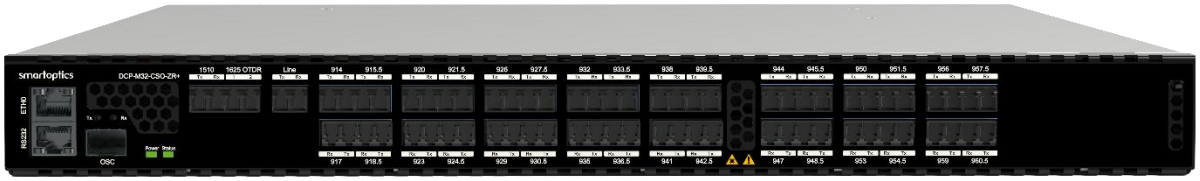
smartoptics

DCP-M

User Manual

dcp-release-12.1.3

DCP-M40-PAM4-ER
DCP-M40-PAM4-ER+
DCP-M40-PAM4-ZR — Multi-format 40 channel DWDM open line system
DCP-M40-C-ZR+
DCP-M40-MSO-ZR



DCP-M32-CSO-ZR+ — Multi-format 32 channel DWDM open line system

DCP-M8-PAM4 — PAM4 8 channel DWDM open line system

Contents

1 Introduction

1.1 General

DCP-M is a true open line system for multiplexing and demultiplexing DWDM signals.

Up to 40 optical DWDM channels are supported from ITU channel 21 to 60 and work with any combination of PAM4, Coherent or NRZ DWDM interface types and offers an unparalleled level of plug and play and simplicity regardless of traffic type and network application.

All cabling toward Optical Channel Monitors, EDFAs, Dispersion Compensation and OSCs are fully integrated in a simple plug and play 1U system. The fully integrated system supervises and monitors detected traffic formats and optical power levels both on incoming signals and fiber connectivity values.

1.2 DCP-M

The key features for the DCP-M are:

- Up to 40 optical DWDM channels with any combination of PAM4, Coherent or NRZ DWDM interface types. (32 coherent channels for DCP-M32-CSO-ZR+)
- Simple plug and play platform that can be up and running in minutes.
- No complicated installation procedures or configurations required.
- Redundant, hot pluggable power supplies, with support for both AC and DC power.
- LED status indicators for system, client ports, line interface(s) and power supplies.
- Management interfaces.
- 1U building practice with front-to-back airflow.
- The unit can be managed/monitored via CLI, SNMP and supports SYSLOG as well as TACACS+ and RADIUS for remote authentication

1.3 In commercial confidence

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

1.4 Document Revision History

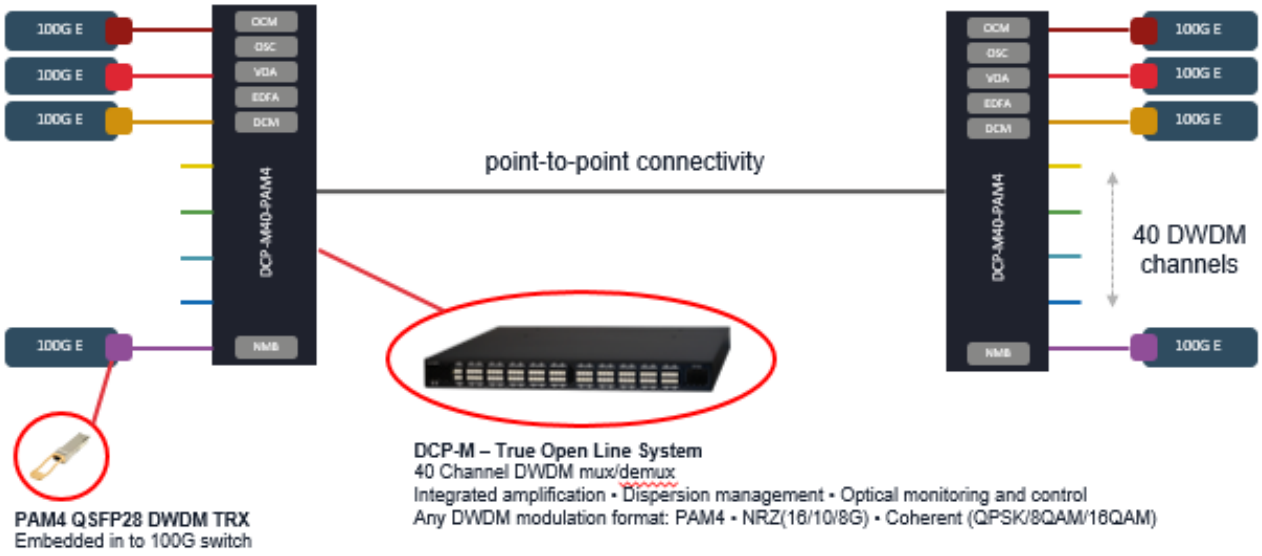
Revision	Date	Description of changes
8.1.1 A	2023-07-05	Added Appendix D with table about minimum input power on the mux ports Updated reach for 25GbE
8.1.3 A	2023-10-06	Updated alarm list Added chapter about dark mode Added special settings for 32G Updated power consumption for DCP-M40-C-ZR+ Added extendedDistance table for DCP-M40-C-ZR+ Added special settings for 16G
8.1.4 A	2023-10-12	No update
8.1.4 B	2023-10-23	Updated severity on alarms “Exceeded PAM4 channel limit” and “Loss of OSC link”
8.1.5 A	2023-11-02	No update
8.1.6 A	2023-12-05	Updated text about special settings for 32G transceivers
8.1.7 A	2024-01-10	SNMPv3 added
9.0.1 A	2024-01-17	No update
9.0.1 PB1	2024-04-02	Added footnote to distance table for mixed services
10.0.1 A	2024-06-25	Added chapter about waste management Updated chapter about user accounts Added show alarm list
10.0.2 A	2024-09-05	Updated appendix B with typical power for SO-QSFP28-Dxx-A Added text about user levels admin, opertor, readonly Added chapters for RADIUS and TACACS settings for different user levels
10.0.500 A	2024-10-25	Added DCP-M32-CSO-ZR+
10.0.502 A	2024-11-29	Updated pictures for DCP-M32-CSO-ZR+ Updated reach table
10.2.1 A	2024-12-04	No update
11.0.1 A	2024-12-12	Updated with examples for user roles in RADIUS
11.0.2 A	2024-12-17	Updated alarm list
11.2.1 A	2025-02-24	Added chapter for gNMI Added chapter for embedded ILA

12.0.1 A	2025-06-24	Updated product names Added chapter about secure mode for gNMI
12.0.2 A	2025-08-06	Added table with allowed actions for different users
12.1.1 A	2025-09-08	Added product DCP-M40-MSO-ZR
12.1.3 A	2025-10-23	Added list of supported OSC transceivers
12.1.3 B	2025-12-18	Added link scenarios for DCP-M40-MSO-ZR Text about remote management via optical ETH port updated

2 APPLICATIONS

DCP-M is a true open line DWDM networking platform designed specifically for modern data center interconnect (DCI). DCP-M has the same form factor and simple plug and play usability of a passive multiplexer, but unlike a passive multiplexer it monitors the traffic, amplifies the signals for longer distances and can handle higher data rate protocols. A best of both worlds approach to DCI networking. This is because it has all the features usually reserved for the more complex DWDM platforms fully integrated into a simple plug and play 1U module. No separate amplifier, management, dispersion compensation or traffic cards to configure. No messy wiring between modules. No additional knowledge or spares handling is usually associated with the bigger systems. Instead, DCP-M provides everything required for an open line networking system:

- Simple
- Reliable
- Multi-service



3 Functional description

3.1 Open line system

The DCP-M´s are operationally designed to emulate a passive multiplexer, but unlike a passive multiplexer it monitors the traffic, amplifies the signals for longer distances and can also handle higher data rate protocols like 100G PAM4, 100G QPSK and 400G 16QAM. DCP-M32-CSO-ZR+ can also handle 800G signals with 16QAM modulation. A fully automated system that ensures a true plug and play feeling where the systems automatically adjust to the correct optical power levels and intuitive front panel LEDs guide the user through the installation process. Where others talk about “Alien Wavelengths”, the DCP-M considers all incoming light equally regardless of origin. One DCP-M at each site creates a point-to-point connection.

3.2 Transmitting path

The multiplexer section (Mux) of the DCP-M unit receives the DWDM wavelength signals and combines all optical wavelength signals into one fiber. In the next phase, an Optical Channel eQualizer (OCQ) is used to adjust the optical power levels to a pre-defined target value before entering the Erbium-Doped Fiber Amplifier (EDFA). The EDFA amplifies all wavelengths and is connected to the Variable Optical Attenuator (VOA). The VOA adjusts the launch power to compensate for the different fiber losses between locations. As a final step the Optical Supervisory Channel (OSC) is added to the signal path.

3.3 Receiving path

On the remote side, the OSC is extracted from signal path and another EDFA is used to amplify the receive signals. After the amplification the signal also passes through a Dispersion Compensation Module (DCM) that provides compensation for chromatic dispersion caused by the optical fiber distance and wavelength spacing which ensures as low residual dispersion as possible for the client signals. As a final step, the de-multiplexer section (Demux) splits all the wavelengths into individual fibers.
Note that the DCP-M40-C-ZR+ and DCP-M32-CSO-ZR+ don’t have a tunable dispersion compensation module since it is optimized for coherent services.

Each unit has a tap couple in the transmit and receive path and all power levels are monitored via the Optical Channel Monitor (OCM). The OCM measures the power level and traffic format for each channel.

The above description is only typical and can differ between DCP-M unit types.

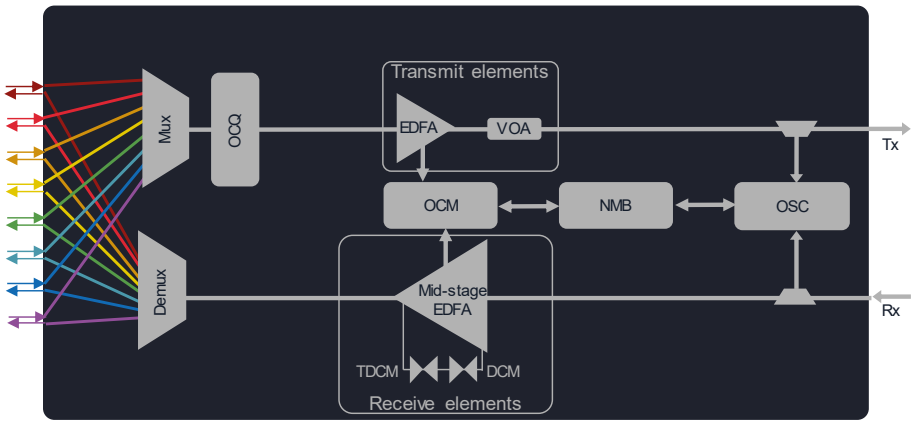


Figure 1. *Basic functions of a DCP-M.*

3.4 DCP-M versions and compatibility

The DCP-M family contains several different models of DCP-M units. They are all similar in the way they operate, but there are some differences in HW to optimize for different applications and reach.

- **DCP-M40-PAM4-ER**
  This unit is for 40ch multi-service applications from 0 to 40km
- **DCP-M40-PAM4-ER+**
  This unit is for 40ch multi-service applications from 20 to 60km
- **DCP-M40-PAM4-ZR**
  This unit is for 40ch multi-service applications from 0 to 80km (R1A is only for 40-80km)
- **DCP-M8-PAM4**
  This unit is for 8ch PAM4 applications from 0 to 80km
- **DCP-M40-C-ZR+**
  This unit is mainly for coherent services or other signal formats that will not require dispersion compensation. The unit supports 40ch and is mainly limited by attenuation rather than distance. See Appendix A with link tables for maximum reach for different signal formats.
- **DCP-M32-CSO-ZR+**
  This unit is mainly for coherent services or other signal formats that will not require dispersion compensation. The unit supports 32ch with up to 800G and is mainly limited by attenuation rather than distance. This model includes a passive OTDR filter that can be accessed from the front.
- **DCP-M40-MSO-ZR**
  This unit is for 40ch multi-service applications from 0 to 80km.This model includes a passive OTDR filter that can be accessed from the front.

Different models are not allowed to be mixed on same link. This is because they have different HW and SW.

For some of the DCP-M models there are also different HW revisions. In most cases it is OK to mix different HW revisions of same model and different minor revisions (e.g. R1A + R1B). It is not OK to mix systems from different major revision (e.g. R1A +R2A).

See HW revision compatibility matrix below.

DCP-M Model	HW revisions that are OK to mix	HW revisions that should not be mixed
DCP-M40-PAM4-ER	R1A, R1B, R1C	R2A
DCP-M40-PAM4-ER+	R1A, R1B	R2A
DCP-M40-PAM4-ZR	R1A	R2A[1]
DCP-M8-PAM4	R1A	
DCP-M40-C-ZR+	R1A	
DCP-M32-CSO-ZR+	R1A	
DCP-M40-MSO-ZR	R1A	

[1]Possible to mix R1A with R2A for distances 40-80km, but not for 0-40km.

For SW it is always recommended to run the same SW revision on both sides of a DCP-M link. Mixed cases with different SW revisions are not supported.

It is supported during upgrade to temporarily have different SW versions on the two sides. No configuration changes in SW or channel count should be made before both ends are updated.

3.5 Connections

All optical traffic connections are in the front of the unit. The Line connection is labelled “Line” and is located in the top left. The client interfaces are labeled with the Smartoptics channel number (e.g. 921 for ITU channel 21). The DCP-M supports 40 channels on a 100GHz grid starting from ITU channel 21.0 up to ITU channel 60.0.
DCP-M32 supports 32ch with 150GHz grid starting from channel 914.5 to channel 961.

LEDs illustrate the presence/status of the optical channel(s).

Figure 2. *Front view of DCP-M*

Figure 3. *Front view of DCP-M32-CSO-ZR+*

The back of the DCP-M unit houses 4 x RJ45 Ethernet ports for management access. ETH4 is a dual functionality port and can also be used with an optical SFP interface. An additional RS-232 serial interface is accessible as console port.

Both the power supplies and fan unit are hot pluggable.

Below figure shows the back of the DCP-M40 chassis.

Figure 4.

Back view 2 AC power supplies, 1 fan unit (with 4 fans) and network management interfaces.

Below figure shows the back of the DCP-M32-CSO-ZR+ and DCP-M40-MSO-ZR.

Figure 5.

DCP-M32-CSO-ZR+ and DCP-M40-MSO-ZR back view 2 AC power supplies, 1 fan unit (with 4 fans) and network management interfaces.

3.6 Visual indicators

The front panels visual indicators are:

3.6.1 Power LED

Power supply status is represented by the Power LED.

Function	Indication	Description
Power	Green	Normal operation.
Power	Off	Power is not connected to the DCP-M

3.6.2 Status LED

After power up, the DCP-M initiates a software startup sequence. In this start up sequence all LEDs are activated one at a time according to a certain rotating pattern. The status LED is initiated as green and then turns red during start-up. After start-up, the status LED represents the current system status.

Function	Indication	Description
Status LEDs	Green	No active alarm
Status LEDs	Red	Any active alarm of severity Critical or Major

3.6.3 Line LEDs

The Line LEDs represent light status is on the ports.

Function	Indication	Description
Line Tx	Green	The port is currently transmitting light.
Line Rx	Green	The port is currently receiving light
Line Rx	Orange	The port is currently receiving light with OSC Rx fault
Line Rx	Off	The port is not receiving any light.

3.6.4 Client LEDs

The Client LEDs represent light status is on the ports.

Function	Indication	Description
Client Tx/Rx	Green	The ports is currently receiving or transmitting light.
Client Tx/Rx	Off	The port is not receiving or transmitting light.

3.7 Physical Description & Plug-in Units

The DCP-M is a compact unit, intended for installation in 19” racks or on shelves. The unit height is 1U (1.77 in).

For DCP-M40 all power and management connections are in the back panel. For DCP-M32-CSO-ZR+ and DCP-M40-MSO-ZR the console management connection and ETH0 are located on the front while ETH1 to ETH5 ports are located in the back.
All traffic connections are made to the front panel. DCP-M has a front-to-back airflow.

The DCP-M chassis is populated with 2 redundant power supplies and 1 fan unit (with 4 fans).

