LFOR-4G

User Manual

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Change Log

Revision	Revision History	Date
-	Initial Release	06/21/2022

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Contact Us

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https://itiengineering.com

Product Specifications

Spec	RDR	NAC
Size (approx.)	2RU x 16.7"D	1/2 width x 1RU x 14.2"D
Weight (approx.)	17.4 - 19.8 lbs (w/o cartridges)	4.4 lbs
Data Interfaces	None	10 Gb Ethernet (RJ-45 Copper)
Admin Interface	None	1 Gb Ethernet
Fiber Interface	Connector on NAC • Cable plugs directly into SFP • Cable is Standard 9/125 single mode fiber patch cable with LC/UPC-LC/UPC Duplex connectors Connector on RDR • There is an internal cable from the internal SFP to an external angled LC adapter • Cable is Standard 9/125 single mode fiber patch cable with LC/UPC-LC/UPC Duplex connectors Link Specification: • Data Rate: 4/8/16 Gbps Fiber Channel (FC) • Cabling: Single Mode Fiber (1310nm) • Max Fiber Segment Length: 9km • Link Budget: 18 dBm	
Operating Temp	+0 to +49 C	+10 to +40 C
Grounding	chassis ground stud for MIL-STD-1310H sec. C.6 implementation	
Power	100/240VAC, 50/60 Hz, 1.5A max Fuse 250V/3.15A	100/240VAC, 50/60 Hz, 1.5A max

CAUTION: Refer to Appendix C for fiber optic power ratings and cable plant design considerations

PMD Reader System Components

- **Network Access Controller Chassis (NAC)**
- **Power Cords (North American)**
- **Fiber Cable**
- **PMD Reader Chassis (RDR)**

Power Cords and Outlets

These devices should be installed in close proximity to socket outlets that are easily accessible.

These devices support universal AC input: 100/240VAC @ 50/60Hz. The product is sold in a base configuration with a North American AC power cord with the following characteristics: device side has a 3-prong "PC" power type C13 beveled connector; the wall outlet end has a US type 110-volt outlet connector.

For specific country power cords, contact the manufacturer or purchase the needed power cord directly from an international power cord provider.

System Overview

This guide provides instructions and information details on the LFOR 4G PMD Reader system. The term PMD (portable memory device) is used interchangeably with EDTC (enhanced data transfer cartridge), TR3 Data Cartridge and AMS cartridge. The PMD Reader consists of two hardware components, the Network Access Controller (NAC) and the Reader Chassis. The LFOR 4G is the new system to support the TR3 data cartridges while still supporting older TR2 cartridges (*hybrid and dual bay configurations*).

System Overview

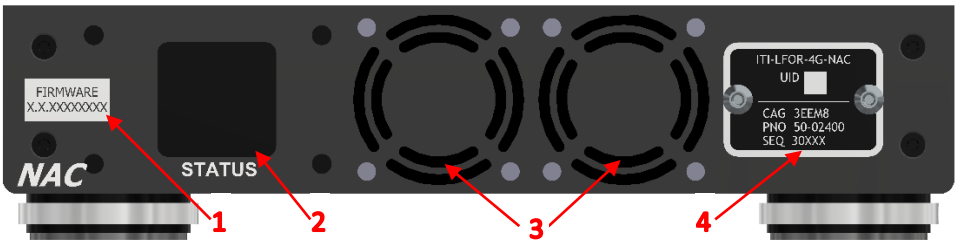
The PMD Reader system downloads data from the PMD using the same file system protocol used by the F-35 Aircraft. The PMD Reader system only implements 'read messages' and as such lacks the software required to write to the PMD. Data must be loaded onto the PMD from an outside source prior to performing a download. The PMD Reader system is compatible with EDTCs running version AS2.2 or newer of the Operational Flight Program (OFP) load for TR2 cartridges and support for TR3 cartridges.

The NAC is used for configuration and management of the system. Management is provided through a dedicated Ethernet port. It is not possible to manage the device through the data port. The NAC maintains positive control over the Reader chassis, initiating and managing transfer of data from a PMD residing in the Reader chassis to the destination FTP server.

When the Download button is pressed, the Reader chassis signals the NAC that a download is ready and the NAC initiates the data transfer.

The Fiber connection between the NAC and Reader Chassis supports FIPS 104-2 compliant encryption to protect the data transfer. The LFOR-4G implementation of FIPS does not require licensing.

NAC Front Panel



1 Firmware Label

Label displaying the current firmware version of the NAC.

2 Status Screen

Displays current link state between the NAC and Reader Chassis, internal temperature of NAC, IP address for the administration port, and firmware version.

3 Dual Exhaust Fans

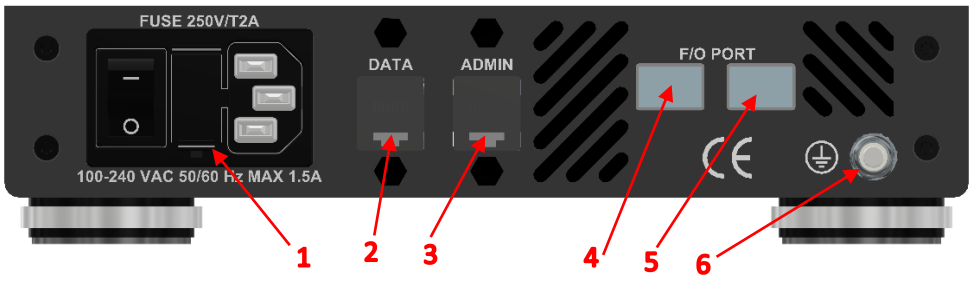
The exhaust fans provide help regulate the internal temperature of the NAC, do not block the exhaust fans or overheating may occur.

4 ID Tag

Identification tag containing model number and serial number of the device and must not be removed.

⚠ *If removed the warranty will be voided.*

NAC Rear Panel



1 Power Entry Module with Fuse and Switch

Connect power cable to the connector. When the power switch is in the "|" or on position, the internal power supply is energized and the NAC is ready for use.

2 Data Ethernet port

Connect a computer or network with an accessible FTP server.

3 Admin Ethernet port

Port used to configure and maintain the NAC.

4 Fiber Connector

Port used to connect to the PMD Reader Chassis (*or third-party fiber switch*).

⚠ *ATTENTION: Only the left port may be used, the right-most fiber port is disabled and will not provide any connectivity.*

5 Inactive Fiber Port

This port is inactive and provides no functionality.

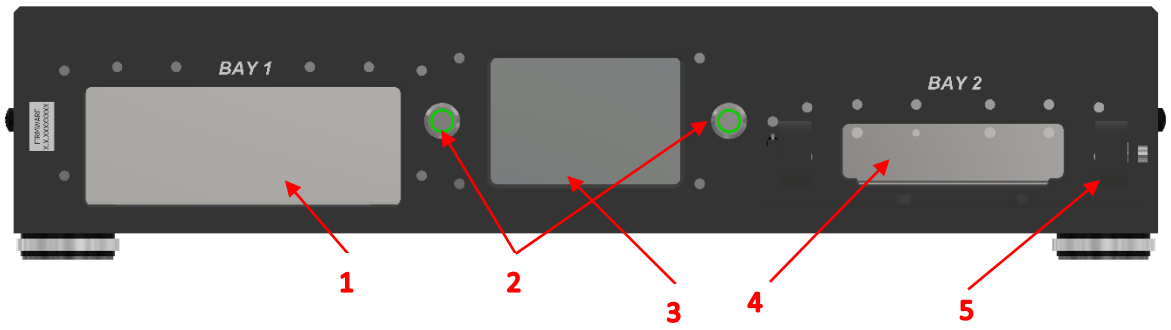
6 Grounding Post

Connect the post to a ground.

