

VIAVI Solutions

CPRI Analyzer Based PIM Detection and Mitigation TB-5800v2/3 or OneAdvisor-800

September 2021

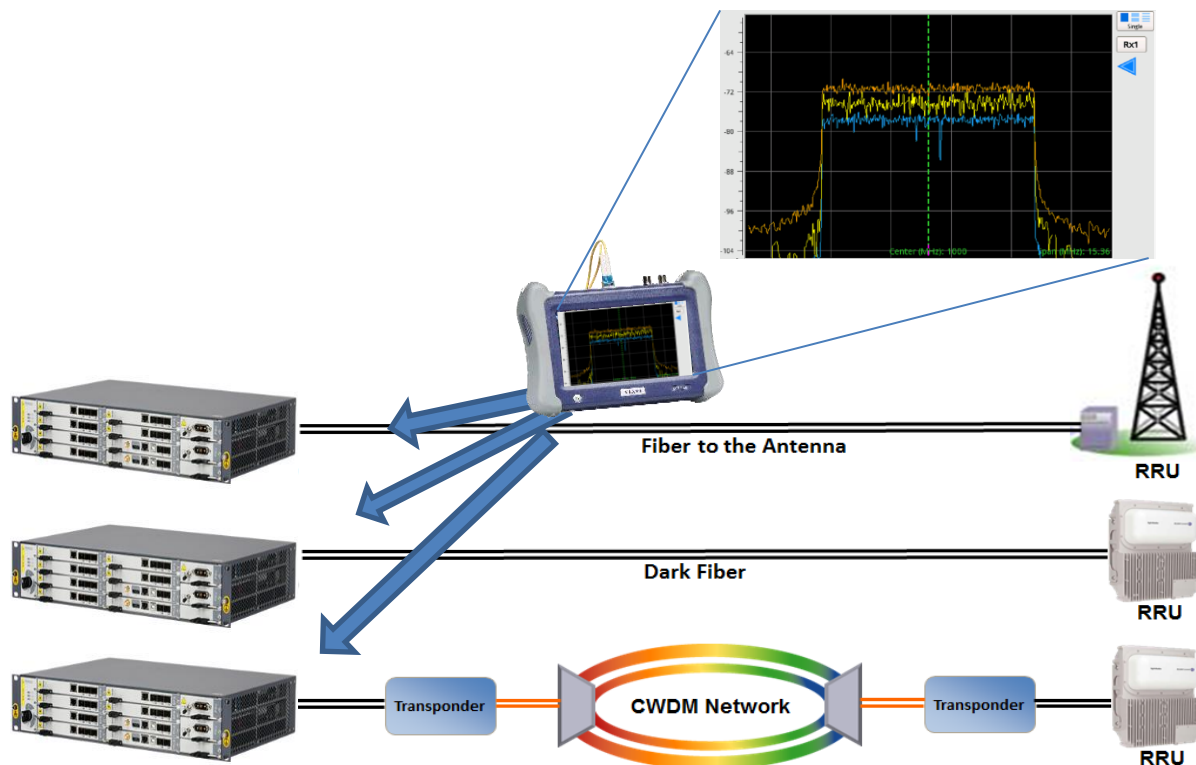
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1. Overview

This procedure describes an alternate PIM troubleshooting methodology centered on using a CPRI analyzer with the cell site receiver in real-time. Advantages include:

- Intrusive test access to RF connections is not required. Sometimes breaking and making these connections introduces new problems and a return climb.
- Work can be performed during daylight hours with very small interruption of service (only to insert/remove optical tap)
- Minimal customer impact during test process. All carriers are up, and the site processing calls.
- No 'waiting time' on communications with Integrator contractor as RRHs can be put into full power mode and remain in that mode during entire detection / mitigation process
- Improves the effectiveness of PIM hunting and mitigation efforts through immediate feedback from the site's receive path.
- Less time and expense will be spent fixing PIM sources that do not reach the site's receiver.
- Uplink monitoring is performed under peak Tx power load from one or all carriers at site whereas PIM testers might be stimulating one or two duplexed ports at a time. See the effect of multiple RRH and carriers (multiband PIM) on the affected uplink Rx
- Validate various power levels and tilts and their effect on PIM, if necessary.



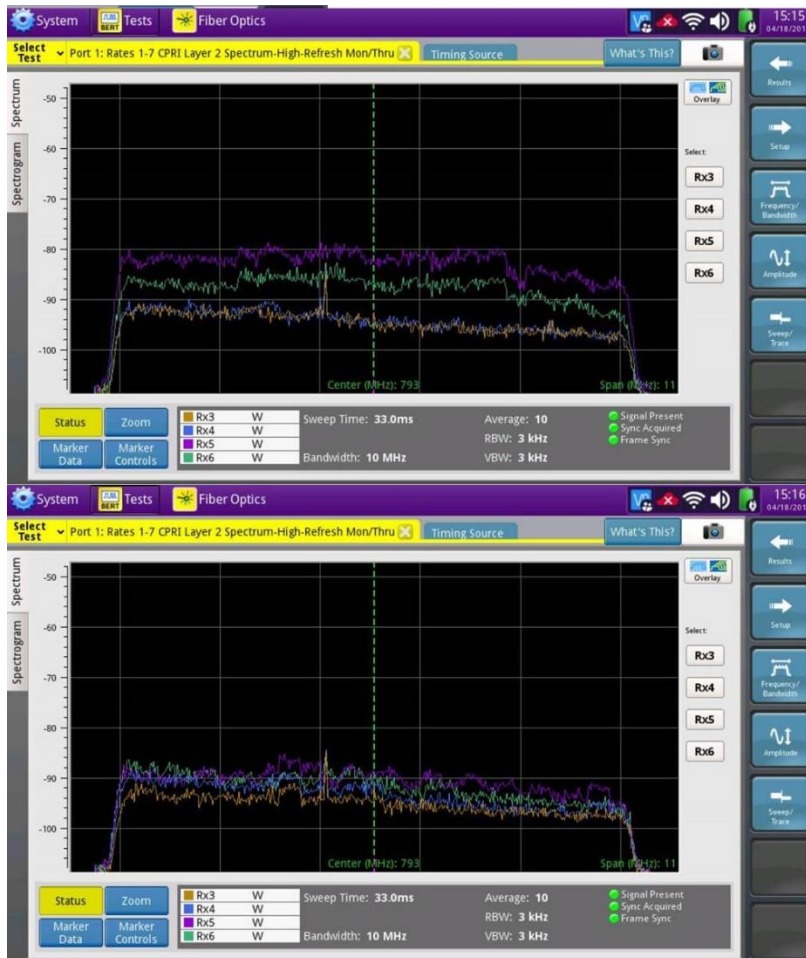
2. High Level Process

- Use the cell site base station hardware to observe and quantify PIM impairments with a CPRI analyzer. In this example with a Viavi T-BERD 5800 connected between the BBU and RRH it is possible to see the PIM from the perspective of the cell site receive path that results from the mixing of the cell site transmitters in real-time. The instantaneous feedback permits individuals to identify the sources using familiar temporary or permanent techniques such as placement of isolation material (e.g. PIM blankets), adding separation between antennas and sources, and ensuring mechanical integrity of mating surfaces (tapping components, connectors, mounts).
- Mechanical shakedown (tapping) can be extremely useful in tracking intermittent problems that change with the environment.
- The techniques simplify troubleshooting where it is impractical to connect traditional RF generating PIM test equipment including tower tops and DAS installations.

This procedure DOES NOT replace other approved methods and requirements for measuring PIM during new construction or site modifications. Instead, this method is recommended when troubleshooting PIM on a previously integrated site to reduce the time required and possibly avoid the expense and the risks of introducing new problems by disconnecting the antenna from the radio for active PIM testing.

This MOP assumes that PIM is already suspected at a sit. Following is a high-level overview of this process:

- A. Lock the carrier(s) that is/are transported on the CPRI link to be analyzed.
- B. Insert the optical tap(s) in the path of the CPRI link between the BBU/DU and RRU (multi-port taps permit rapid connection to other sectors without service disruption).
- C. Unlock the carrier(s) to restore normal operation
- D. Connect the TBERD 5800 to the test port of the tap and configure it to display 2 (2x2 MIMO – Band 17) or 4 (4X4 MIMO – Band 14) RX branches in spectral overlay.
- E. Capture a baseline of the spectrum in this normal state of operation.
- F. Turn on full power mode for all downlink signals suspected of contributing to PIM
 - a. For Ericsson it is AILG (Air Interface Load Generator)
 - b. For Nokia it is OCNS (Orthogonal Channel Noise Simulator)
- G. Verify the existence of PIM by observing the shape and change of the receiver noise floor as power is changed, bands locked/unlocked, and/or activation of artificial loading (OCNS/AILG).
- H. Survey sector HW and nearby structures/objects/components in front of and behind the antenna for possible PIM sources.
- I. Tap, shake, and/or cover suspected PIM sources while observing uplink spectrum on TBERD 5800 (on screen or via remote viewer). Frequently multiple PIM sources can combine and create localized peaks far away from actual sources that while visible to a probe/spec are not in view of the BTS antenna. PIM that does not reach the receiver is of no consequence. Continue process until PIM observed on the TBERD 5800 is reduced/improved or all accessible PIM sources have been exhausted. Capture new baseline showing improvement, if any.
- J. Mark and record PIM source locations for more permanent corrective action.
- K. Turn off full power mode for all RRHs that were previously put in full power mode.
- L. Lock carrier(s), remove the optical tap, restore normal connections, and unlock carrier(s).
- M. Create report showing examples of system spectrum
 - a. In normal operation (unlocked)
 - b. Operating with full power invoked (OCNS, AILG, etc.)
 - c. Operating with full power with PIM mitigation measures in place
- N. After permanent PIM Mitigation steps have been implemented, run M-Pilot to confirm system improvement.



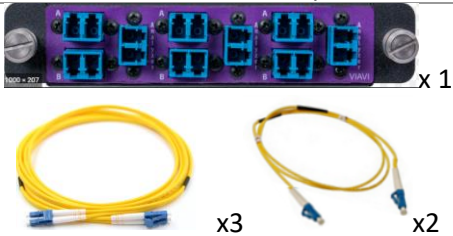


3. Procedure example with Viavi 5800

VIavi TBERD 5800v2, 5882, or 5800-100G with:

- Dual port version (serial number format will be WMME##### or WMNK#####)
- CPRI line rate licenses 3, 5, 7, 8
- RFoCPRI license.
- SW version 28.1 or above (this procedure based on 29.1.2)
- Optical splitter(s), SFP+, Fibers

New complete package with all licenses and parts shown below

Description	Diagram/Photo
Dual Port TBERD 5882 Unit <ul style="list-style-type: none"> - CPRI line rates 3, 5, 7, 8 - RFoCPRI SW Feature (C5RFOCPRI) - Carry Case and Strand Hook 	
Fiber Microscope and CPRI Capable SFP+ <ul style="list-style-type: none"> - SFP+ for rates up to Rate 8 (10.1Gbps) - P5000i Fiber Inspection Probe with necessary adapters 	 <p style="text-align: center;">SFP+</p> <p style="text-align: center;">P5000i Microscope</p>
Optical Taps and Cables <ul style="list-style-type: none"> - 3 Port SM Optical CPRI Tap - (3) 3M duplex LC-LC - (2) 3M simplex LC-LC 	 <p style="text-align: right;">x 1</p> <p style="text-align: center;">x3</p> <p style="text-align: right;">x2</p>

3.1 Required Supplies – PIM Mitigation Related

PIM mitigation products such as PIM blankets, PIM Foil, PIM tape, foam, etc.