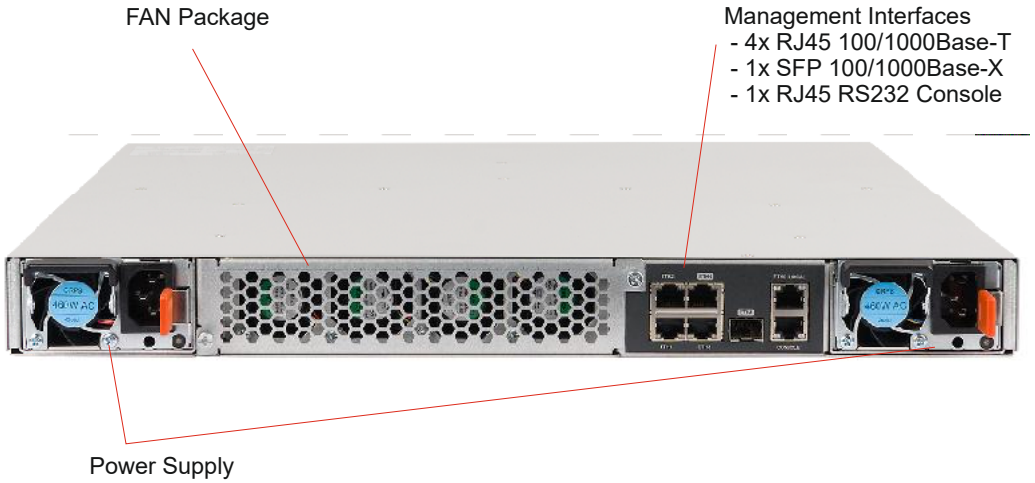


Figure 6. *DCP-M40 chassis back-view.*

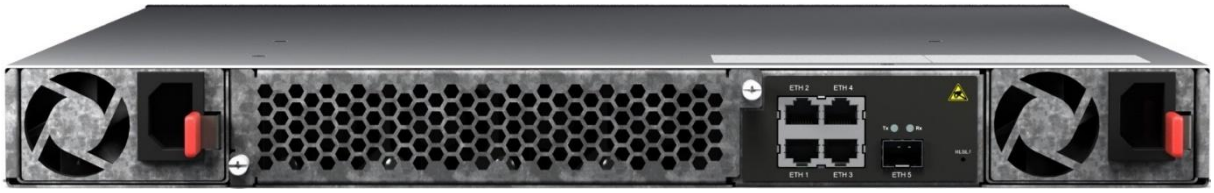


Figure 7. *DCP-M32-CSO-ZR+ and DCP-M40-MSO-ZR chassis back-view.*

3.7.1 Power supplies

In figure 5, two power supplies are shown. The left power supply, DCP-2-PSU-AC-FB, is supporting 100-127VAC and 200-240VAC. The right power supply, DCP-2-PSU-DC-FB, supports -40 to -72 VDC. The DCP-M is dual feed and the power supplies are hot swappable. Both types can be used simultaneously. A Green LED indicator indicates a functioning unit.

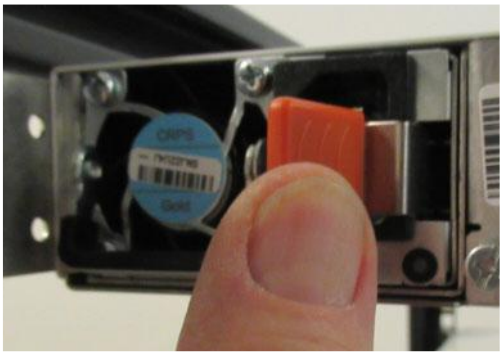
Figure 8. *The DCP-2-PSU-AC-FB and DCP-2-PSU-DC-FB unit.*

3.7.1.1 Installing Power supplies (AC and/or DC)

1. Slide the power supply module into the power supply slot until you hear a click.
2. Push/pull on the black handle to ensure that it is engaged to the backplane connector.

3.7.1.2 Replacing a Power supplies

1. Remove the power cord
2. Push the locking lever in towards the power connector.
3. Lift the handle and pull out the power supply.
4. Install the new power supply (as previously described).
5. Reconnect the power cord



3.7.2 DCP-2-FAN-FB Fan Unit

The DCP-M has a fan unit that consists of 4 fans. The fan speed is regulated by temperature and the system is designed to operate with 3 fans working. If one fan fails, the other 3 will speed up to compensate and an alarm will be triggered to exchange the fan unit.

Figure 9. *The DCP-2-FAN-FB unit.*

3.7.2.1 Replacing DCP-2-FAN-FB Fan Unit

NOTE - To prevent overheating, install the replacement fan tray immediately after removing the existing fan tray.

1. Loosen the screws on each side of the fan tray faceplate.
2. Grasp both sides of the fan tray and pull it out.

WARNING - To avoid injury, keep tools and your fingers away from the fans as you slide the fan module out of the chassis. The fans might still be spinning.

3.7.2.2 Installing DCP-2-FAN-FB Fan Unit

1. Grasp the fan tray on each side and insert it straight into the chassis.
2. Tighten captive screws on each side of the fan tray faceplate to secure it in the chassis to a torque of 17 cm-kg (15 in-lb.)

3.7.3 Network Management Interfaces

The Network Management Interface is a part of the DCP-M chassis.
For DCP-M40 all the management interfaces are available at the back panel.
For DCP-M32-CSO-ZR+ and DCP-M40-MSO-ZR, the management ports are available both in the front and in the back of the chassis.
The management system collects and controls the relevant information system.

The module has:

- Console - 1x RJ45 console port for serial access to the unit and initial setup.
- ETH1/ETH2/ETH3/ETH4 - 4x 100/1000Base-T. Management interfaces to the NMB that can be connected to a DCN.
- ETH4 - 1x SFP port 100/1000Base-X for optical management access to the DCP-M that can be connected to a DCN network. The SFP port is shared with the electrical ETH4 port.
- ETH0 - 1x 100/1000Base-T “local” port access to the unit for engineers onsite.

Figure 10. *Network management communication interfaces in the back of the DCP-M40 chassis.*

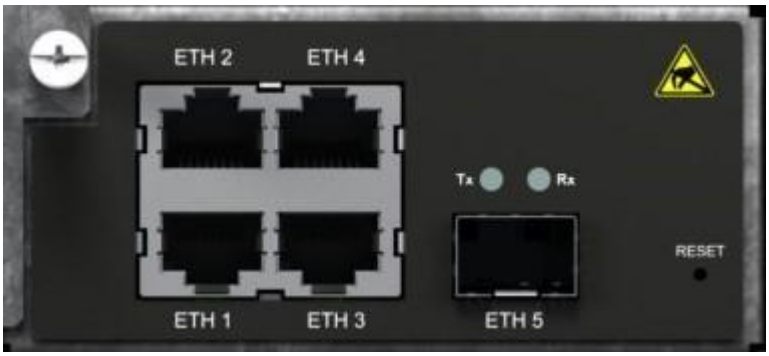


Figure 11. *Network management communication interfaces in the back of the DCP-M32-CSO-ZR+ and DCP-M40-MSO-ZR chassis.*

Figure 12. *Network management communication interfaces in the front of the DCP-M32-CSO-ZR+ and DCP-M40-MSO-ZR chassis.*

OSC

The DCP-M communicates between local and remote systems through an integrated Optical Service Channel (OSC). Once a connection is established between the sites a communication channel with the far-end DCP-M is created and actual distance is measured as well as optical span loss. For actual distance the values are only measurable (and updated) upon OSC initialization with the far-end, new updated values occur only after fiber reconnect or DCP-M cold restart.

For DCP-M40-PAM4 versions, the OSC is integrated into the chassis.
For DCP-M32-CSO-ZR+ and DCP-M40-MSO-ZR, the OSC is a pluggable SFP that can be inserted in the front of the chassis and then connected to the 1510nm OSC filter port.

3.8 Management Architecture

Smartoptics Embedded software is Linux-based and uses Yocto as an open-source collaboration framework. The below figure shows the principal architecture of the system management. The currently implemented APIs are CLI and SNMP. REST and Netconf are planned for future releases.

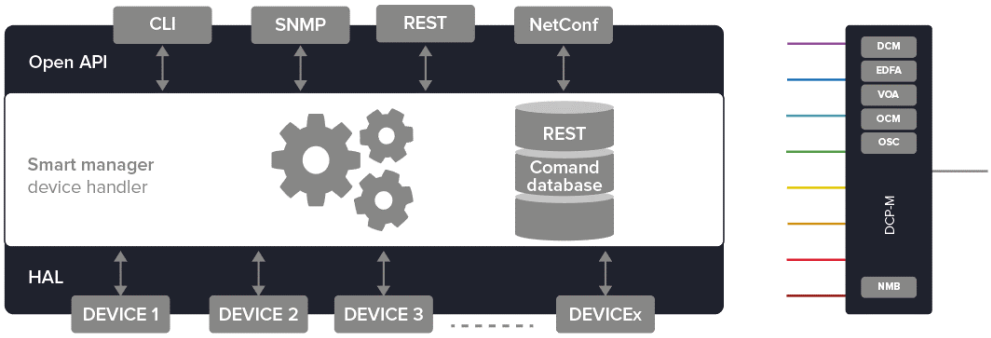
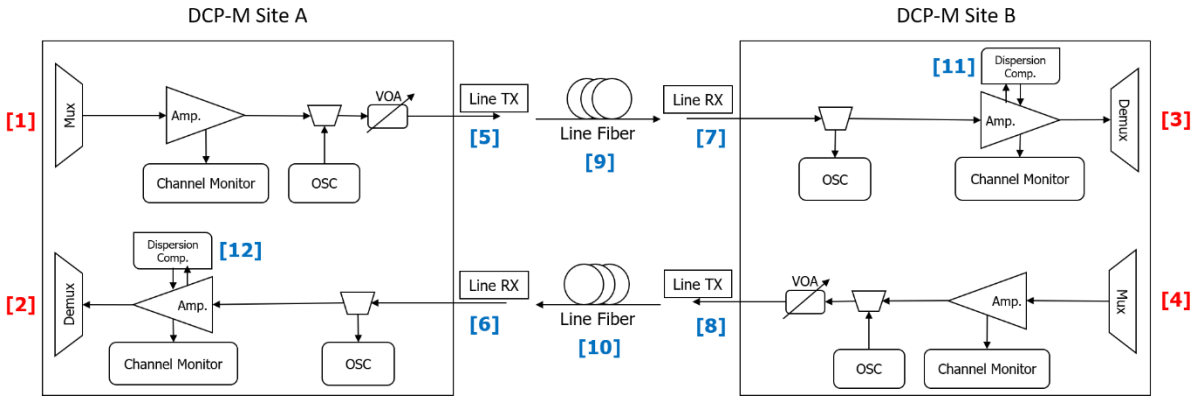


Figure 13. *Management architecture*

3.9 Monitor points

The illustration below indicates the optical monitor points of the DCP-M. The red numbers in the illustration indicate the client DWDM monitor points of the system, while the blue numbers indicate the line side monitor points.



The list below explains what each monitor point represents.

[1]. Estimated Rx power level in to the local DCP-M.
[2]. Estimated Tx power level out of the local DCP-M.
[3]. Estimated Tx power level out of the remote side DCP-M.
[4]. Estimated Rx power level in to the remote side DCP-M.

[5]. Line Tx power level out of the local line fiber port.
[6]. Line Rx power level in to the local line fiber port.
[7]. Line Rx power level in to the remote line fiber port.
[8]. Line Tx power level out of the remote line fiber port.
[9]. Line fiber length, calculated dispersion and line fiber loss.
[10]. Line fiber length, calculated dispersion and line fiber loss.
[11]. Dispersion compensation for line fiber **[9]** in the remote end.
[12]. Dispersion compensation for line fiber **[10]** in the local end.

The table below indicates which command(s) to use to retrieve information.

CLI Command	Monitor points
show interface	[1] [2]
show interface detail	[1] [2] [3] [4]
show linkview	[5] [6] [7] [8]
show linkview detail	[5] [6] [7] [8] [9] [10] [11] [12]

The power levels provide a measurement of optical power in dBm to one decimal place accuracy. The system determines a total loss of power, when the measured power is below the threshold used to signify a total loss of optical power, the value returned for this case is -99.0 dBm.

3.10 Alarms

The DCP-M keeps a list of the alarms currently detected in 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. Previous cleared alarms can be found in the alarm log that contains both active and cleared alarms.

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.

All possible alarms can be listed with the command:
show alarm list

ALARM MESSAGE	LOCATION	SEVERITY	INTERPRETATION
Loss of optical input power	if-1/<channel -id>-rx	Critical	The optical input power is lost at Client Rx port. Check the status of the transmitter on the switch/router.
Loss of optical output power	if-1/<channel -id>-tx	Critical	The optical output power is lost at Client Tx port. Indicates there is a problem with the remote ends client Rx port. Check the status of the remote ends transmitter on the switch/router.
Loss of optical input power(Line)	if-1/line-rx	Critical	Loss of optical input power(Line) indicates there is a problem with the line signal or that the remote tx EDFA is shut down as a protection mechanism.
Loss of optical input power(OSC)	if-1/line-rx	Major	Loss of optical input power(OSC) indicates there is a problem with the line signal. It is likely that the line fibre is broken or disconnected.
Loss of OSC link	if-1/line-rx	Critical	Loss of OSC link indicates there is no communication to the remote hosts OSC channel.
Dark mode enabled	if-1/line-tx	Warning	Dark mode is enabled. This means that optical power is turned off on the line Tx port.
Fan failure	fan-1/1	Major	Fan unit has failed. Replace within 24 hours.
Fan missing	fan-1/1	Critical	Fan is missing in chassis.

Power supply failure	psu-1/1 psu-1/2	Major	Input AC/DC power is lost on the unit
External power missing	psu-1/1 psu-1/2	Minor	This alarm appears when the external power is not connected or not working.
Power supply fan failure	psu-1/1 psu-1/2	Minor	The fan unit in the power supply has failed
Power supply communication failure	psu-1/1 psu-1/2	Major	The chassis cannot communicate with the power supply unit
Power supply input voltage high	psu-1/1 psu-1/2	Minor	The input voltage is too high
Power supply input voltage low	psu-1/1 psu-1/2	Minor	The input voltage is too low
Power supply missing	psu-1/1 psu-1/2	Critical	This alarm appears when the unit is not inserted.
Power supply unsupported	psu-1/1 psu-1/2	Major	This alarm appears if an unknown power supply unit is inserted.
Exceeded PAM4 channel limit	if-1/line-tx	Critical	This alarm appears when more than 20xPAM4 channels is active on DCP-M40-PAM4-ZR units.
Unsupported channel detected	if-1/<channel -id>-rx	Minor	An unsupported signal format is detected by the OCM.
Low disk space	chassis	 Minor Major Critical	Check current disk space with command “show system diskUsage” <5MB available <7.5MB available <10MB availale
eMMC failure	chassis	Critical	The memory is not formatted. Contact support.

3.11 Consequent actions

3.11.1 Loss of signal Client

Local loss of ingress client signal renders in remote egress client signal shutdown (this means that the WSS attenuation is set to max). Reported defects are illustrated with a red X mark at the detecting interface. Generated consequent actions are illustrated with green X marks.

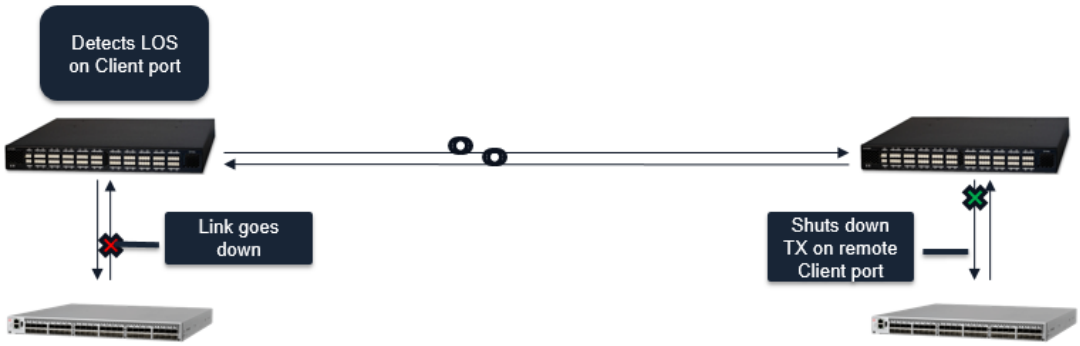


Figure 14. *Loss of signal client*

3.11.2 Loss of signal Line

Loss of ingress line signal renders in egress client signal shutdowns. The Tx EDFA is shut down as a protection mechanism. Reported defects are illustrated with a red X mark at the detecting interface. Generated consequent actions are illustrated with green X marks.

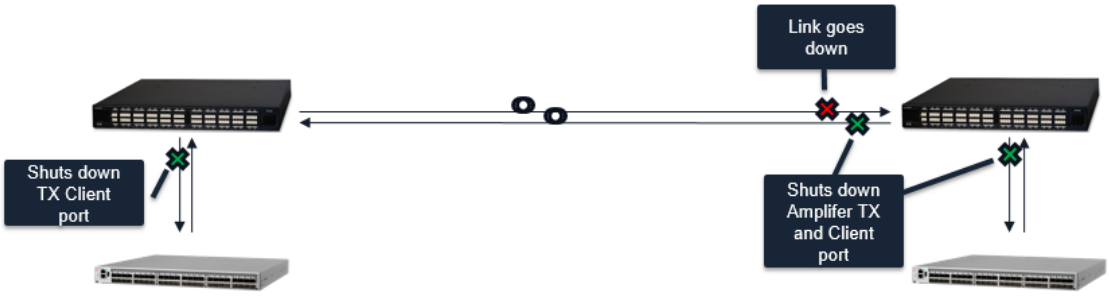


Figure 15. *Loss of signal line*

3.12 Channel Power Mode

The channel power mode is used to configure the target Booster and Pre-Amp optical power levels per channel. The mode should be set identical on both sides of the Line fiber.

