Redbooks Paper

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IBM System z Qualified WDM: Nortel Optical Metro 5200 at Release Level 10.0

This IBM® Redpaper is one in a series describing System z™ qualified optical Wavelength Division Multiplexing (WDM) vendor products for GDPS® solutions with Server Time Protocol (STP). The products that we describe in this series are also the IBM supported solutions for non-GDPS applications. Non-GDPS applications include the protocols that are needed for cross-site connectivity of a multi-site Parallel Sysplex®, or one of the remote copy technologies described in this paper. GDPS qualification testing is carried out at the IBM Vendor Solutions Connectivity (VSC) Lab in Poughkeepsie, NY, U. S.

IBM and Nortel have successfully completed qualification testing of the Nortel Optical Metro 5200 Multiservice Platform. This paper describes the applicable environments, protocols, and topologies that are qualified and supported by System z for connecting to the Nortel Optical Metro 5200 product hardware and software at release level 10.0. This paper supersedes all previous versions.

Release 8.0: The Nortel Optical Metro 5200 multi-service Dense Wavelength Division Multiplexing (DWDM) platform has also been qualified at release level 8.0. For details regarding interface cards, modules, and applications that were tested with Release 8.0, refer to the IBM GDPS qualification letter on Resource Link:

https://www-01.ibm.com/servers/resourcelink/lib03020.nsf/web+search/DEE1EBFC287E488885256ED80053791D/$file/Nortel+Optical+Metro+5200+Rel8+Feb07.pdf

At the time of publication, System z qualified WDM vendor products that support GDPS and STP include:

- Adva Fiber Service Platform 2000 (FSP 2000) DWDM system (and selected FSP 3000 configurations)
- Ciena CN 4200 FlexSelect Advanced Services Platform
- Cisco ONS 15454 Multiservice Transport Platform (MSTP)
- Nortel Optical Metro 5200 Multiservice Platform

System z qualified WDM vendor products that support GDPS but have not been qualified for STP include:

- Ciena Online Metro Multiservice DWDM and CN2000 Storage Extension platform
- Cisco ONS 15530 DWDM and ONS 15540 ESPx (withdrawn from marketing)
- Lucent Technologies Metropolis Enhanced Optical Network (EON) System

For current information about qualified vendor products, visit the Resourcelink Web site:

https://www.ibm.com/servers/resourcelink/lib03020.nsf/pages/systemzQualifiedWdmProductsForGdpsSolutions?OpenDocument&pathID=

System z GDPS qualification overview

GDPS, an industry-leading e-business continuity solution, is a multisite solution that is designed to provide the capability to manage remote copy configuration and storage subsystems, automate Parallel Sysplex operational tasks, and perform failure recovery from a single point of control, thereby improving application availability. Historically, this solution was known as a *Geographically Dispersed Parallel Sysplex™*. Today, GDPS continues to be applied as a general term for a suite of business continuity solutions, including those that do not require a dispersed or multi-site sysplex environment.

GDPS supports the following forms of remote copy:

- IBM System Storage™ Metro Mirror, synchronous Peer-to-Peer Remote Copy (PPRC)
- IBM System Storage Global Mirror
- IBM System Storage z/OS® Global Mirror, asynchronous Extended Remote Copy (XRC)

Depending on the form of remote copy implemented, the solution is referred to as *GDPS/PPRC*, *GDPS/Global Mirror*, or *GDPS/XRC*. The GDPS solution is also independent of disk vendor, as long as the vendor meets the specific levels of Metro Mirror, Global Mirror, and z/OS Global Mirror architectures. For more information about GDPS, visit the GDPS Web site:

http://www.ibm.com/systems/z/gdps/

IBM only supports WDM products that are qualified by System z for use in GDPS/PPRC, GDPS/Global Mirror, and GDPS/XRC two-site solutions, as well as in GDPS Metro/z/OS Global Mirror, and GDPS Metro/Global Mirror three-site solutions. To obtain this qualification, WDM vendors obtain licensed IBM patents, intellectual property, and know-how that are related to the GDPS architecture. This gives vendors access to the proprietary IBM protocols and applications used in a GDPS environment (including Sysplex Timer®, InterSystem Channel (ISC), Server Time Protocol (STP), Metro Mirror, Global Mirror, and z/OS Global Mirror).

Licensing of IBM patents also provides the WDM vendor with technical information pertaining to future IBM releases. Qualified vendors will typically license this information for an extended period, allowing them to subscribe to the latest GDPS architecture changes, and to be among the first to market with offerings that support these features.

Note: We recommend that you check with your WDM vendor for current licensing status.

In addition, these vendor products have been tested and qualified by IBM with the same test environment and procedures used to test the protocols used to provide the required connectivity of a GDPS configuration. This testing includes functionality, recovery, and in some cases performance measurements. Having access to these test facilities allows IBM to

configure a fully functional sysplex, and simulate failure and recovery actions that could not be tested as part of a working customer environment.

IBM has the facilities to test and qualify these products with both current and previous generation equipment within the IBM Vendor Solutions Connectivity (VSC) Lab in Poughkeepsie, NY, U. S. This qualification testing allows IBM to reproduce any concerns that might arise while using this equipment in a customer's application.

Figure 1 shows one of the test configurations used for WDM vendor qualification.