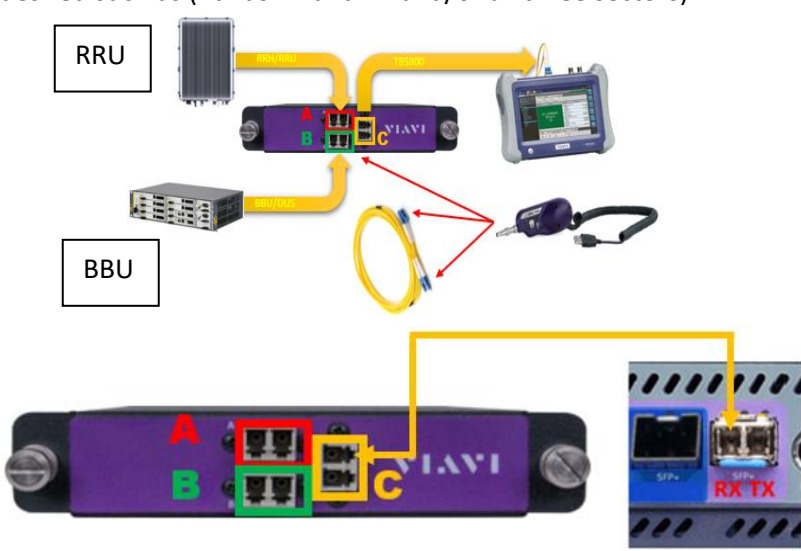

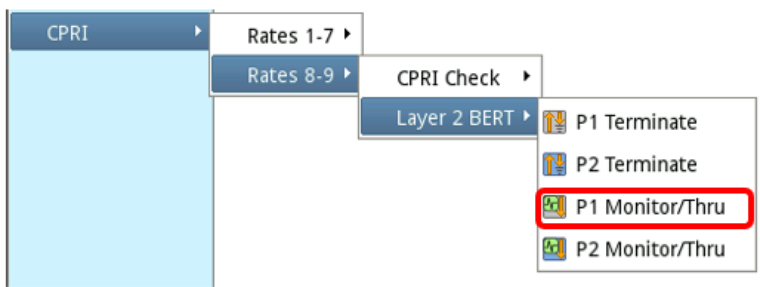
3.2 Required Test Setup Information


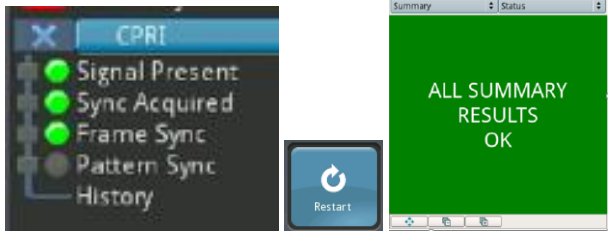

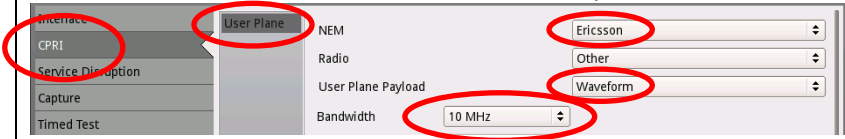


The following information is required to complete the test, and should be included in the Work Order:


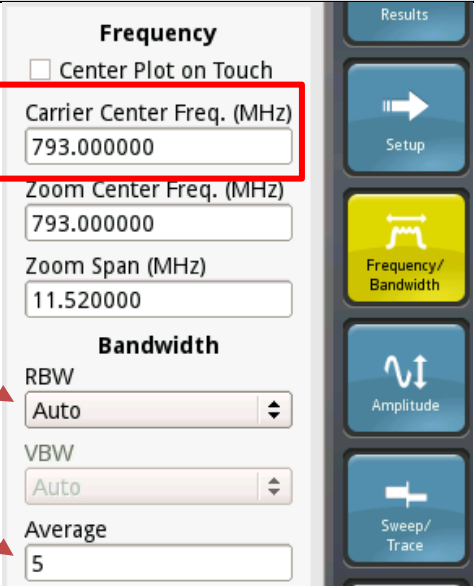



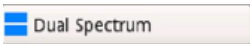
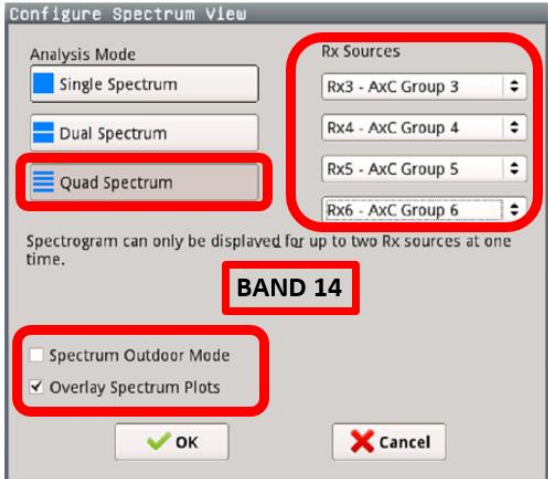
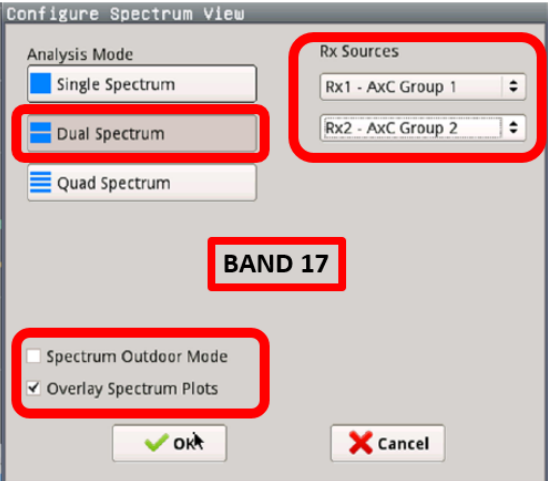
- Active frequencies/bands at site to be tested
- OSS statistics or test results for site showing sectors / antennas affected by PIM
- RRH NEM Vendor (Ericsson/Nokia/Samsung)
- Carrier center frequency / Channel BW / MIMO config for RX antennas
 - Example: Band 17 UL @ 709 Mhz, 10MHz Channel, 4 x 4 MIMO


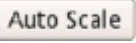
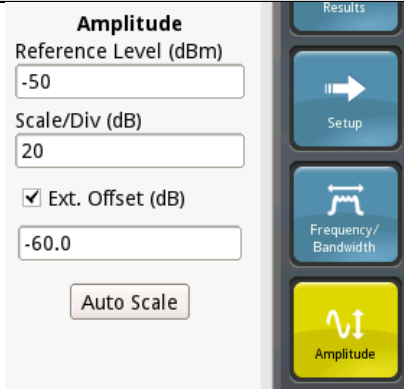





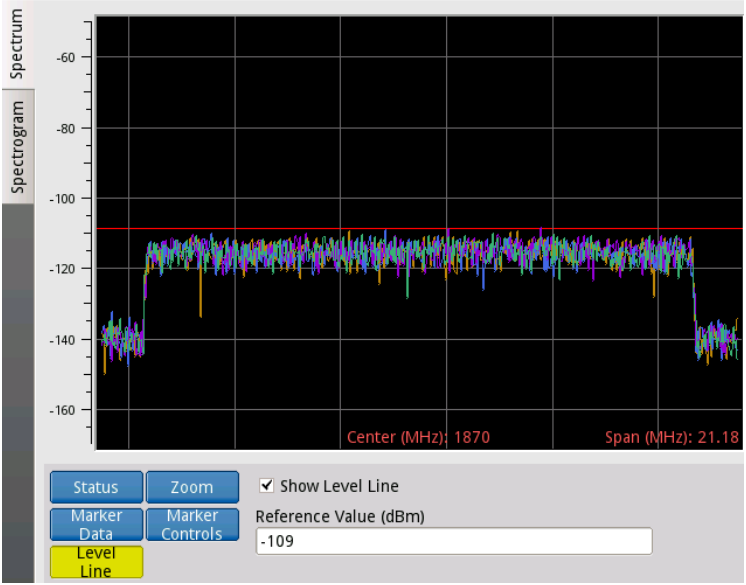
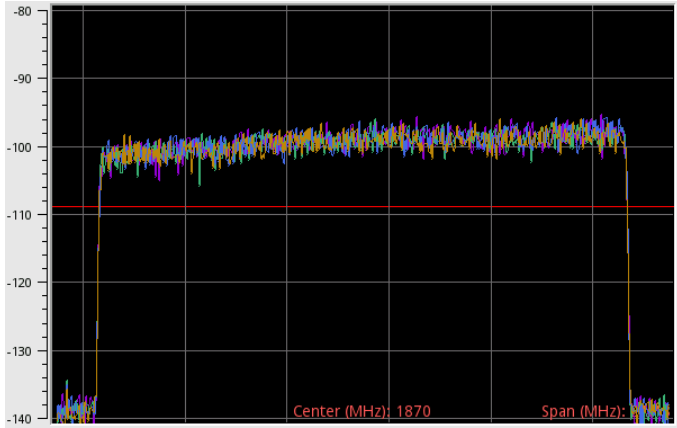
4. Setup Procedure

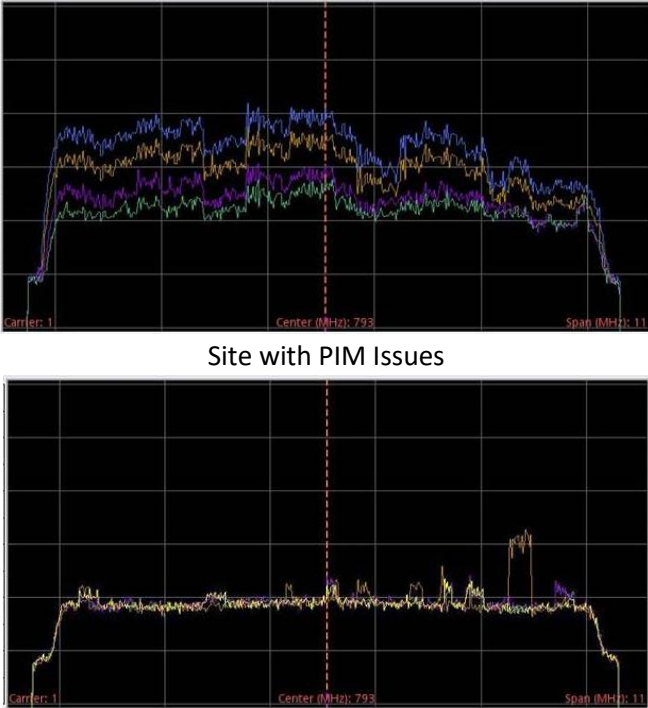
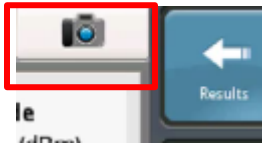
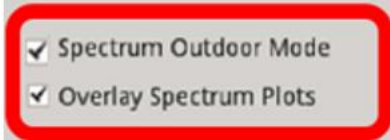

This document is not intended to be a user guide. This MOP should be used in conjunction with T-BERD User's Guides for detailed explanation of all testing steps and options.