Mode	Description
PAM4	This is the default mode for DCP-M units supporting PAM4, which is the optimum setting for PAM4 compatibility. This mode is not available on DCP-M40-C-ZR+, DCP-M40-MSO-ZR nor DCP-M32-CSO-ZR+.
Manual	Manual mode allows for custom target power values and should only be used if recommended by Smartoptics.
CoherentNRZ	The 'CoherentNRZ' mode can be used to optimize the system for 1-32G and 100G-400G Coherent for extended distances. This is the default mode for DCP-M40-C-ZR+, DCP-M40-MSO-ZR and DCP-M32-CSO-ZR+. (In this mode PAM4 channels will not be supported by the system)

3.12.1 config chpowerlevel PAM4/manual/CoherentNRZ

This command is used to configure the chpowerlevel of the unit.

For DCP-M units with support for PAM4:

```
admin@hostname>config chpowerlevel

PAM4         - Configure channel power level mode PAM4.
manual       - Configure channel power level manually.
CoherentNRZ  - Configure channel power level mode CoherentNRZ.
Description:
These commands configures the wanted channel power mode.

PAM4    : This is the default mode, which is the optimum setting for PAM4
compatibility.
manual  : Manual mode allows for custom target power values and should only be
used if recommended by support.
CoherentNRZ : The CoherentNRZ mode can be used to optimize the system for 1G-32G
and 100G Coherent for extended distance. PAM4 is not supported in this mode.

admin@hostname>
```

For DCP-M units without PAM4:

```
admin@hostname>config chpowerlevel

CoherentNRZ  - Configure channel power level mode CoherentNRZ.
manual       - Configure channel power level manually.

Description:
These commands configures the wanted channel power mode.

manual  : Manual mode allows for custom target power values and should only be
used if recommended by support.
CoherentNRZ : The CoherentNRZ mode can be used to optimize the system for 1G-32G
and 100G Coherent for extended distance. PAM4 is not supported in this mode.
admin@hostname>
```

```
admin@hostname>config chpowerlevel PAM4

Channel power mode set to PAM4.

admin@hostname>
```

```
admin@hostname>config chpowerlevel manual 4.6 4.5

Channel power mode set to manual.
Booster Tx target power set to : 4.6
Preamp Tx target power set to  : 4.5

admin@hostname>
```

```
admin@hostname>config chpowerlevel CoherentNRZ

Channel power mode set to nonPAM4.

admin@hostname>
```

3.13 Extended Distance Mode

The extended distance mode is used to remove the Line VOA´s default attenuation. The mode should be set identical on both sides of the Line fiber.
This setting is not valid for DCP-M32-CSO-ZR+ nor DCP-M40-MSO-ZR.

Mode	Description
auto (default)	This is the default mode, which is the optimum setting for PAM4 compatibility. The ‘auto‘ setting controls the Line VOA´s ensuring that the line is attenuated correctly even for 0dB links.
extendedDistance	The ‘extendedDistance’ setting is required for 1-32G and 100-400G Coherent links above 22 dB. The ‘extendedDistance’ setting removes the Line VOA´s attenuation until a link has been established. When using this mode, a minimum 10dB link attenuation is required to avoid permanent damage of the module.

3.13.1 config interface if-1/line voapreset auto/extendedDistance

This command is used to configure and remove the preset attenuation from the integrated VOA and enables the possibility to commission NRZ and Coherent waves for extended distances where the attenuation is above PAM4 limits.

```
admin@hostname>config interface if-1/line voapreset

auto              - Set the VOA preset mode to auto (Default).
extendedDistance  - Set the VOA preset mode to extendedDistance.

Description:
This command configures the VOA preset mode. VOA preset allows extended
distances on the line side. Refer to system documentation for more details.

  - auto             - The system is set to work for normal line fiber distance.
(Default)
  - extendedDistance - The system is set to operate on extended line fiber
distance.

admin@hostname>
```

```
admin@hostname>config interface if-1/line voapreset auto

Preset VOA set to auto.

admin@hostname>
```

```
admin@hostname>config interface if-1/line voapreset extendedDistance

Preset VOA set to extendedDistance.

admin@hostname>
```

3.14 TDCM Mode

The TDCM mode is used to manually configure the wanted dispersion compensation settings. The mode should be set identical on both sides of the Line fiber.

Mode	Description
auto (default)	This is the default mode, which enables the automatic setting of dispersion compensation for a G.652 slope.
Manual	The ‘manual’ mode can be used to manually set the dispersion compensation level.

3.14.1 config interface if-1/line tdcm auto/manual

This command is used to configure the dispersion compensation mode.

```
admin@hostname>config interface if-1/line voapreset

admin@hostname>config interface if-1/line tdcm

auto    - Automatic control of TDCM setting by the system.
manual  - Manual control of the TDCM setting.

Description:
This command controls the TDCM dispersion compensation of the Line Rx fiber of
the system.

admin@hostname>
```

```
admin@hostname>config interface if-1/line tdcm auto G.652

admin@hostname>
```

```
admin@hostname>config interface if-1/line tdcm manual -843

Dispersion manually set to '-843' ps/nm.

admin@hostname>
```

3.15 DCM Mode

In the DCP-M40-PAM4-ZR with hardware revision R2A or later the DCM module can be enabled or disabled. If the DCM is disabled it is optically bypassed and the systems dispersion compensation will consist of only the TDCM setting. The functionality of the DCM can be enabled/disabled automatically in auto mode or manually in manual mode. In auto mode the fiber length will decide the DCM state. If the fiber is shorter than 40 km the DCM will be disabled and above 40 km the DCM will be enabled. The auto DCM mode is only applicable for G652 fiber. In manual DCM mode user decides whether the DCM is enabled or disabled.

3.16 Dark Mode

It is possible to enable dark mode when service or trouble shooting should be done. Dark mode means that all optical power on the line Tx port is turned off, i.e, both the amplifier and the OSC channel. Dark mode can be activated for a specific number of minutes. If enabled, it can also be disabled manually at any time.
Dark mode is not available on DCP-M32-CSO-ZR+ and DCP-M40-MSO-ZR.

3.17 Manual traffic format configuration

The manual format detection configuration is needed when 40G PAM4 services are required. The configuration is per interface and needs to be set identical on both sides of a connected system.

Mode	Description
auto (default)	This is the default mode, which enables the automatic format detection of 1-32G, coherent and 100Gpam4
Manual	The ‘manual’ mode is used to manually configure interfaces to traffic formats 1-32G, coherent, 100Gpam4 and 40Gpam4

When an interface is manually configured the user can identify them under “show interfaces” as they are visible as <format>*.

For example:

```
admin@DCP-M40-PAM4-ER-181>show interface

  Interface  Status     Alarm     Rx power  Tx power  Format      Expected        Description
             [Rx/Tx]              [dBm]     [dBm]               wavelength[nm]
  ---------  ---------  --------  --------  --------  ----------  --------------  -------------------------
  if-1/line  up/up      ok            -7.6       4.4  wdm         -
  if-1/9220  idle/idle  ok           -99.0     -99.0  n/a         1559.79
  if-1/9240  up/up      ok            -3.3       1.6  1-32G       1558.17
[This output has been modified to only show relevant information for documentation purposes]

  if-1/9400  up/up      ok            -7.6       6.5  100Gpam4*   1545.32
  if-1/9600  idle/idle  ok           -99.0     -99.0  100G/200G*  1529.55         012345678901234567890...

admin@DCP-M40-PAM4-ER-181>
```

3.17.1 config interface <interface id> formatDetection auto/manual

This command is used to configure the format detection mode.

```
admin@DCP-M40-PAM4-ER-181>config interface if-1/9400 formatDetection

auto    - Configure traffic format detection to auto.
manual  - Configure traffic format detection manual.
Description:
This command controls the detection of traffic format for a channel.
```

```
admin@DCP-M40-PAM4-ER-181>config interface if-1/9400 formatDetection auto

Traffic format set to 'auto'

admin@DCP-M40-PAM4-ER-181>
```

```
admin@DCP-M40-PAM4-ER-181>config interface if-1/9400 formatDetection manual

1-32G      - Configure traffic format to 1-32Gb/s.
100G/200G  - Configure traffic format to 100G/200G.
100Gpam4   - Configure traffic format to 100G PAM4.
40Gpam4    - Configure traffic format to 40Gb/s.

Description:
This command manually controls which traffic format the client interface has. This configuration needs to be set
on both sides of the connected systems.
```

```
admin@DCP-M40-PAM4-ER-181>config interface if-1/9400 formatDetection manual 100Gpam4

Traffic format set to '100Gpam4'.

admin@DCP-M40-PAM4-ER-181>
```

3.17.2 Special settings for 100G PAM4

There are two versions of 100G PAM4 available in Smartoptics portfolio of pluggable optics.

SO-QSFP28-Dxx: QSFP28 form factor. This unit uses two carriers with a total 3dB bandwidth of 75GHz. These signals will automatically be recognized as 100G PAM4 in the DCP-M system. Auto mode for format detection can be used.

Channel power mode: PAM4
Format detection mode: auto

SO-QSFP28-Dxx-A: QSFP28 form factor. This unit uses one carrier with a 3dB bandwidth of 72.5GHz.
These signals will not automatically be recognized as 100G PAM4 in the DCP-M system. They will be recognized as NRZ signals (1-32G). The DCP-M will operate NRZ signals at a lower power level than PAM4, but this will not work for SO-QSFP28-Dxx-A. It is necessary to use manual format detection mode and select 100GPAM4 for these signals.

Channel power mode: PAM4
Format detection mode: manual
Specified format: 100Gpam4

Note that it is required to have release 7.0.1 or later if the network only will use SO-QSFP28-Dxx-A. It is possible to use R6.x.x if the network has a mix of SO-QSFP28-Dxx and SO-QSFP28-Dxx-A.

Note that an extra attenuator is needed between the demux and the Rx port on SO-QSFP28-Dxx-A in order to avoid overload. Recommended attenuation 3-5dB.

Note that SO-QSFP28-Dxx-A will not work in DCP-M8-PAM4.

3.17.2.1 Pre-FEC BER values and transmission performance

A good way to check transmission performance for PAM4 signals is to look at Pre-FEC BER. This parameter can be monitored in DCP-108 transponders and in some switches/routers.

The tables below give an indication of what to expect at different Pre-FEC BER values. The transmission could work at all those levels, but the margin is better, the lower the Pre-FEC BER value is.

Single Lambda PAM4 (SO-QSFP28-Dxx-A)

Pre-FEC BER value	Performace
>1.0E-04	Bad, may experience issues.
5.0E-05 – 1.0E-04	Average, is OK if stable at this value.
9.0E-06 – 5.0E-5	Good
<9.0E-06	Excellent

Dual Lambda PAM4 (SO-QSFP28-Dxx)

Pre-FEC BER value	Performace
>3.0E-03	Bad, may experience issues.
8.0E-04 – 3.0E-03	Average, is OK if stable at this value.
1.0E-04 – 8.0E-04	Good
<1.0E-04	Excellent

3.17.3 Special settings for 40G PAM4

There are two versions of 40G PAM4 available in the Smartoptics portfolio of pluggable optics.

SO-QSFP-Dxx: It has QSFP28 form factor. Performance is then the same as in 100G PAM4.

SO-QSFP-40G-Dxxxx: Dedicated Channel power mode: PAM4
Format detection mode: manual
Specified format: 40Gpam4

QSFP+ plug that can only run 40G PAM4.

Channel power mode: PAM4
Format detection mode: manual
Specified format: 100Gpam4

Note that 100G PAM4 setting is needed here to get correct power levels

Note that extra attenuator is needed between the demux and the Rx port on SO-QSFP-40G-Dxxxx in order to avoid overload. Recommended attenuation 3-5dB.

3.17.4 Special settings for 32G transceivers in 16G or 32G mode

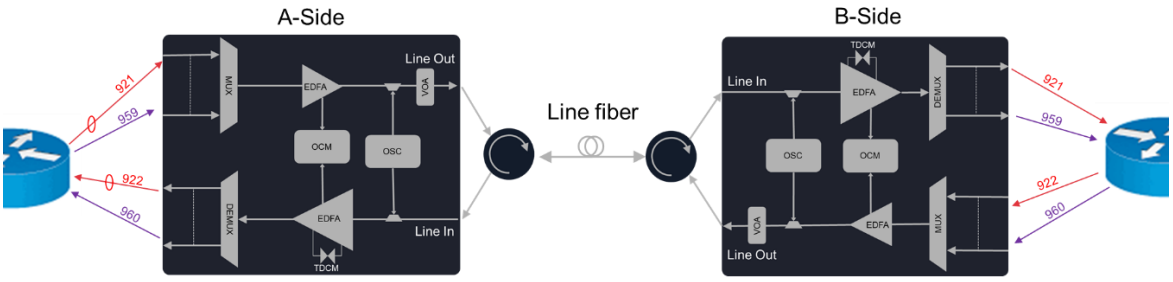
DWDM transceivers for 32G (32G-IR-Dxxx-BR, 32G-IR-DxxS-BR) require high OSNR, high input power and small residual dispersion. However, they are NRZ modulated and will be recognized by DCP-M as 1-32G NRZ signals. With these settings the transmission performance could be close to the specification limits in certain conditions. This could also be the case if the 32G transceivers are operated in 16G mode. In order to get better transmission performance, it is possible to operate the 16G NRZ or 32G NRZ signals as a 40G PAM4. This is done by using manual detection mode and specifying that the channel should be 40G PAM4.

Channel power mode: PAM4
Format detection mode: manual
Specified format: 40Gpam4

Note that an extra attenuator is needed between the demux and the Rx port for the 32G DWDM transceiver in 40G PAM4 mode in order to avoid overload. Recommended attenuation 4-6dB.

3.18 Fiber mode

All DCP-M PAM4 models support dual fiber and single fiber operation. DCP-M32-CSO and DCP_M40-MSO-ZR don't support single fiber mode. To function properly with single fiber the fiberMode in each DCP-M end must be correctly configured. Moreover, circulators must be connected after the Line Rx and Line Tx on each DCP-M to mix the signal for single fiber. The circulator is available in the passive H-series. See below picture for connections:



In order to handle the reflections caused by single fiber operation channel Rx and Tx will have different wavelengths. The port mapping of each channel is explained below:

DCP-M40

	A-Side			B-Side	
Port 1	RX if channel	921	---->	921	TX if channel
	TX if channel	922	<----	922	RX if channel
Port 2	RX if channel	923	---->	923	TX if channel
	TX if channel	924	<----	924	RX if channel
Port 3	RX if channel	925	---->	925	TX if channel
	TX if channel	926	<----	926	RX if channel
Port 4	RX if channel	927	---->	927	TX if channel
	TX if channel	928	<----	928	RX if channel
Port 5	RX if channel	929	---->	929	TX if channel
	TX if channel	930	<----	930	RX if channel
Port 6	RX if channel	931	---->	931	TX if channel
	TX if channel	932	<----	932	RX if channel
Port 7	RX if channel	933	---->	933	TX if channel
	TX if channel	934	<----	934	RX if channel
Port 8	RX if channel	935	---->	935	TX if channel
	TX if channel	936	<----	936	RX if channel
Port 9	RX if channel	937	---->	937	TX if channel
	TX if channel	938	<----	938	RX if channel
Port 10	RX if channel	939	---->	939	TX if channel
	TX if channel	940	<----	940	RX if channel

	A-Side			B-Side	
Port 11	RX if channel	941	---->	941	TX if channel
	TX if channel	942	<----	942	RX if channel
Port 12	RX if channel	943	---->	943	TX if channel
	TX if channel	944	<----	944	RX if channel
Port 13	RX if channel	945	---->	945	TX if channel
	TX if channel	946	<----	946	RX if channel
Port 14	RX if channel	947	---->	947	TX if channel
	TX if channel	948	<----	948	RX if channel
Port 15	RX if channel	949	---->	949	TX if channel
	TX if channel	950	<----	950	RX if channel
Port 16	RX if channel	951	---->	951	TX if channel
	TX if channel	952	<----	952	RX if channel
Port 17	RX if channel	953	---->	953	TX if channel
	TX if channel	954	<----	954	RX if channel
Port 18	RX if channel	955	---->	955	TX if channel
	TX if channel	956	<----	956	RX if channel
Port 19	RX if channel	957	---->	957	TX if channel
	TX if channel	958	<----	958	RX if channel
Port 20	RX if channel	959	---->	959	TX if channel
	TX if channel	960	<----	960	RX if channel