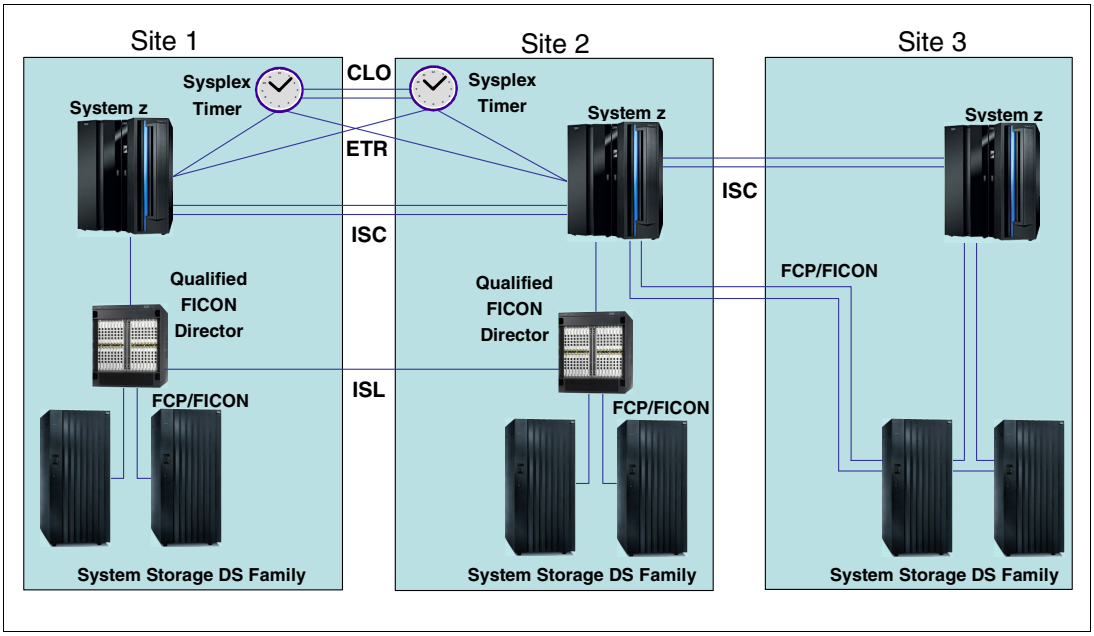

Figure 1 IBM Vendor Solutions Connectivity Lab GDPS environment

Qualification testing

The VSC Lab contains System z hardware with software applications that test the interoperability of WDM products within a GDPS. A typical qualification test cycle is three to four weeks.

Hardware used for testing purposes includes (but is not limited to) the following components:

- IBM System z and zSeries® servers
- IBM 9037 Model 2 Sysplex Timers
- IBM System Storage DS™ Family
- IBM 9032 ESCON® Directors
- IBM System z qualified FICON® Directors

WDM links of varying distances are deployed using spools of single-mode fiber in lengths from 5 km to 50 km. Multiple spools are interconnected to test WDM link protocols up to the maximum supported distances. To achieve the maximum distances qualified for GDPS protocols, vendors can use optical amplifiers and dispersion compensation units, inserted at various link points, to condition the signals on the fiber links that are connected to the WDM equipment.

Operating system and application software is installed to create, and stress test, the GDPS environment. Software used in the test environment includes (but is not limited to):

- z/OS, Linux® on System z, and Parallel Sysplex software exploiters
- Coupling Facility Control Code (CFCC)
- IBM proprietary software and microcode utility test suites

As part of the GDPS qualification test, IBM proprietary software and microcode utility test suites drive the various GDPS components and protocols to the full data rate of each link type being transported by the WDM equipment. This level of testing ensures maximum channel utilization is achieved and tested to levels well beyond typical customer environments.

The test suites are used for verification of System z architecture functionality. During these functionality tests, for a test to be classified as successful, zero errors are detected by the attached subsystems. Any errors detected during this testing are captured and analyzed by the test suites.

The test suites are also used for verification of System z architecture recovery by creating various fault and error conditions. The recovery tests check for the correct detection of a fault or error condition by the attached subsystems, and ensure that the recovery adheres to System z architecture rules.

Some of the recovery tests performed for each link type include:

- Link state change interrupt detection and recovery. Links are deliberately broken and re-established to ensure that detection and error recovery takes place correctly.
- Link error threshold and link synchronization error detection and recovery. Errors are deliberately injected, at the application and channel subsystem levels, into the link protocol data streams to ensure that detection and error recovery takes place correctly.
- Link service and maintenance package recovery. Link hardware maintenance actions are performed to ensure that link state change detection and recovery takes place correctly.
- Link protection schemes and recovery. Vendor-specific protection methods are tested to ensure that the expected link errors are detected, and recovery takes place correctly.

GDPS components and protocols

The following IBM technologies are functional components of GDPS and are tested during the qualification process. Customers can also use these components in environments that do not require a full GDPS solution. The testing provides a level of assurance that these components will function when used with a qualified WDM platform.

Components

The following GDPS components are tested during the qualification process:

- IBM Parallel Sysplex
- IBM System Storage DS Family
- Optical Wavelength Division Multiplexer (WDM)
- IBM System Storage Metro Mirror (PPRC), a synchronous form of remote copy
- IBM System Storage Global Mirror
- IBM System Storage z/OS Global Mirror (XRC), an asynchronous form of remote copy

Protocols

The following GDPS connectivity protocols are tested during the qualification process:

- Enterprise Systems Connection (ESCON)
- IBM Sysplex Timer (ETR/CLO)
- Fibre Connection (FICON) (1 Gbps)
- Fibre Connection (FICON) Express2 (1 Gbps and 2 Gbps)
- Fibre Connection (FICON) Express4 (1 Gbps, 2 Gbps, and 4 Gbps)
- Fibre Channel (FCP) (FC 100) (1 Gbps)
- Fibre Channel (FCP) (FC 200) (2 Gbps)
- Fibre Channel (FCP) (FC 400) (4 Gbps)
- Fibre Channel InterSwitch Links (ISL) (up to 10 Gbps)
- InterSystem Channel-3 (ISC-3) Compatibility Mode (1 Gbps)
- InterSystem Channel-3 (ISC-3) Peer Mode (2 Gbps)
- InterSystem Channel-3 (ISC-3) Peer Mode (1 Gbps) through RPQ 8P2197
- Server Time Protocol (ISC-3 Peer Mode with STP messaging)

Often, these tested protocols are used in non-GDPS environments as well. The robust testing performed during the qualification process should provide customers with a high level of confidence when using these System z qualified optical WDM vendor products in non-GDPS environments.