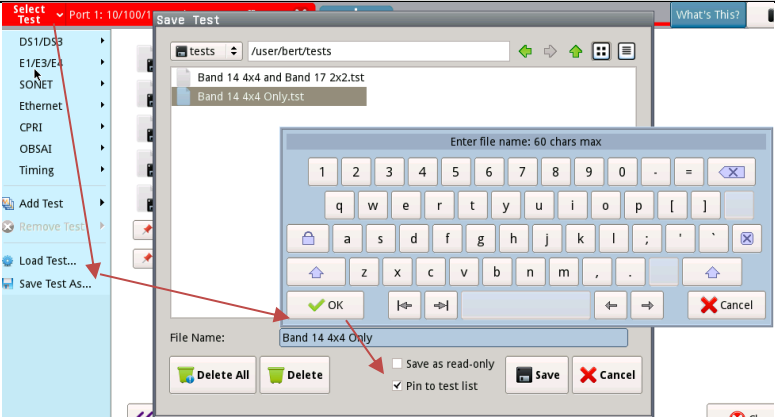
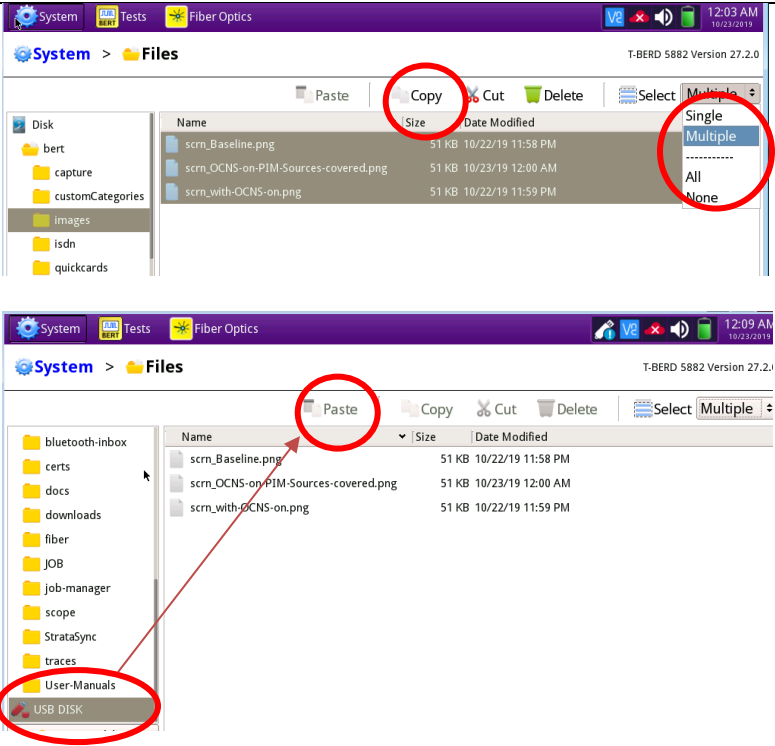
Step	Action	Description/Diagram
1	Verify the correct port/fiber from the OSS (AMOS, etc.) Do not relay on potentially incorrect fiber labels.	Lock the Sector/Carrier(s) to be tested. Prevent users from being abruptly dropped
2	<p>Splitter Installation</p> <ul style="list-style-type: none"> Inspect (ALWAYS) and clean (as necessary) all SFPs, fibers and the ports on the splitter Disconnect the duplex fiber from the BBU/DU and connect to the top duplex port (A) on the splitter Using the spare duplex jumper connect the bottom (B) port back to the BBU/DU Look for the LED on BBU/DU to indicate the port is back "up" Connect the simplex fiber from the top "tap" port (C) to the Rx side of the SFP+ in Port 1 of the TBERD 	<p>Single splitter shown for simplicity. Tap multiple CPRI links at once if desired such as (Bands 14 and 17 and/or all three sectors)</p> 
3	Unlock the Sector/Carrier(s)	Restore normal operation
4	<p>Configure the TBERD for RFoCPRI Monitoring</p> <p>In the Select Test menu , choose the CPRI test at the desired line rate, for example:</p> <p>CPRI ► Rates 1-7 ► Layer 2 BERT ► P1 Monitor/Thru</p> <p>Or for Rate 8</p> <p>CPRI ► Rates 8-9 ► Layer 2 BERT ► P1 Monitor/Thru</p>	

Step	Action	Description/Diagram
5	Set the CPRI Rate for the RRU <ul style="list-style-type: none"> - On most RRUs setting the Line rate to Auto will work. - On some Ericsson RRUs, select the specific CPRI Rate needed to lock on the signal (Rate 3, 5, 7, 8) 	
6	Confirm that the TBERD also sees a clean CPRI signal from the optical tap <ul style="list-style-type: none"> - Signal Present - Sync Acquired - Frame Sync Once ALL the lights on the summary screen turn GREEN, press Restart	
<u>AUTO SETUP</u>		
7	Click the Set-Up Button in the upper right of the screen.  <p>Each CPRI Antenna Container (AxC) can transport 3.84 MHz of the channel (which correlates to the size of a WCDMA signal). Some number of AxC need to be "grouped" to transport a wider signal. EXAMPLE: Either 3 or 4 AxC are grouped to transport a 10 Mhz LTE signal.</p>	Click on the CPRI tab (left side) and enter the NEM (OEM) (ALU/Ericsson/None) and set the User Plane Payload to Waveform  <p>Set the Network Equipment Manufacturer (NEM) Set the Bandwidth of the Signal to be monitored For Ericsson – Set the Antenna Container Group Size (Radio dependent)</p> <p>Rx AxC Group Size 4AxC - 15.36 MHz</p>
<u>SPECTRUM SETUP</u>		
8	Press the Spectrum soft key located on the right side of the screen. 	The spectrum screen should look like the right side below. That is typical of LTE FDD uplink spectrum derived from a CPRI payload.  <p>If the screen looks like the left side, that is the downlink. Move the simplex fiber to the other port on the splitter. That will be the uplink.</p>

Step	Action	Description/Diagram
9	<p>Make desired adjustments to Frequency Settings. Select the Freq/BW button:</p>  <ul style="list-style-type: none"> - Enter the center frequency of the UL Signal (793 when viewing Band 14 and 709 when viewing Band 17) - Adjust RBW to Auto - Adjust Average to 5 <p>RBW and Averaging settings shown are recommended. If you are, or as you become more familiar with Spectrum Analysis settings and tuning, you may choose different settings based on the situation</p>	
10	<p>Set-up Spectrum Overlay For Band 14 with 4 x 4 MIMO:</p> <p>Press the Single soft key</p>  and select  <p>Assign the Rx Sources as shown and check the Overlay Spectrum Plots box</p> <p style="text-align: center;">OR</p> <p>For Band 17 with 2 x 2 MIMO:</p> <p>Press the Single soft key</p>  and select  <p>Assign the Rx Sources as shown and check the Overlay Spectrum Plots box</p>	 

Step	Action	Description/Diagram
11	Adjust the Amplitude as necessary  <ul style="list-style-type: none"> - Set the External Offset to -60dB - Use  - Or Adjust the Reference Level (top of the trace) and/or the Scale/Division to optimize the trace based on your requirements	
12	Set the Reference Line for the Trace   	Check the “Show Level Like” box and use the   to adjust the line to the top of the trace. 
13	Turn on full power mode for all downlink signals suspected of contributing to PIM <ul style="list-style-type: none"> - For E// it is AILG (Air Interface Load Generator) - For Nokia it is OCNS (Orthogonal Channel Noise Simulator) 	Observe the Traces on the screen. IF the traces have increased in power (above the reference line) there is PIM present at the site. 

Step	Action	Description/Diagram
14	<p>Observe changes to the spectrum for any one or more of the RX signals</p> <ul style="list-style-type: none"> - Since M-Pilot indicated PIM using similar methods, it should show up now as well. - Example on right shows Band 14 4 x 4 RX with OCNS/AILG invoked - The spectrum rose throughout the band and has an obvious tilt characteristic of PIM on Band 14 	 <p style="text-align: center;">Site with PIM Issues</p> <p style="text-align: center;">Same Site without PIM Issues</p>
15	<p>Take one or more snapshots of the spectrum. Name the file(s) as desired indicating the system state.</p>	<p>Use the Camera Icon in the upper right near the Set-up/Results button</p> 
16	<p>Perform PIM Mitigation Methods:</p> <p>Survey sector HW and nearby structures/objects/components in front of and behind the antenna for possible PIM sources.</p> <p><i>Appendix L describes how to set-up a remote-control session to the TBERD so that you can go to the roof or climb the tower and still see instantaneous changes to the UL Spectrum.</i></p>	<p>If desired, change to Spectrum Outdoor mode to make the TBERD and Remote screens more visible.</p>  <ul style="list-style-type: none"> • While observing uplink on TBERD 5800 screen, begin methodically covering suspected PIM sources with PIM blankets, Foam, etc. and note changes in PIM level on TBERD 5800/remote screen. • Continue process until PIM observed on the TBERD 5800 is reduced/improved or all accessible PIM sources have been exhausted. • Mark, photograph, and record PIM source locations for more permanent corrective action.
17	<p>Save your test set-up for quick recall in the future.</p> <p>Use the Select Test button  and "Save Test as". Name the test</p>	

Step	Action	Description/Diagram
	<p>something you find useful for easy recall in the future and select "Pin to Test List" check box.</p> <p>Save all set-up variations that you use often for one click recall in the future.</p>	
18	<p>Export Images</p> <ul style="list-style-type: none"> - Go to System > Files - In the bert/images directory - Select Single, multiple, or All and Copy <p>Paste to a USB stick</p>	

Appendix A: CPRI Settings by RRU Vendor and Model Number

Nokia and Ericsson map the RF IQ (RF) information differently into the CPRI payload based on the RRU. The TBERD 5800 has an IQ Activity Detection function as a visual aid to ensure proper configuration and therefore an accurate decode.

Manufacturer	Radio Model	Setup	Uplink Center Frequency (MHz)
Nokia	AHFB B25	Appendix B	1855.00
Nokia	AHIB B66	Appendix B	1715.00
Nokia	AHCA B5	Appendix B	826.00
Nokia	AHLBA B12/14	Appendix C	709.00/793.00
Nokia	AHFIB B25/66	Appendix C	1855.00/1715.00
Nokia	AAFIA B25/66	Appendix C	1855.00/1715.00
Nokia	AAFIB B25/66	Appendix C	1855.00/1715.00
Nokia	AAFID	Appendix B	1855.00/1715.00
Nokia	AHNA B30	Appendix B	2310.00
Nokia	AHBCB B5/29	Appendix C	826.00
Nokia	AHLBBA B12/14/29	Appendix C	709.00/793.00
Nokia	AHBC B14	Appendix B	1715.00
Nokia	AHCE 1600	Appendix B	826.00
Nokia	FWPF	Appendix B	1715.00
Ericsson	2203 B66a	Appendix B	1715.00
Ericsson	2203 B5	Appendix B	826.00
Ericsson	2203 B25	Appendix B	1855.00
Ericsson	2203 B14	Appendix B	793.00
Ericsson	4478 B14	Appendix B	793.00
Ericsson	4478 B5	Appendix B	826.00
Ericsson	4478 B12	Appendix B	709.00
Ericsson	4415 B25	Appendix B	1855.00
Ericsson	4415 B30	Appendix B	2310.00
Ericsson	4426 B66	Appendix B	1715.00
Ericsson	8843 B2/66a	Appendix C	1855.00/1715.00
Ericsson	4449 B5/12	Appendix C	826.00/709.00
Ericsson	AIR 3246 B66	Appendix C	1715.00
Ericsson	AIR 3246 B25	Appendix C	1855.00
Ericsson	4402 B66a	Appendix B	1715.00
Ericsson	4402 B25	Appendix B	1855.00
Ericsson	RD 2243 B25	Appendix B	1855.00
Ericsson	RD 2243 B66a	Appendix B	1715.00
Ericsson	RD 4442 B25/66a	Appendix C	1855.00/1715.00
Ericsson	RD 4442 B30	Appendix B	2310.00
Ericsson	RD 2243 B14	Appendix B	793.00
Ericsson	4480 B25/B66a	Appendix C	1855.00/1715.00
Ericsson	4455 B25/B66a	Appendix C	1855.00/1715.00
Ericsson	AIR 4455 B25/B66a	Appendix C	1855.00/1715.00

Appendix B: TB5800 CPRI Settings For Single Carrier RRUs

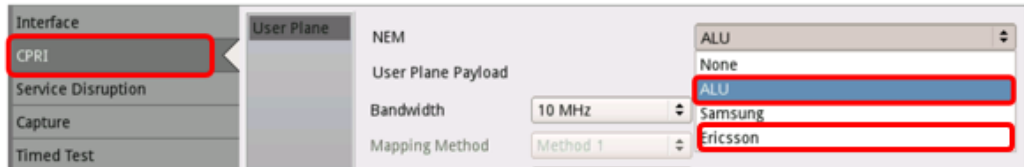
Follow this procedure to set up a T-BERD to visualize and verify the CPRI Mapping.

Single Carrier RRUs

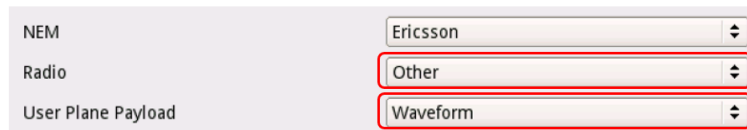
Step	Action	Details
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1. Setup Click the  button to enter the RF information.