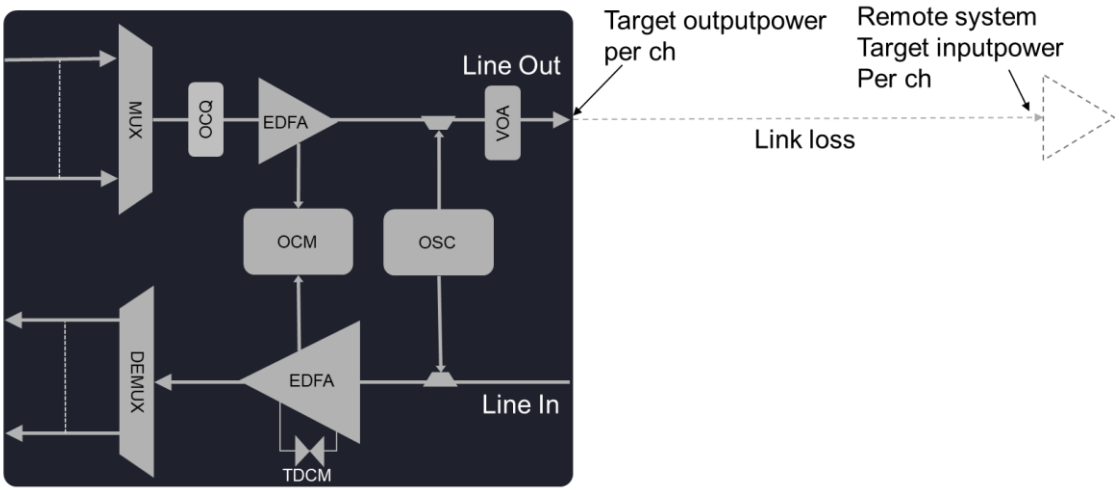
DCP-M8

	A-Side			B-Side	
Port 1	RX if channel	944	---->	944	TX if channel
	TX if channel	945	<----	945	RX if channel
Port 2	RX if channel	946	---->	946	TX if channel
	TX if channel	947	<----	947	RX if channel
Port 3	RX if channel	948	---->	948	TX if channel
	TX if channel	949	<----	949	RX if channel
Port 4	RX if channel	950	---->	950	TX if channel
	TX if channel	951	<----	951	RX if channel

3.19 Automation mode

All DCP-M40 models can run in different automation modes, embedded and managed CLI. The automation mode decides what level of automatic interaction will exist between units. Note that managed CLI mode is not supported for DCP-M32-CSO-ZR+ or DCP-M40-MSO-ZR.

The default mode is embedded automation. In this mode all optical power regulations and configurations are taken care of by the system. If for instance, the link loss changes the system will reconfigure itself to match the new link loss values. If PAM4 traffic is used the automation mode should always be embedded. Changing the automation mode to managedCLI means that the line regulation will no longer be automated. The channel target power on Line Tx port is configured in the CLI and it is up to the user to set this correctly. The unit will strictly keep this value and not adapt based on changes in link loss. See picture below:



The link loss can be obtained by using the function OSC linkview (see CLI manual for details) if a DCP-M or DCP-F is the remote system. The following equation should be fulfilled:

Target outputpower (dBm) = Remote system target inputpower (dBm) + Link loss (dB)

Note that max settable target output power is +4.5dBm. Use this value if the calculated value is higher.

After the target output power on the line has been set, it is required to set the optical control mode to power. See CLI manual for details.

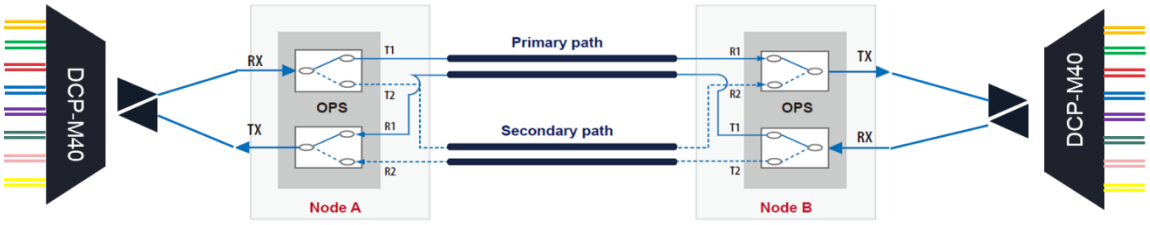
For DCP products find the remote system target input power in the table below:

Remote system model PN	Remote system target input power (dBm/ch)
DCP-M40	-18.5

Note that DCP-M40-MSO-ZR and DCP-M32-CSO-ZR+ don’t support managedCLI mode so target input power is not important.

3.20 Optical protection restoration

All DCP-M models support protection restoration when using an external optical switch. The software will automatically detect and adjust the dispersion compensation when a path is changed. The attenuation on each path in each direction, however, needs to be attenuated so that they are within 1 dB of each other. Path A to B needs to have the same attenuation on both primary and secondary path. Likewise for path B to A. Path A to B does not need to have the same attenuation as path B to A.



It is also required that the optical protection switch (OPS) is of a type 1:1 by which means that at a failure on any of the directions of a path, both directions are switched. It is not supported to use an OPS where one direction is on the primary path and the other direction is on the secondary path. Since the protection switch is placed directly after the DCP-M it must operate properly with optical powers of up to 20 dBm (100 mW) in the RX port of the OPS. The optical power levels on the clients will be restored instantly after switch (<50 ms). The dispersion compensation restoration after a switch takes between 60 and 90 seconds. DCP-M40-C-ZR+, DCP-M40-CO-ZR+ and DCP-M32-CO-ZR+ have no dispersion compensation so with these units the traffic signals can start to recover directly after the optical switch.

3.21 Backup and restore

The backup and restore functionality can be used to create complete backups of all configurations for chassis and then restore exactly same configuration.
Only one backup file is allowed. The backup file will be removed at reboot.

Restore is only possible if product and hardware revision are same. For HW revision the last character is allowed to be different. For SW the revision must be the same on all characters.
HW example: backup from a R1A can be restored on a R1C but not on a R2A.
SW example: backup from a R7.0.1 can be restored on a R7.0.1 but not on a R7.0.2.

3.23 Telemetry streaming with gNMI

This section provides details on using gNMI (gRPC Network Management Interface) for DCP-M32-CSO-ZR+ and DCP-M40-MSO-ZR, including connection setup, supported encoding, extensions, and subscription options.

Connection Details

- Port: 57400
- Authentication: Uses the same username and password as SSH.
- Security: Currently operates in an insecure mode.
- Encoding: JSON is the supported encoding format.

gNMI Extensions

Our product supports gNMI extensions, including depth control and master arbitration.

Subscription Modes

gNMI supports different subscription methods for retrieving data:

i. Poll
The client explicitly requests updates by polling the server.

ii. Once
A single snapshot of the requested data is returned.

iii. Stream
A continuous stream of updates is sent based on the chosen mode:

1. Sample Mode
Data is sent at regular intervals. Configurable interval determines the frequency of updates. Option to suppress redundant updates. Heartbeat ensures periodic updates even if no changes occur.

2. On-Change Mode
Only sends updates when the data changes.
Options:

a. Updates Only: No initial state report; only changes are sent.

b. Suppress Redundant: Only changes are reported (no duplicates).

c. Heartbeat: Periodic updates are sent regardless of suppress redundant settings.

XPath and Wildcard Support

Our implementation provides light support for wildcards in XPath queries, enabling flexible data selection.

This manual serves as a guide for configuring and managing gNMI in DCP products. For additional configuration details, refer to the official gNMI specification.

CLI commands to enable/disable gNMI:

```
root@M32-gNMI>config gnmi service enable
Service: enabled

root@M32-gNMI>config gnmi service disable
Service: disabled
```

3.23.1 Support for secure gNMI with TLS

The DCP-M Network Element (NE) can act as a gNMI server. It is possible to enable an encrypted TLS (Transport Layer Security) session between the client and the NE for gNMI. In standard TLS mode, the NE (DCP-M) will use a certificate that will be validated on the client side. It is also possible to use mutual TLS, mTLS, where both the client and the server will have their own certificates.

CLI commands to enable secure gNMI with TLS:

```
root@M32-gNMI>config gnmi mode secure
Mode: secure

root@M32-gNMI>config gnmi mode insecure
Mode: insecure
```

CLI command to generate a private key:

```
root@M32-gNMI>config gnmi tls privateKey generate
Enter key type [RSA,EC]: EC

Enter Curve (valid curves can be found with 'openssl ecparam -
list_curves'): secp384r1
This operation can take some time, keep patient.
private key generated.
```

CLI command to create a certificate signing request:

```
root@M32-gNMI>config gnmi tls deviceCert csr

Enter Country (C): SE
Enter State (ST): Stockholm
Enter Locality (L): Stockholm
Enter Organization (O): Smartoptics

Generated CSR:
-----BEGIN CERTIFICATE REQUEST-----
MIIBVTCB3QIBADBeMQswCQYDVQQGEwJTRTESMBAGA1UECAwJU3RvY2tob2xtMRIw
EAYDVQQHDAlTdG9ja2hvbG0xFDASBgNVBAoMC1NtYXJ0b3B0aWNzMREwDwYDVQQD
DAhNMzItZ05NSTB2MBAGByqGSM49AgEGBSuBBAAiA2IABF8HTGYTwyoLbyZyV6Rl
bmpTUuV2tv7bhq5fBYVkgdYzR+Az6956fTAPY8OyQTRz1pbyGdh4yctk5DRXQh7l
Fo+akRfMMbWUVJLpUt/HHHjXh5pBdiXe3uaajq7cKxOgO6AAMAoGCCqGSM49BAMC
A2cAMGQCMAxduJQ9YlvNlwyfbJGroIsgWHSmbG2ms6pK9DeLz502xgjMLat/KIQR
Vj3CcMcurwIwaYc8T7uibTGoFKt94PwFv2sNptcs5v1C9gRBCyE8MsL3AmypslY+
op0a/ehVGy/C
-----END CERTIFICATE REQUEST-----
```

CLI command to import a device certificate file:

```
root@M32-gNMI>config gnmi tls deviceCert import device
Input content of cert
-----BEGIN CERTIFICATE-----
<snip>
-----END CERTIFICATE-----, end with an empty line. :
```

CLI command to import a Certificate Authority (CA) certificate file:

```
root@M32-gNMI>config gnmi tls deviceCert import ca
Input content of cert
-----BEGIN CERTIFICATE-----
<snip>
-----END CERTIFICATE-----, end with an empty line. :
```

CLI command to configure mTLS (validate means that mTLS is activated, ignore means that mTLS is deactivated):

```
root@M32-gNMI>config gnmi tls clientCert cert ignore
Client cert: ignore

root@M32-gNMI>config gnmi tls clientCert cert validate
Client cert: validate
```

3.24 Embedded ILA

For solutions with DCP-M32 it is possible to include ILAs (inline amplifiers) with automatic configuration. Embedded control loops will automatically adjust the line VOAs. OSC is used for communication between DCP-M and ILA nodes.

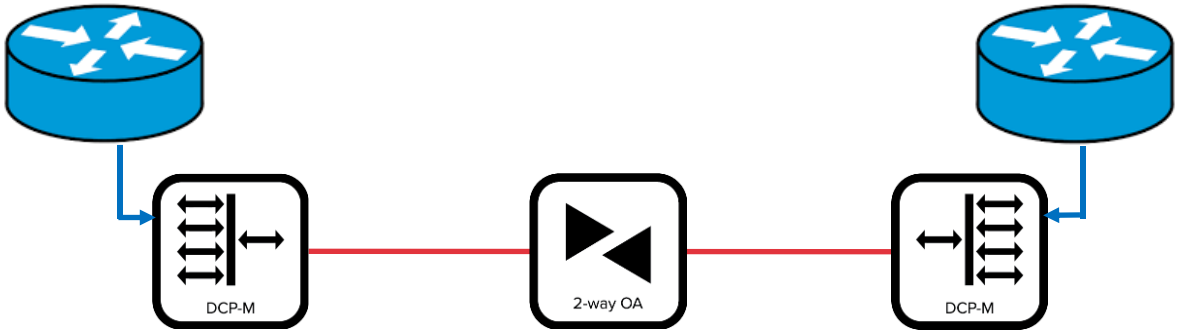


Figure 16. *DCP-M with ILA.*

In this solution the ILAs will need a certain pre-defined configuration to work in an automated way. The equipment per ILA will be:

- 1x DCP-2 chassis
- 2x DCP-F-A22
- 2x OSC filter
- 2x OTDR filter
- 2x VOA SFP
- 2x OSC optics

The picture below shows the functional diagram of the ILA.

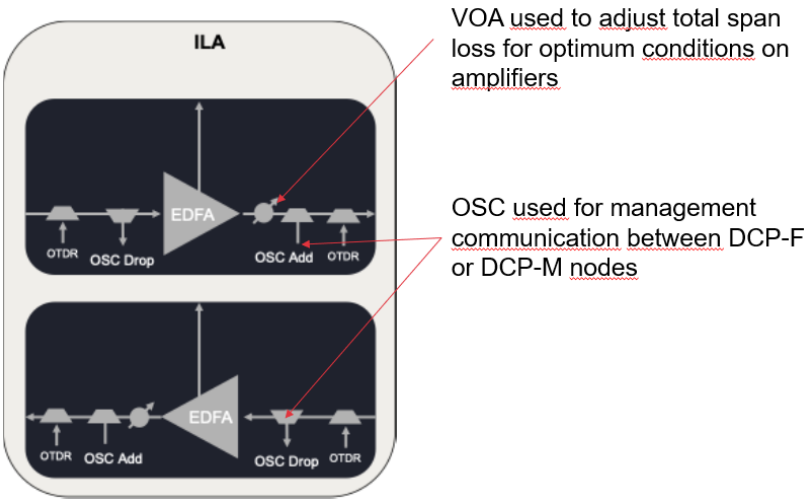


Figure 17. *ILA functional diagram*

The picture below shows how to connect the internal fibers in the ILA.

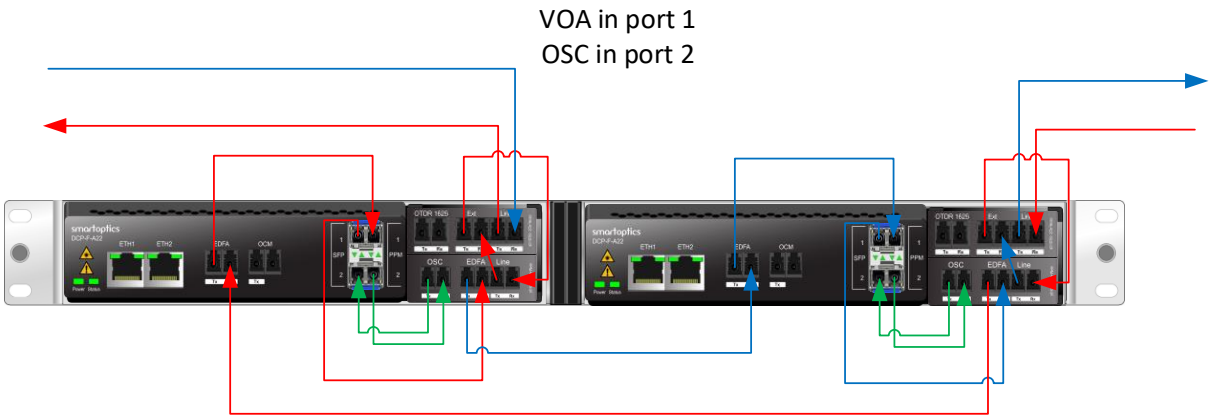


Figure 18. *ILA connection diagram*

4 Installation and Safety

4.1 Safety Precaution

Fasten the chassis securely to a 19”-rack.

Connect the PSU to the power source. The chassis will automatically power up as soon as the PSU is connected.

4.1.1 General Safety Precautions

The following are the general safety precautions:

The equipment should be used in a restricted access location only.

No internal settings, adjustments, maintenance, and repairs may be performed by the operator or the user; such activities may be performed only by skilled service personnel who are aware of the hazards involved.

Always observe standard safety precautions during installation, operation and maintenance of this product.

4.1.2 Electrical Safety Precautions

Warning: Dangerous voltages may be present in the cables connected to the DCP-M.

Never connect electrical cables to a DCP-M unit if they are not properly installed and grounded.

Disconnect the power cable before removing a pluggable power supply unit.

Grounding: For your protection and to prevent possible damage to equipment when a fault condition occurs on the cables connected to the equipment (for example, a lightning strike or contact with high voltage power lines), the case of the DCP-M unit must be properly grounded at all times. Any interruption of the protective (grounding) connection inside or outside the equipment, or the disconnection of the protective ground terminal, can make this equipment dangerous. Intentional interruption is prohibited.