Table 1 lists the data transfer rates and supported distances for GDPS qualified protocols. For some extended distances, the use of optical amplifiers might be required.

Table 1 Qualified protocols and distances

Protocol	Data transfer rate	Supported Distance[a]
ESCON	200 Mbps[b]	100 km
CLO	8 Mbps	40 km
ETR	8 Mbps	100 km
FICON (1 Gbps)[c]	1 Gbps	100 km
FICON (2 Gbps)	2 Gbps	100 km
FICON (4 Gbps)	4 Gbps	100 km
Fibre Channel FC100 (1 Gbps)	1 Gbps	100 km
Fibre Channel FC200 (2 Gbps)	2 Gbps	100 km
Fibre Channel FC400 (4 Gbps)	4 Gbps	100 km
ISC-3 Compatibility Mode	1 Gbps	40 km
ISC-3 Peer Mode	2 Gbps	100 km
ISC-3 Peer Mode (1 Gbps)[d]	1 Gbps	100 km
STP (ISC-3 Peer)	2 Gbps	100 km
STP (ISC-3 Peer 1 Gbps)[d]	1 Gbps	100 km

a. Requires RPQ 8P2263 for System z Extended Distance or 8P2262 for S/390® Extended Distance, if the actual distance is greater than the supported distance.
b. Effective channel data rate of an ESCON channel is affected by distance.
c. Including FICON Bridge card.
d. Requires RPQ 8P2197. This RPQ provides an ISC-3 Daughter Card that clocks at 1.062 Gbps in peer mode.

Note: Consult your SAN switch vendors for qualified ISL supported distances.

Server Time Protocol

Server Time Protocol (STP) is designed to provide the capability for multiple servers and Coupling Facilities to maintain time synchronization with each other, without requiring an IBM Sysplex Timer. STP can help provide functional and economic benefits when compared to the Sysplex Timer. STP allows concurrent migration from an External Timer Reference (ETR) network, and can coexist with an ETR network.

STP is a message-based protocol in which STP timekeeping information is passed over externally defined coupling links: ICB-3, ICB-4, and InterSystem Channel-3 (ISC-3) Peer Mode. ISC-3 links in Peer mode is the only coupling link that can be used to transport STP messages between data centers over a WDM.

The STP design has introduced a new concept called Coordinated Timing Network (CTN). A CTN is a collection of servers and Coupling Facilities that are time synchronized to a time value called Coordinated Server Time (CST). The CST represents the time for the entire network of servers. A CTN can be configured as either an STP-only CTN or a Mixed CTN. For more information, refer to *Server Time Protocol Planning Guide*, SG24-7280 and *Server Time Protocol Implementation Guide*, SG24-7281.

Figure 2 shows a multisite STP-only CTN.

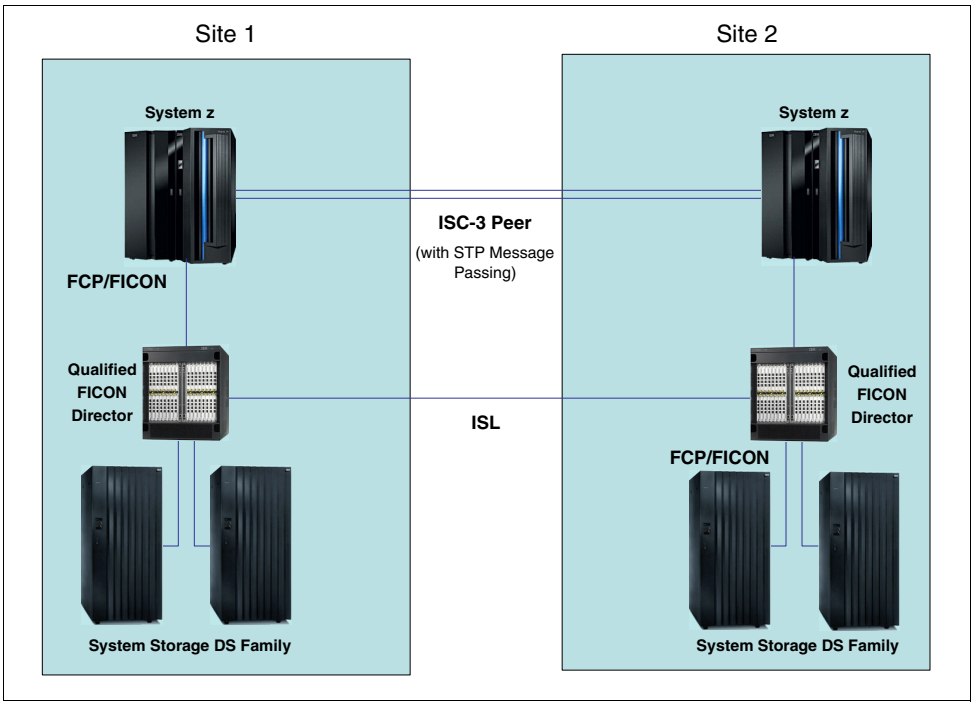

Figure 2 Multisite STP-only CTN

IBM Sysplex Timer

The IBM Sysplex Timer is a mandatory component of an ETR network and an STP Mixed CTN. The Sysplex Timer provides an External Time Reference (ETR) to synchronize the time of day (TOD) clocks on attached System z servers in a GDPS/PPRC environment.

Figure 3 shows a multisite ETR network.