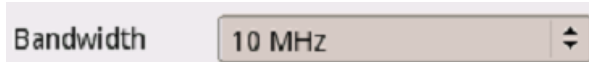
2. NEM Click on the **CPRI tab (left side)** and enter the **NEM (ALU(Nokia) or Ericsson)**



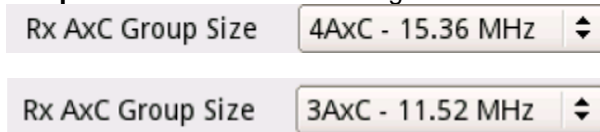
Set the **User Plane Payload** to “Waveform”



3. Bandwidth Set the Bandwidth of the Radio



4. Set the **Rx AxC Group Size** to one of the following



Optional – Enter the Center Frequency of the Uplink carrier as a visual reference



5. Spectrum Press the  button to view the trace.

Appendix C: TB5800 CPRI Settings Dual-band and Tri-Band RRUs

Step Action

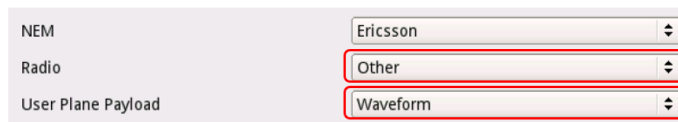
Details

1. Setup Click the  button to enter the RF information.

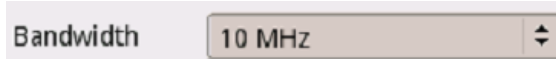
2. NEM Click on the CPRI tab (left side) and enter the NEM (ALU or Ericsson)



a. Set the **User Plane Payload** to “Waveform”



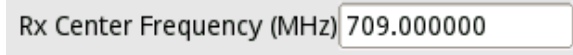
2. Bandwidth Set the Bandwidth of the Radio



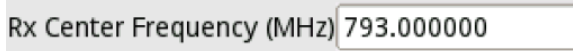
4. Carrier Set the # of Carriers to “2”



Carrier 1 – Enter the Center Frequency of the Uplink carrier



Carrier 2 – Enter the Center Frequency of the Uplink carrier



5. Antenna **Carrier 1 (1-4 - default settings).** **Carrier 2 (5-8)**

Rx	AxC Group	AxC0	AxC1	AxC2	AxC3
Rx1	1	0	15	30	45
Rx2	2	60	75	90	105
Rx3	3	120	135	150	165
Rx4	4	180	195	210	225
Rx1	5	240	255	270	285
Rx2	6	300	315	330	345
Rx3	7	360	375	390	405
Rx4	8	420	435	450	465

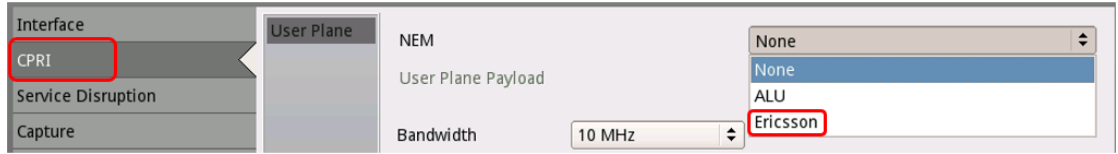
6. Spectrum Press the  button to view the trace.

Appendix D: TB5800 CPRI Settings Ericsson RRU11

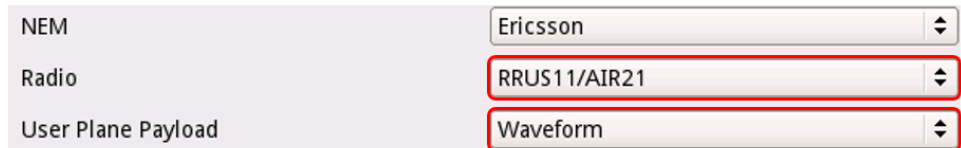
Step	Action	Details
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3. Setup Click the  button to enter the RF information.

4. NEM Click on the **CPRI tab (left side)** and enter the NEM (Ericsson)



- a. Set the **Radio** to “RRUS11/AIR21”
- b. Set the **User Plane Payload** to “Waveform”



5. Bandwidth Set the Bandwidth of the Radio




Verify the **Rx AxC Group Size** is set to “4AxC – 15.36 MHz”



Optional – Enter the Center Frequency of the Uplink carrier




4. Spectrum Press the  button to view the trace.

Appendix E: TB5800 CPRI Settings Ericsson Radio 4449 and 8843 with Compression

Step Action Details

1. Setup

Click the  button to enter the RF information

2. NEM

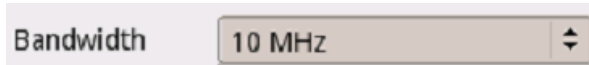
Click on the **CPRI tab (left side)** and enter the NEM (NONE)



a. Set the **User Plane Payload** to “Waveform”

3. Bandwidth

Set the Bandwidth of the Radio



4. Setup

Set the Sample Width to “9” and the Stuffing Bits to “1”



Verify the Rx AxC Group Size is set to “3AxC – 11.52 MHz”



Optional – Enter the Center Frequency of the Uplink carrier



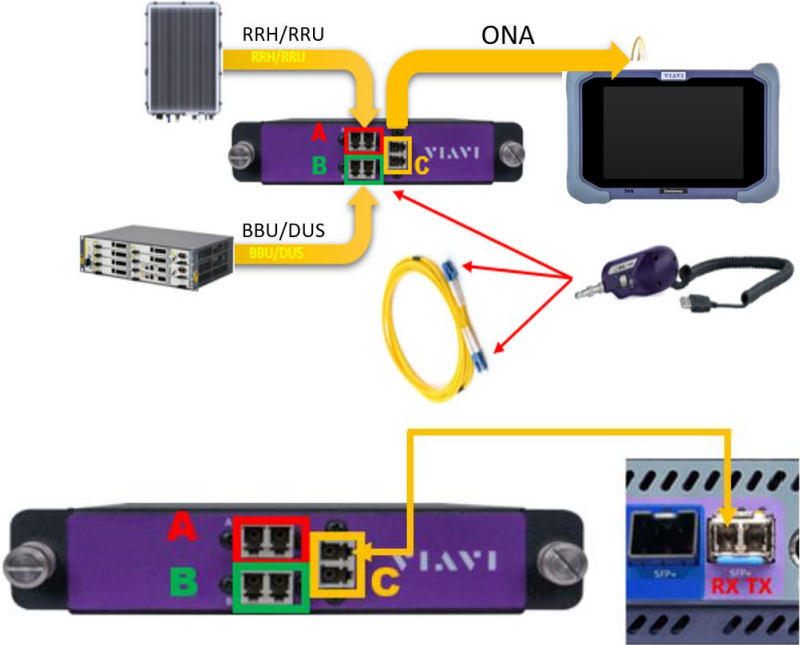

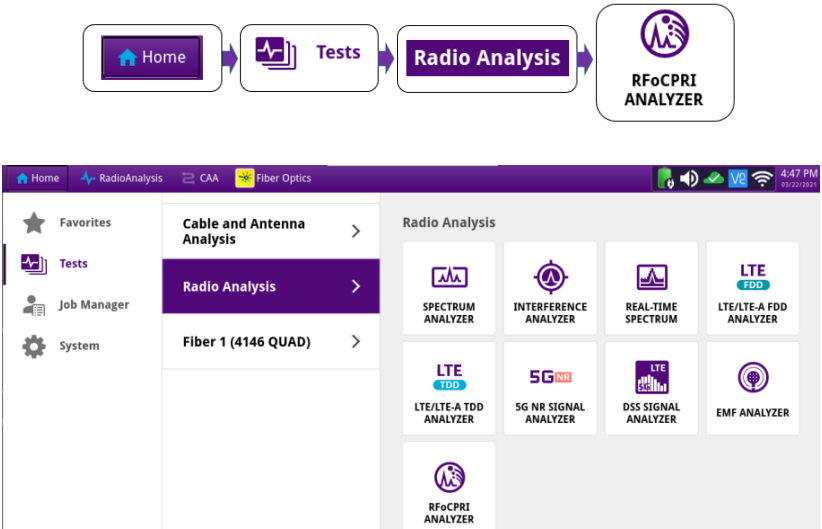
7. Antenna

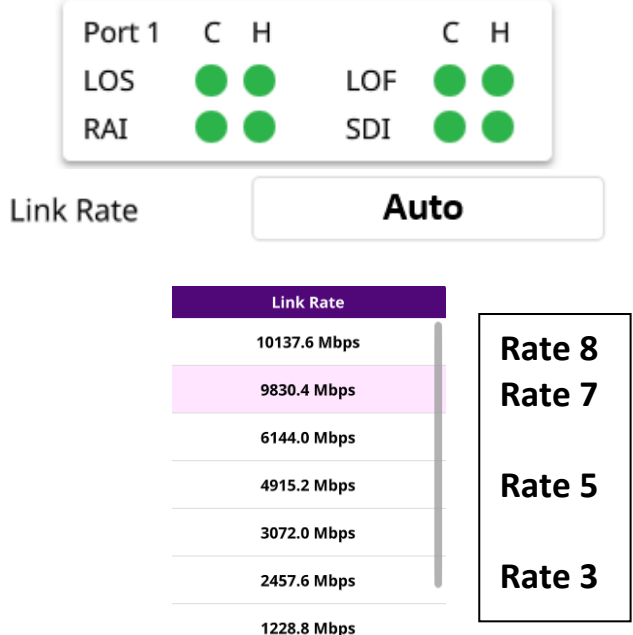
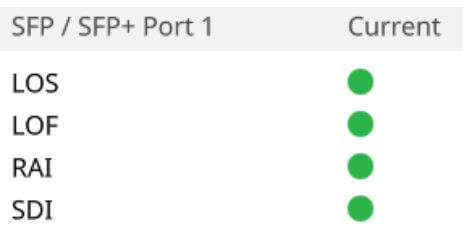


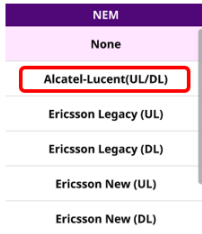
Set the AxC Groups to the LARGEST number possible.

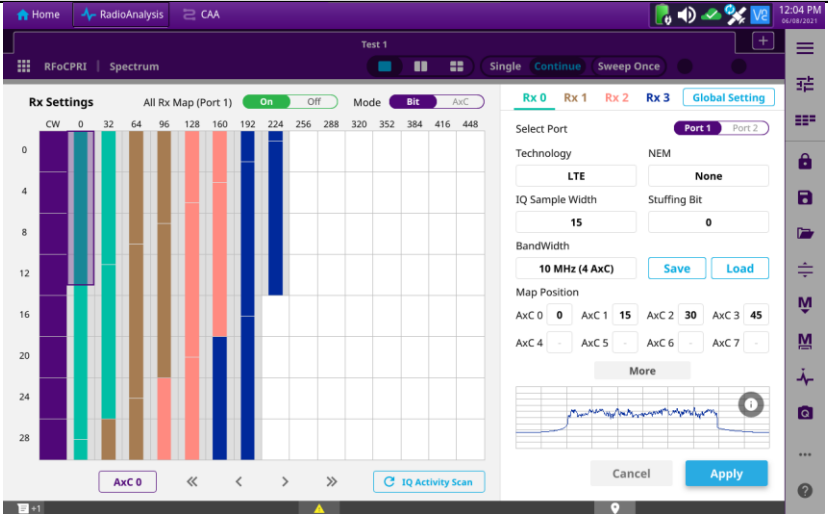
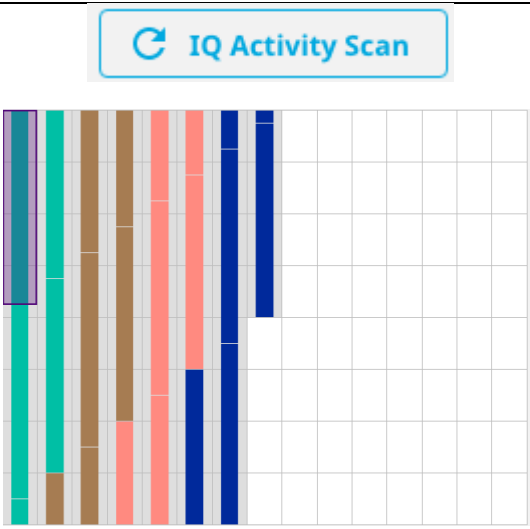
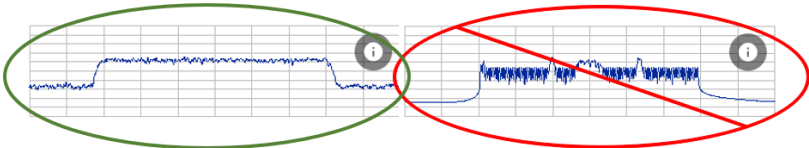