When a DCP-M is installed in a rack, make sure that the rack is properly grounded and connected to a reliable, low resistance grounding system.

Connect the DCP-M via an external cable to ground. See Section 4.2.8 for further details.

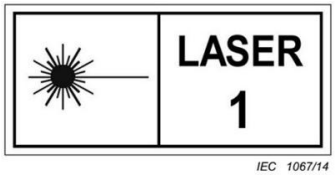
If AC power is used, the grounding must also be made through the AC power cable, which should be inserted in a power outlet with a protective ground contact. Therefore, the power cable plug must always be inserted in a socket outlet provided with a protective ground contact, and the protective action must not be negated by use of an extension cord (power cable) without a protective conductor (grounding).

4.1.3 Laser Safety Classification

The DCP-M complies with Class 1. The incorporated laser has a divergent beam, operates within the wavelength span of 1504 – 1563 nm and has a maximum output of +20 dbm.

The following warning applies to Class 1 laser products.

Invisible Laser Radiation: Do not view directly with optical instruments.



Class 1 Laser Warning.

Laser Safety Statutory Warning and Operating Precautions

All personnel involved in equipment installation, operation, and maintenance must be aware that laser radiation is invisible. Therefore, the personnel must strictly observe the applicable safety precautions and in particular, must avoid looking straight into optical connectors, either directly or using optical instruments.

In addition to the general precautions described in this section, be sure to observe the following warnings when operating a product equipped with a laser device. Failure to observe these warnings could result in fire, bodily injury, and damage to the equipment.

Warning: To reduce the risk of exposure to hazardous radiation:

Do not try to open the enclosure. There are no user serviceable components inside.

Do not operate controls, adjust, or perform procedures to the laser device other than those specified herein.

Allow only authorized service technicians to repair the unit.

4.1.4 Protection against Electrostatic Discharge

An electrostatic discharge (ESD) occurs between two objects when an object carrying static electrical charges touches or is brought near the other object. Static electrical charges appear as a result of friction between surfaces of insulating materials or separation of two such surfaces. They may also be induced by electrical fields.

Routine activities, such as walking across an insulating floor, friction between garment parts, and friction between objects, can easily build charges up to levels that may cause damage, especially when humidity is low.

Caution: DCP-M contains internal components sensitive to ESD. To prevent ESD damage, do not touch internal components or connectors. If you are not using a wrist strap, before touching a DCP-M or performing any internal settings on the DCP-M, it is recommended to discharge the electrostatic charge of your body by touching the frame of a grounded equipment unit.

Whenever feasible during installation, use standard ESD protection wrist straps to discharge electrostatic charges. It is also recommended to use garments and packaging made of anti-static materials, or materials that have a high resistance, yet are not insulators.

4.1.5 Site Requirements

This section describes the DCP-M site requirements.

PHYSICAL REQUIREMENTS

The DCP-M unit can be mounted in a 19-inch, 23-inch, or ETSI rack with the GND cable connected. The rack depth needs to be at least 600 mm.

All the electrical connections are made to the back panel. The optical traffic connections are made in the front panel.

POWER REQUIREMENTS

AC-powered DCP-M units should be installed within 3m (10 feet) of an easily accessible, grounded AC outlet capable of furnishing the required AC supply voltage, of 100-127VAC (3A) and 200-240VAC (1,5A) maximum.

DC-powered DCP-M units require a -48VDC (-40V to -72V) (Max 7A @ -48V) DC power source with the positive terminal grounded. In addition, the DC power connector contains the chassis (frame) ground terminal.

AMBIENT REQUIREMENTS

The ambient operating temperature of the DCP-M is 0° to +45°C/+32° to +113°F, at a relative humidity of 5% to 85% RH non-condensing.

The DCP-M is cooled by free air convection and a pluggable cooling fan unit. The DCP supports front-to-back cooling. The intakes/outtakes are positioned in the front and back.

Caution: Do not obstruct these vents.

The DCP-M contains a fan speed control for lower noise, improved MTBF, and power savings.

ELECTROMAGNETIC COMPATIBILITY CONSIDERATIONS

The DCP-M is designed to comply with the electromagnetic compatibility (EMC) requirements according to ETSI EN 300 386 V2.1.1 class A. To meet these standards, the following conditions are necessary:

The DCP-M must be connected to a low resistance grounding system.

The RJ45 Ethernet interfaces ETH0 – ETH4 can be used for intra-building connections provided that a Cat 5e (or higher) class shielded cable is used. The cables must not be electrically connected directly to outside-plant cables.

Warning: The intra-building port(s) (ETH0-ETH4 management ports) of the equipment or subassembly is suitable for connection to intra building or unexposed wiring or cabling only. The intra-building port(s) of the equipment or subassembly MUST NOT be metallically connected to interfaces that connect to the OSP or its wiring. These interfaces are designed for use as intra-building interfaces only (Type 2 ports as described in GR-1089-CORE) and require isolation from the exposed OSP cabling. The addition of Primary

Protectors is not sufficient protection in order to connect these interfaces metallically to OSP wiring.

Warning: The intra-building port(s) (ETH0-ETH4 management ports) of the equipment or subassembly must use shielded intra-building cabling/wiring that is grounded at both ends.

Maximum allowed cable length for intra-building connections is 100m.

The DCP-M must be installed in a CBN (common bonding network) per NEBS GR-1089.

The DCP-M is designed to be used in Network Telecommunication Facilities.

Common DC return (DC-C) Is applicable for the DCP-M.

4.2 Rack mounting

The following instructions provides detail how to mount the system in racks that are 600 mm to 1200 mm deep (24”- 48”).

The system can be mounted in a rack in the following ways:

1. With the front side flush with the front of the rack posts. (Four-Post Rack).

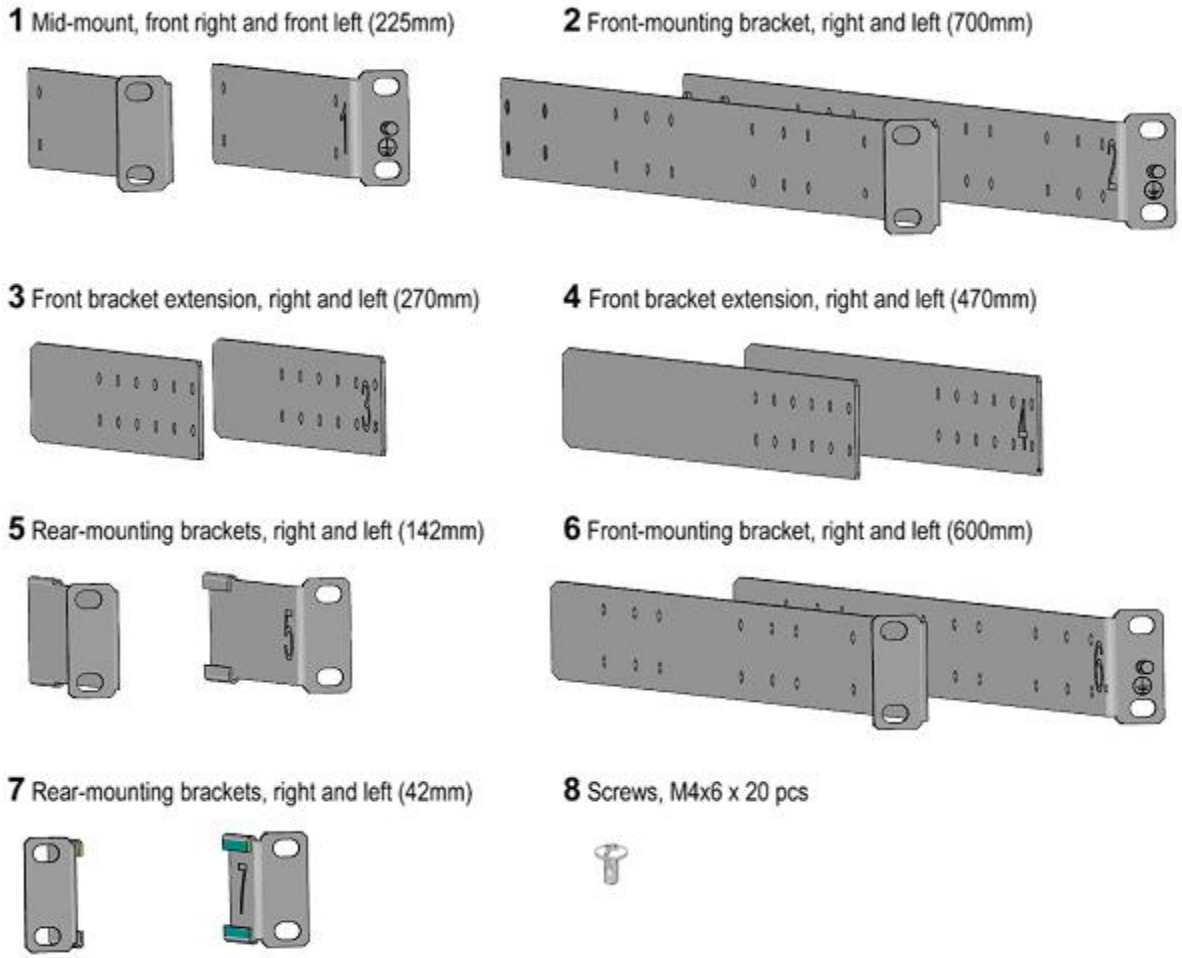
2. With the front side in a recessed position. A recessed position allows a more gradual bend in the fiber-optic cables connected and less interference in the aisle at the front of the rack (Four-Post Rack).

3. With the rack posts mounted to the mid-section of the system (Two-Post Rack).

4.2.1 Rack-mount kit parts list

The following parts are provided with the rack-mount kit.

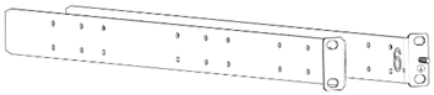
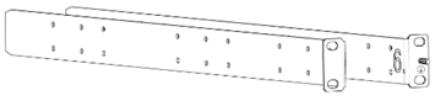
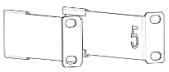
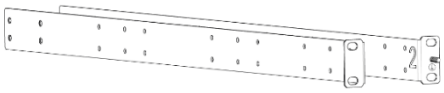
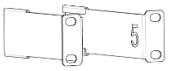
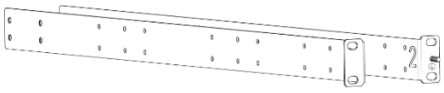
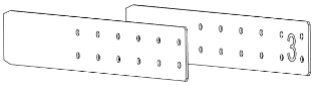
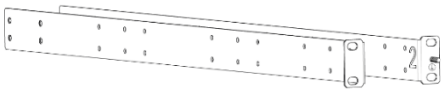
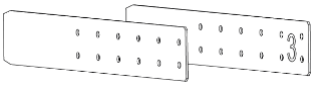
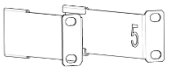
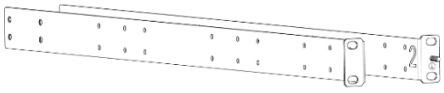
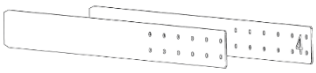
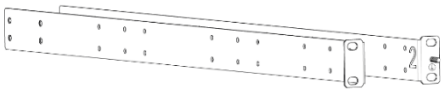
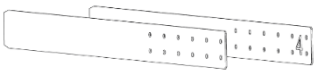
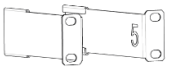
1. Mid-mount, front right and front left (225mm)
2. Front-mounting Bracket, right and left (700mm)
3. Front bracket extension, right and left (270mm)
4. Front bracket extension, right and left (470mm)
5. Rear-mounting brackets, right and left (142mm)
6. Front-mounting Bracket, right and left (600mm)
7. Rear-mounting brackets, right and left (42mm)
8. Screws, M4x6, Phillips (20 pcs)



4.2.2 Determining bracket configuration

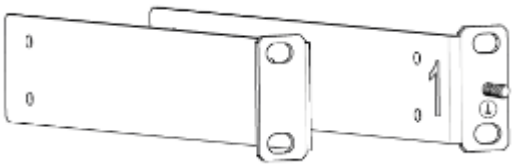
4.2.2.1 4-Post Rack

The bracket configuration to use depends on the depth of the rack where the system is installed into. Use the following table to determine the correct bracket configuration.

	Rack-kit Parts		
Rack Depth	**Front bracket**	**Middle extension**	**Rear bracket**
600 mm 24”	 **6**		 **7**
600 – 700 mm 24” - 28”	 **6**		 **5**
700 – 820 mm 28” - 32”	 **2**		 **5**
800 – 900 mm 32” - 36”	 **2**	 **3**	 **7**
840 – 1000 mm 34” - 40”	 **2**	 **3**	 **5**
1000 – 1100 mm 40” - 44”	 **2**	 **4**	 **7**
1100 – 1200 mm 44” - 48”	 **2**	 **4**	 **5**

4.2.2.2 2-Post Rack

For a 2-post rack, use part number one. Refer to chapter 4.2.6 for mounting instructions.



Part number 1.

4.2.3 Flush and recessed position mounting

Complete the following steps to attach the front brackets to the system.

1. Position the right front-mounting bracket with the flat side against the front right side of the system.
2. Insert five M4x6 screws through the vertically aligned holes in the bracket and then into the holes on the side of the system.
3. Position the left front-mounting bracket with the flat side against the front left side of the system.
4. Insert six M4x6 screws through the vertically aligned holes in the bracket and then into the holes on the side of the system.
5. Tighten all the eleven M4x6 screws to a torque of 17 cm-kg (15 in-lb.).

4.2.4 Attaching the bracket extensions to the front brackets

Complete the following steps to attach the extension brackets to the front brackets.

1. Position the right bracket extension along the side of the front-mounting bracket.
2. Insert four M4x6 screws through the vertically aligned holes in the bracket extension and then into the holes on the front-mounting bracket.
3. Repeat step 2 and step 3 to attach the left bracket extension to the front-mounting bracket.
4. Tighten all the eight M4x6 screws to a torque of 17 cm-kg (15 in-lb.).

4.2.5 Attaching the rear brackets to the rack posts

Complete the following steps to attach the rear brackets to the rack posts.

1. Attach the right rear-mounting bracket to the right rear rack post using two screws and two retainer nuts.
2. Attach the left rear-mounting bracket to the left rear rack post using screws and two retainer nuts.
3. Tighten all the screws to a torque of 29 cm-kg (25 in-lb.).

4.2.6 Attaching brackets for mid-mounting

Complete the following steps to attach the front brackets to the system.

1. Position the right mid-mount bracket with the flat side against the right side of the system.
2. Flip it over so that the L-shaped bracket angle is placed inwards.
3. Insert three screws through the vertically aligned holes in the bracket and then into the holes on the side of the system.
4. Position the left mid-mount bracket with the flat side against the left side of the system.
5. Insert four screws through the vertically aligned holes in the bracket and then into the holes on the side of the system.
6. Tighten all seven M4x6 screws to a torque of 17 cm-kg (15 in-lb.).

4.2.7 Installing the system in the rack

Complete the following steps to install the system in the rack.

1. Position the system in the rack, providing temporary support under the system until it is secured to the rack.
2. If applicable, slide the right and left front-mounting brackets into the rear-mounting brackets that should already be mounted at the rear posts of the rack.
3. Attach the right front-mounting bracket to the right front rack post using two screws and two retainer nuts.
4. Attach the left front-mounting bracket to the left front rack post using screws and two retainer nuts.
5. Tighten all the screws to a torque of 29 cm-kg (25 in-lb.).

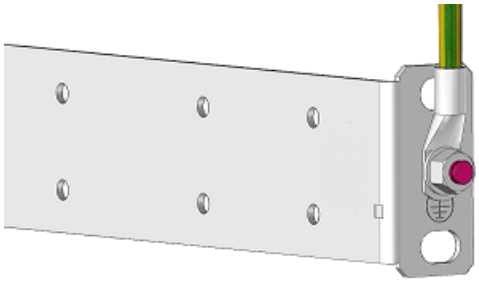
4.2.8 Protective Ground Terminal

Connecting the DCP chassis to earth ground is required for all DC powered installations, and any AC powered installation where compliance with Telcordia grounding requirements is necessary.

Before connecting power to the device, the grounding terminal must be connected to ground to ensure proper operation and to meet electromagnetic interference (EMI) and safety requirements.

The front rack mount brackets include a grounding terminal. The surface area around this terminal is not painted to provide a good electrical connection. It is located on the right-side front rack mount(s). The front rack mount(s) are also interchangeable between left and right if there is requirement to have the ground terminal on the left side.

The grounding cable should have a cable area of minimum 2.5 mm2 (14 AWG). 14 AWG grounding lugs is included together with the rack mounting kit. The nut size of the grounding terminal is M5 and is also included in the rack mounting kit along with an external toothed locking washer which should be placed between the lug and the nut.



