forced on to enable. Default is that link loss forwarding is on. When link loss forwarding is enabled the client lasers will be turned off in case of an error on the line side

From R8.0 it is possible to use both client link loss forwarding and line link loss forwarding if the coherent QSFP-DD can support it.

3.5.1 Line Link Loss Forwarding

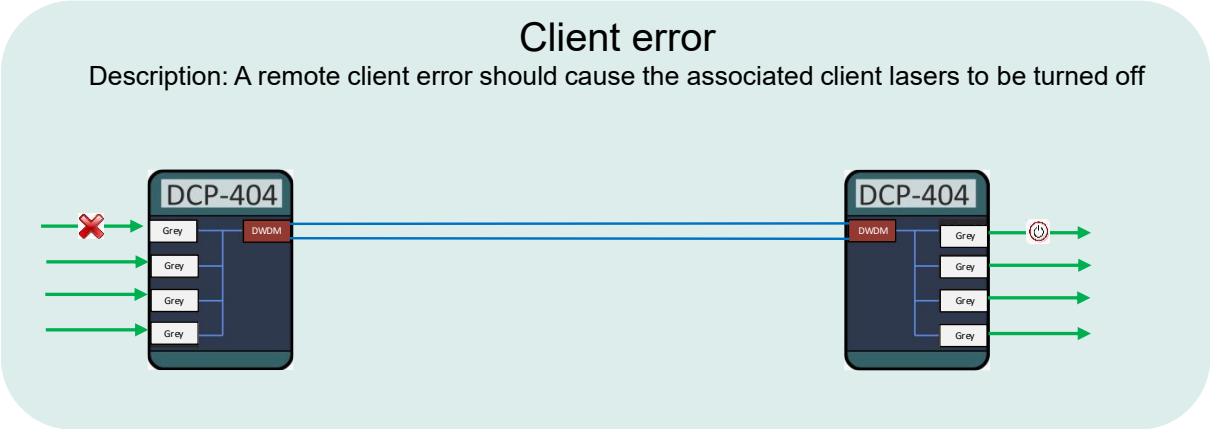
If the link loss forwarding is enabled (client laser forced on = disabled) then all client lasers will be automatically turned off if there is a line error..



3.5.2 Client Link Loss Forwarding

If the link loss forwarding is enabled (client laser forced on = disabled) then the corresponding client lasers on the remote site will be automatically turned off if there is a local client error.

This feature is only possible on coherent QSFP-DDs that support this feature, e.g. TQD013-TUNC-SO and TQD014-TUNC-SO. Client LLF is not possible when grey optics is used on the line side.



3.6 Performance monitoring

Many optical performance parameters are available on the DCP-404. The performance value presented is the current value for the last second. Accumulated or historical data are not presented.

Performance parameters on board level

Parameter	Unit	Description
Temperature	C°	Board temperature

Table 2. Performance parameters on board level

Performance parameters on client ports

Parameter	Unit	Description
Total Optical Rx power	dBm	Total received power for all lanes
Optical Rx power	dBm	Received power level per lane
Optical Tx power	dBm	Transmitted power level per lane
Total Optical Tx power	dBm	Total transmitted power for all lanes
Temperature	C°	QSFP28 temperature
Tx bias current	mA	Laser bias current

Table 3. Performance parameters on client ports

Performance parameters on the line ports

Parameter	Unit	Description
Total Optical Rx power	dBm	Total received power
Optical Signal Rx power	dBm	Received signal power level
Optical Tx power	dBm	Transmitted power level
Tx bias current	mA	Laser bias current
Temperature	C°	QSFP56-DD temperature
OSNR	dB	Optical signal to noise ratio
CD	ps/nm	Chromatic dispersion
DGD	ps	Differential Group Delay
Pre-FEC BER	Errors/s	BER before error correction
Pre-FEC BER avg	Errors/s	Average BER before error correction
Post-FEC BER	Errors/s	BER after error correction
Uncorrected BER	Errors/s	Uncorrected errors
Uncorrected BER avg	Errors/s	Average uncorrected errors
PDL	dB	Polarization Dependent Loss
SOP	Rad/s	State of polarization
Q-value	dBQ	Quality of transmission performance related to BER
Q-margin	dB	Margin for Quality of transmission performance related to BER

Table 4. Performance parameters on the line port

Note that the SO-TQSFPDD4CCZRP unit has a bug that will stop counting FEC parameters (Pre-FEC BER, Pre-FEC BER avg, Uncorrected BER, Uncorrected BER avg, Q-value, Q-margin) after LOS (loss of signal). The counters can be restarted by clearing the FEC counters. (clear interface if-1/<slot>/5 diagnostics)

There is a firmware bug in SO-TQSFPDD4CCZRP that causes FEC counters stop counting after toggling application code or frequency. This means that diagnostics will show 0 all the time for the FEC counters. It is possible to clear this fault by doing reboot, clear interface diagnostics or toggle admin status.