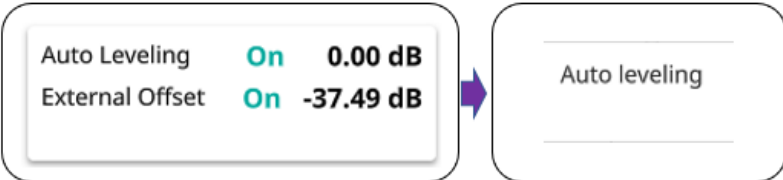


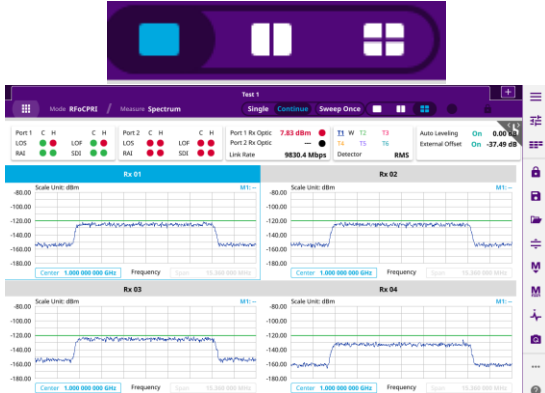



Appendix F: ONA-800 Setup Procedure

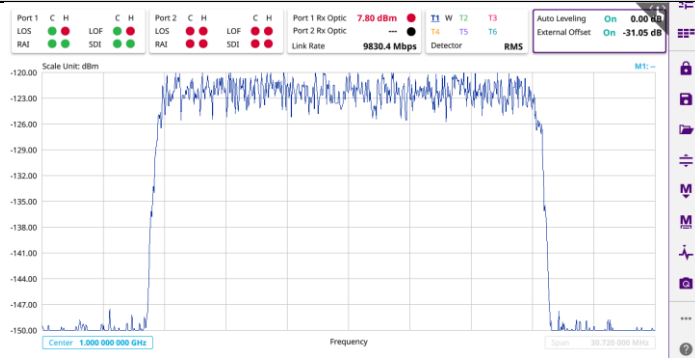




This document is not intended to be a user guide. This MOP should be used in conjunction with ONA User’s Guides for detailed explanation of all testing steps and options.

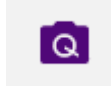





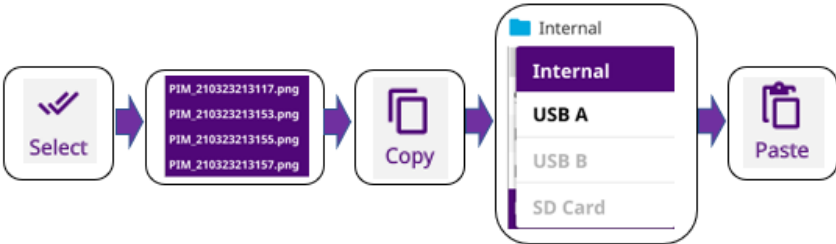
Step	Action	Description/Diagram
1	Lock the Sector/Carrier(s) to be tested	Prevent users from being abruptly dropped
2	<p>Splitter Installation</p> <ul style="list-style-type: none"> Inspect (ALWAYS) and clean (as necessary) all SFPs, fibers and the ports on the splitter Disconnect the duplex fiber from the BBU/DU and connect to the top duplex port (A) on the splitter Using the spare duplex jumper connect the bottom (B) port back to the BBU/DU Look for the LED on BBU/DU to indicate the port is back “up” Connect the simplex fiber from the top “tap” port (C) to the Rx side of the SFP+ in Port 1 of the OneAdvisor-800 	<p>Single splitter shown for simplicity. Tap multiple CPRI links at once if desired such as (Bands 14 and 17 and/or all three sectors)</p> 
3	Unlock the Sector/Carrier(s)	Restore normal operation
4	<p>Configure the OneAdvisor for RFoCPRI Monitoring</p> <p>In the Home menu , choose Tests and Radio Analysis.</p> <p>Select RFoCPRI Analyzer</p>	

Step	Action	Description/Diagram
5	<p>Set the CPRI Rate for the RRU</p> <ul style="list-style-type: none"> - On most RRUs setting the Line rate to Auto will work. <p>On some Ericsson RRUs, select the specific CPRI Rate needed to lock on the signal (Rate 3, 5, 7, or 8)</p> <ul style="list-style-type: none"> - Once the correct line rate is selected the lights will turn GREEN in the “Current” section. 	 <p>Port 1 C H C H</p> <p>LOS ● ● LOF ● ●</p> <p>RAI ● ● SDI ● ●</p> <p>Link Rate Auto</p> <p>Link Rate</p> <ul style="list-style-type: none"> 10137.6 Mbps 9830.4 Mbps 6144.0 Mbps 4915.2 Mbps 3072.0 Mbps 2457.6 Mbps 1228.8 Mbps <p>Rate 8 Rate 7 Rate 5 Rate 3</p>
6	<p>Confirm that the OneAdvisor also sees a clean CPRI signal from the optical tap</p> <ul style="list-style-type: none"> - LOS - LOF - RAI - SDI <p>Once ALL the lights on the summary screen turn GREEN, press Restart</p>	 <p>SFP / SFP+ Port 1 Current</p> <p>LOS ●</p> <p>LOF ●</p> <p>RAI ●</p> <p>SDI ●</p>
<u>AUTO SETUP</u>		
7	<p>Select the  button to access the Rx Settings.</p>	 <p>Rx Settings</p>
	<p>Auto Setup</p> <ul style="list-style-type: none"> - Select the NEM/OEM of the Radio 	<p>Select and set the NEM/OEM of the Radio</p>  <p>NEM</p> <ul style="list-style-type: none"> None Alcatel-Lucent(UL/DL) Ericsson Legacy (UL) Ericsson Legacy (DL) Ericsson New (UL) Ericsson New (DL)
	<p>Set the Bandwidth</p>	<p>BandWidth</p> <p>10 MHz (4 AxC)</p>

Step	Action	Description/Diagram
	<p>- Verify the spectrum</p>	
	<p>Optional - Verify the Antennas line up with the correct locations</p> <p>The COLORED BARS shown are the Antenna Carriers (AxC) configured on the ONA-800. The GREY BARS in the background are the actual detected payload on the CPRI link.</p> <p>Examples of valid configurations. The CPRI rate (Rate3, Rate5, etc..) will change how the configurations looks. The important item is the colored bars align over the top of the grey bars.</p>	
<h2><u>SPECTRUM SETUP</u></h2>		
<p>8</p>	<p>Validate the correct Fiber is connected</p> <p>When the TAP is in place, there are two fibers that can be connected.</p> <p>One of the fibers is for the RRU/Antenna (correct) One fiber is for the BBU (wrong).</p> <p>The pictures in the left show an example of the correct and incorrect fiber.</p>	<p>The spectrum screen should look like the left side below. That is typical of LTE FDD uplink spectrum derived from a CPRI payload.</p>  <p>If the screen looks like the RIGHT side, that is the downlink. Move the simplex fiber to the other port on the splitter. That will be the uplink.</p> <p style="text-align: center;">  </p> <p>Press  to return to the main screen.</p>

Step	Action	Description/Diagram
9	<p>Auto Leveling the trace</p> <p>Press the Auto Leveling icon and select "Auto Leveling" to adjust the trace on the screen</p>	
10	<p>Set-up Spectrum Overlay For 2 x 2 or 4 x 4 MIMO:</p> <p>Press  for 2x2 MIMO</p> <p>Or press  for 4x4 MIMO</p> <p>4x4 MIMO example</p>	
11	<p>Overlay the Traces</p> <ul style="list-style-type: none"> - Press the  button to access the Window Mode 	 
12	<p>Turn on full power mode for all downlink signals suspected of contributing to PIM</p> <ul style="list-style-type: none"> - For E// it is AILG (Air Interface Load Generator) - For Nokia it is OCNS (Orthogonal Channel Noise Simulator) 	<p>(Option) To Validate that the load generator is on, you can switch the simplex fiber from the UL port to DL port on the splitter. If load generation is on the downlink should look something like this.</p>


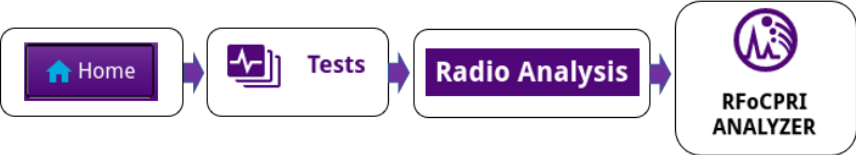
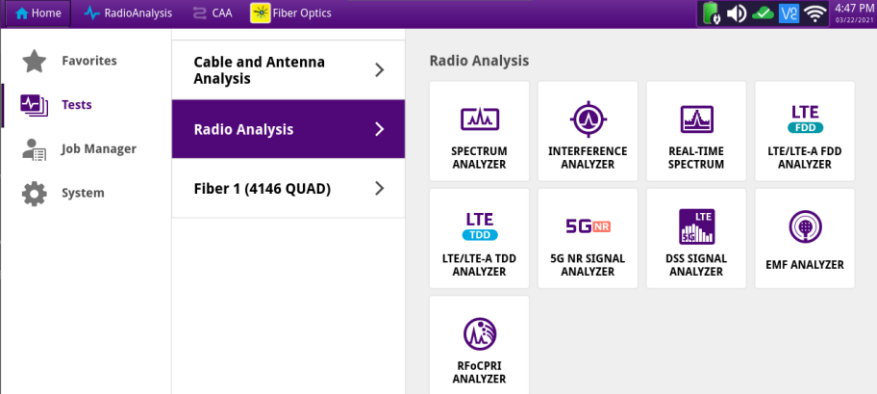
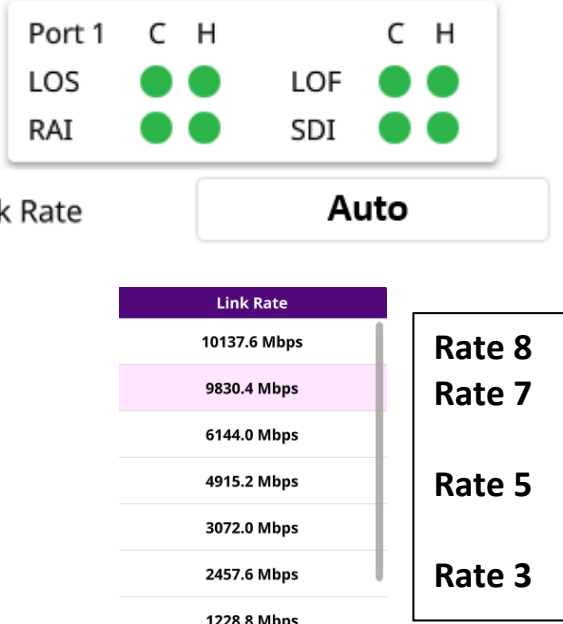
Step	Action	Description/Diagram
		