Attach the grounding cable from the grounding terminal to an appropriate grounding point at your site.

Never defeat the ground conductor or operate the equipment in the absence of a suitable installed ground conductor.

5 Startup guide

5.1 Package Contents

The DCP-M package includes the following items:

- 2x (1,8m/6 ft.) Power cord (model depends on country/region)
- 2 x Ethernet patch cords
- RJ45 to DB9 adapter
- Rack-mount kit (Refer to 4.2.1 for contents)
- DCP-M system (chassis, PSUs, fan unit)
- Quick Installation Guide

5.2 Initial start up

Connect power to the power supplies that are preinstalled in the chassis. The chassis will automatically power up as soon as the first PSU is connected. The power LED turns green.

The fan package starts up after a few seconds.

After power up, the DCP-M initiates a SW startup sequence. In this start up sequence all LEDs are activated one at a time according to a certain rotating pattern. The status LED is initiated as green and turns red during start-up. After start-up, the status LED represents the current system status:

RED: Any active alarm of severity Critical or Major

GREEN: No active alarm

During power up, the DCP-M will perform an LED test at the end of the start-up sequence.

Once the startup sequence is completed, and assuming no client port is connected, the status LEDs should be green, and all the line and client LEDs should be off except for line Tx. The system is now ready for use.

5.3 Connection to Serial Port

Connect the Serial port of the DCP to a computer using the serial port or a USB/Serial port adapter. Use the following settings for the serial transaction.

Parameter	Setting
Protocol	Serial
Baud rate	115200
Data bits	8
Parity	None
Stop bits	1
Flow control	None

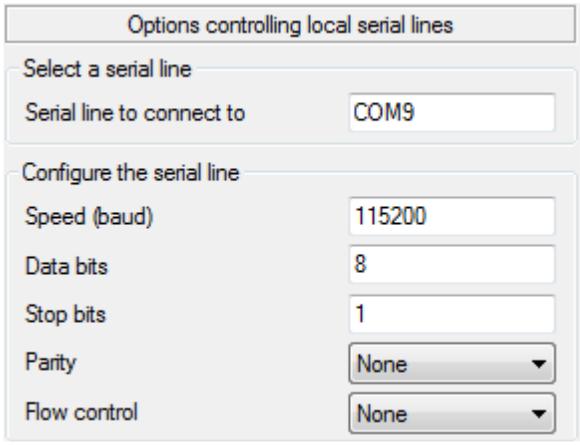


Figure 19. *COM9 is shown only as an example. Use the appropriate port ID for the connection.*

5.3.1 Serial console cable connectors

You can connect a serial RJ45 console port on the DCP units using the following diagram and table.

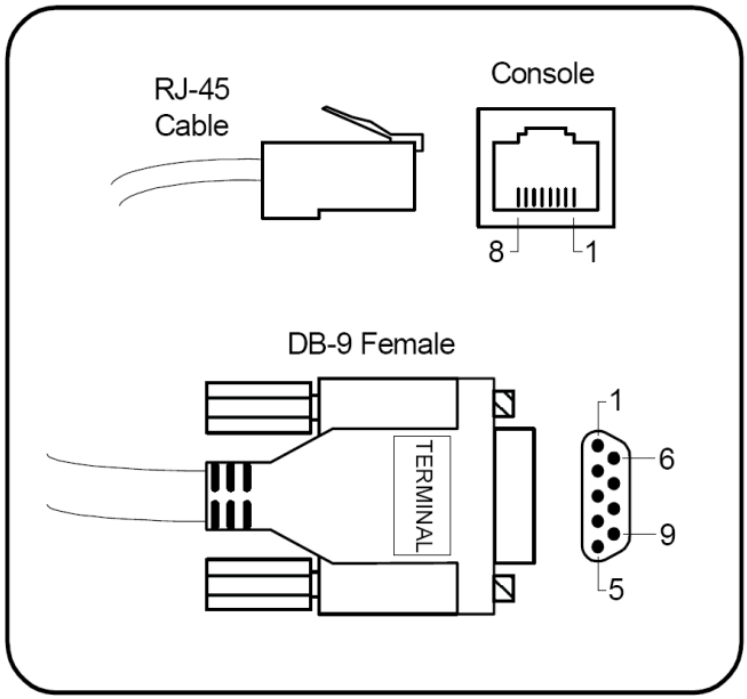


Figure 20. *Serial Console Cable Connectors*

5.3.2 Console Port Cable Pinouts

Unit Console Port (RJ45)		**Serial Port (DB9)**	
PIN	**Signal**	**PIN**	**Signal**
1	Not connected		
2	Not connected		
3	Tx Data	2	Rx Data
4	Ground	5	Ground
5	Ground	5	Ground
6	Rx Data	3	Tx Data
7	Not connected		
8	Not connected		

5.4 IP setup

After starting the CLI session as described above, a prompt should appear on the screen, showing the factory default name for the node and asking for login information.

```
login as:
```

The factory default login is “admin” with password “admin”.

The default IP address of ETH1-4 is 192.168.1.1.

Use ***‘config network mgmt ipv4address <IP address> <Netmask> [Gateway]’*** query to set the IP address of the node.

For example:

```
admin@DCP-M-19>config network mgmt ipv4address 10.10.134.181 255.255.255.0 10.10.134.1

Re-configuring interface network parameters may result in lost connections.
Are you sure you want to continue? (Yes/NO): y

IP address for interface mgmt set to 10.10.134.181, subnet mask 255.255.255.0, default
gateway 10.10.134.1.

admin@DCP-M-19>
```

Once the IP, netmask and gateway addresses are suitably set, it should be possible to start an SSH session by connecting one of the ETH1-4 ports on the DCP-M to a switch with a CAT5/6 cable.

Note: ETH0 uses the fixed IP address 192.168.0.1.

```
admin@DCP-M-19>show network interfaces

mgmt: eth1, eth2, eth3, eth4
IP Address:      10.10.134.181
Netmask:         255.255.255.0
Default gateway: 10.10.134.1
MAC address:     94:DE:0E:02:05:93

eth0 / local:
IP Address:      192.168.0.1
Netmask:         255.255.255.0
MAC address:     94:DE:0E:02:05:92

DNS primary:     10.10.134.254
DNS secondary:

admin@DCP-M-19>
```

5.5 Use CLI interface

After a successful login, some system information is displayed on the screen.

Then press the ***tab*** key to see an overview of the available queries. You can also type "***?***" to get more detailed information of available commands and options.

```
bye         - Logout from shell.
clear       - Clear parameter.
config      - Configure system information.
exit        - Logout from shell.
logout      - Logout from shell.
ping        - Send echo messages.
quit        - Logout from shell.
reboot      - Reboot of the system.
show        - Show system information.
swupgrade   - Software image management.
techlog     - upload log for technicians.
traceroute  - Trace route to destination.
```

It is always possible to use "***tab***" in order to display more information on any query, as for the example which arguments, if any, are required to complete a query.

It is also recommended to start, type the first letters of a query and then use the Tab key to complete the query. This avoids mistakes in typing manually.

5.6 User accounts

The DCP-M is shipped with 1 default user account, admin/admin.

The admin user cannot be deleted and will always be present in a system.
For security reasons, it is recommended to change the admin password.

The admin user account can do both monitoring, configuration and user administration.
It is also possible for the admin user to enable additional user accounts:

- readonly
  This account can be used for monitoring and reading, but this user cannot configure anything.
- operator
  This account can be used both for monitoring and configurations. However, this account cannot do user administration.
- sftpuser
  This account can be enabled to handle file management via sftp. It can access folders in the node file system with files for SW upgrade, techlog and PM.

In addition to these accounts, the DCP platform got a root user account that can be used by support to debug issues with the system. By default, this account is only enabled on the console port. This account can also be fully disabled or fully enabled by the user. It is recommended that the customer makes an active decision to decide what level of access the root user should have.

Possible settings:

- disable – The root account is disabled.
- enable – The root account is open over ssh and console.
- enableConsole – The root account is only open on console port.

User	Show commands	Config commands	User administration	SFTP File transfer	SW upgrade	Encryption
readonly	Yes					
operator	Yes	Yes			Yes	
admin	Yes	Yes	Yes		Yes	
sftpuser				Yes		
cryptouser	Yes	Yes	Yes		Yes	Yes

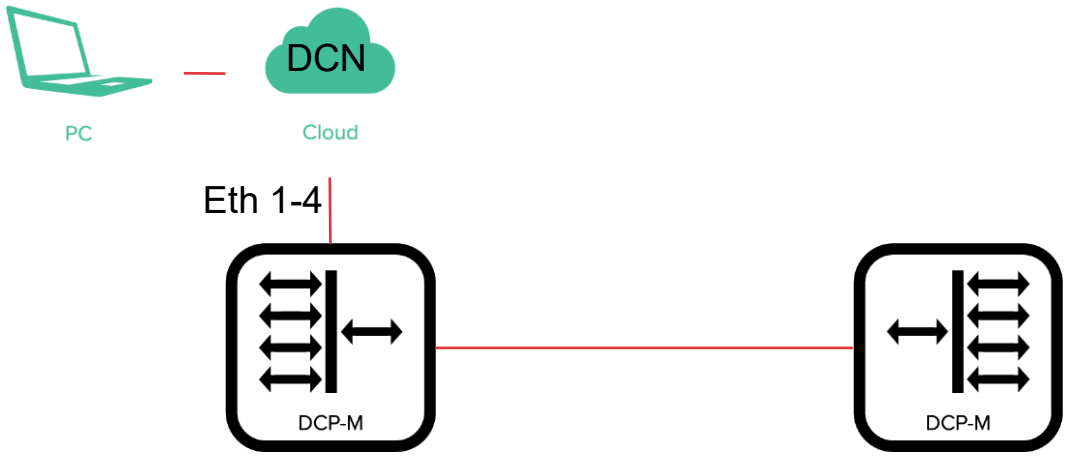
6 Management communication

DCP-M has an OSC (optical supervisory channel) that can be used for management communication.

6.1 Remote management

Remote management can be used to get access to a remote node. Communication is carried out over the OSC. Remote management can be set to enable or disable. It is necessary to have it enabled on both sides if communication should work.

When remote management is enabled, it is possible to talk to the remote node via one of the Eth ports (Eth1-4) on the DCP-M chassis.
The two DCP-Ms must be in the same subnet.



The OSC has a bandwidth of 100Mb/s and the prioritized traffic is used for the distance measurements and for control loops. The rest can be used for management communication between two nodes. It is not allowed to connect external devices to the remote device.

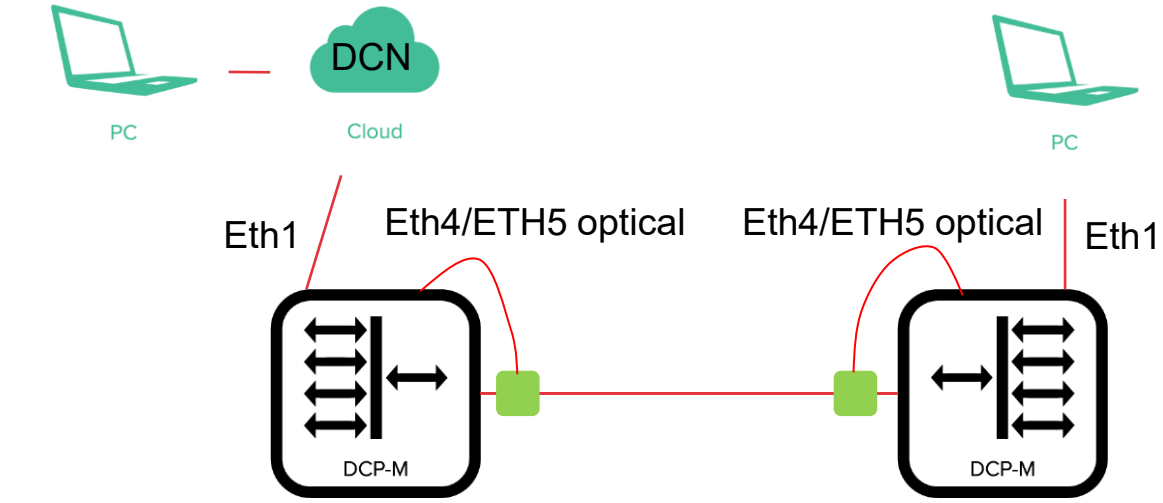
6.2 Remote management via Eth4/ETH5 optical

The DCP-M units have one optical port on the rear side. It is port ETH4 on DCP-M8-PAM4, DCP-M40-PAM4-xx and DCP-M40-C-ZR+. For the other DCP-M units it is ETH5 that is the optical port. The optical Eth4/ETH5 port on the back of DCP-M can use optical SFPs for 1Gb/s. This can be used to create a management connection to the remote site without going via OSC.

In this solution the Eth4/ETH5 port will use a xWDM SFP and an external xWDM filter. The connection will then terminate at the Eth4/ETH5 port on the remote DCP-M. This will allow the two DCP-M to be in the same switch domain. It is required to have the two DCP-Ms in the same subnet.

In the example below Eth4/ETH5 is used to create an optical connection to the remote chassis. The DCP-M chassis can be accessed locally on another Eth port, e.g. Eth1.

WARNING - WARNING - It is not allowed to use Eth4/Eth5 optical for management while having remote management enabled. This could create a loop.



Note that DCP-M already uses a channel with wavelength 1510nm for the OSC. A different wavelength and a different filter should be used for ETH4/ETH5.

7 Software upgrade/downgrade

The SW can be upgraded or downgraded with swupgrade commands in CLI. See CLI User Manual for details about SW upgrade/downgrade.

8 SNMP

8.1 General

Simple Network Management Protocol (SNMP) is a protocol used for managing and monitoring network devices.

The DCP-M supports SNMP versions 1 and 2c. In SNMP version 1 and 2c user authentication is accomplished using community strings.

The default community string for the DCP-M is ‘public’.

For security reasons, it is recommended to change the default community string.

The SNMP Interface supports:

a. SNMPv1 for Traps.

b. SNMPv2c for Traps and for Get operations.

c. SNMPv3 for Get operations.

SNMP Set is not supported.

8.2 SNMP MIBS

Smartoptics provides a range of MIBs that can be used to monitor the DCP-M system. These include line fiber monitoring, port states including optical parameters such as TX/RX power levels and identified format.

For more specific details of the available SNMP MIBs, please refer to the manual ‘DCP MIB description‘.

8.3 SNMP Traps

Traps or notifications are messages that alert events occurring in the DCP-M.

Trap	Description
coldStart	A coldStart trap signifies that the SNMP agent has been restarted.
dcpAlarmNotificationCleared	Sent when alarms are deactivated.
dcpAlarmNotificationCritical	Sent when an alarm of severity critical is activated
dcpAlarmNotificationMajor	Sent when an alarm of severity major is activated
dcpAlarmNotificationMinor	Sent when an alarm of severity minor is activated
dcpAlarmNotificationWarning	Sent when an alarm of severity warning is activated

9 User Access and Authentication

The DCP-M supports local authentication and RADIUS or Terminal Access Controller Access Control System Plus (TACACS+) to control access to the units.

9.1 Local authentication

The local authentication method is always enabled. The authentication is performed against a local database stored in the unit. The default user admin is a local user with default password admin. The admin user can’t be removed from the node. Local authentication requires manual updates of usernames and passwords of each unit in the network.

For security reason, it is recommended to change the admin password.

Three user levels are possible: admin, operator and readonly. The admin user exists from start while the other two have to be enabled in CLI by the admin user.

9.2 RADIUS

RADIUS for DCP is implemented according to IETF RFC 2865 and RFC 2866.

The RADIUS remote authentication method is optional and can be enabled/disabled by the administrator. When enabled it establishes a TCP connection with a configured RADIUS server. When the user enters the username, the DCP unit communicates with the RADIUS server and verifies and confirms user credentials against a centralized database stored on the remote RADIUS server.

9.2.1 Parameters used by RADIUS authentication.

Parameter	Description
adminStatus	**up**: Specifies if the RADIUS authentication is enabled **down**: Specifies if the RADIUS authentication is disabled
Timeout	Length of time that the DCP waits to receive a response from a RADIUS server. By default, the DCP waits 3 seconds. It´s possible to configure this value in the range from 0 through 90 seconds.
Retry	Number of times that the unit should try to verify the user's credentials. By default, the value is 1. It´s possible to configure this value in the range from 0 to 5.
primaryServer address	IPaddress or DNS name of the primary RADIUS server.
primaryServer port	RADIUS server port number. Valid values are between 0 and 65535. The default value is 1812.
primaryServer key	Specifies an authentication and encryption key of the primary RADIUS server. The key used by the local unit must match that used by the primary RADIUS server. The length of the key is restricted to 63 characters and can include any printable ASCII characters (If the password includes spaces, enclose the password in quotation marks).
secondaryServer address	IPaddress or DNS name of the secondary RADIUS server.
secondaryServer port	RADIUS server port number. Valid values are between 0 and 65535. The default value is 1812.
secondaryServer key	Specifies an authentication and encryption key of the secondary RADIUS server. The key used by the local unit must match that used by the secondary RADIUS server. The length of the key is restricted to 63 characters and can include any printable ASCII characters (If the password includes spaces, enclose the password in quotation marks).