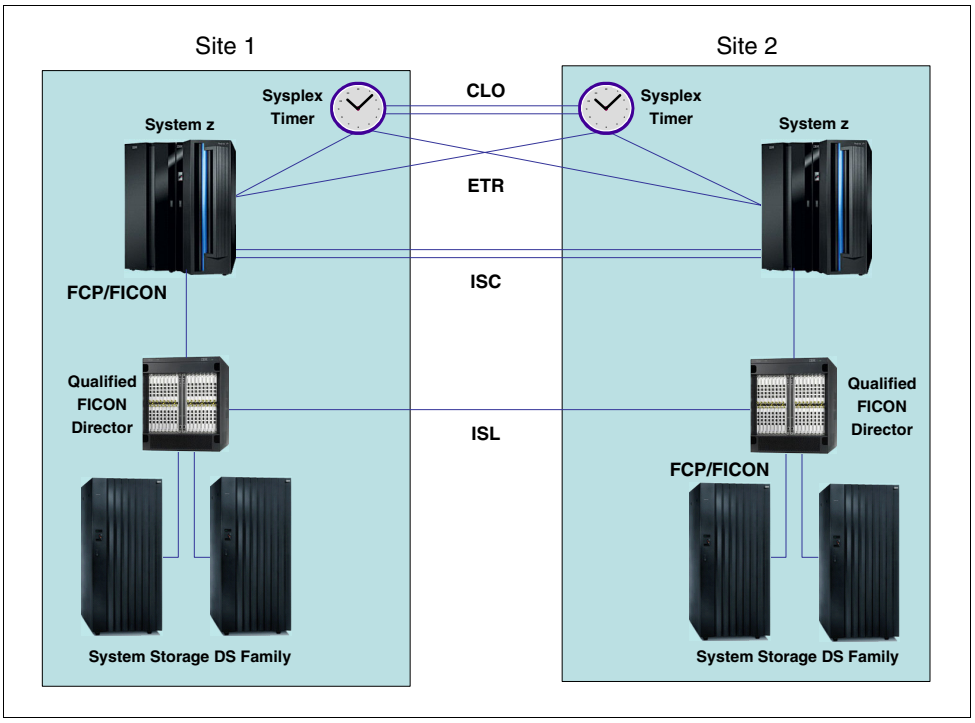

Figure 3 Multisite ETR network with Sysplex Timers

The Sysplex Timer uses two link types:

- External Time Reference (ETR)

  ETR links are connections between the Sysplex Timer and the System z server ETR ports providing TOD clock sychronization between multiple servers.

- Control Link Oscillator (CLO)

  CLO links are connections between two Sysplex Timer units in an Expanded Availability configuration allowing synchronization of the Sysplex Timer timing signals.

GDPS connectivity considerations with WDM

When planning WDM intersite connectivity for GDPS environments, consider the following items:

- Differential Delay, the difference in distance or latency between a transmit fiber and a receive fiber in a single fiber pair, of timing links must adhere to the following requirements:
  - To ensure correct server time synchronization, the end-to-end lengths of the transmit and receive fibers within an individual STP link (ISC-3 Peer Mode with STP messaging) must not exceed the equivalent of *900 meters* differential delay between transmit and receive paths of the link. This includes all DWDM components, optical amplifiers (OAs), dispersion compensation units (DCUs), dark fiber links, and any time division multiplexing (TDM) based aggregation.
  - To ensure correct Sysplex Timer and server time synchronization, the end-to-end lengths of the transmit and receive fibers within an individual ETR or CLO link must be equal (within *10 meters*). This includes all DWDM components, optical amplifiers (OAs), dispersion compensation units (DCUs), dark fiber links.

Note: OAs and DCUs contain significant lengths of fiber that must be included in the differential delay calculation for timing links.

- Protection schemes for individual timing links, or for fiber trunks transporting timing links, must be bidirectional to ensure the correct differential delay is maintained.
- WDM configurations should have high availability topologies to ensure that there are no single points of failure.
- Fiber trunk protection schemes should be designed with two trunk switching modules and four site-to-site fiber pairs carried over at least two diverse routes. STP, ETR, and CLO links should connect using different trunk switching modules to ensure that a fiber trunk protection event does not interrupt all timing links simultaneously.
- Unless specifically qualified by IBM GDPS testing, STP links (ISC-3 Peer Mode with STP messaging) should not be transported by TDM-based aggregation WDM hardware.
- GDPS WDM configurations should be a point-to-point fixed dark fiber network.

Technical description

The Nortel Optical Metro 5000 Multiservice Platform is a scalable, high-speed fiber-optic data transport system. It consists of multiple shelves that can be interconnected to form an optical network supporting up to 32 (200 Ghz) International Telecommunications Union (ITU) wavelengths. These ITU wavelengths are multiplexed onto a single pair of fibers using optical wavelength division multiplexing (WDM).

The optical network connecting the shelves can be configured in a two site point-to-point or a multi-site ring network (for IBM qualifies point-to-point topologies only). A fully configured point-to-point network can consist of up to 32 protected ITU wavelengths or up to 64 unprotected ITU wavelengths over multiple fiber pairs (trunks) connected between data sites. Multiple client interfaces can be aggregated on to a single wavelength with the use of sub-rate multiplexer (SRM) or Muxponder interface cards.

The System z qualified products in the Nortel Optical Metro 5000 Multiservice Platform series are:

- Optical Metro 5200 Multiservice Platform, Release 10.0

  The Optical Metro 5200 is a rack mountable shelf capable for housing up to 16 client optical interface cards. Multiple Optical Metro 5200 shelves can be interconnected to support larger quantities of client interfaces.

- Optical Metro Cabinet 5200E (Enterprise)

  The Optical Metro Cabinet 5200E (Enterprise) is a free standing relocatable cabinet for the Enterprise environment. The Optical Metro Cabinet 5200E is capable of housing up to four Optical Metro 5200 shelves, and is equipped with redundant AC power systems. It is factory assembled, configured, and tested.