14	<p>Set the Limit Line</p> <ul style="list-style-type: none"> - Press the  button to access the Window Mode - Press the  button to access the main menu - Select Limit 	<p>Adjust the limit line to the top of the trace</p> <p>Reference Line Mode</p> <p><input checked="" type="checkbox"/> On <input type="checkbox"/> Off</p> 
15	<p>Observe changes to the spectrum for any one or more of the RX signals</p> <ul style="list-style-type: none"> - Since M-Pilot indicated PIM using similar methods, it should show up now as well. - Example on right shows Band 17 RX with OCNS/AILG invoked - The spectrum rose throughout the band and has an obvious tilt characteristic of PIM 	
16	<p>Perform PIM Mitigation Methods</p>	<p>Survey sector HW and nearby structures/objects/components in front of and behind the antenna for possible PIM sources. This can be done visually and/or by use of a Spectrum Analyzer and a Yagi or PIM wand.</p> <p>While observing uplink on OneAdvisor-800 screen, begin methodically covering suspected PIM sources with PIM blankets, PIM tape, etc. and note changes in PIM level on OneAdvisor-800 screen.</p> <p>Continue process until PIM observed on the OneAdvisor-800 is reduced/improved or all accessible PIM sources have been exhausted.</p>



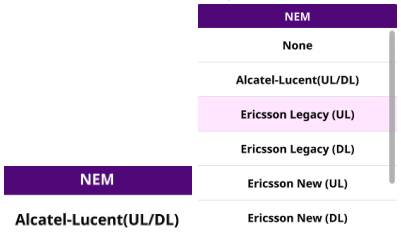
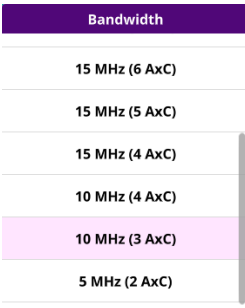
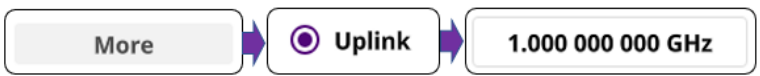
Step	Action	Description/Diagram
		Mark and record PIM source locations for more permanent corrective action.
17	Take a snapshot of the spectrum. Name the file as desired indicating it is at full power, WITH PIM Mitigation measures in place	Use the Camera Icon in the lower right of the action icons 
18	Save your test set-up for quick recall in the future. Select the  button Name the File Select Setup	File Name <input type="text" value="RFoCPRI"/> <input checked="" type="checkbox"/> Setup <input type="button" value="Save"/>
19	To Export Images - Go to Select  to enter the file menu System > Files - In the bert/images directory. Select the  button - Select Single, Multiple or All and Copy the files to be moved to a USB stick - Select  Copy - Select the Internal Folder - Paste to a USB stick. Select the USB A - Select  Paste	

Appendix G: ONA-800 CPRI Settings For Single Carrier RRUs

Follow this procedure to set up a OneAdvisor-800 to visualize and verify the CPRI Mapping.


Single Carrier RRUs

<p>Configure the OneAdvisor for RFoCPRI Monitoring</p> <p>In the Home menu , choose Tests and Radio Analysis.</p> <p>Select RFoCPRI Analyzer</p>	 																																	
<p>Set the CPRI Rate for the RRU</p> <ul style="list-style-type: none"> - Select the Port 1 shortcut at the top of the screen. - Once the correct line rate is selected the lights will turn GREEN in the "Current" section 	 <table border="1"> <tr> <td>Port 1</td> <td>C</td> <td>H</td> <td>C</td> <td>H</td> </tr> <tr> <td>LOS</td> <td>●</td> <td>●</td> <td>●</td> <td>●</td> </tr> <tr> <td>RAI</td> <td>●</td> <td>●</td> <td>●</td> <td>●</td> </tr> <tr> <td>LOF</td> <td>●</td> <td>●</td> <td>●</td> <td>●</td> </tr> <tr> <td>SDI</td> <td>●</td> <td>●</td> <td>●</td> <td>●</td> </tr> </table> <p>Link Rate: Auto</p> <table border="1"> <thead> <tr> <th>Link Rate</th> </tr> </thead> <tbody> <tr><td>10137.6 Mbps</td></tr> <tr><td>9830.4 Mbps</td></tr> <tr><td>6144.0 Mbps</td></tr> <tr><td>4915.2 Mbps</td></tr> <tr><td>3072.0 Mbps</td></tr> <tr><td>2457.6 Mbps</td></tr> <tr><td>1228.8 Mbps</td></tr> </tbody> </table> <div style="border: 1px solid black; padding: 5px; display: inline-block;"> <p>Rate 8</p> <p>Rate 7</p> <p>Rate 5</p> <p>Rate 3</p> </div>	Port 1	C	H	C	H	LOS	●	●	●	●	RAI	●	●	●	●	LOF	●	●	●	●	SDI	●	●	●	●	Link Rate	10137.6 Mbps	9830.4 Mbps	6144.0 Mbps	4915.2 Mbps	3072.0 Mbps	2457.6 Mbps	1228.8 Mbps
Port 1	C	H	C	H																														
LOS	●	●	●	●																														
RAI	●	●	●	●																														
LOF	●	●	●	●																														
SDI	●	●	●	●																														
Link Rate																																		
10137.6 Mbps																																		
9830.4 Mbps																																		
6144.0 Mbps																																		
4915.2 Mbps																																		
3072.0 Mbps																																		
2457.6 Mbps																																		
1228.8 Mbps																																		
<p>Confirm that the OneAdvisor also sees a clean CPRI signal from the optical tap</p> <ul style="list-style-type: none"> - LOS - LOF - RAI - SDI 	<table border="1"> <thead> <tr> <th>SFP / SFP+ Port 1</th> <th>Current</th> </tr> </thead> <tbody> <tr><td>LOS</td><td>●</td></tr> <tr><td>LOF</td><td>●</td></tr> <tr><td>RAI</td><td>●</td></tr> <tr><td>SDI</td><td>●</td></tr> </tbody> </table>	SFP / SFP+ Port 1	Current	LOS	●	LOF	●	RAI	●	SDI	●																							
SFP / SFP+ Port 1	Current																																	
LOS	●																																	
LOF	●																																	
RAI	●																																	
SDI	●																																	

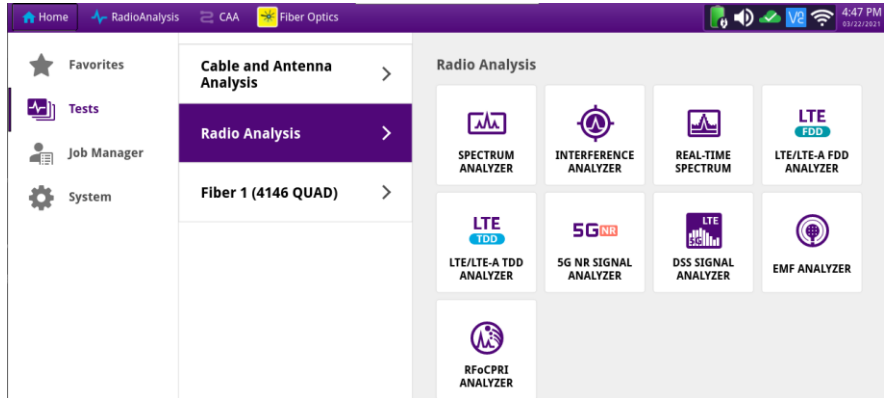
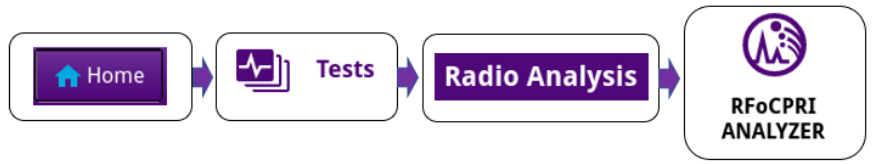
<p>Select the  button to access the Rx Settings.</p>	<p>Enter the NEM (ALU/Ericsson/None) and set the User Plane Payload to W</p> 
<p>Setup the Radio</p>	<p>Select and set the NEM/OEM of the Radio</p> 
<p>Setup the Bandwidth</p> <ul style="list-style-type: none"> - Nokia is 10 MHz (4 AxC) - Ericsson is 10 MHz (4AxC or 3AxC) 	<p>Set the Bandwidth</p>  <p>BandWidth</p> <p>10 MHz (4 AxC) or</p>
<p>Enter the Uplink Frequency (e.g. 709 for Band 12/17 and 793 for Band 14/FirstNet)</p>	

Appendix H: ONA-800 CPRI Settings For Dual Carrier RRUs

Configure the OneAdvisor for RFoCPRI Monitoring

In the Home menu , choose Tests and Radio Analysis.

Select RFoCPRI Analyzer



- Set the CPRI Rate for the RRU
- Select the Port 1 shortcut at the top of the screen.
- Once the correct line rate is selected the lights will turn GREEN in the "Current" section

Port 1 C H C H

LOS ● ● LOF ● ●

RAI ● ● SDI ● ●

Link Rate **Auto**


Link Rate
10137.6 Mbps
9830.4 Mbps
6144.0 Mbps
4915.2 Mbps
3072.0 Mbps
2457.6 Mbps
1228.8 Mbps

Rate 8
Rate 7
Rate 5
Rate 3

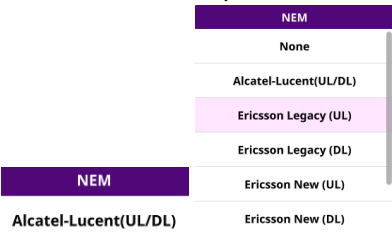

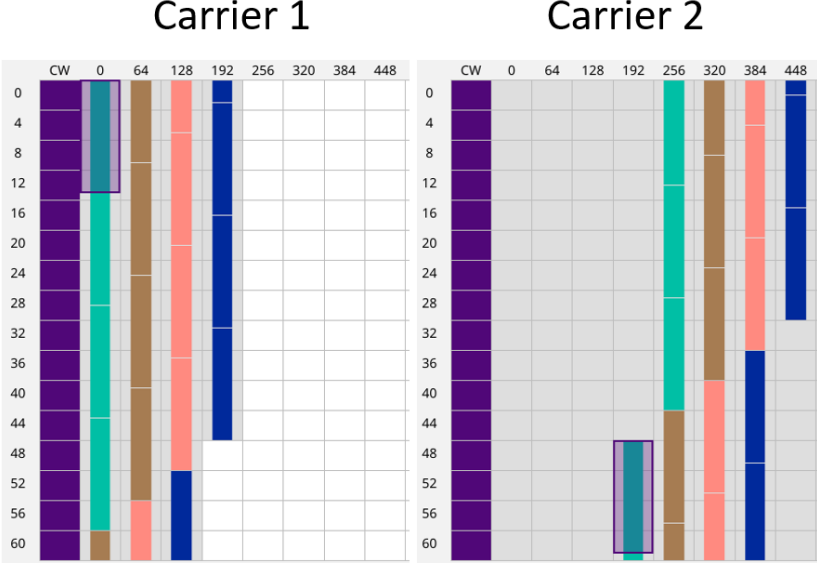
Confirm that the OneAdvisor also sees a clean CPRI signal from the optical tap

- LOS
- LOF
- RAI
- SDI

SFP / SFP+ Port 1	Current
LOS	●
LOF	●
RAI	●
SDI	●


Select the  button to access the Rx Settings.