Reader Chassis Front Panel

The front of the chassis provides access to two PMD bays (PMD 1 and PMD 2). There are three models of the Reader chassis to support different environments:

- TR3 chassis (*ITI-LFOR-4G-RDR-TR3*) – supports two TR3 cartridges
- TR2 chassis (*ITI-LFOR-4G-RDR-TR2*) – supports two TR2 cartridges
- Hybrid chassis (*ITI-LFOR-4G-RDR-HYB*) – supports one TR3 and one TR2 (*pictured below*)



LFOR RDR HYBRID CONFIGURATION
*(***other chassis models support strictly TR3 or TR2 cartridges***)*

1 TR2 Receptacle

This receptacle accepts TR2 cartridges.

2 Download Button

Press the download button to initiate the download process on the corresponding bay. When the button is pressed the NAC will initiate the download process and read the data from the PMD.

3 Status Screen

Status screen displays the current download progress of PMD in the corresponding bay. When no PMD's are inserted the status screen will display current fiber optic power status. Error codes will be displayed here as well if issues occur. Refer to *Appendix B* for error code definitions.

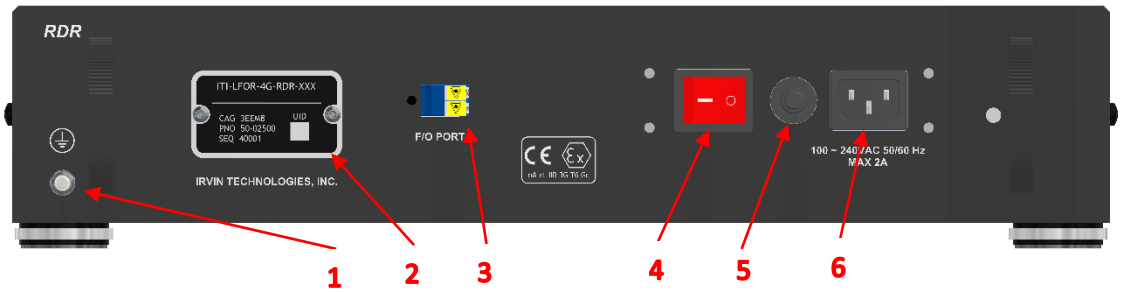
4 TR3 Receptacle

This receptacle accepts TR3 cartridges. The handle must be locked in the up position in order for downloads to be processed.

5 TR3 Locking Handle

This handle must be locked before pressing the download button to successfully trigger a TR3 download.

Reader Chassis Rear Panel



1 Grounding Post

Connect the post to an available ground.

2 ID Tag

Identification tag containing model number and serial number of the device and must not be removed.

⚠ *If removed the warranty will be voided.*

3 Fiber Connector

Port used to connect to the NAC (*or third-party fiber switch*).

4 Main Power Switch

Controls power to the internal AC-DC power supply. Move to "|" (ON) position to energize the Reader Chassis.

5 Fuse

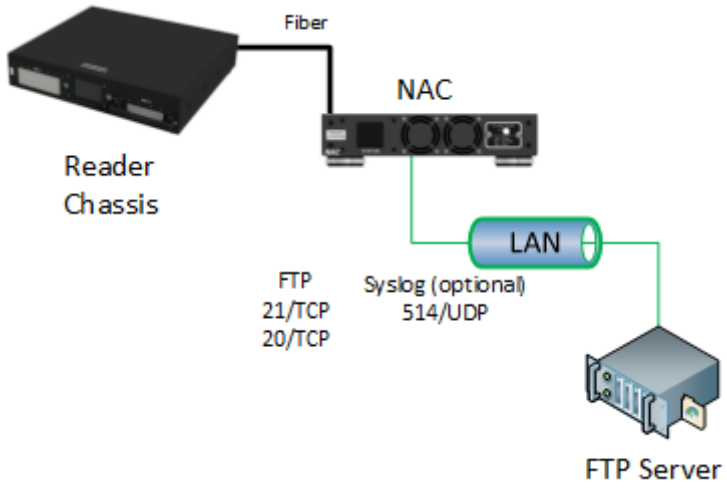
If needed, use only fuse type designated on the panel.

6 Power connector

Connect power cable.

Connecting the NAC to the Reader Chassis

Single Reader Chassis



Follow these instructions to connect the devices:

1. Connect the provided Fiber cable to the NAC and the Reader Chassis.
2. Plug the power cable into the Reader Chassis.
3. Plug the power cable into the NAC.
4. Connect a standard Ethernet cable to the data port in the back of the NAC to an FTP server or network with FTP services available.
5. Power on the NAC and wait 30 seconds for it to completely boot
6. Power on the Reader Chassis. The system is now ready for configuration.

CAUTION: Refer to Appendix C for fiber optic power ratings and cable plant design considerations

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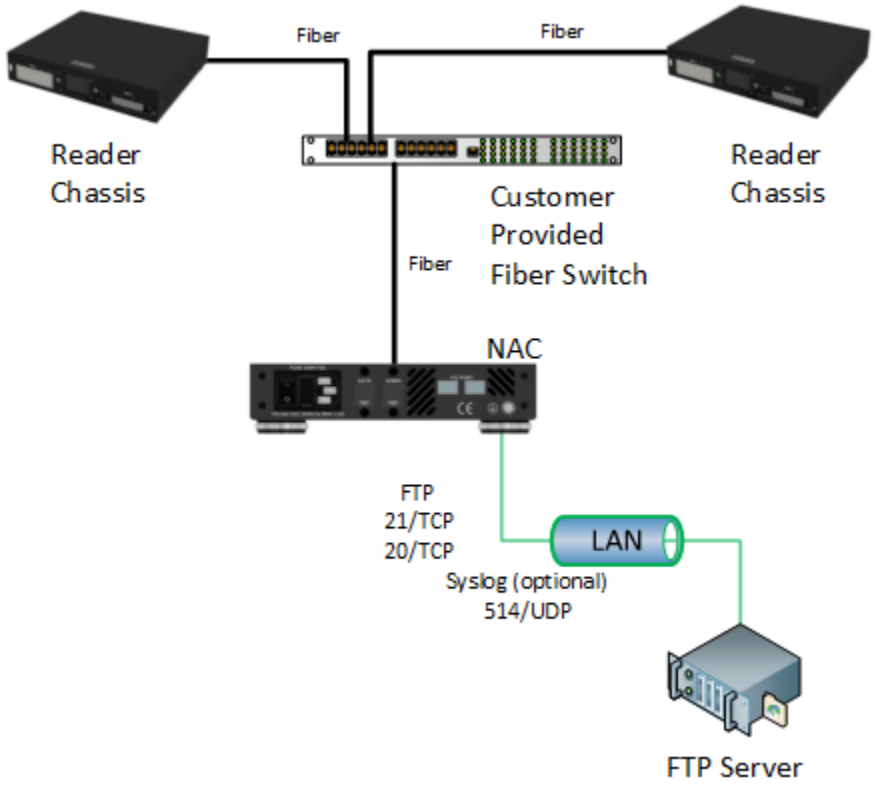
Multiple Reader Chassis through Fiber Switch



Up to a maximum of 22 Reader Chassis units are supported by a single NAC. For 3rd party fiber switch configuration information refer to *Appendix B*.