Interface cards and modules

This section includes a detailed list of the Nortel Optical Metro 5200 optical interface cards and circuit packs qualified by IBM System z GDPS testing.

Optical interface cards and circuit packs:

- Optical Channel Interface (OCI)

  The Optical Channel Interface (OCI) card connects client equipment to the WDM platform. The OCI card converts client optical signals to electrical signals, which are transported on the shelf backplane to the Optical Channel Laser and Detector (OCLD) cards.

  OCI Subrate Multiplexer (OCI SRM) cards use time division multiplexing (TDM) to aggregate multiple client optical interfaces for transport over a single ITU specific wavelength OCLD card.

  The qualified OCI card types are:

  - OCI 1.25 Gbps 1310 nm (1 port), NT0H10CB
  - OCI ISC 1310 nm (1 port), NT0H20CH
  - OCI SRM ESCON (8 port), NT0H21JN

- Optical Channel Laser and Detector (OCLD)

  The OCLD card receives electrical signals from the OCI card and converts these signals to ITU specific optical wavelengths for transmission to the remote site. The ITU wavelengths used by OCLD cards are either coarse wavelength based (CWDM) or dense wavelength based (DWDM). Only DWDM based OCLD cards have been qualified by IBM System z GDPS testing.

  DWDM based OCLD cards are available in three types, which have different chromatic dispersion (CD) distance limits on the line facing interface.

  The qualified OCLD card types are:

  - OCLD 2.5 Gbps Flex™ DWDM (Normal Reach, 110km), NT0H03xx
  - OCLD 2.5 Gbps Flex DWDM (Extended Reach, 175km), NT0H04xx
  - OCLD 2.5 Gbps Universal DWDM (200km), NT0H05xx

  Note: The OCLD 2.5 Gbps Universal circuit packs are not line-side compatible with the OCLD 2.5 Gbps Flex circuit packs. (You cannot have an OCLD 2.5 Gbps Universal circuit pack on one end of a link inter-operating with an OCLD 2.5 Gbps Flex circuit pack on the other end of the same link.)

  Flex OCLD card types have been withdrawn.

- Optical Transponder (OTR)

  OTR cards perform the combined function of OCI and OCLD cards in one package, a single client optical signal is converted to an ITU specific optical wavelength for transmission to the remote site. The ITU wavelengths used by OTR cards are either coarse wavelength based (CWDM) or dense wavelength based (DWDM). Only DWDM based OTR cards have been qualified by IBM System z GDPS testing.

  DWDM based OTR cards are available in several types, which have different chromatic dispersion (CD) distance limits on the line facing interface.

The qualified OTR card types are:

- OTR 2.5 Gbps Flex 1310 nm DWDM (1 port, Normal Reach, 110km), NT0H16xx
- OTR 2.5 Gbps Flex 1310 nm DWDM (1 port, Extended Reach, 175km), NT0H16xx
- OTR 2.5 Gbps Universal 1310 nm DWDM (1 port, 200km), NT0H06xx
- OTR 2.5 Gbps Flex 850 nm DWDM (1 port, Normal Reach, 110km), NT0H17xx
- OTR 2.5 Gbps Flex 850 nm DWDM (1 port, Extended Reach, 175km), NT0H17xx
- OTR 2.5 Gbps Universal 850 nm DWDM (1 port, 200km) NT0H07xx

Note: The OTR 2.5 Gbps Universal circuit packs are not line-side compatible with the OTR 2.5 Gbps Flex circuit packs. (You cannot have an OTR 2.5 Gbps Universal circuit pack on one end of a link inter-operating with an OTR 2.5 Gbps Flex circuit pack on the other end of the same link.)

Flex OTR card types have been withdrawn.

- OTR 4 Gbps Fibre Channel/FICON (1 port, 80km), NT08AAE5

Note: The OTR 4 Gbps card is chromatic dispersion limited to 80 km. For distances greater than 80 km, DCUs might be required. You should check with dark fiber provider and WDM vendor for Fiber Link Engineering planning.

OTR 4 Gbps card based protection is not available at Release 10.0. An optical trunk switch is required for protection.

- OTR 10 Gbit/s Ultra™ (1 port, 175km), NT0H14xx

- Multiplexer optical transponder (Muxponder or MOTR)

  Muxponder cards use TDM to aggregate multiple client optical interfaces for transport over a single ITU specific wavelength, the muxponder card combines the function of an SRM card and an OTR card into a single package.

  The qualified Muxponder cards are:

  - Muxponder 10 Gbps GbE/FC (8 port, 110km), NT0H15xx
  - Muxponder 10 Gbps GbE/FC VCAT (10 port, 110km), NT0H15xx
  - Muxponder 10 Gbps GbE/FC VCAT Tunable (10 port, 110km), NT0H15xx

  Note: IBM does not support V-Cat (virtual concatenation) configuration on Muxponder cards at Release 10.0. Muxponders should be configured using C-Cat (contiguous concatenation).

- Optical Multiplexer (OMX)

  The Optical Multiplexer (OMX) is a passive optical filter that optically multiplexes and demultiplexes a specific band of ITU wavelengths.

  In the transmit direction, the OMX modules multiplex signals transmitted by OCLD or OTR cards, and provide the interfaces to connect the multiplexed signals to the WDM site-to-site fiber link.

  In the receive direction, the OMX modules demultiplex the signals from the site-to-site fiber link before passing to the corresponding OCLD or OTR cards.

- Optical Trunk Switch

  An optical trunk switch is a stand-alone component that provides optical path protection for a point-to-point WDM network. It protects site-to-site traffic from physical damage to a fiber pair (trunk) by switching to a redundant fiber pair.