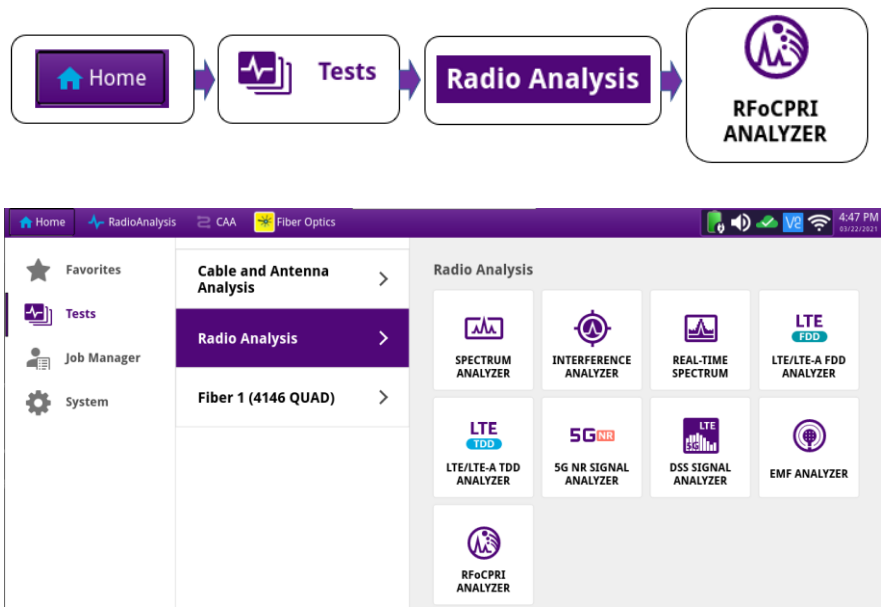
<p>Setup the Radio</p>	<p>Select and set the NEM/OEM of the Radio</p>  <p>The screenshot shows a scrollable list of NEM/OEM options. The selected option is 'Ericsson Legacy (UL)'. Other visible options include 'None', 'Alcatel-Lucent(UL/DL)', 'Ericsson Legacy (DL)', 'Ericsson New (UL)', and 'Ericsson New (DL)'.</p>
<p>Setup the Bandwidth</p> <ul style="list-style-type: none"> - Nokia is 10 MHz (4 AxC) - Ericsson is 10 MHz (4AxC or 3AxC) 	<p>Set the Bandwidth</p>  <p>The screenshot shows a scrollable list of bandwidth options. The selected option is '10 MHz (4 AxC)'. Other visible options include '15 MHz (6 AxC)', '15 MHz (5 AxC)', '15 MHz (4 AxC)', '10 MHz (4 AxC)', and '5 MHz (2 AxC)'. A 'Bandwidth' label is positioned above the list, and a '10 MHz (4 AxC)' button is shown below it.</p>
<p>Enter the Uplink Frequency (e.g. 709 for Band 12/17 and 793 for Band 14)</p>	 <p>The screenshot shows a sequence of three input fields: 'More', 'Uplink' (with a radio button selected), and '1.000 000 000 GHz'.</p>
<p>Adjust the colored bars to the correct antenna location</p>	 <p>The diagrams show two carrier configurations, Carrier 1 and Carrier 2, plotted on a grid. The x-axis represents subcarriers (0 to 448) and the y-axis represents antenna locations (0 to 60). Carrier 1 shows a full set of colored bars (purple, cyan, brown, orange, blue) across all antenna locations. Carrier 2 shows a similar set of bars, but with a gap in the cyan bar at antenna location 48.</p>

Appendix I: ONA-800 CPRI Settings Ericsson RRUs11

Configure the OneAdvisor for RFoCPRI Monitoring

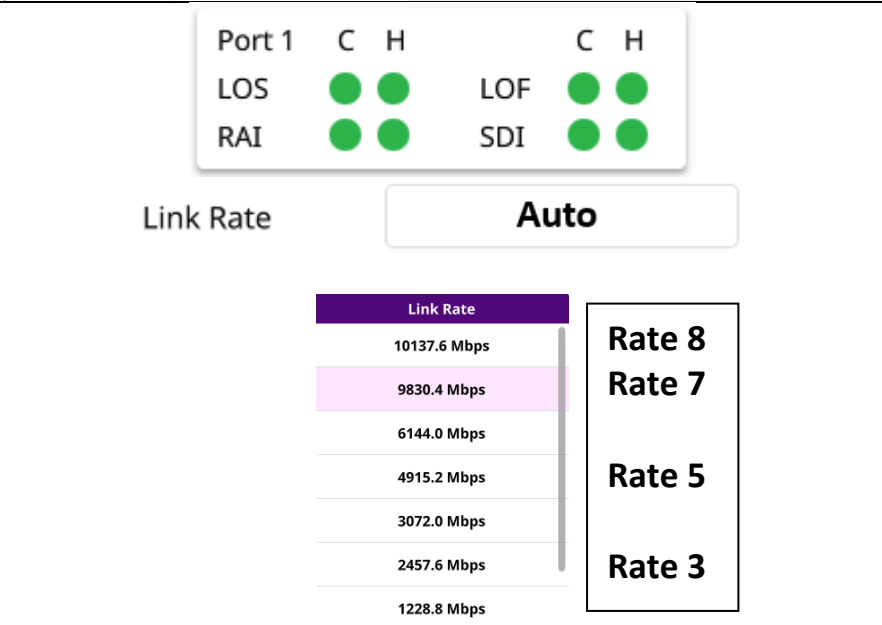
In the Home menu  Home, choose Tests and Radio Analysis.

Select RFoCPRI Analyzer



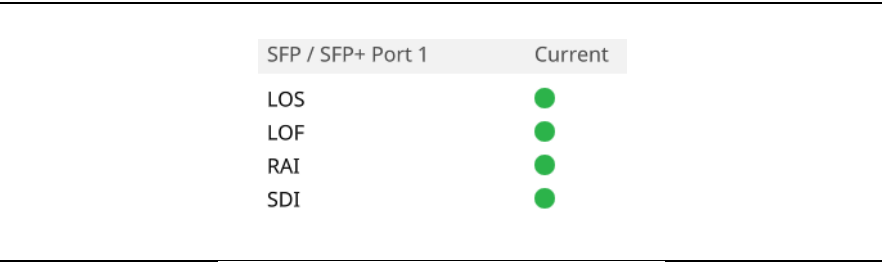
Set the CPRI Rate for the RRU

- Select the Port 1 shortcut at the top of the screen.
- Once the correct line rate is selected the lights will turn GREEN in the "Current" section



Confirm that the OneAdvisor also sees a clean CPRI signal from the optical tap

- LOS
- LOF
- RAI
- SDI




Select the  button to access the Rx Settings.



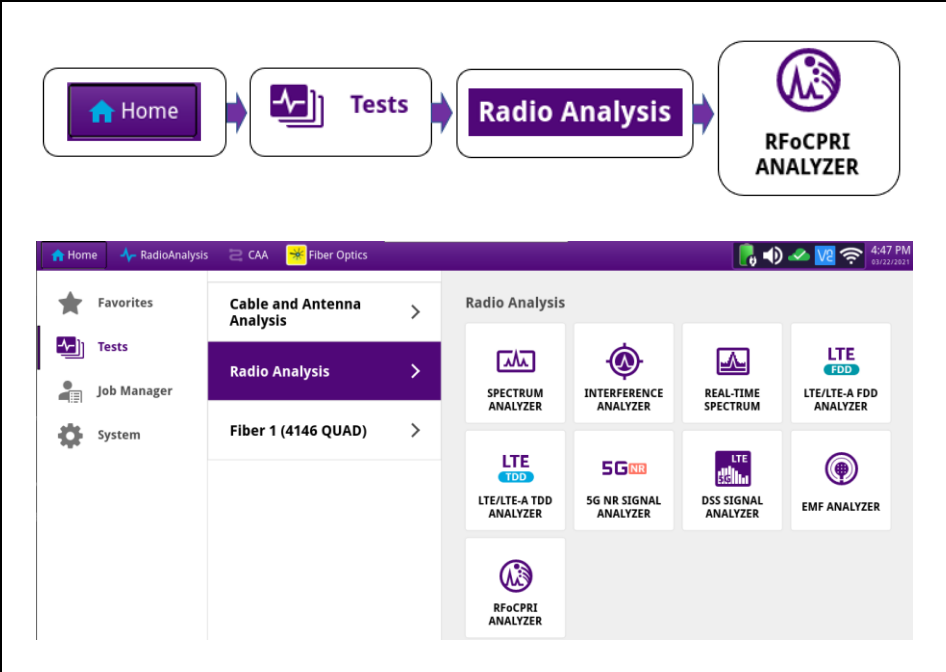
<p>Setup Radio</p>	<p>Select the NEM to Ericsson Legacy (UL)</p> <div> <p>NEM</p> <p>None</p> <p>Alcatel-Lucent(UL/DL)</p> <p>Ericsson Legacy (UL)</p> <p>Ericsson Legacy (DL)</p> <p>Ericsson New (UL)</p> <p>Ericsson New (DL)</p> </div>
<p>Setup the Bandwidth</p>	<p>Set the Bandwidth to 10 MHz (3 AxC)</p> <div> <p>Bandwidth</p> <p>15 MHz (6 AxC)</p> <p>15 MHz (5 AxC)</p> <p>15 MHz (4 AxC)</p> <p>10 MHz (4 AxC)</p> <p>10 MHz (3 AxC)</p> <p>5 MHz (2 AxC)</p> </div>
<p>Enter the Uplink Frequency (e.g. 709 for Band 12/17 and 793 for Band 14)</p>	<div> <p>More → Uplink → 1.000 000 000 GHz</p> </div>

Appendix J: ONA-800 CPRI Settings Ericsson Radio 4449 and 8843 with Compression

Configure the OneAdvisor for RFoCPRI Monitoring

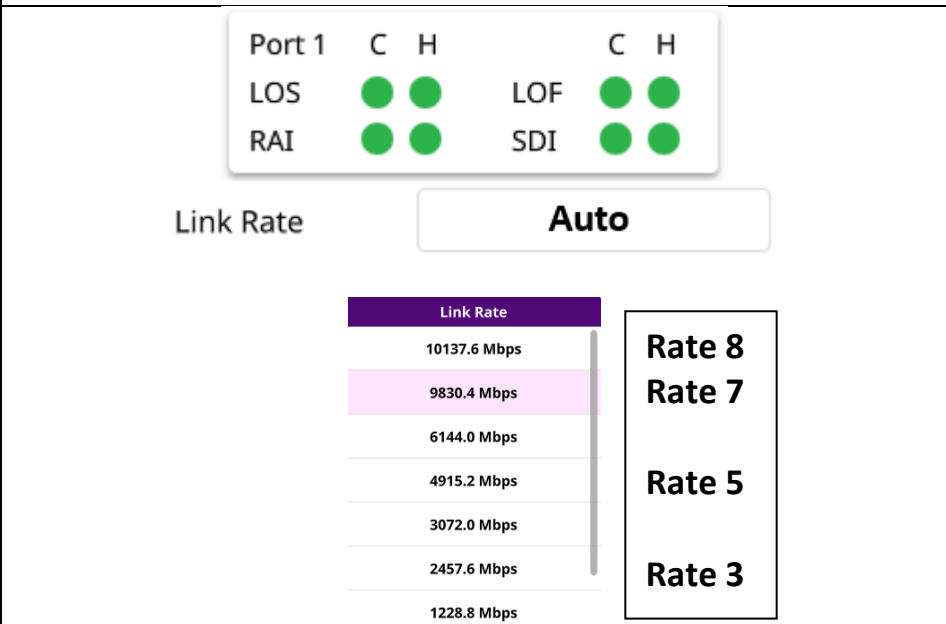
In the Home menu , choose Tests and Radio Analysis.

Select RFoCPRI Analyzer



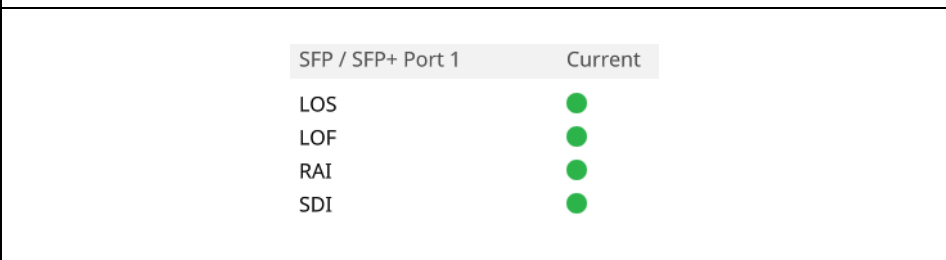
Set the CPRI Rate for the RRU

- Select the Port 1 shortcut at the top of the screen.
- Once the correct line rate is selected the lights will turn GREEN in the "Current" section



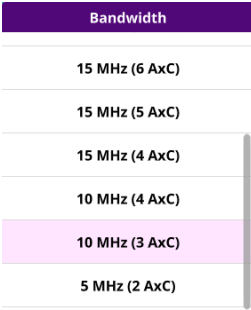



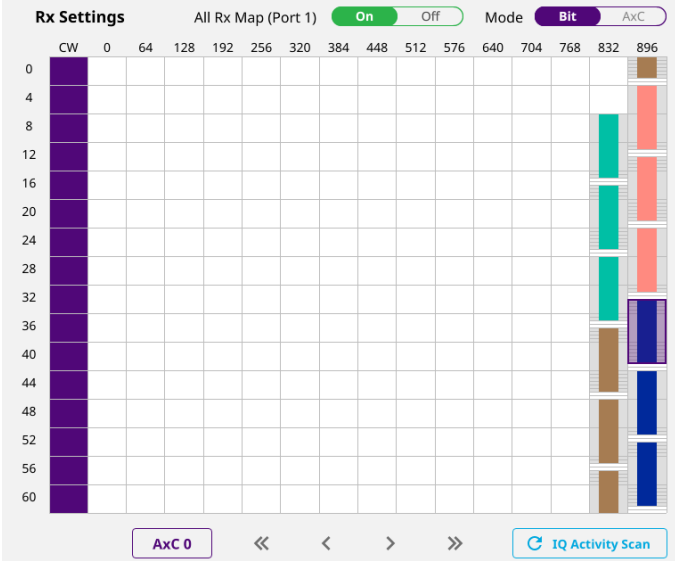
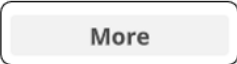


Confirm that the OneAdvisor also sees a clean CPRI signal from the optical tap

- LOS
- LOF
- RAI
- SDI



Select the  button to access the Rx Settings.