CAUTION: Refer to Appendix C for fiber optic power ratings and cable plant design considerations

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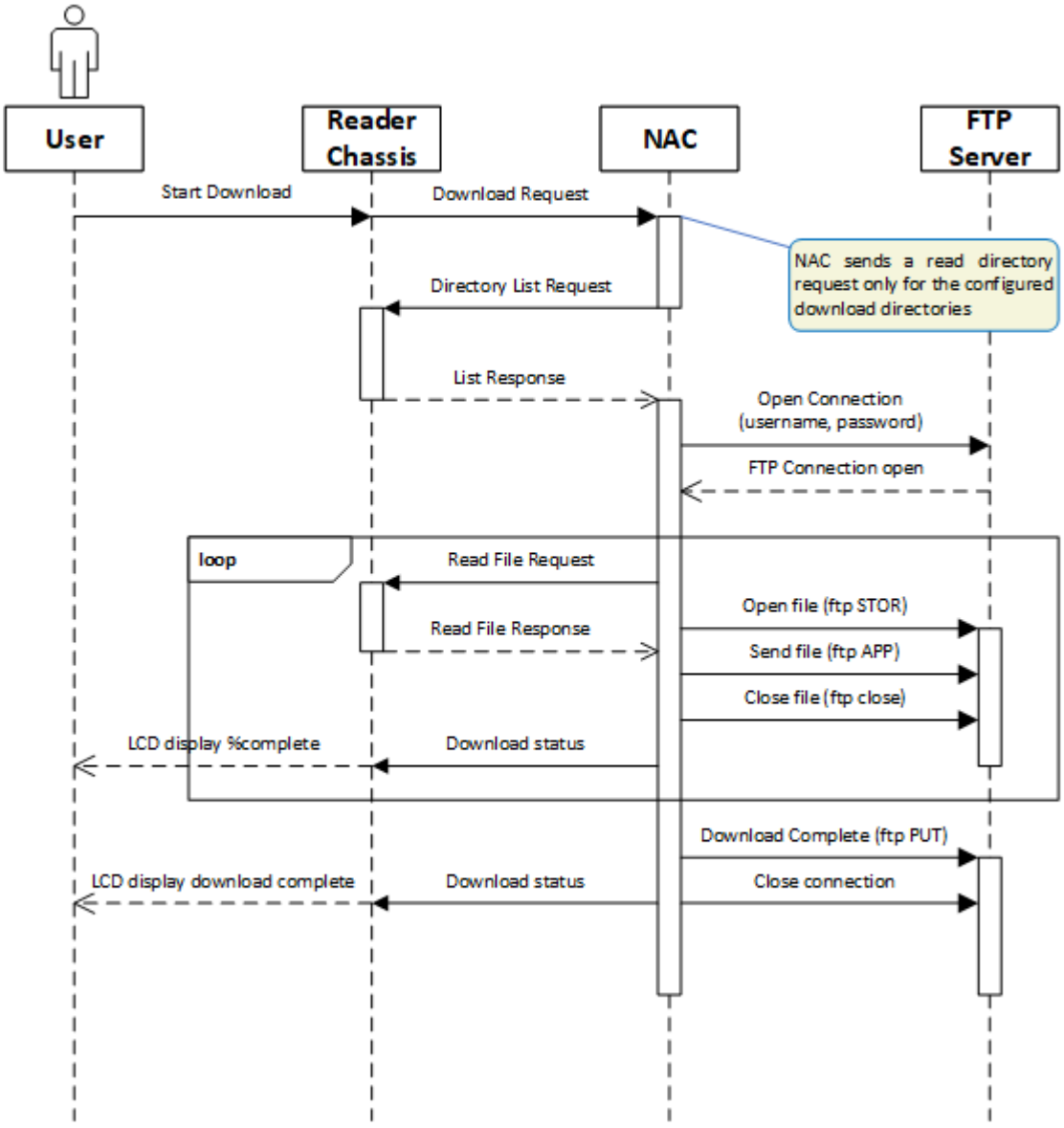
Basics

How it works

When a user presses the download button on the Reader Chassis, the chassis signals the NAC to perform a download. The NAC initiates the download process by reading the configured phases in order (from 1 to 4) and retrieving the directory listing from the Reader Chassis. After processing the directory information, the NAC opens an FTP connection to the FTP server. Multiple connections are made to the FTP server in order to perform the download process.



Configuration

The system is configured using a command line interface (CLI) by connecting a client computer via Ethernet cable to the **Admin Port** on the NAC and using telnet. The current IP configuration of the NAC is displayed on the front panel LCD (*factory default 192.168.10.1*). Once the client is configured within the same subnet open a telnet session (*port 23*) to the IP of the NAC.

Use the '*showfiber*' command from within the telnet session to display status on the current active Reader Chassis on the fiber network. If the Reader Chassis is idle, they will not be displayed in the status screen. Use the '*print*' command to view all configurations including configured Reader Chassis.

```
CMD> showfiber

Fiber Channel Status:
---------------------

NAC Fiber Channel WWN: 21:00:00:90:9e:84:01:94

Connection Type:  PRIVATE LOOP (point to point)
Connection Speed: 8 Gbps
RX Status:        Passed
RX Power:         -3.2 dBm
TX Status:        Passed
TX Power:         -1.8 dBm

Fiber Channel Nodes Found = 1
Fiber_Channel_WWN       SEQ_ID TYPE   MSG_RCV   Fiber_Status RX(dBm) TX(dBm)
20:00:00:90:9e:84:04:c7 30013  4G     247       PASS         -4.0    -1.7

CMD>
```

The *ConnectionType* will display 'private loop' for single NAC-to-Reader Chassis configurations. For multiple Reader Chassis configurations with a fiber switch, 'public loop' will be displayed. The summary will list the Reader Chassis sequence id's configured and the messages received from the chassis. The messages will only increment if the Reader Chassis is powered on (*non-idle state*). The fiber optic status will be updated each time the message count increases and report fiber optic power as well as the overall status.

The World Wide Name (WWN) is the fiber switch address. The last four octets of the WWN are also displayed on the Reader Chassis LCD panel along with the chassis sequence id.

New devices that have had FIPS keys exchanged may take a few seconds to display in the 'showfiber' command.

Pairing a NAC and Reader

If connecting a new Reader to a NAC, unless the NAC has already been configured and the FIPS keys have been synced between the NAC and Reader, the Reader will hang on 'PMD RDY' when attempting a download assuming the fiber connection is good. While the process for pairing a new device is described below, a comprehensive guide on the commands used can be found in the **CLI Reference** section in this user manual.