It is also possible to monitor FEC counters by using the command "*show interface diagnostics*".
Two values will be shown for each parameter, per second value and accumulated value.

Performance parameters for FEC counters

Parameter	Unit	Description
Uncorrected errors	errors	Number of errors that have not been corrected
Corrected errors	errors	Number of errors that have been corrected
Corrected 0 -> 1	errors	Number of bits identified as 0, but that have corrected to 1.
Corrected 1 -> 0	errors	Number of bits identified as 1, but that have corrected to 0.

Table 5. FEC counters in interface diagnostics

Ethernet BIP PM counters

From R8.0 it is possible to monitor BIP (Bit Interleaved Parity) errors in the Ethernet frames on the client and line ports.

```
Interface  Per second BIP counters  Accumulated BIP counters
=========  ========================  ========================
DCP-404
 if-1/2/1                        0                         0
 if-1/2/2                     1893                     13386
 if-1/2/3                        0                         0
 if-1/2/4                        0                         0
 if-1/2/5                        0                         0
```

It is possible to turn off the BIP threshold alarms by setting the threshold to 0.
The threshold is set to 0 by default so the user must activate the alarm threshold by changing the threshold from 0 to something else.

3.7 G.826 PM reporting

From R9.0.1 it is possible to get PM reports according to standard ITU-T G.826. This means that performance data will be presented in a standardized way with the 4 parameters, BBE, ES, SES and UAS. The system can produce PM reports for every 15 minutes and 24 hours time intervals. The errors that are reported could come from anomalies or defects. An anomaly is typically a bit error and a defect could be a loss of signal, alarm indication signal or loss of frame error.

- **BBE = Background Block Error**
  A BBE is observed when one anomaly occurs in a block not being part of an SES

- **ES = Error Second**
  An ES is observed when, during one second, at least one anomaly or one defect occurs. A block in which one or more bits are in error is called errored block, EB. For the ES event, the actual count of EBs is irrelevant; it is only the fact that an EB has occurred in a second which is significant.
- **SES = Severe Error Second**
  An SES is observed when, during one second, at least 30% EB:s (error blocks); derived from anomaly or one defect according occur.
- **UAS = Unavaliable Second**
  A period of unavailable time begins at the onset of ten consecutive SES events. These ten seconds are considered to be part of unavailable time. A new period of available time begins at the onset of ten consecutive non-SES events.

It is possible to enable and disable PM alarms on individual interfaces. This can be done separately for 15min and 24h periods. For each PM parameter there is a configurable alarm threshold.
The node can store 192 15min reports and 7 24h reports. When the maximum number has been reached the node will replace the oldest report with the newly generated one. The PM reports can be fetched by using sftpuser.
The reports are generated at pre-defined UTC time. 15min reports are generated 1min after the last period has ended. 24h reports are generated 5min after the last period has ended.

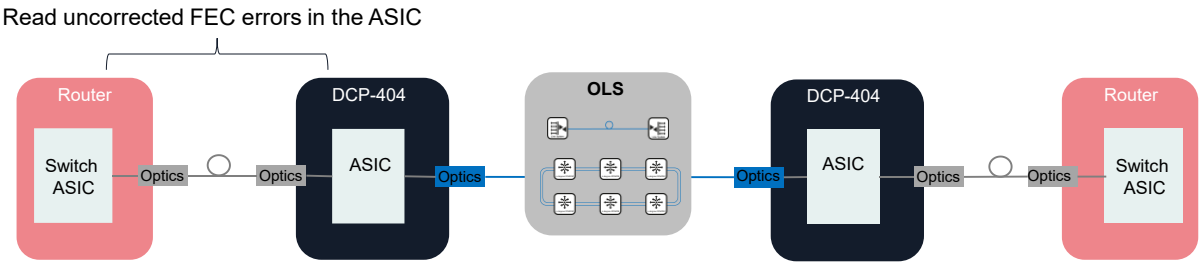
Note that client PM is based on BIP errors and FEC counters. Other L2 issues like alignment markers, undersized, runt or FCS errors are not detected.

The G.826 PM data will be calculated from different error parameters depending on the configuration and if it is on the client or line side.