9.2.2 Configuring RADIUS Authentication

These commands are used to configure the RADIUS settings. The system will only authenticate with the RADIUS server when RADIUS is configured to admin status up.

```
admin@dcpf-189>config aaa radius

adminStatus      - Configure RADIUS admin status.
primaryServer    - Configure RADIUS primary server.
retry            - Configure RADIUS server connection retry attempts.
secondaryServer  - Configure RADIUS secondary server.
timeout          - Configure RADIUS server connection timeout.

admin@dcpf-189>config aaa radius
```

9.2.2.1 Configuring RADIUS Server address

This command is used to configure the RADIUS server's addresses.

```
admin@dcpf-189>config aaa radius primaryServer address 10.10.134.33
Primary RADIUS server address set to '10.10.134.33'.

admin@dcpf-189>config aaa radius secondaryServer address 10.10.134.34
Secondary RADIUS server address set to '10.10.134.34'.
```

9.2.2.2 Configuring RADIUS Key

This command is used to configure the RADIUS server's key.

```
admin@dcpf-189>config aaa radius primaryServer key dcpRADIUSkey
Primary RADIUS server key set to 'dcpRADIUSkey'.

admin@dcpf-189>config aaa radius secondaryServer key dcpRADIUSkey2
Secondary RADIUS server key set to 'dcpRADIUSkey2'.
```

9.2.2.3 Configuring RADIUS Adminstatus

This command is used to enable/disable RADIUS authentication

```
admin@dcpf-189>config aaa radius adminStatus up
RADIUS admin status set to up.
admin@dcpf-189>
```

9.2.3 Show RADIUS status

To display the status for the RADIUS configuration, use the following command:

```
admin@dcpf-189>show aaa radius status

RADIUS admin status     : up
                                                          Timeout
  Server     Address       Port  Key            Retry   [seconds]
  ---------  ------------  ----  -------------  -----   ---------
  Primary    10.10.134.33  1812  dcpRADIUSkey   1       3
  Secondary  10.10.134.33  1812  dcpRADIUSkey2  1       3

admin@dcpf-189>
```

9.2.4 Change a RADIUS user's password

To change the RADIUS user password, use the following command:

```
dcp_cli> config user chpasswd
```

The system will prompt the user to ask for old password and new password after the user executes the command.

9.2.5 How to specify user roles in RADIUS

There are three user levels available in the DCP platform: admin, operator and readonly. It is possible to map RADIUS users to any of these groups.

Use the following settings on the RADIUS server to map users to specific groups.

In Vendor-Specific attributehttps://datatracker.ietf.org/doc/html/rfc2865 (Type = 26), set Vendor-Id to 30826 (IANA Enterprise Number for Smartoptics), Vendor type to 1, and the Attribute-Specific string to one of admin, operator, readonly.

Here is an example configuration for FreeRADIUS:

- In file: /etc/freeradius/3.0/dictionary add the following line
  $INCLUDE dictionary.smartoptics
- Create also the file /etc/freeradius/3.0/dictionary.smartoptics with the content:
  VENDOR Smartoptics 30826
  BEGIN-VENDOR Smartoptics
  ATTRIBUTE Smartoptics-Userrole 1 string
  END-VENDOR Smartoptics
- Users and their roles are defined in /etc/freeradius/3.0/users like usual using this syntax:
  readonly123 Cleartext-Password := "read123"
  Smartoptics-Userrole := "readonly"

  operator123 Cleartext-Password := "operator123"
  Smartoptics-Userrole := "operator"

- If changes are made to dictionary or users, you need to restart Freeradius (as root or using sudo):
  systemctl restart freeradius

9.3 TACACS+

TACACS+ for DCP is implemented according to IETF “The TACACS+ Protocol”, draft-ietf-opsawg-tacacs-18. TACACS+ protocol uses Transmission Control Protocol (TCP) as the transport protocol with destination port number 49.

https://datatracker.ietf.org/doc/draft-ietf-opsawg-tacacs/

The TACACS+ remote authentication method is optional and can be enabled/disabled by the administrator. When enabled it establishes a TCP connection with a configured TACACS+ server. When the user enters the username, the DCP unit communicates with the TACACS+ server and verifies and confirms user credentials against a centralized database stored on the remote TACACS+ server.

9.3.1 Parameters used by TACACS+ authentication

Parameter	Description
adminStatus	**up**: Specifies if the TACACS+ authentication is enabled **down**: Specifies if the TACACS+ authentication is disabled
Timeout	Length of time that the DCP waits to receive a response from a TACACS+ server. By default, the DCP waits 3 seconds. It´s possible to configure this value in the range from 1 through 90 seconds.
Retry	Number of times that the unit should try to verify the user's credentials. By default, the value is 1. It´s possible to configure this value in the range from 0 to 5.
primaryServer address	IPaddress or DNS name of the primary TACACS+ server.
primaryServer port	TACACS+ server port number. Valid values are between 0 and 65535. The default value is 49.
primaryServer key	Specifies an authentication and encryption key of the primary TACACS+ server. The key used by the local unit must match that used by the primary TACACS+ server. The length of the key is restricted to 63 characters and can include any printable ASCII characters (If the password includes spaces, enclose the password in quotation marks).
secondaryServer address	IPaddress or DNS name of the secondary TACACS+ server.
secondaryServer port	TACACS+ server port number. Valid values are between 0 and 65535. The default value is 49.
secondaryServer key	Specifies an authentication and encryption key of the secondary TACACS+ server. The key used by the local unit must match that used by the secondary TACACS+ server. The length of the key is restricted to 63 characters and can include any printable ASCII characters (If the password includes spaces, enclose the password in quotation marks).

9.3.2 Configuring TACACS+ Authentication

These commands are used to configure the TACACS+ settings. The system will only authenticate with the TACACS+ server when TACACS+ admin status is up.

```
dcp_cli> config aaa tacplus
adminStatus      - Configure TACACS+ admin status.
primaryServer    - Configure TACACS+ primary server.
retry            - Configure TACACS+ server connection retry attempts.
secondaryServer  - Configure TACACS+ secondary server.
timeout          - Configure TACACS+ server connection timeout.
dcp_cli>
```

9.3.2.1 Configuring TACACS+ Server address

This command is used to configure the TACACS+ server's addresses.

```
dcp_cli> config aaa tacplus primaryServer address 10.10.134.33
Primary TACACS+ server address set to '10.10.134.33'.

dcp_cli>config aaa tacplus secondaryServer address 10.10.134.34
Secondary TACACS+ server address set to '10.10.134.34'.
```

9.3.2.2 Configuring TACACS+ Key

This command is used to configure the TACACS+ server's key.

```
dcp_cli>config aaa tacplus primaryServer key sosrvtest01
Primary TACACS+ server key set to 'sosrvtest01'.

dcp_cli> config aaa tacplus secondaryServer key testing123
Secondary TACACS+ server key set to 'testing123'.
```

9.3.2.3 Configuring TACACS+ Adminstatus

This command is used to enable/disable TACACS+ authentication

```
dcp_cli> config aaa tacplus adminStatus up
TACACS+ admin status set to up.
```

9.3.3 Show TACACS+ status

To display status for a TACACS+, use the following command:

```
dcp_cli> show aaa tacplus status
TACACS+ admin status     : up
                                                    Timeout
  Server     Address       Port  Key          Retry  [seconds]
  ---------  ------------  ----  -----------  -----  ---------
  Primary    10.10.134.33  4950  sosrvtest01  1      5
  Secondary  10.10.134.34  49    testing123   1      5
dcp_cli>
```

9.3.4 Change a TACACS+ user's password

If the server is configured with "End User Authentication Settings" it is possible to change the password of the current TACACS+ user via CLI commands on the DCP.

To change the TACACS+ user password, use the following command:

```
dcp_cli> config user chpasswd
```

The system will prompt the user to ask for old password and new password after the user executes the command.

9.3.5 Troubleshooting TACACS+ server connection with NETCAT

In case the DCP unit is not able to connect with the TACACS+ server, there might be some firewall or access list blocking the traffic. Verify the connectivity to the TACACS+ server with netcat by issuing the following commands.

```
dcp_cli> nc <address> <port>
```

Attribute	Description
<address>	Specifies the IP address of the TACACS+ server.
<port>	Specifies the port number of the TACACS+ server. Valid value is between 0 and 65535. Default value is 49.

9.3.6 How to specify user roles in TACACS

There are three user levels available in the DCP platform: admin, operator and readonly. It is possible to map TACACS users to any of these groups.

Use the following settings on the TACACS server to map users to specific groups.

Set attribute userrole=<role> where <role> is one of admin, operator, readonly.
In TACACS+ servers based on https://shrubbery.net/tac_plus/ this can be done as follows:

```
user = albert {
        name = "Albert Einstein"
        login = cleartext "E=mc^2"
        member = "admin"
        service = exec {
                userrole = readonly        <-- this line sets the user role to
'readonly'
        }
}
```

10 Audit Trail

The DCP platform records events that occur within the system and provides logging mechanisms for Authentication, Fault management and Accounting.

10.1 Authentication

The Access Logs enables tracking of login/logout and password changes activity of users including unsuccessful login events. The last 200 events are kept within the node and for longer history keeping of events an external Syslog should be configured. When the max allowed log entries are reached, the oldest entries are overwritten with new events.

10.1.1 show syslog access

To display access logs, use the following command:

```
dcp_cli> show syslog access
  Time                 PID   Remote host     Event
  -------------------  ----  --------------  --------------------------
  2020-06-02 08:25:42  1021  10.212.148.241  Local User admin logged in
dcp_cli>
```

10.2 Fault management

The Alarm log keeps track of all activated and deactivated alarms occurred within the system. The last 200 events are kept within the node and for longer history keeping of events an external Syslog should be configured. When the max allowed log entries are reached, the oldest entries are overwritten with new events.

10.2.1 show syslog alarm

To display alarm logs, use the following command:

```
dcp_cli>show syslog alarm
  Time                 Alarm
  -------------------  ------------------------------------------------------------------------------------
  2020-05-29 06:16:13  Alarm "Power supply missing" activated on interface psu-1/2 with severity critical.
dcp_cli>
```

10.3 Accounting

The Configuration log enables tracking of all configs, clear, reboot and swupgrade commands activity within the system. The last 200 events are kept within the node and for longer history keeping of events an external Syslog should be configured. When the max allowed log entries are reached, the oldest entries are overwritten with new events.

10.3.1 show syslog config

To display the configuration logs, use the following command:

```
dcp_cli>show syslog config
  Time                 User       Remote host     Event
  -------------------  ---------  --------------  --------------------
  2020-06-02 08:49:57  admin@CLI  10.212.148.241  clear alarm log
  2020-06-02 08:50:12  admin@CLI  10.212.148.241  config slot 1 reboot
dcp_cli>
```

11 Syslog

Syslog is a standard log transport mechanism that enables the aggregation of log data into a central repository for archiving, analysis, and reporting. The DCP platform can be configured to forward Access, Alarm and Configuration logs to an external syslog server. It's possible to configure the transport with TCP for reliable and secure log forwarding, or UDP for non-secure forwarding.

11.1.1 Parameters to communicate with remote syslog

Parameter	Description
Access	**Disable**: Disables sending access log to remote syslog server. **Enable:** Enables sending access log to remote syslog server.
adminStatus	**up**: Specifies if the remote syslog server is enabled **down**: Specifies if the remote syslog server is disabled
Alarm	**Disable**: Disables sending alarm log to remote syslog server. **Enable:** Enables sending alarm log to remote syslog server.
Config	**Disable**: Disables sending config log to remote syslog server. **Enable:** Enables sending config log to remote syslog server.
Port	Remote syslog server port number. Valid values are between 0 and 65535.
Protocol	**tcp:** Configure remote syslog server network protocol to tcp. **udp**: Configure remote syslog server network protocol to udp.
Primary Server	IP address or DNS name of the primary syslog server.
Secondary Server	IP address or DNS name of the secondary syslog server.

11.1.2 Configuring remote syslog

These commands are used to configure and send system messages to a specified syslog server. The system will only send messages to the server when admin status is up.

```
dcp_cli> config syslog remote
access           - Configure sending access log to remote syslog servers.
adminStatus      - Configure remote syslog server admin status.
alarm            - Configure sending alarm log to remote syslog servers.
config           - Configure sending configuration log to remote syslog servers.
primaryServer    - Configure remote primary syslog server.
secondaryServer  - Configure remote secondary syslog server.
dcp_cli>
```

11.1.2.1 config syslog remote access enable/disable

This command is used to enable/disable sending access log system messages to remote syslog server.

```
dcp_cli>config syslog remote access enable
Enabled sending access log to remote syslog server.
admin@hostname>config syslog remote access disable
Disabled sending access log to remote syslog server.
dcp_cli>
```

11.1.2.2 config syslog remote adminStatus up/down

This command is used to enable/disable sending system messages to remote syslog server.

```
dcp_cli>config syslog remote adminStatus up
Remote syslog server admin status set to up.
dcp_cli>config syslog remote adminStatus down
Remote syslog server admin status set to down.
dcp_cli>
```

11.1.2.3 config syslog remote alarm enable/disable

This command is used to enable/disable sending alarm log system messages to remote syslog server.

```
dcp_cli>config syslog remote alarm enable
Enabled sending alarm log to remote syslog server.
dcp_cli>config syslog remote alarm disable
Disabled sending alarm log to remote syslog server.
dcp_cli>
```

11.1.2.4 config syslog remote config enable/disable

This command is used to enable/disable sending config log system messages to remote syslog server.

```
dcp_cli>config syslog remote config enable
Enabled sending configuration log to remote syslog server.
dcp_cli>config syslog remote config disable
Disabled sending configuration log to remote syslog server.
dcp_cli>
```

11.1.2.1 config syslog remote primaryServer address <address>

This command is used to configure the IP address of the primary syslog server.

```
dcp_cli> config syslog remote primaryServer address 10.10.11.22
Remote primary syslog server address set to '10.10.11.22'.
dcp_cli>
```

11.1.2.2 config syslog remote primaryServer port <port>

This command is used to configure the remote syslog port number for the primary server.

```
dcp_cli>config syslog remote primaryServer port 514
Remote primary syslog server port set to '514'.
dcp_cli>
```

11.1.2.3 config syslog remote primaryServer protocol <protocol>

This command is used to configure the remote syslog network protocol for the primary server.

```
admin@L8-109-B-D1>config syslog remote primaryServer protocol
tcp udp
admin@L8-109-B-D1>config syslog remote primaryServer protocol udp
Primary remote syslog server network protocol set to udp.
```

11.1.3 show syslog status

To display the status of the configured syslog, use the following command:

```
admin@Stockholm-97>show syslog status
Remote syslog admin status     : up
  Server     Address      Protocol  Port
  ---------  -----------  --------  ----
  Primary    10.10.11.22  udp       514
  Secondary               udp       514

  Log     Remote logging  Facility
  ------  --------------  ---------------
  Access  enabled         auth + authpriv
  Alarm   enabled         local7
  Config  enabled         local6
```

12 Waste management

The HW should be treated as an electronic waste when it is decommissioned and taken out of service.

13 Technical Specifications

ENVIRONMENT	
OPERATING TEMPERATURE	0° C to 45° C
HUMIDITY	5% to 85% RHI
SUPPLY VOLTAGE	Dual feeding DCP-2-PSU-AC-FB: 100-127VAC (3A) and 200-240 VAC (1,5A) DCP-2-PSU-DC-FB: -40 to -72 VDC (7A)
POWER CONSUMPTION	Max during powerup: 65W (55W for DCP-M40-C-ZR+ and DCP-M40-MSO-ZR+) ~55 W for DCP-M32-CSO-ZR+ Normal operation: 45W (35W for DCP-M40-C-ZR+ and DCP-M40-MSO-ZR+) ~35 W for DCP-M32-CSO-ZR+
REDUNDANCY	Hot swappable fan & PSUs
COOLING FANS	Front-to-Back straight through airflow
ALTITUDE	3000 m (10.000 ft.)
DIMENSIONS	
WIDTH	440mm, 17.3”
DEPTH	510mm, 20”
HEIGHT	1RU
WEIGHT	13 Kg, 28.7 lbs. ~13 kg, ~28.7 lbs for DCP-M32
OPTICAL	
FIBER TYPE	G.652 (SMF-28)
TOPOLOGY	Point-to-Point
FRONT SIDE CONNECTIONS	Up to 40 DWDM client channels D921 to D960 (Model dependant) Line port(s) LC/UPC connector type
SUPPORTED PROTOCOLS	Transparent to ITU channel signals PAM4 2 lambda
LATENCY	0.15 µs
EYE SAFETY CLASS	Laser safety class 1

NETWORK MANAGEMENT	
MANAGEMENT INTERFACES	4 x RJ45 LAN ports 10/100/1000Base-T 1 x SFP LAN port 1000 Base-X 1 x RS-232 serial port 1 x RJ-45 local craft 10/100/1000 Base-T
SOFTWARE UPGRADE	Traffic hitless – dual image
BOOT TIMING	Booting from Coldstart < 5min Warmstart reboot < 2min
PROTOCOLS	CLI, SNMP, gNMI, SYSLOG, TACACS+, RADIUS
MANAGEMENT CHANNEL	Optical Supervisory Channel (OSC) at 1510nm (standard)
VISUAL INDICATORS	LED status indicators for client ports, line interfaces, power, shelf
SPECIAL CONSIDERATIONS	Maximum recommended fiber distance and loss between a PAM4 Client and the DCP-M is 500 m (1640 ft.) and 1 dB.