1. Connect the NAC and Reader via fiber optic cable, connect an ethernet cable between the NAC's admin port and a computer with a telnet client.
2. Power on the NAC, the LCD will display **NAC BOOT** until the device has finished booting, at which point it will begin displaying status screens.
3. Once the NAC has booted, establish a telnet session to the NAC. The admin port's IP address will be displayed on the NAC LCD on one of its status screens (the default admin IP is generally either 192.168.0.1 or 192.168.10.1).

4. Add the Reader to the NAC's configuration via the `+reader [Reader SEQ ID]` command, the Reader SEQ ID is the 5-digit number listed on the ID Tag of the Reader, beginning with either a 3 or 4 depending on if connecting a 3G or 4G device. The `print` command can be used to confirm which readers have been added to the configuration.
5. The `+reader` command must be followed by a `save` command, otherwise upon reboot the NAC will no longer recognize that Reader.
6. Power on the Reader, if screen is black with flashing download button LEDs press either bay download button with no PMD inserted to put unit out of idle mode.
7. Reader will show **LFOR BOOT** until it has completed booting. After boot, enter `showfiber` command into the NAC telnet session, this should show a node found with either the Reader's seq id if the keys are already synced, or if the FIPS Keys are not in sync: `(unknown/unkeyed device - VERIFY WWN)`.
8. If the device is showing as unknown/unkeyed, the FIPS keys can be synced via the `add_all_rdrs` command. For this command to succeed the Reader cannot be in idle mode.
9. After the FIPS keys have been synced a proper connection can be verified by first ensuring the Reader is not in idle mode, then entering `showfiber` command. The newly configured Reader should be listed as one of the connected nodes with its seq id shown.

Defining Phase Download Paths

When starting a download, the Reader will only download directories and phases specified in the NAC configuration. To check the current configuration, establish a telnet session via the NAC admin port and run the `print` command. This will output all phases and directories defined, if no phase definitions exist, the following message will be displayed:

```
INFO> no download phases are defined.
```

To create a phase, use the `create_phase` command. You will then be prompted to enter in a list of directories for that phase to download. At any point you may finish adding directories by inputting a '^' character followed by pressing enter.

For a list of commands detailing how to manipulate phases, see the **CLI Reference** under the **Phase** section.

NOTE: Any changes to phases will not persist between reboots unless `save` command is entered.

CLI Reference

Configuration Daemon

Use the telnet configuration daemon to set IP addresses, phase downloads, backups, and configuration restores. Once in the configuration daemon the following CLI commands are available.

NOTE: *Enter all commands on a single line.*

General	
backup	Backups the current configuration to the FTP server
clear_configuration	Restore NAC to factory defaults (used to clear nonvolatile configuration data, see CoV)
fw	Display NAC Firmware version
help	Prints list of commands
print	Prints the current configuration
save	Saves any changes that were made to the configuration
reboot	Reboots the NAC
recover	Loads a configuration file from the FTP server
test_mode <0:1>	Places the NAC into test mode, forcing all FTP downloads to a "TEST" directory on the FTP server. Note: This setting is not preserved between power cycles
testFTP	Performs an FTP test by generating and sending data to the FTP server. Testing does not require a PMD. This can only be performed once server configuration has been completed using the configuration daemon
quit	Exits the configuration daemon
testSyslog	Performs a syslog test by sending multiple test syslog messages to the configured syslog server
lforLogEnable lforLogDisable	Enables/disables verbose logging in the console session.

Chassis	
+reader <*seq id*>	Adds a reader chassis to the NAC configuration (max 23 supported)
-reader <*seq* id>	Removes a reader chassis

showfiber [-l]	Displays the fiber channel information on configured chassis. Use the optional parameter -l (*lowercase L*) to print the fiber channel information continuously until the enter key has been pressed.

FIPS (*Reader Chassis must be powered on)*	
create_fips_key	Creates a new key for encryption between the NAC and Reader Chassis
fips_status	Gets the current FIPS status of the link between the NAC and Reader Chassis. The Reader Chassis must be booted with "LINK UP" displayed on the screen
add_all_rdrs	Sets FIPS keys on all the online readers. The reader must already be in the +reader list. (*firmware 3.4.20191009 or later*).

Network	
eth1 <*ipaddress*> <*subnet mask*> <*gateway*>	Sets the IP address of the Admin port
eth0 <*ipaddress*> <*subnet mask*> <*gateway*>	Sets the IP address of the Data port
ftp <*ipaddress*> <*username*> <*password*>	Sets the FTP server address and credentials for the FTP server *Note:* FTP server must always use port 21
syslog <*ipaddress*> <*port*>	Sets the IP address and port of the syslog server
ifconfig	Displays NAC adapter properties including the MAC address

Phase	
create_phase <*id*>	Creates a phase used when performing downloads (max 4 phases supported)

delete_phase <*id*>	Deletes a phase
add_phase_path <*id*> <*path*>	Adds a directory path to the specified phase (max 4 paths supported)
delete_phase_path <*id*> <*path*>	Removes a directory path from the specified phase

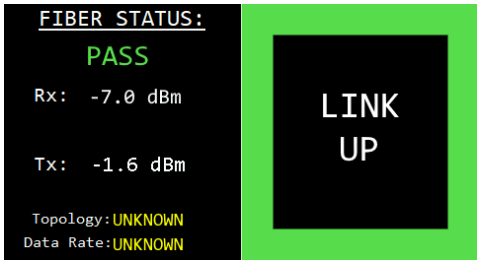
Logging	
clear_log	Resets rolling log
log	Prints out the contents of the rolling log starting at power on of NAC.
log_level <*0-4*>	Changes the log level of the rolling log starting from 0(trace) which is the most verbose, and going to 4(error) which will only log errors.

PMD Download Process

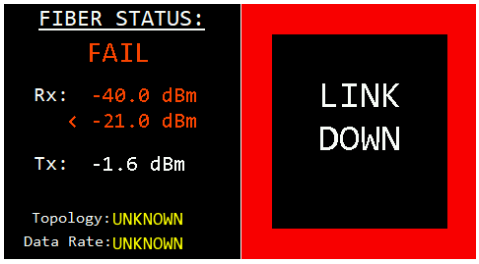
Follow these instructions to download from a PMD:

1. Unlock the handle on the PMD and insert with the top facing upwards.
2. Lock the handle on the PMD. If the handle does not close, the PMD is not in all the way.
3. Once the handle is closed press the **Download** button for the corresponding bay. Do not hold the button down.
4. Status will be displayed on the screen as the download progresses (*see examples below)*.
5. Once complete, then button LED will turn off. If the button is lit the download is still processing.
6. It is now safe to remove the PMD.
7. The data (*specified by the phase configuration*) will reside in the destined FTP server.