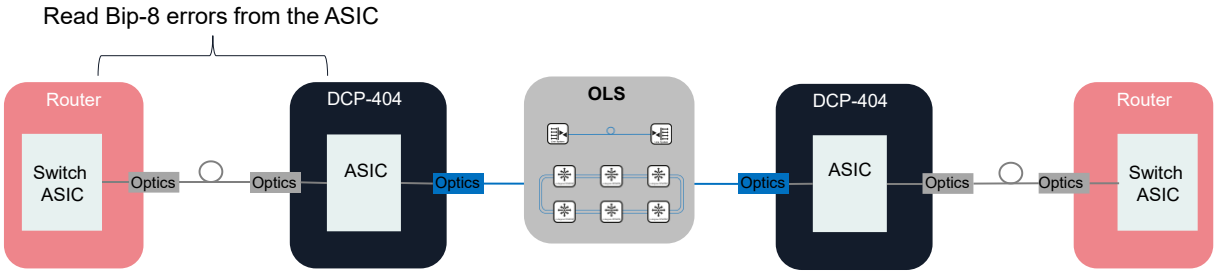
It is strongly recommended to use NTP servers to get same time in the chassis and slots when G.826 PM is monitored.

3.7.1 G.826 PM on client side

When FEC is enabled on the client ports the G.826 PM will be based on uncorrected FEC counters.

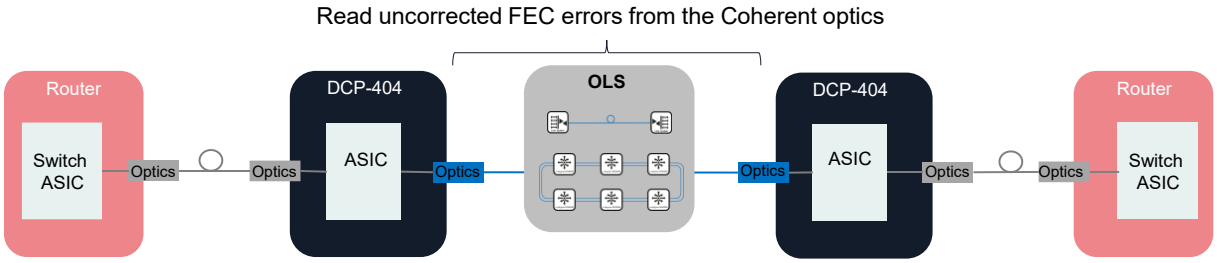


When FEC is disabled on the client ports the G.826 PM will be based on BIP-8 errors.

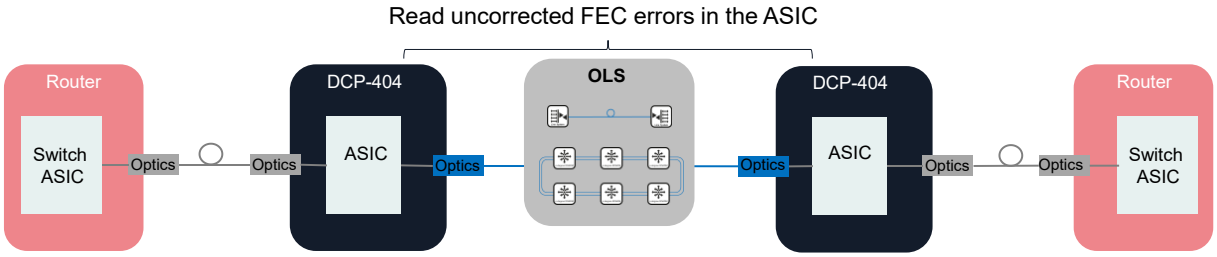


3.7.2 G.826 PM on line side

When coherent QSFP-DD is used on the line port the G.826 PM will be based on uncorrected FEC counters presented by the transceiver.