  The qualified optical trunk switches are:

  – Photonic Trunk Switch (PTS), NTUG75BAE5. The PTS provides bidirectional protection against trunk fiber damage and can only be used in unamplified point-to-point configurations.

    The PTS is qualified for the protection of GDPS timing links (ETR, CLO, and STP), up to 50 km.

  – Enhanced Trunk Switch (ETS), NTUG90AN. The ETS provides uni-directional protection against trunk fiber damage and can be used in unamplified point-to-point configurations, and in some amplified point-to-point configurations that contain only a single pre-amplifier in the fiber link.

    The ETS cannot be used for the protection of GDPS timing links (ETR, CLO, and STP), because it does not provide bidirectional switching.

- Optical Fiber Amplifier (OFA)

  OFA circuit packs provide in-line optical amplification of multiple ITU specific wavelengths within a single fiber. For some extended distances, the use of these erbium doped fiber amplifiers (EDFAs) and dispersion compensation units (DCUs) might be required.

  The qualified OFA circuit packs are:

  – OFA Standard, C-band and L-Band, NT0H35AA and NT0H35BA
  – OFA High Input Power (HIP), C-band and L-Band, NT0H35AB and NT0H35BB
  – OFA Variable Gain Amplifier (VGA), C-band and L-Band NT0H35AC and NT0H35BC

Note: OFAs and DCUs contain significant lengths of fiber that must be included in the differential delay calculation for timing links.

Topologies and protection schemes

System z qualifies a two site point-to-point WDM network topology and protection against failures in site-to-site fiber links or failures in individual components within the WDM network for GDPS.

GDPS is a high availability solution that can use several protection schemes. Some restrictions apply for particular protocols, for example, Sysplex Timer (ETR/CLO) and STP (ISC-3 Peer Mode with STP messaging) links.

Important: Protection schemes must guarantee the correct differential delay for individual timing links:

- STP links must not exceed the equivalent of *900 meters* differential delay between transmit and receive paths of the link.
- ETR and CLO links must not exceed the equivalent of *10 meters* differential delay between transmit and receive paths of the link.

Protection schemes

The Optical Metro 5000 Multiservice Platform provides the following protection schemes:

- Unprotected

  An *unprotected* OCI card is connected to one OCLD card, which is connected to one site-to-site fiber link only. A failure in any of the cards or in the fibre link will result in a loss of client communications. An unprotected OTR or Muxponder card is similarly connected to one remote OTR or Muxponder card by one site-to-site fiber link.

- Client-based protection

  Client-based protection uses at least two client interfaces that are connected to the WDM. These interfaces are arranged so that the OCLD, OTR, or Muxponder cards that connect the two sites are distributed over two diverse site-to-site fiber links. The client device is responsible for ensuring that a failure of a WDM card or of a single site-to-site fiber link will not result in total loss of client communications.

  GDPS timing links (ETR, CLO, and STP) are qualified for use in a client-based protection scheme, as long as they are using separate paths (routes).

  Note: For simplicity, we do not show all components in the optical path in the diagrams in this section.

  Figure 4 shows a high-level view of a client-based protection scheme. In this case, a client device has two separate site-to-site connections: one through OCI A and the other through OCI B.

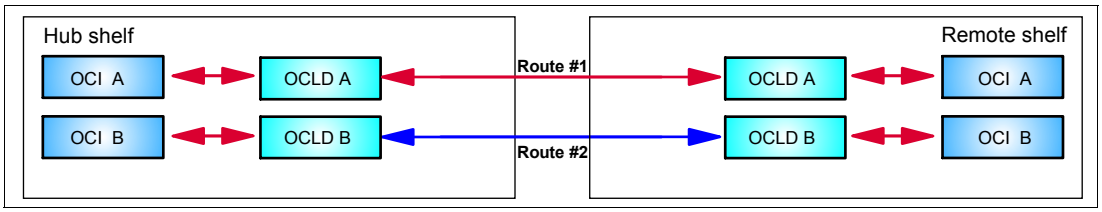

Figure 4 Client-based protected scheme

- OCLD protection

  OCLD protection provides per wavelength protection against an OCLD card failure and also against a site-to-site fiber failure. The client signal from the OCI card is carried by two OCLD cards over redundant diverse site-to-site fiber links. At the remote site, WDM control logic ensures that only one OCLD card transports the client signal to the OCI card.

  OCLD protection cannot be used to protect GDPS timing links (ETR and CLO), as it does not provide bidirectional switching. ISC-3 Compatibility Mode links should not be used with OCLD protection. Use Unprotected, Client Protected, or Photonic Trunk Switch (PTS) schemes for these link types.

Figure 5 shows a high-level view of the OCLD protection scheme.

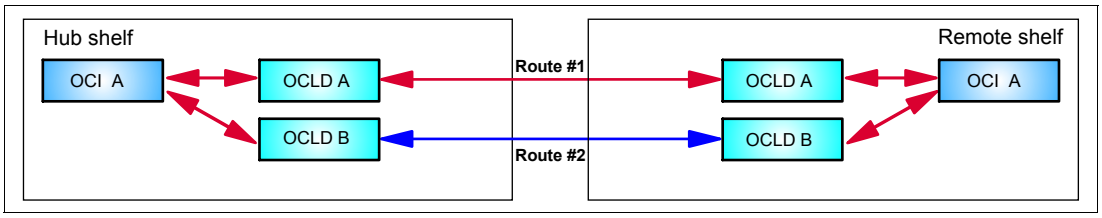

Figure 5 OCLD protected scheme

- Transponder Protection Tray

  The *Transponder Protection Tray* (TPT) provides per wavelength protection against an OTR card failure and also against a site-to-site fiber failure. The signal received from the client is optically split using a TPT and connected into two OTR cards. The OTR cards are configured to send their trunk facing signals over two diverse site-to-site fiber links. At the remote site, WDM control logic ensures that the client facing transmit laser of only one OTR card is enabled for the remote client interface.