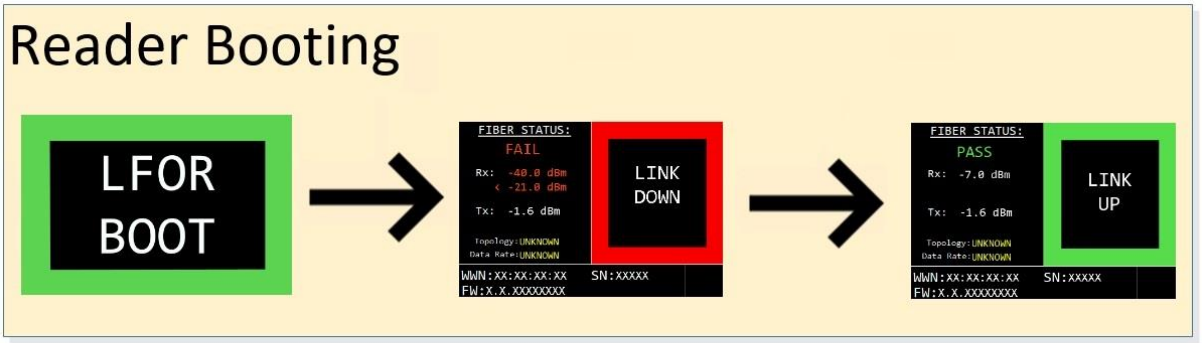
When the Reader chassis is powered on and not downloading, the screen will display fiber status. The fiber must be healthy otherwise downloads may fail intermittently which can make troubleshooting difficult.

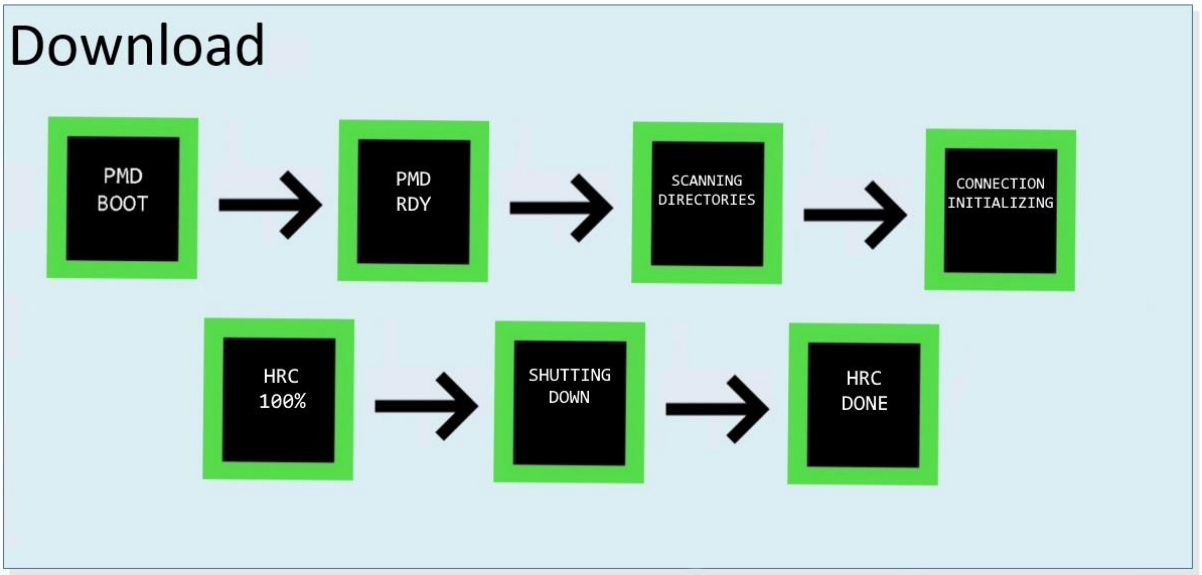


Good Fiber Example



Bad Fiber Example





Security

Architecture

During operation the NAC maintains positive control of the interface and is responsible for initiating all PMD read operations. The Reader Chassis proxies all read messages from the NAC to the PMD and from the PMD to the NAC. A user must press the download button to initiate the download which then signals the NAC to start processing. The Reader Chassis itself cannot initiate any downloads and does not store any PMD data in non-volatile memory.

The NAC monitors the Reader Chassis Fiber Channel port for download requests. The NAC only accepts download requests from a configured Reader Chassis. Additionally, a registration process occurs during this configuration that uses an encrypted token to establish valid connections. All messages received by the NAC are validated using an encrypted token. The NAC only implements file read messages and lacks any ability to write to the PMD.

The NAC creates a file download list by sending directory and object queries to the PMD. The NAC does not know the PMD file system structure and must be configured with fully qualified PMD file system paths for download. Once configured, the NAC only reads the configured directory paths.

Audit Functions

The NAC transmits audit events using the RFC 5424 syslog protocol over UDP to the administratively configured syslog server and port. The syslog server is responsible for time stamping the audit events and processing the events into a security audit log.

The following table lists the available audit events:

Audit types	Description
Telnet session was established	A telnet session was established on the admin Ethernet port. The log message includes the source IP address.
Invalid fiber channel source detected	The NAC received a fiber channel message from an unregistered fiber channel source. The message is rejected and a security event is created recording the fiber channel source address (ID).
Invalid fiber channel message detected	The NAC received an invalid fiber channel message from an authorized fiber channel device. The message is rejected and a security event is created recording the fiber channel source address (ID).
NAC Restarted	The NAC startup process generates an audit event to record the startup of the NAC.
Valid PMD download request received	The NAC received a PMD download request from an authorized Reader Chassis. The security event includes the serial number of the initiating Reader Chassis.
PMD Download Completed	The NAC records the completion of a PMD download event. The security event includes the serial number of the initiating Reader Chassis.

An additional error log file (error_log.txt) is generated in the event a download fails. The log file will reside on the FTP server in the download location. Details of the error will reside in the log file.

FIPS

The PMD Reader is FIPS 140-2 Level 1 compliant. The LFOR FIPS encryption uses a third-party OpenSSL FIPS 140-2 module.

https://www.redhat.com/en/blog/how-rhel-8-designed-fips-140-2-requirements

The software is integrated into the LFOR system to provide secure, high-speed AES-256 encryption between the NAC and Reader chassis. FIPS configuration of the PMD Reader system, to include 140-2 integrity checks, is provided using the “fips_status” command documented in *CLI* reference.

Data Integrity

The PMD Reader employs multiple techniques to provide data integrity throughout the download process. Files stored on the PMD are read into the Reader Chassis using data blocks. The data blocks are formatted into messages for transmission across fiber channel. The formatting process adds tokens to the beginning and end of the file data block. The message is then fully encrypted using the certified encryption engine and transmitted to the NAC chassis over the fiber channel interface. The NAC decrypts the message and performs multiple data integrity checks to assure the message is valid. The tokens at the beginning and end of the data block are used to confirm data block integrity. After completing the message validation, the file data block is transmitted to the FTP server using the File Transmission Protocol over TCP/IP sockets. The FTP protocol combined with TCP/IP messaging provides data integrity for the final leg of PMD data download.

Appendix A – BIT Errors

BIT (Built In Test) Errors are detected by the NAC and RDR units on boot, a BIT error will display as BIT XXX, where XXX is one of the 3 digit error codes listed below:

BIT Errors

Code	Error description
000	Security Compromised
001	System is Read-only
002	Memory Failure
003	CPU Temperature above threshold
004	LCD is not connected
005	Ethernet configuration failed
006	FIPS not supported
007	FIPS key not loaded
008	Unsupported bay configuration
009	CIO Initialization Failed
010	SFP Not Installed
011	SFP Power Overdriven
012	SFP Over Temperature threshold
013	LCD Not Responding
014	PCIe Link Speed Error
015	Data port not found
016	Admin port not found
017	Fiber Channel card not found
018	BIOS configuration error
019	10Gbe adapter is not connected
0FF	Unrecognized Error

Appendix B – Error Codes

Error codes will be displayed in the form: A-BB-CCC. Where A is the cartridge stage, BB is the Primary Error Code, and CCC is the Secondary Error Code.