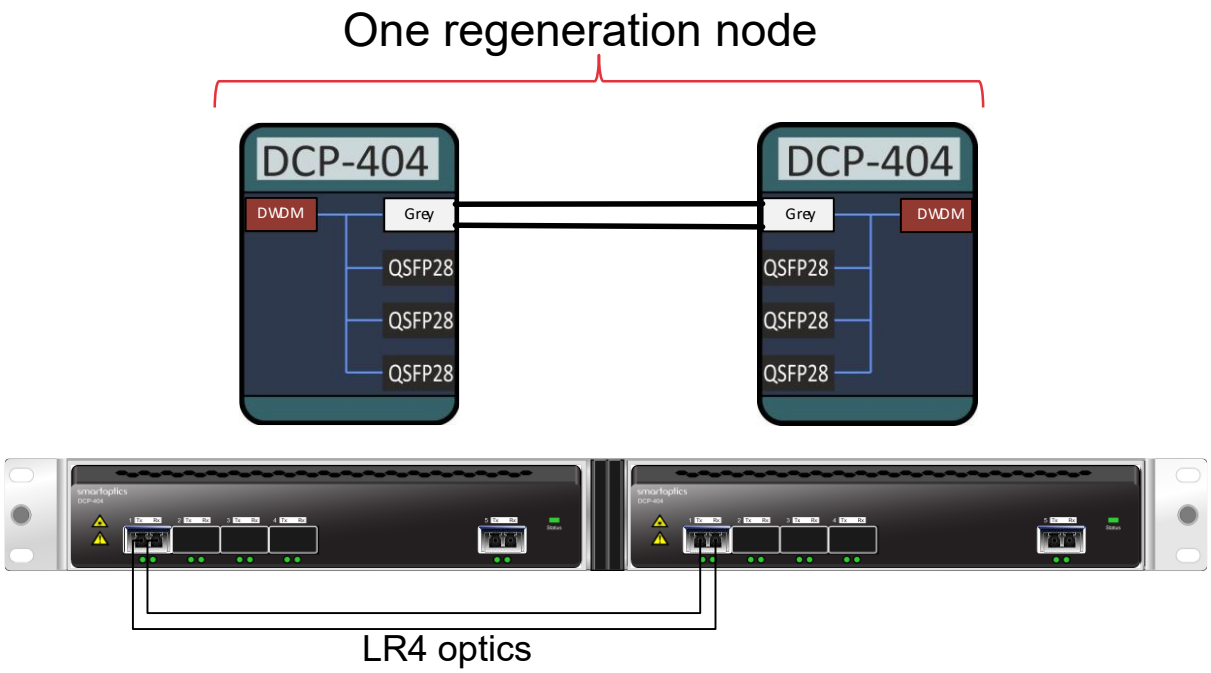
When grey QSFP-DD with FEC is used on the line port the G.826 PM will be based on uncorrected FEC counters presented by the ASIC.



Note that it is not possible to disable FEC for the line side.

3.8 Regeneration

Regeneration of the traffic can be done by connecting two DCP-404 cards back-to-back and patch between the clients. It is possible to regenerate the signal 8 times, i.e. in 8 intermediate regeneration nodes. This is tested with LR4 client optics.



3.9 In-band management

In-band management is not supported in this release.

3.10 Encryption

DCP-404 is HW prepared with a crypto chip to support encryption, but it is also required to have a QSFP-DD that supports encryption and a SW encryption license. QSFP-DDs based on OpenROADM standard support encryption. Following coherent QSFP-DDs can be used for encryption: TQD017-TUNC-SO (100G-400G) and TQD011-TUNC-SO (100G)

The encryption solution is based on layer 1 AES-256 GCM encryption with Diffie-Hellman key exchange.

Crypto chip functions:

- Digital signature generation and verification
- Secure storage of certificates, public keys, private and secret keys
- Cryptographic algorithms supported by the crypto chip include ECC, ECDSA signature scheme, SHA and MAC digest algorithms.
- Secure Hash: SHA-256
- MAC Digest: HMAC-SHA256
- Signature Schemes: Elliptic Curve Digital Signature Algorithm (ECDSA) (FIPS 186-4)
- Random Number Generation: True RNG

AES 256 GCM encryption details:

- Data encryption, key generation, certificate generation, key verification and storage of keys is all implemented in the hardware crypto chips
- A new pair of Tx and Rx AES keys are generated every 10 minutes for every active encrypted channel.
- The process of generating a new pair of AES keys for each channel starts by authenticating the boards, and the keys are always randomly generated uniquely for each channel.
- Secret session keys for data encryption are never stored, only temporarily residing in a secure environment
- All private and public keys generated randomly and saved securely inside the crypto chips and the software doesn't have access to the private keys nor to the shared secret generated after a successful Diffie Hellman key exchange
- Support for custom authentication ID for each port