  TPT protection cannot be used to protect GDPS STP (ISC-3 Peer Mode with STP messaging) timing links, as it does not provide bidirectional switching. Use Unprotected, Client Protected, or Photonic Trunk Switch (PTS) schemes for this link type.

  Figure 6 shows a high-level view of the TPT protection scheme.

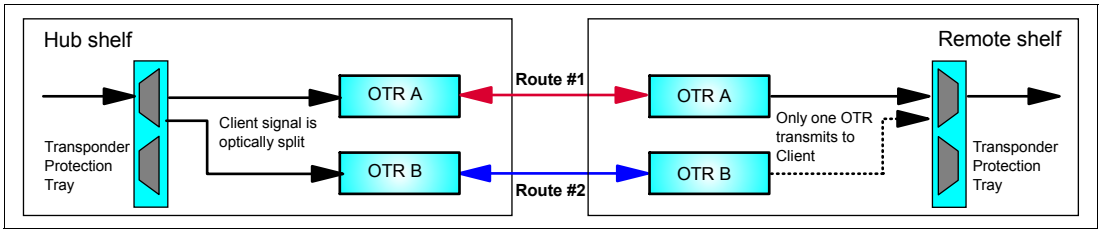

Figure 6 TPT protected scheme

- Optical Trunk Switch protection

  An optical trunk switch provides protection at the site-to-site fiber (trunk) level. The trunk switch protects all wavelengths being carried on a fiber pair simultaneously. In the event of a site-to-site fiber failure, all traffic is switched to the backup link.

  Trunk switch protection is only available for point-to-point WDM network topologies.

  Figure 7 shows a high level view of an optical trunk switch protection scheme.

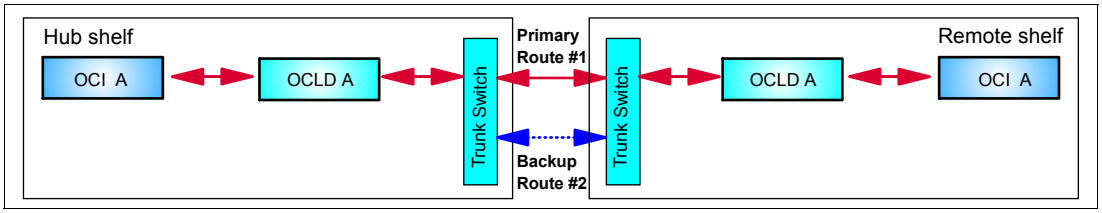

Figure 7 Trunk switch protection scheme

GDPS timing links (STP, ETR, and CLO) links are qualified for use with the PTS only; however, a single trunk switch protection scheme should not be used with GDPS/PPRC environments.

The ETS cannot be used for the protection of GDPS timing links (ETR, CLO, and STP), because it does not provide bidirectional switching.

If a GDPS/PPRC solution is to use trunk switching, then dual trunk switches with four site-to-site fiber pairs (trunks) are recommended. GDPS timing links (ETR, CLO, and STP) should connect using different optical trunk switches.

Figure 8 shows a high-level view of the dual trunk switch protection scheme.

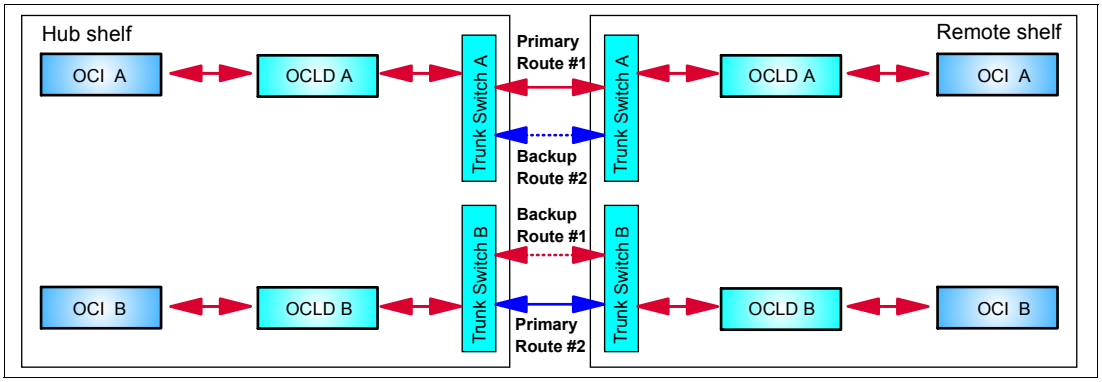

Figure 8 Dual trunk switch protection scheme

Protection scheme intermix

Unprotected, Client protected, OCLD, and TPT protected schemes can be intermixed within the same Optical Metro 5000 shelf or network on a per client interface basis. TPT and OCLD protected schemes should not be intermixed with optical trunk switch protection.

Interface card specifications

Table 2 lists the specifications of the qualified Optical Metro 5000 Multiservice Platform interface cards.

Optical Metro 5000 Multiservice Platform interface cards do not support auto-negotiation of link speeds. For System z FICON and FCP client links, the desired link speed must be preconfigured in the WDM OTR or Muxponder client interface at both ends of the link.

Refer to the WDM vendor documentation for distance and link budget specifications.