Bay Error Message Screen

Cartridge Stages

Code	Error description
0	Stage Unknown
1	Powering On
2	Creating Directories
3	Downloading Files
4	Processing Cartridge Read Errors
5	Powering Off

Primary Error Codes

Code	Error description
00	Unknown Cartridge Error
01	Cartridge was removed unexpectedly.
02	Failed to receive GPIO status from supervisor.
03	Cartridge failed to boot.
04	Unable to initialize download threads.
05	Failed to send message buffer over Fiber channel.
06	Unexpected Cartridge Error.
07	Unexpected System Error.
08	NAC encountered error with FTP server.
09	Timeout waiting for NAC to respond to download request.

Secondary Error Codes

Errors specific to TR2 PMDs are in the range 200-299, while errors specific to TR3 PMDs are in the range 300-399.

Code	Error description
000	No Secondary Error Code
201	Arp Listener Initialization Failed.
202	OFP Not Supported.
203	RPC Failure.
204	OBM Command Socket Startup Failed.
205	OBM Transfer Socket Startup Failed.
206	OBM File Load Failed.
207	OBM Startup Failed.
208	OBM Returned Error.
209	EDTC Timeout.
220	Command Socket Failure.
221	Command Socket Incorrect Data Received
230	Data Receive Thread Error
240	Data Transfer Thread Error
301	PMD Not on PCIe Bus.
310	System Partition Error.
320	Data Partition Error.

Appendix C – Fiber Switches

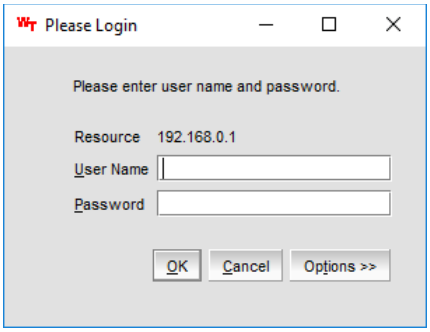
3rd Party Fiber Switches

Fiber channel zoning is required to use multiple Reader Chassis. The proper zoning configuration for connecting a NAC to multiple Reader Chassis through a fiber channel switch requires the creation of unique zones, each consisting of the NAC and one Reader Chassis. This appendix illustrates the steps used to setup a zoning scheme for a NAC and multiple Reader chassis connected to a Brocade 300 or G610 fiber channel switch. This is for reference purposes as different fiber switches may be used.

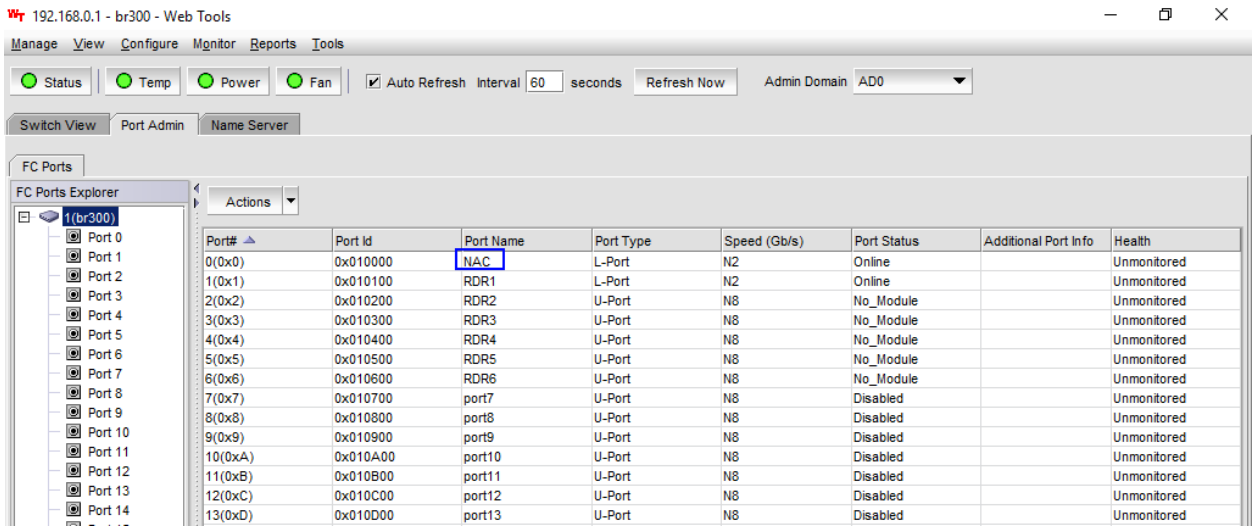
This procedure was captured using FabricOS v7.4.2c

(***NOTE:*** *Screen shots may vary depending on the version of the Brocade software*)

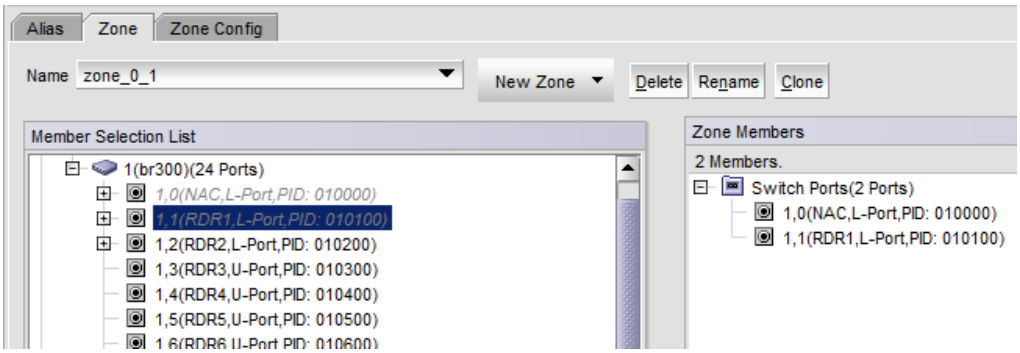
1. Log into the switch GUI. This requires Java 7 or higher. If the switch is running a lower version of firmware it must be upgraded as older firmware versions are not compatible with newer Java versions.
   To access the switch user Internet Explorer and navigate to the device's web page. The IP address varies but may be defaults of 192.168.0.1 or 192.168.10.1. If the browser complains about Java then execute it from a command prompt as follows:
   javaws "http://<*ip address*>/switchExplorer_installed.html"
   (*specify IP address as appropriate*)
2. The plugin should execute and prompt with a login.



3. Specify credentials. Defaults are admin/password.
4. The primary ports screen will be displayed. At this time, it is recommended to rename the ports accordingly and label the NAC and the other RDR ports (*simply right click and rename*).
5. For the Brocade 300 switches, all ports must be configured as L-Port:
   a. Right click the port->Properties.
   b. Click Next.
   c. Only have the L-Port option checked, click Next.
   d. Click Finish.