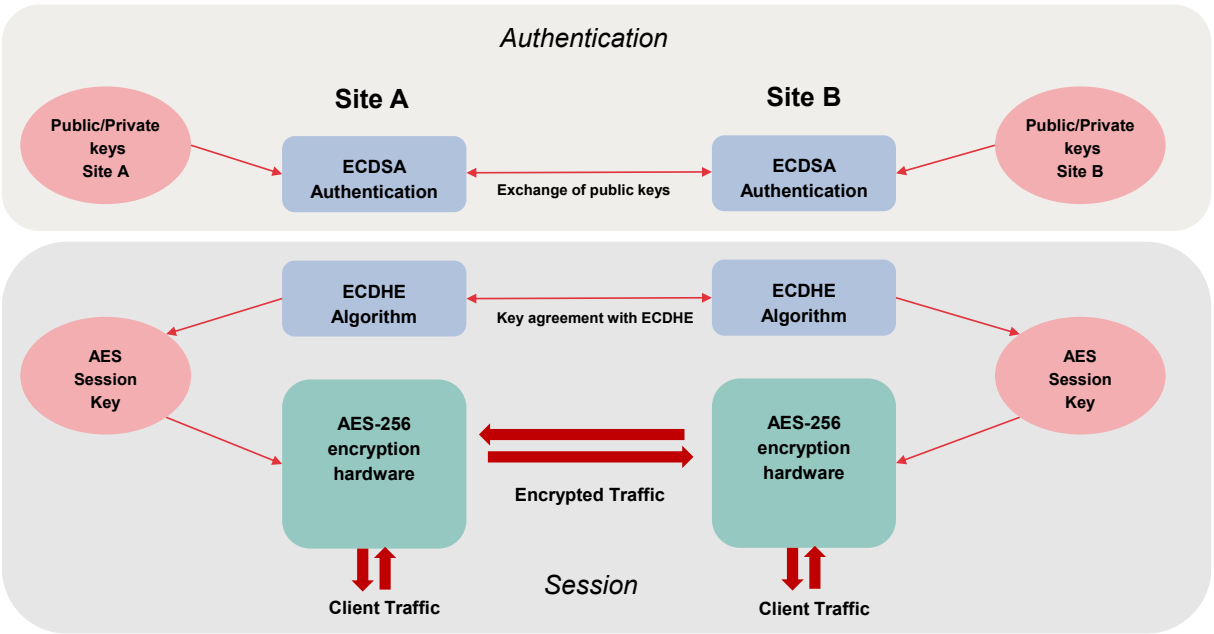
Authentication and key exchange details:

Endpoint Authentication: Elliptic Curve Digital Signature Algorithm (ECDSA)
Pre-defined private/public Elliptic Curve Cryptography (ECC) keys in DCP-1610, DCP-404, DCP-1203 and DCP-110 HW
Optional use of custom certificates for each port

Session Key Agreement: ECC Diffie-Hellman Ephemeral (ECDHE)
Ephemeral (temporary) keys, only used once per session
Perfect forward secrecy

Authenticated Encryption: AES-256 GCM

Advanced Encryption Standard (AES) and Galois Counter Mode (GCM) for encryption and authentication on byte level



is enabled, the latency will increase 2.35ms per side.

3.10.1 Fiber intrusion alarm

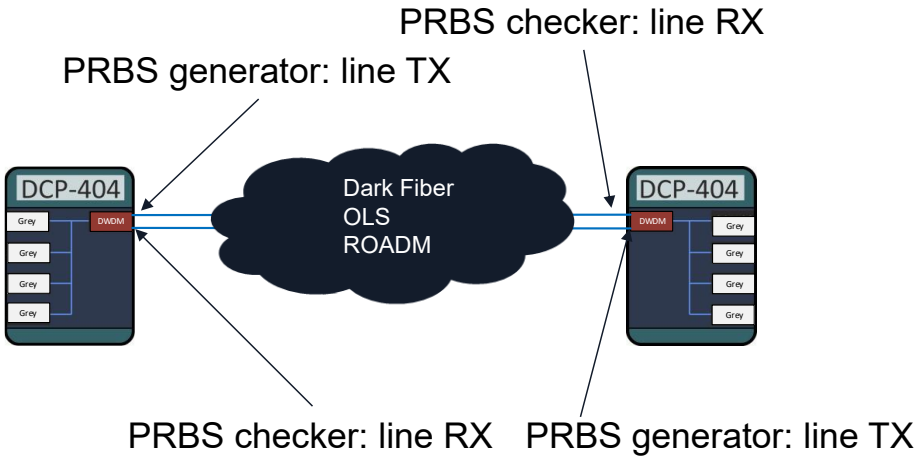
When encryption is used, it is possible to configure a fiber intrusion threshold.
A fiber intrusion alarm will be triggered if the power level on the line side is below the configured threshold.

3.11 PRBS

From R8.0 it is possible to start PRBS (Pseudo Random Binary Sequence) test sessions in DCP-404 if the coherent QSFP-DD supports it. It is possible to set a defined test time or just start and stop the test manually.

Note that the customer traffic cannot run at the same time as a PRBS test.

The PRBS test pattern will be generated in the coherent QSFP-DD so the test will always start on the Tx port of the QSFP-DD. The PRBS test will also be terminated in a QSFP-DD.



3.12 Temperature requirements

The 400G QSFP56-DD modules are sensitive to high temperatures and can even shut down itself if the temperature is too high. It is important to get best possible air flow for cooling. When DCP-404 is used in DCP-2 chassis it is mandatory to use a blind panel in the other slot if no other card is already used there. The blind panel will ensure that the air for cooling will take the optimum path through the chassis.