REGULATORY COMPLIANCES	
EMC	Title 47 CFR Part 15 Subpart B EN55024/CISPR24: 2011 + A1:2015 EN55032:2015/CISPR32 ETSI EN 300 386 V2.1.1
SAFETY	CB (IEC 60950-1:2005+A1+A2, IEC 62368-1:2014) ETL (CSA C22.2#62368-1:2014 Ed.2, UL 62368-1:2014 Ed.2)
NEBS	Level 3
LASER SAFETY	IEC 60825-1 : 2007 (2nd Edition) IEC 60825-1:2014 (Third Edition)

13.1 Supported OSC transceivers

CERTIFIED TRANSCEIVERS FOR OSC	
PART NUMBER	Description
SO-SFP-155M-L80D-C51	SFP STM1/OC3 FE CWDM 80km 1510nm
SO-SFP-155M-L120D-C51	SFP STM1/OC3 FE CWDM 120km 1510nm
SO-SFP-155M-L200D-C51	SFP STM1/OC3 FE CWDM 200km 1510nm
SO-SFP-155M-O-C51-E	SFP 155M OTDR C51 E-tmp
SO-SFP-1G-O-C51-E	SFP 1G OTDR C51 E-tmp
SO-SFP-L80D-C51	SFP 1GE FC CWDM 80km 1510nm
SO-SFP-L120D-C51	SFP 1GE FC CWDM 120km 1510nm
SO-SFP-L160DH-C51	SFP 1GE FC CWDM 160km HP 1510nm
SO-SFP-L160D-C51	SFP 1GE FC CWDM 160km 1510nm
SO-SFP-L50D-C51	SFP, 1G Ethernet, 1G FC, CWDM, 50km, 19dB, LC, 1510nm

Appendix A Link Scenarios

DCP-M "PAM4 Mode" Mixed Services

DCP-M Model	25GbE/ 32G FC	16G FC	8/10G w/o FEC	8/10G with FEC	100G QPSK	400G ZR & ZR+ 16QAM[1]	100G PAM4	Distance
DCP-M40-PAM4-ER Rev. R1C	0-14 dB	0-14 dB	0-14 dB	0-14 dB	0-14 dB	0-14 dB	0 - 14 dB	0 - 40 km
DCP-M40-PAM4-ER Rev. R2A or later	0-14 dB	0-14 dB	0-14 dB	0-14 dB	0-14 dB	0-14 dB	0 - 14 dB	0 - 40 km
DCP-M40-PAM4-ER+ Rev. R1A	0-14 dB	0-14 dB	0-14 dB	0-14 dB	0-14 dB	0-14 dB	0 - 14 dB	20 - 60 km
DCP-M40-PAM4-ER+ Rev. R2A or later	0-14 dB	0-14 dB	0-14 dB	0-14 dB	0-14 dB	0-14 dB	0 - 14 dB	20 - 60 km
DCP-M8-PAM4	N/A	N/A	N/A	N/A	N/A	N/A	0 - 20 dB	0 – 80 Km
DCP-M40-PAM4-ZR	N/A	N/A	0-18 dB	0-18 dB	0-18 dB	0-18 dB	0 - 18 dB	40 - 80 km
DCP-M40-PAM4-ZR Rev. R2A or later	0-18 dB	0-18 dB	0-18 dB	0-18 dB	0-18 dB	0-18 dB	0 - 18 dB	0 - 80 km

1. Includes also 200G QPSK and 300G 8QAM

DCP-M "coherentNRZ" Mixed Services

DCP-M Model	25GbE/ 32G FC	16G FC	8/10G w/o FEC	8/10G with FEC	100G QPSK	400G ZR & ZR+ 16QAM[1]	100G PAM4	Distance[2]
DCP-M40-PAM4-ER Rev. R1C	0-22 dB	0-22 dB	0-22 dB	0-22 dB	0-22 dB	0-22 dB	N/A	0 - 80 km
DCP-M40-PAM4-ER Rev. R2A or later	0-22 dB	0-22 dB	0-22 dB	0-22dB	0-22 dB	0-22 dB	N/A	0 - 80 km
DCP-M40-PAM4-ER+ Rev. R1A	0-22 dB	0-22 dB	0-22 dB	0-22 dB	0-22 dB	0-22 dB	N/A	20 - 100Km
DCP-M40-PAM4-ER+ Rev. R2A or later	0-22 dB	0-22 dB	0-22 dB	0-22 dB	0-22 dB	0-22 dB	N/A	20 - 100Km
DCP-M8-PAM4	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
DCP-M40-PAM4-ZR	N/A	N/A	0-22 dB	0-22 dB	0-22 dB	0-22 dB	N/A	40 - 120Km
DCP-M40-PAM4-ZR Rev. R2A or later	0-22 dB	0-22 dB	0-22 dB	0-22 dB	0-22 dB	0-22 dB	N/A	0 - 120Km

1. Includes also 200G QPSK and 300G 8QAM
2. Max distance for 10-32G requires max manual setting on dispersion compensation. However, with this setting it is not possible with 400G or PAM4 due to channel narrowing.

DCP-M "coherentNRZ – extendedDistance" Individual Services

DCP-M Model	25GbE/ 32G FC	16G FC	8/10G w/o FEC	8/10G with FEC	100G QPSK	Minimum link loss
DCP-M40-PAM4-ER Rev. R1C	10-22 dB (0 - 80 km)	10-22 dB (0 - 100 km)	10-25 dB[1] (0 - 120 km)	10-25 dB[1] (0 - 120 km)	10-25 dB[1] (0 - 120 km)	10 dB
DCP-M40-PAM4-ER Rev. R2A or later	10-22 dB (0 - 80 km)	10-22 dB (0 - 100 km)	10-26 dB (0 - 120 km)	10-29 dB[1,2] (0 - 120 km)	10-29 dB[1,2] (0 - 120 km)	10 dB
DCP-M40-PAM4-ER+ Rev. R1A	10-22 dB (20 - 100 km)	10-22 dB (20 - 120 km)	10-25 dB[1] (20 - 140 km)	10-25 dB[1] (20 - 140 km)	10-25 dB[1] (0 - 120 km)	10 dB
DCP-M40-PAM4-ER+ Rev. R2A or later	N/A	N/A	10-26 dB (20 - 140 km)	10-29 dB[1,2] (20 - 140 km)	10-29 dB[1,2] (0 - 140 km)	10 dB
DCP-M40-PAM4-ZR	N/A	N/A	10-23 dB (40 - 100 km)	10-29 dB[1,2] (40 - 160 km)	10-29 dB[1,2] (0 - 160 km)	10 dB
DCP-M40-PAM4-ZR Rev. R2A or later	N/A	N/A	10-26 dB (40 - 160 km)	10-29 dB[1,2] (40 - 160 km)	10-29 dB[1,2] (0 - 160 km)	10 dB

1. Limited by OSC reach

2. Minimum 2ch needed to avoid low input power alarms on pre-amp.

DCP-M "coherentNRZ – extendedDistance" Individual Services continue

DCP-M Model	100G QPSK	200G QPSK	300G 8QAM	400G ZR 16QAM	400G ZR+ 16QAM	Minimum link loss
DCP-M40-PAM4-ER Rev. R1C	10-25 dB[1] NA[3]	10-25 dB[1] NA[3]	10-25 dB1[,6] NA[3]	10-22.5 dB NA[3]	10-24.5 dB[4] NA[3]	10 dB
DCP-M40-PAM4-ER Rev. R2A or later	10-29dB[1, 6] NA[3]	10-29dB[1,5] NA[3]	10-27 dB[5] NA[3]	10-22.5 dB NA[3]	10-24.5 dB[4] NA[3]	10 dB
DCP-M40-PAM4-ER+ Rev. R1A	10-25 dB[1] NA[3]	10-25 dB[1] NA[3]	10-25 dB1[,6] NA[3]	10-22.5 dB NA[3]	10-24.5 dB[4] NA[3]	10 dB
DCP-M40-PAM4-ER+ Rev. R2A or later	10-29dB[1,6] NA[3]	10-29dB[1,5] NA[3]	10-27 dB[5] NA[3]	10-22.5 dB NA[3]	10-24.5 dB[4] NA[3]	10 dB
DCP-M40-PAM4-ZR	10-29dB[1, 6] NA[3]	10-29dB[1, 5] NA[3]	10-28dB [5] NA[3]	10-22 dB NA[3]	10-24 dB[2] NA[3]	10 dB
DCP-M40-PAM4-ZR Rev. R2A or later	10-29dB[1, 6] NA[3]	10-29dB[1, 5] NA[3]	10-29dB[1, 5] NA[3]	10-25 dB NA[3]	10-27 dB[2] NA[3]	10 dB

1 Limited by OSC reach

2. 27dB possible with Tx power -10dBm or better. For Tx power -13dBm the link budget is 25dB.

3. Not limited by dispersion

4. 24.5dB possible with Tx power -10dBm or better. For Tx power -13dBm the link budget is 22.5dB.

5. Minimum 4ch needed to avoid low input power alarms on pre-amp.

6. Minimum 2ch needed to avoid low input power alarms on pre-amp.

DCP-M40-C-ZR+ Individual Services

DCP-M Model	8/10G w/o FEC	8/10G with FEC	100G QPSK	200G QPSK	400G ZR	400G OpenZR+
DCP-M40-C-ZR+	26dB 80km	29dB[1] 80km	29dB[1] NA[3]	29dB[1] NA[3]	26dB 120km	28 dB[2] NA[3]

DCP-M40-C-ZR+ "extendedDistance" Individual Services

DCP-M Model	8/10G w/o FEC	8/10G with FEC	100G QPSK	200G QPSK	400G ZR	400G OpenZR+
DCP-M40-C-ZR+	26dB 80km	29dB[1] 80km	29dB[1] NA[3]	29dB[1] NA[3]	26dB 120km	28 dB[2] NA[3]

1 Limited by OSC reach

2. 28dB possible with Tx power -10dBm or better. For Tx power -13dB the link budget is 26dB.

3. Not limited by dispersion

DCP-M32-CSO-ZR+ Individual Services

DCP-M Model	8/10G w/o FEC	8/10G with FEC	100G QPSK	200G QPSK	400G ZR	400G OpenZR+	800G ZR	800G ZR PCS
DCP-M32-CSO-ZR+	28dB 80km	33dB[1] 80km	33dB[1] NA[3]	33dB[1] NA[3]	25dB 120km	30 dB[2] NA[3]	27dB 120km	29dB NA[3]

1 Limited by low input power alarms on pre-amp for 1ch.

2 30dB possible with Tx power 0dBm or better. For Tx power -10dB the link budget is 28dB.

3. Not limited by dispersion

DCP-M40-MSO-ZR Individual Services

DCP-M Model	8/10G w/o FEC	8/10G with FEC	25G/32G FC	40/100G PAM4[3]	100G-ZR+ QPSK	200G-ZR+ QPSK	300G-ZR+ 8QAM	400G-ZR+ (Open ZR+)	400G-ZR (OIF)
DCP-M40-MSO-ZR	26dB 125km	32dB 140km	20dB 90km	17dB 80km	32dB NA[2]	32dB NA[2]	31dB NA[2]	28 dB[1] NA[2]	21dB 1200km

1 28dB possible with Tx power 0dBm or better. For Tx power -10dB the link budget is 24dB

2 Not limited by dispersion

3. Supports only single carrier PAM4 signals

Appendix B Optical Interface Specifications

LINE INTERFACE

TRANSMIT (LINE FIBER IS INTERRUPTED)	around -9 dBm (OSC channel Tx power)

Please note, the DCP-M units have a protection mechanism where the line signals are turned off if the line fiber link is interrupted. In this case only the OSC channel transmit power can be measured.

CLIENT INTERFACE – TYPICAL OPTICAL POWER LEVELS FOR FORMATS 100GPAM4 AND 40GPAM4

RECEIVE	-9 to -6 dBm (total power) for SO-QSFP28-Dxx (dual carriers) -7 to +4 dBm (total power) for SO-QSFP28-Dxx-A (single carrier)
TRANSMIT	+2 to +6 dBm (total power)

Maximum recommended fiber distance and loss between a PAM4 Client and the DCP-M is 500 m (1640 ft.) and 1 dB.
The Transmit power levels from the DCP-M are optimized for SO-QSFP28-Dxx. If SO-QSFP28-Dxx-A is used it must be attenuated to the receiver expected range (approximately 5 dB).

CLIENT INTERFACE - TYPICAL OPTICAL POWER LEVELS FOR FORMATS 1-32G AND COHERENT

RECEIVE	-10 to +3 dBm -11.5 to +3 dBm for DCP-M40-PAM4-ZR, DCP-M40-C-ZR+ -12.5 to +3 dBm for DCP-M32-CSO-ZR+
TRANSMIT	-4 to +1 dBm -19 to -4 depending on VOA setting for DCP-M32-CSO-ZR+. Note that the attenuation in the VOA for drop side is settable.

Please note, the DCP-M units has has been optimized for ER optics or receivers that support high input powerlevels. When deploying ZR optics attenuators are required on the receiving transceivers to avoid overload.

After installation ensure that tranceivers are receiving and transmitting optical powers within the expected range according to the tranceivers datasheet.

Appendix C List of protocols and port numbers used by DCP-M

The table below contains information on which services and network protocols are used in the DCP-M and their intended purpose. This information is useful if the DCP-M is installed in a secure network where firewalls might need to be configured to allow for full functionality.

Service	Port	Protocol	Description
FTP	21	TCP	Used for software upgrades.
SSH	22	TCP	Used for secure logins to the CLI.
TACACS+	49	TCP	Used for authentication, authorization and accounting (AAA) services
DNS	53	TCP & UDP	Used for mapping host names to IP-addresses.
HTTP	80	TCP	Used for software upgrades.
NTP	123	UDP	Used to synchronize the system against an NTP server.
SNMP	161	UDP	Used for SNMP management and monitoring of the system.
SNMP Trap	162	UDP	Used by SNMP to send traps to the SNMP receiver(s).
Syslog	514	TCP & UDP	Used for system logging
RADIUS	1812	UDP	Used for authentication, authorization and accounting (AAA) services

Appendix D Minimum input power levels to the mux

The minimum input power that can be detected on the DCP-M is different for different products and also for different releases. This depends on internal settings for the OCM and the amplifiers.
The table below shows minimum input power on the mux ports for different units and releases.

Min input power to mux on DCP-M

DCP-M model	Release	Mux+OCQ loss (dB)	WSS setting (dB)	Booster gain (dB)	Monitor loss (dB)	Margin (dB)	Min input on OCM (dBm)	Min input to mux (dBm)
DCP-M40-PAM4-ER	<=6.1.2	8	15	19.5	20	1.5	-33	-8
DCP-M40-PAM4-ER	>=7.0.1	8	15	19.5	20	1.5	-35	-10
DCP-M40-PAM4-ER+	<=6.1.2	8	15	19.5	20	1.5	-33	-8
DCP-M40-PAM4-ER+	>=7.0.1	8	15	19.5	20	1.5	-35	-10
DCP-M40-PAM4-ZR	<=6.1.2	8	15	22	20	1.5	-30	-7.5
DCP-M40-PAM4-ZR	>=7.0.1	8	15	22	20	1.5	-34	-11.5
DCP-M40-C-ZR+	<=6.1.2	8	15	22	20	1.5	-30	-7.5
DCP-M40-C-ZR+	>=7.0.1	8	15	22	20	1.5	-34	-11.5
DCP-M32-CSO-ZR+	>=10.1.1	9	15	22	20	1.5	-36	-12.5
DCP-M40-MSO-ZR	>=12.1.1	8	15	19	20	1.5	-36	-10.5

Note that the default WSS attenuation for DCP-M32-CSO-ZR+ and DCP-M40-MSO-ZR is settable.