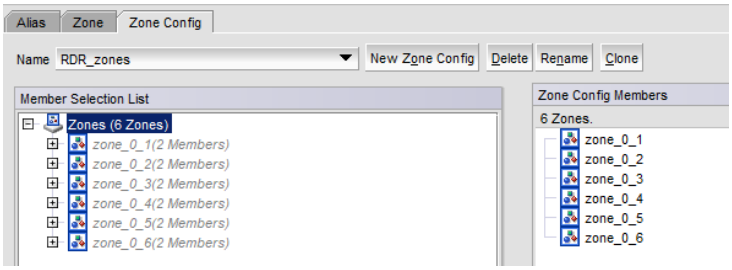


6. Disable other unused ports (*right click set disable*).
7. Click **Configure->Zone Admin**.
8. Once the zone screen loads click the **Zone** tab.
9. On this screen, add a zone for each RDR port that is configured. Each zone contains the NAC port and a single RDR port (*IMPORTANT, only one RDR port*).
    a. Click **New Zone**
    b. For the zone name the easiest nomenclature is '**zone_0_1**', '**zone_0_2**', and so on. Assuming that port 0 is the NAC. This is just for reference purposes but is much easier to read with a port naming convention.
    c. Click **OK**.
    d. The new zone is added and automatically selected.
    e. Expand the ports and select the NAC port, click the right arrow to add it.
    f. Select a RDR port and click the right arrow to add it.



    g. Notice on the right side it contains the NAC port and one RDR only.
    h. Repeat steps A-F for each additional RDR port to create zones for each.
    i. Once the zones are created click **Save Config**, Yes to the prompt.
    j. Wait for the save to complete (*noted on the bottom left of the window*).
10. Next click the **Zone Config** tab.

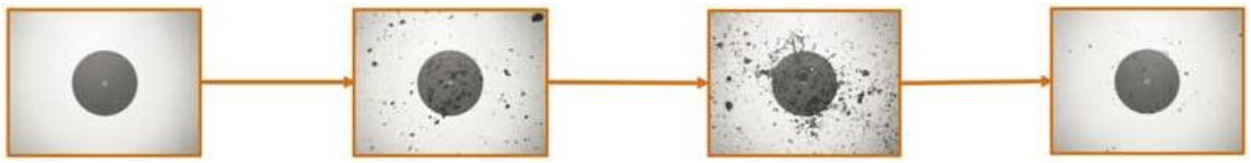
11. Here a zone configuration will be created and the new zones added to that configuration. This is how the switch determines what is applied at boot up.
    a. Click **New Zone Config**.
    b. Specify a name for the config, in this example '**RDR_zones**' is used.
    c. The new zone config is automatically selected, expand the zone list and add all of the created zones.



    d. Once the zones are created click **Save Config**, Yes to the prompt.
    e. Wait for the save to complete (*noted on the bottom left of the window*).
12. Click **Enable Config**, select the new config, click **OK** and **Yes** to the prompt.
13. Configuration complete.
14. The NAC/Readers will need to be rebooted to pick up the topology change.
15. To verify that the fiber switch configuration is working properly, log into the NAC console and run the *showfiber* command (see *CLI Reference*) to view the status of the Reader Chassis.

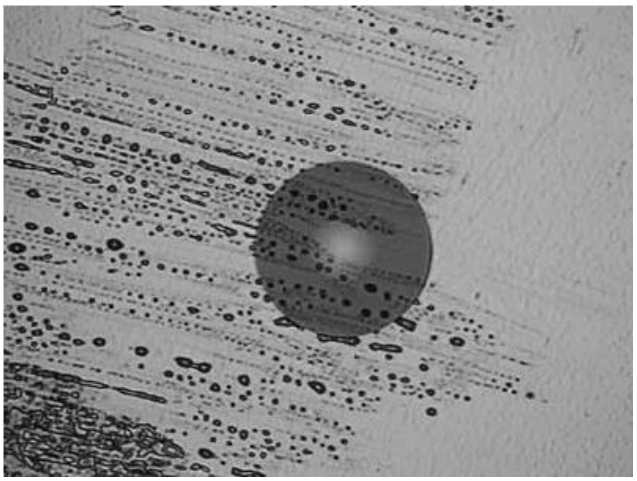
Brocade Diagnostics

This section talks about how to help diagnose fiber connectivity power issues. Fiber is sensitive on how the cable is installed. If the cable is bent, dirty, or fractured, these will all inhibit the signal and create connectivity problems. Dirt is relatively large compared to the size of the core of a single mode fiber. Much of the dirt is hard enough to scratch the fiber if sandwiched between two spring-loaded ferrules. Uncleaned or improperly cleaned connectors can transfer their dirt and contamination to another when mated as well.



**source thefoa.org*

The end photo is after cleaning the connector; however, ultimately the connector has been damaged as shown in the last image. The final specs are actual indentions on the fiber itself and would require further repair and/or possible re-termination.



*Example of a fingerprint smudge. *source thefoa.org*

ITI can provide a cleaning instruction upon request.

Power readings between the switch and NAC/Reader can help diagnose fiber problems.

1. Log into the switch via telnet.
2. At the prompt run: **sfpshow <port id> -f**
3. The output will resemble:

```
=============
Port  2:
=============
Identifier:  3    SFP
Connector:   7    LC
Transceiver: 1501001202000000 1,2,4_Gbps SM lw Long_dist
Encoding:    1    8B10B
Baud Rate:   42   (units 100 megabaud)
Length 9u:   4    (units km)
Length 9u:   40   (units 100 meters)
Length 50u (OM2):  0    (units 10 meters)
Length 50u (OM3):  0    (units 10 meters)
Length 62.5u:0    (units 10 meters)
Length Cu:   0    (units 1 meter)
Vendor Name: BROCADE
Vendor OUI:  00:05:1e
Vendor PN:   57-1000014-01
Vendor Rev:  A
Wavelength:  1310 (units nm)
Options:     003a Loss_of_Sig,Tx_Fault,Tx_Disable
BR Max:      0
BR Min:      0
Serial No:   VCF1112100007MB
Date Code:   110516
DD Type:     0x68
Enh Options: 0xf8
Status/Ctrl: 0x92
Alarm flags[0,1] = 0x5, 0x40
Warn Flags[0,1] = 0x5, 0x40
                                       Alarm                  Warn
                                  low         high       low         high
Temperature: 40      Centigrade      -15         75         -10         70
Current:     40.474  mAmps           1.000       100.000    3.000       90.000
```

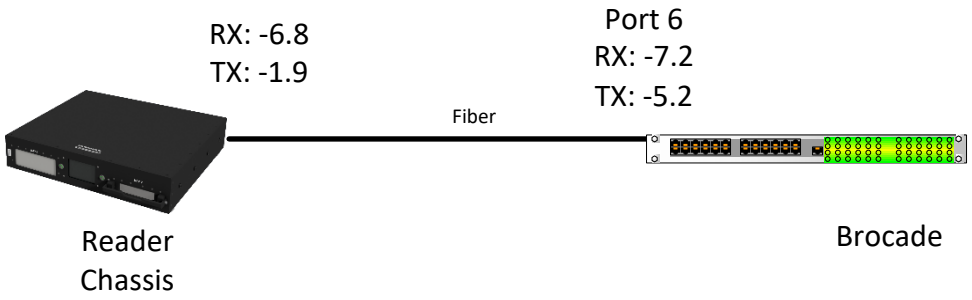
```
Voltage:      3267.7  mVolts          2900.0     3700.0     3000.0      3600.0
RX Power:     -6.9    dBm (201.9uW)   4.0    uW  1584.9 uW  6.3    uW   1000.0 uW
TX Power:     -5.4     dBm (1599.5 uW)  631.0  uW  5011.9 uW  1000.0 uW   3162.3 uW

State transitions: 3
Last poll time: 04-27-2020 UTC Mon 00:02:25
```

4. The important readings are the RX/TX power. In the above example RX power indicates the power coming from the Reader (*if this is the NAC port then it's coming from the NAC*). Depending on how the fiber is installed, some Db loss (0-6) is acceptable.
5. The Reader fiber power is displayed on the screen when the unit is powered on and idle.
6. The NAC fiber power is displayed in the NAC telnet session under the show fiber command.