It is also important to use two power supplies in the chassis so that air flow on the back side will be correct. If one power supply is missing some of the air will leak out through the empty slot and the cooling will not be optimized.

Note that the fan units are essential for the cooling and the DCP-404 will not work without them.
For fan DCP-2-FAN-FB there is a risk that the temperature will rise quickly and that the QSFP-DD will turn off during fan unit replacement. For this reason it is recommended to do fan unit replacements for DCP-2-FAN-FB during a service window.
For DCP-FAN-UNIT-01 it is possible to change one fan module at a time and then a service window is not needed for replacement.

3.12.1 Temperature alarms in QSFP-DD

The temperature of the QSFP56-DD is presented in the CLI and there are three alarm levels related to this:

- “High temperature warning”: Will give a warning if the temperature of the QSFP56-DD exceeds 75 deg C (for SO-TQSFPDD4CCZRP. Other units may have different limits).
  The alarm will automatically be cleared when the temperature drops below the limit again.
- “High temperature alarm”: Will raise a critical alarm if the temperature of the QSFP56-DD exceeds 80 deg C (for SO-TQSFPDD4CCZRP. Other units may have different limits).
  In this case it is critical to find out why the temperature is so high and to fix it.
  The alarm will automatically be cleared when the temperature drops below the limit again.
- “High temperature shutdown”: The QSFP56-DD will shut down to protect itself from being damaged due to high temperature. This will typically happen when the QSFP-DD temperature is around 85 deg C (for SO-TQSFPDD4CCZRP. Other units may have different limits). A critical alarm will also be raised at the same time.
  This alarm will not automatically be cleared when the temperature drops below the limit again. Here it is necessary to toggle the admin status of the port so that the QSFP56-DD can be restarted.

3.13 Alarms

The DCP-2 keeps a list of the alarms currently detected on the system and collected by the system. When an alarm is detected, it is added to the active alarm list. When the alarm is cleared the alarm is removed from the active alarm list. Previously cleared alarms can be found in the alarm log.

The following information is stored for each alarm:

Start time: The date and time when the alarm was detected.

End time: The date and time when the alarm was cleared.

Location: The entity that caused the alarm.

Severity: The severity of the alarm.

The alarms available for DCP-404 are listed in the table below:

ALARM MESSAGE	LOCATION	SEVERITY	INTERPRETATION
Loopback enabled	if-<chassi>/<slot>/<Interface>	Warning	Loopback Enabled is raised when an interface is configured in loopback mode.
Loss of lock	if-<chassi>/<slot>/<Interface>	Critical	Loss of lock has been detected on the interface. Check that the input signal format is correct.
Loss of optical input power	if-<chassi>/<slot>/<Interface>	Critical	The optical power of the interface has gone below the minimum power level. Check the fiber connection and/or clean the fiber connector.
High optical input power	if-<chassi>/<slot>/<Interface>	Major	The optical power of the interface is above the high optical input power threshold. Insert attenuator or lower the power in another way.
Low optical input power	if-<chassi>/<slot>/<Interface>	Major	The optical power of the interface is below the low optical input power threshold. Check the fiber connection and/or clean the fiber connector.
Transmitter failure	if-<chassi>/<slot>/<Interface>	Major	The transceiver is not transmitting. Replace the optical module.
Transceiver missing	if-<chassi>/<slot>/<Interface>	Critical	The Transceiver has been removed. Insert an Transceiver or disable the alarm with “clear interface portreset <interface_id>”
High temperature warning	if-<chassi>/<slot>/<Interface>	Warning	The temperature of the QSFP56-DD has exceeded the limit 75 deg

			C. Check if the second slot in DCP-2 has a card or a dummy front panel. If not, insert a dummy front panel to improve air flow.
High temperature alarm	if-<chassi>/<slot>/<Interface>	Critical	The temperature of the QSFP56-DD has exceeded the limit 80 deg C. Check if the second slot in DCP-2 has a card or a dummy front panel. If not, insert a dummy front panel to improve air flow.
High temperature shutdown	if-<chassi>/<slot>/<Interface>	Critical	The QSFP56-DD has shutdown due to high temperature.. Check if the second slot in DCP-2 has a card or a dummy front panel. If not, insert a dummy front panel to improve air flow. Restart the QSFP56-DD by toggling the admin status of the interface.
PM-BIP error threshold exceeded [1s]	if-<chassi>/<slot>/<Interface>	Major	The BIP error counter per second shows a higher number than the configured threshold
PRBS enabled	if-<chassi>/<slot>/<Interface>	Warning	PRBS testing enabled. Traffic is down while PRBS test is running. Turn off PRBS test when it has finished.
eMMC failure		Minor	The memory is not formatted. Contact support.
rxBBE15 threshold exceeded	if-<chassi>/<slot>/<Interface>	Major	Number of BBE errors for the current 15min period has exceeded the configured threshold
rxBBE24 threshold exceeded	if-<chassi>/<slot>/<Interface>	Major	Number of BBE errors for the current 24h period has exceeded the configured threshold
rxES15 threshold exceeded	if-<chassi>/<slot>/<Interface>	Major	Number of ES (error seconds) for the current 15min period has exceeded the configured threshold
rxES24 threshold exceeded	if-<chassi>/<slot>/<Interface>	Major	Number of ES (error seconds) for the current 24h period has exceeded the configured threshold
rxSES15 threshold exceeded	if-<chassi>/<slot>/<Interface>	Major	Number of SES (severe error seconds) for the current 15min period has exceeded the configured threshold