Table 2 Qualified client interface card details

Card Type / Protocol	Fiber Type	Client Attenuator on Tx port
OCI 1.25 Gbps 1310 nm Card SM / MM, NT0H10CB		
ETR/CLO MM	MM 50 / 62.5 um	12 dB
OCI ISC 1310 nm, NT0H20CH		
ISC-3 Compatibility Mode	SM 9 um	n/a
ISC-3 Peer 1 Gbps[a]	SM 9 um	n/a
OCI SRM ESCON Card 8 port, MM, NT0H21JN		
ESCON /SBCON 200 Mbps MM	MM 50 um or 62.5 um	n/a
OTR 2.5 Gbps Universal / Flex 1310 nm Card, SM, NT0H06xx, NT0H16xx (Flex card withdrawn from marketing)		
FICON (1 Gbps, 2 Gbps), SM, 1310nm	SM 9 um	1 dB: Protected 3 dB: Unprotected

Card Type / Protocol	Fiber Type	Client Attenuator on Tx port
Fibre Channel (1 Gbps, 2 Gbps), SM, 1310nm	SM 9 um	1 dB: Protected 3 dB: Unprotected
ISC-3 Peer 1 Gbps SM[a]	SM 9 um	3 dB: Unprotected
ISC-3 Peer 2 Gbps SM	SM 9 um	3 dB: Unprotected
STP (ISC-3 Peer Mode with STP messaging)	SM 9 um	3 dB: Unprotected *
OTR 2.5 Gbps Universal / Flex 850 nm Card, MM, NT0H07xx, NT0H17xx (Flex card withdrawn from marketing)		
FICON (1 Gbps, 2 Gbps), MM, 850 nm	MM 50 or 62.5 um	n/a
Fibre Channel (1 Gbps, 2 Gbps), MM, 850 nm	MM 50 or 62.5 um	n/a
OTR 4 Gbps Fibre Channel/FICON[b], NT08AAE5		
Fibre Channel 4 Gbps FC 400 MM	MM 50 um or 62.5 um	n/a
Fibre Channel 4 Gbps FC 400 SM	SM 9um	n/a
FICON 4 Gbps MM	MM 50 um or 62.5 um	n/a
FICON 4 Gbps SM	SM 9um	n/a
ISL 4 Gbps MM[c]	MM 50 um or 62.5 um	n/a
ISL 4 Gbps SM[c]	SM 9um	n/a
OTR 10 Gbps Ultra, NT0H14xx		
ISL 10 Gbps MM[c]	MM 50 um or 62.5 um	n/a
ISL 10 Gbps SM[c]	SM 9um	n/a
Muxponder 10 Gbit/s GbE/FC (8 port)[b] Nortel PEC: NT0H15xx Muxponder 10 Gbit/s GbE/FC VCAT (10 port)[b d] Nortel PEC: NT0H15xx Muxponder 10 Gbit/s GbE/FC VCAT Tunable (10 port)[b d] Nortel PEC: NT0H15xx		
FICON (1 Gbps, 2 Gbps), MM, 850 nm	MM 50 or 62.5 um	n/a
FICON (1 Gbps, 2 Gbps), SM, 1310 nm	SM 9um	n/a
Fibre Channel (1 Gbps, 2 Gbps), MM, 850 nm	MM 50 or 62.5 um	n/a
Fibre Channel (1 Gbps, 2 Gbps), SM, 1310 nm	SM 9um	n/a
ISL (1 Gbps, 2 Gbps), MM, 850 nm[c]	MM 50 um or 62.5 um	n/a
ISL (1 Gbps, 2 Gbps), SM, 1310 nm[c]	SM 9um	n/a
SM = single-mode fiber (9/125 micron) MM = multimode fiber (either 50/125 or 62.5/125 micron) ISL = Inter Switch Link		

a. To support ISC-3 Peer at 1 Gbps (RPQ 8P2197), configure the WDM interface protocol as Fibre Channel FC100 (1 Gbps).

b. Protocol and wavelength support is dependant on pluggable client interface transceiver.

c. ISL is configured as Fibre Channel protocol on WDM.

d. IBM does not support VCAT (virtual concatenation) configuration on Muxponder cards at Release 10.0.

References

For more information about System z connectivity, see:

http://www.ibm.com/systems/z/connectivity/

For more information about GDPS solutions, see:

- GDPS home page:

  http://www.ibm.com/systems/z/gdps/

- Parallel Sysplex home page:

  http://www.ibm.com/systems/z/pso/index.html

- GDPS White paper:

  http://www.ibm.com/servers/eserver/zseries/library/whitepapers/

- *GDPS Family An Introduction to Concepts and Capabilities*, SG24-6374

  http://w3.itso.ibm.com/abstracts/sg246374.html?Open

For more information about STP, see:

- *Server Time Protocol Implementation Guide*, SG24-7281

  http://w3.itso.ibm.com/abstracts/sg247281.html?Open

- Server Time Protocol Planning Guide

  http://w3.itso.ibm.com/abstracts/sg247280.html?Open

For more information about the Nortel Optical Metro 5200 Multiservice Platform, see:

http://www.nortel.com

For information about other current System z qualified WDM vendor products, see the following IBM Redbooks publications and Web sites:

- *IBM System z Qualified WDM: Adva FSP 2000*

  http://www.redbooks.ibm.com/abstracts/redp3903.html?Open

  Adva Web site

  http://www.advaoptical.com

- *IBM System z Qualified WDM: Ciena CN 4200*

  http://www.redbooks.ibm.com/abstracts/redp3907.html?Open

  Ciena Web site

  http://www.ciena.com

- *IBM System z Qualified WDM: Cisco ONS 15454*

  http://www.redbooks.ibm.com/abstracts/redp4395.html?Open

  Cisco Web site

  http://www.cisco.com

For information about previous generation System z qualified WDM vendor products, see the following IBM Redbooks publications and Web sites:

- *zSeries Qualified WDM Vendor: Lucent Techologies*, REDP-3906

  http://www.redbooks.ibm.com/abstracts/redp3906.html?Open

  Lucent Web site

  http://www.lucent.com

IBM GDPS qualification letters are available on Resource Link:

https://www.ibm.com/servers/resourcelink/lib03020.nsf/pages/systemzQualifiedWdmProductsForGdpsSolutions?OpenDocument&pathID=

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