So how to troubleshoot?

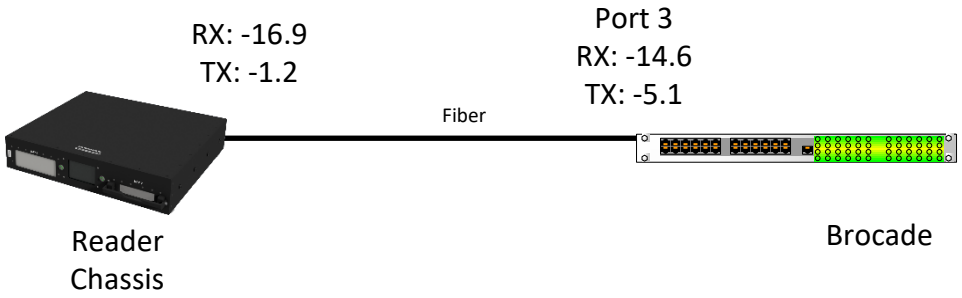
The answer is to look at the RX/TX readings on both sides.

Example 1:



This is a healthy example but could still indicate a problem. The Reader is transmitting -1.9 and the Brocade is receiving it at -7.2. That means there's a 5.3 Db loss. Conversely the other line has a 1.6 loss (*brocade TX 5.2 – Reader RX 6.8*). This could indicate a dirty connector. If the fiber is run through patch panels, the dirt could be in any of the termination points and should be analyzed. It is expected that both directions should drop in similar Db loss.

Example 2:



This is an example that indicates the fiber line has a real problem. Readings on both sides indicate a high Db loss which usually indicates the fiber is possibly broken, has bad termination, is very dirty, possible high angle bends. Troubleshooting would be required to determine the exact issue.

Appendix D – Fiber Optic Power Considerations

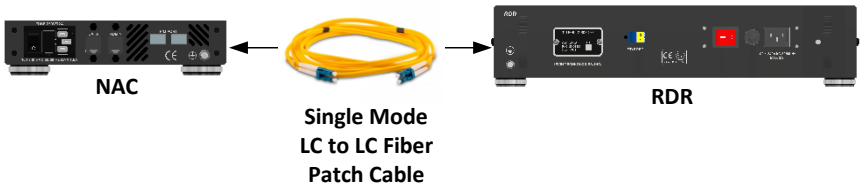
CAUTION: Optical power outside of specified ranges may result in link failure. Measure to be sure!!!

General Considerations:

- Keep dust caps on all connectors until ready to connect the fiber cable.

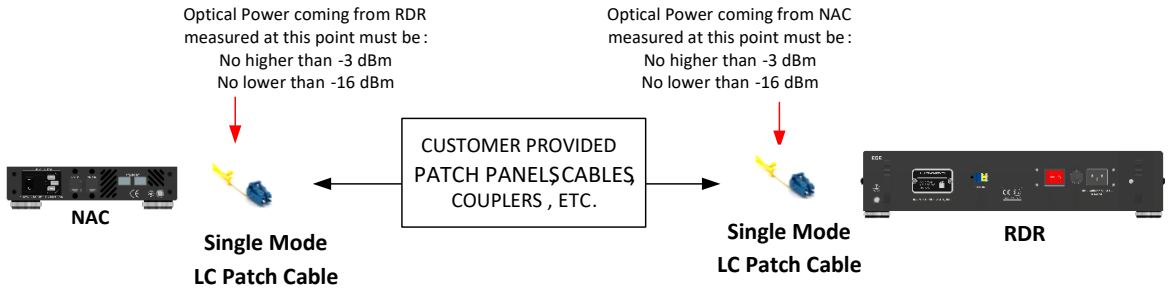
Point to Point Configuration using Direct Interconnect Cable – NAC to one RDR

- No special considerations are necessary.



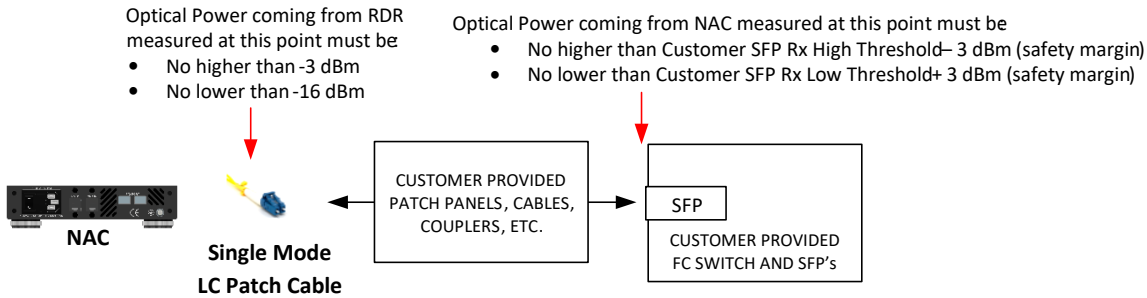
Point to Point Configuration using LC to LC adapter cables – NAC to one RDR

- Measure optical power to be sure it is within required sensitivity levels indicated below.



Switched Configuration– NAC to multiple RDR's

- Measure optical power to be sure it is within required sensitivity levels indicated below.



Appendix E – Troubleshooting

This section provides troubleshooting tips for issues that may occur with the device. The lists are ordered from high to low probability.

Reader Chassis displays LINK DOWN

Typical cause: Fiber connection is not healthy.

1. If the NAC and Reader is connected via point-2-point (*p2p*) with no switch in the middle:
    a. Verify that the fiber is connected properly. Some locations are considered p2p but the fiber runs through multiple patch panels which can cause connection failures due to bad or dirty fiber.
    b. If the connection is directly connected, verify that the cable is secured in the back of both the NAC and Reader chassis.

2. If the NAC and Reader is connected via a switch, make sure that the switch is configured:
    a. Log into the switch and check the ports for the NAC and Reader. The port status should be listed as 'Online' (*screen shot depicted in Appendix B*). If it is not showing as online the likely culprits are invalid SFPs on the switch or dirty/broken fiber. Refer to Appendix B for SFP types.
    b. If the switch shows status as online for each device, make sure the zoning configuration is correct. Refer to Appendix B for zoning information.

3. Verify that the NAC is powered on.

Reader Chassis displays PMD RDY after pressing download button

Typical cause: FTP server is not healthy.

1. Telnet to the NAC and run 'testFTP' from inside of the configuration daemon to determine the health of the FTP server. Errors will be reported to the console.