rxSES24 threshold exceeded	if-<chassi>/<slot>/<Interface>	Major	Number of SES (severe error seconds) for the current 24h period has exceeded the configured threshold
rxUAS15 threshold exceeded	if-<chassi>/<slot>/<Interface>	Major	Number of UAS (unavalable seconds) for the current 15min period has exceeded the configured threshold
rxUAS24 threshold exceeded	if-<chassi>/<slot>/<Interface>	Major	Number of UAS (unavalaible seconds) for the current 24h period has exceeded the configured threshold
Remote client fault	if-<chassi>/<slot>/<Interface>	Critical	Error on the client port in the remote node has been deteted
Local client fault	if-<chassi>/<slot>/<Interface>	Critical	Error on the client port in the local node has been deteted
Channel authentication key mismatch	trp-<chassi>/<slot>/<Interface	Critical	This alarm indicates that the encryption channel authentication id key mismatch with the key from the remote end.
AES/GMAC tag mismatch	trp-<chassi>/<slot>/<Interface	Critical	This alarm indicates that modification of the encrypted payload have occurred. This alarm could also be triggered as a result of link errors.

Table 6. Alarm list

3.14 Dynamic update of certified transceiver list

From R12.0.1 it is possible to update the list of certified transceivers dynamically. The system contains one file with Smartoptics certified transceivers that is installed from start, but it is also possible to add an additional file with transceivers that should be treated as certified. See DCP-Series_User_Manual for more information.

4 Spare part handling

4.1 Replacing DCP-404 card

A new DCP-404 card that is inserted in same slot as the replaced unit will automatically get the same configuration as the previous one. If the SW revision on the new card is different it is necessary to upgrade the SW to same release as the chassis.

The SW for the new traffic card can be upgraded by running the same swupgrade commands as for the whole DCP-2 chassis. It is only the boards with the wrong SW that will be upgraded. DCP-2 chassis and other slot modules with correct SW from start will not be affected by the upgrade.

Note that the QSFP-DD from a newly replaced DCP-404 card may be quite hot. The fan units may not start with full speed when the new DCP-404 card is inserted. This means that there is a risk that the QSFP-DD may reach the temperature for shutdown and not start up. Then it is necessary to wait until the QSFP-DD has cooled down and then toggle the admin status of the port or reinsert the QSFP-DD again.

4.2 Replacing FAN unit in DCP-2 chassis

Note that the fan units are essential for the cooling and the DCP-404 will not work without them.
For fan DCP-2-FAN-FB there is a risk that the temperature will rise quickly and that the QSFP-DD will turn off during fan unit replacement. For this reason it is recommended to do fan unit replacements for DCP-2-FAN-FB during a service window.
For DCP-FAN-UNIT-01 it is possible to change one fan module at a time and then a service window is not needed for replacement.

5 Technical Specifications

CERTIFIED TRANSCEIVERS FOR CLIENT SIDE OF DCP-404	
PART NUMBER	Description
SO-QSFP28-SR4	QSFP28, 100G Ethernet SR4, MM 4x 850nm, 100m, 1.9dB, MPO
SO-QSFP28-LR4	QSFP28, 100G Ethernet LR4, OTU4, SM 1296/1300/1305/1309nm, 10km, 6.3dB, LC
SO-QSFP28-LR4-10L	QSFP28, 100G Ethernet LR4, SM 1296/1300/1305/1309nm, 10km, 6.3dB, LC
SO-QSFP28-CWDM4	QSFP28, 100G Ethernet CWDM4, SM 1271/1291/1311/1331nm, 2km, 5dB, LC
SO-QSFP28-ER4	QSFP28, 100G Ethernet 100G 4WDM-40, SM 1296/1300/1305/1309nm, 40km, 18dB, LC
SO-QSFP28-ZR4	QSFP28, 100G Ethernet ZR4, SM 1296/1300/1305/1309nm, 80km, 31dB, LC
SO-QSFP28-100G-FR	QSFP28 100G Ethernet FR SM 1x 1311nm PAM4 2km 4dB LC
SO-QSFP28-100G-DR	QSFP28 100G Ethernet DR SM 1x 1311nm PAM4 500m 3dB LC
SO-QSFP28-100G-FRX	QSFP28 100G Ethernet FR SM 1x XXXXnm PAM4 2km 4dB LC
SO-QSFP28-100G-LRX	QSFP28 100G Ethernet LR SM 1x XXXXnm PAM4 10km 6.3dB LC
SO-QSFP28-100G-LR	QSFP28 100G Ethernet LR SM 1x 1311nm PAM4 10km 6.3dB LC
SO-QSFP28-AOCXM	QSFP28 100GE AOC 1m
SO-QSFP28-PCUXM	QSFP28 100GE DAC Xm pass
SO-QSFP28-PSM4	QSFP28 100GE 1310nm SM 2km MPO
TQ2020-BXXC-SO	QSFP28 BiDi 100G xxxx/yyyy SM 10km
TQ2021-BXXC-SO	QSFP28 BiDi 100G xxxx/yyyy SM 20km

Table 7. Client transceivers

CERTIFIED TRANSCEIVERS FOR LINE SIDE OF DCP-404	
PART NUMBER	Description
SO-TQSFPDD4CCZRP	QSFP-DD OIF400G/OpenZR+ Coh Tunable Flexgrid, LC
TQD011-TUNC-SO	QSFP-DD 100G COH-T SM 450KM CMIS4.1
TQD013-TUNC-SO	QSFP-DD OPENZR+ HIGH TX POWER COH TUNABLE FLEXGRID CMIS5.0 LC
TQD014-TUNC-SO	QSFP-DD OPENZR+ HIGH TX POWER COH TUNABLE FLEXGRID CMIS5.1 LC

TQD017-TUNC-SO	QSFP-DD OTN HIGH TX POWER COH TUNABLE FLEXGRID ENCRYPTION CMIS5.0
QSFP-DD-4C-LR4-4	QSFP-DD 400G-LR4 ETHERNET, 4X100G-LR, PAM4 CMIS4.0, 1271NM/1291NM/1311NM/1331NM 10KM 6.3DB LC
QSFP-DD-4C-FR4-4	QSFP-DD 400G-FR4 ETHERNET, 4×100G-FR, PAM4 CMIS4.0, 1271NM/1291NM/1311NM/1331NM 2KM 4DB LC
QSFPDD-4C-DR4-4M	QSFP-DD 400G-DR4 ETHERNET, 4X100G-DR PAM4 CMIS4.0, 4X 1311NM 500M 3DB MPO12
TQD023-SL4C-SO	QSFP-DD 400G-ER4 Lite Ethernet, PAM4 CMIS4.0, 1296/1300/1305/1309nm, 30km 15.5dB
TQD027-S55C-SO	QSFP-DD, 400G ETHERNET COHERENT 193.7THZ, 40KM, CMIS 5.0
TQD029-TUNC-SO	QSFP-DD 400G ULTRA LONG HAUL COH TUNABLE FLEXGRID CMIS5.3 LC

Table 8. Line transceivers

GENERAL	
OPERATING TEMPERATURE	0° C to 45° C
POWER CONSUMPTION	DCP-404 <31 W QSFP28 <5W QSFP56-DD <24W Max total <80 W Typical power, full populated card with LR4 at 25° C = 65 W
MTBF	68 years 1679 FITs
LATENCY	Latency for SO-TQSFPDD4CCZRP, DP01QSDD-ZT1-001[1], TQD011-TUNC-SO[1] 400G CFEC: 8 µs 400G OFEC: 5 µs 300G OFEC: 6 µs 200G OFEC: 7 µs 100G OFEC: 11 µs Latency for FTCD3323R1PCL-**: 400G CFEC: 8 µs 400G OFEC: 5 µs 300G OFEC: 6 µs 200G OFEC: 7 µs 100G OFEC: 11 µs Max 1 µs for the card [1]Only for 100G

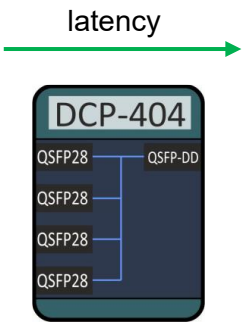
	The latency will increase 2.35 μs when encryption is enabled Latency is for one direction through the card from client to line or vice versa. 

Table 9. General parameters for DCP-404