Setup Radio	<p>Select the NEM/OEM to NONE</p> <p>NEM</p> <p>None</p>
Set the Sample Width	<p>Set the IQ Sample Width to 9</p> <p>Set the Stuffing Bit to 1</p> <p>IQ Sample Width Stuffing Bit</p> <p>9 1</p>
Setup the Bandwidth	<p>Set the Bandwidth to 10 MHz (3 AxC)</p>  <p>A dropdown menu titled 'Bandwidth' with the following options: 15 MHz (6 AxC), 15 MHz (5 AxC), 15 MHz (4 AxC), 10 MHz (4 AxC), 10 MHz (3 AxC) (highlighted), and 5 MHz (2 AxC).</p>
Adjust the colored bars to the correct antenna location	<p>Select Rx 3 and press  until the blue bars are at the very end (far right)</p> <p>Press  and select </p>  <p>The Rx Settings screen shows an 'All Rx Map (Port 1)' grid. The x-axis is labeled 'CW' with values from 0 to 896 in increments of 64. The y-axis is labeled from 0 to 60 in increments of 4. A vertical purple bar is on the left. On the right, there are several colored bars: a brown bar at the top right, a red bar, a cyan bar, a blue bar, and a dark blue bar at the bottom right. At the bottom, there are navigation arrows and an 'IQ Activity Scan' button.</p>
Enter the Uplink Frequency (e.g. 709 for Band 12/17 and 793 for Band 14)	<p>  </p>

Appendix K: IQ Block View for confirming CPRI Settings

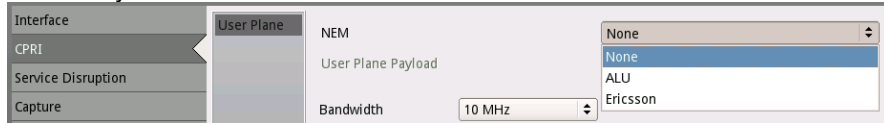
How the NEM (Ericsson, Nokia, etc.) maps the RF IQ information into the CPRI payload can vary. The TBERD 5800 has an **AUTO** IQ Activity Detection function as a visual aid to ensure proper configuration and therefore an accurate decode.

Follow this procedure to set up a T-BERD to visualize and verify an NEM's RF CPRI Mapping.

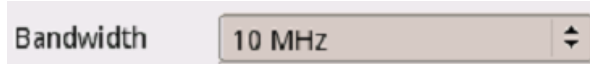
Step	Action	Details
------	--------	---------

1. Setup Click the  button to enter the RF information

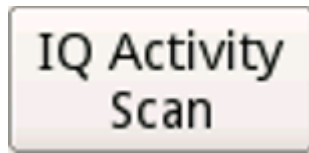
2. NEM Click on the **CPRI tab (left side)** and enter the NEM (ALU/Ericsson/None) and set the User Plane Payload to Waveform



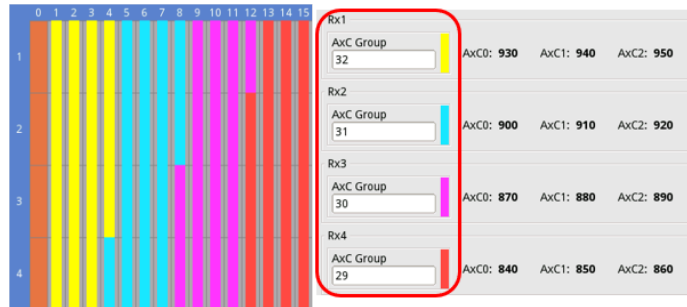
3. Bandwidth Set the Bandwidth of the Radio



4. IQ Block press the IQ Activity Scan button

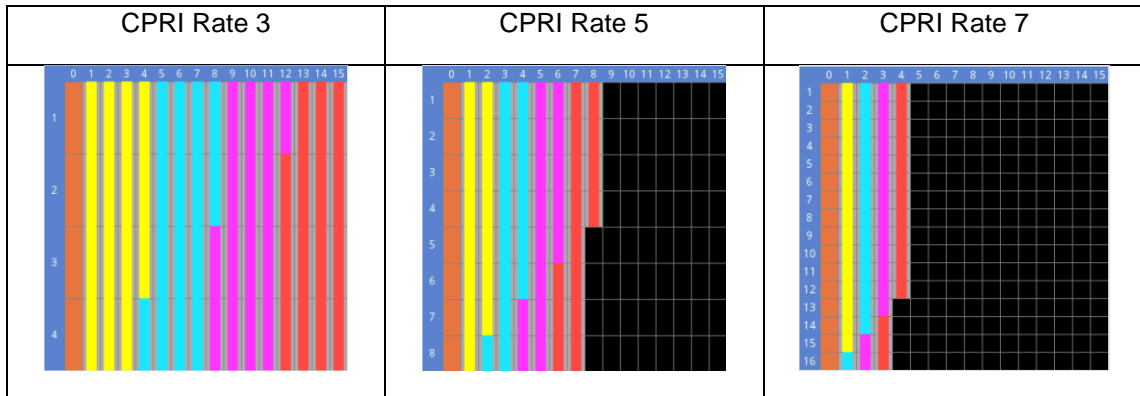


5. Alignment The **COLORED BARS** shown are the Antenna Carriers (AxC) configured on the **TB5800**. The **GREY BARS** in the background are the actual detected payload on the CPRI link.

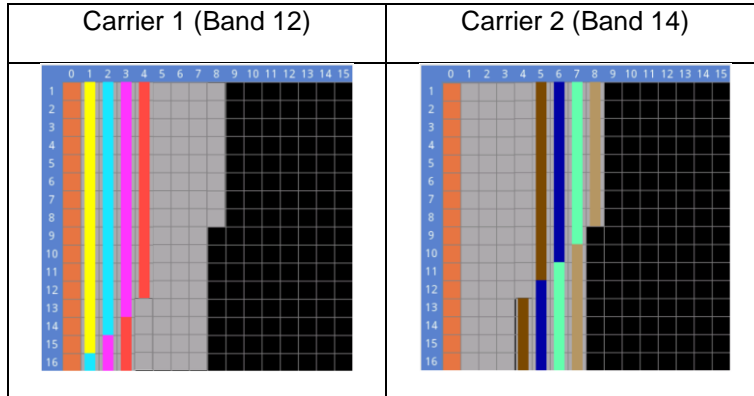


6. Verify is achieved. The GREY bars MUST match with the COLORED bars. Adjust TB5800 settings until that

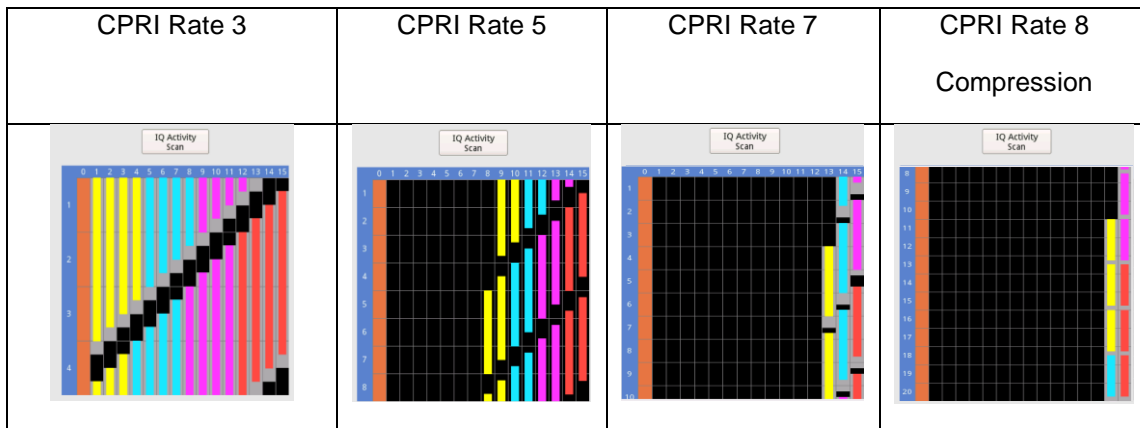
NOKIA EXAMPLES on the TB5800



NOKIA DUAL BAND EXAMPLE on the TB5800



ERICSSON EXAMPLES on the TB5800



Appendix L: Smart Access Anywhere

It may be desired to remotely view the TBERD 5800 or ONA-800 screen from afar or just across the rooftop while performing PIM survey and mitigation efforts. Smart Access Anywhere makes this possible.

Equipment Requirements:

- A Wi-Fi router or personal hotspot on a phone/tablet. This will serve as the hub.
- A second phone or tablet to be used as the remote viewing device.



- If desired, change to Spectrum Outdoor mode to make the TBERD and Remote screens more visible.



Configuring Connectivity Settings:



1. Press the Power button to turn on the T-BERD 5800 or ONA.



2. Tap the **Home/System** icon in the **Status Bar** at the top of the T-BERD or ONA to display the **System menu**.



Figure 2: System Menu

3. Tap on the **Network** icon to display Management Network settings.

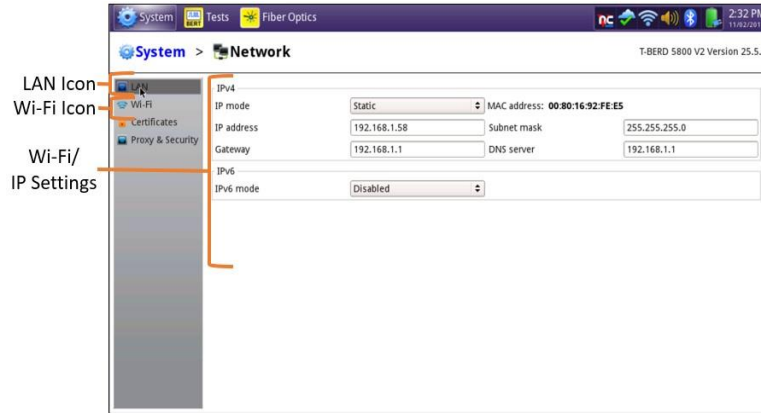




Figure 3: Network Setting



4. If using the **Wi-Fi interface** for remote access, tap the **Wi-Fi** icon on left screen side, and tap the **Enable wireless adapter** check box. Select the desired Wi-Fi network from the list and provide login credentials to join the network and obtain an IP address.

5.  If using the **RJ-45 Ethernet Management Port** for remote access, connect CAT5E or better cable between the RJ-45 connector and the router or PC. Tap the **LAN** icon on left screen side. If using DHCP, set **IP Mode** to **DHCP** and wait until unit obtains an IP address; otherwise set **IP Mode** to **Static** and configure a static IP address.

6.  Tap the **System** icon in the **Status Bar** at the top of the T-BERD or ONA to display the **System menu**.

7.  Tap the **VNC Remote** icon to display Remote operation settings.

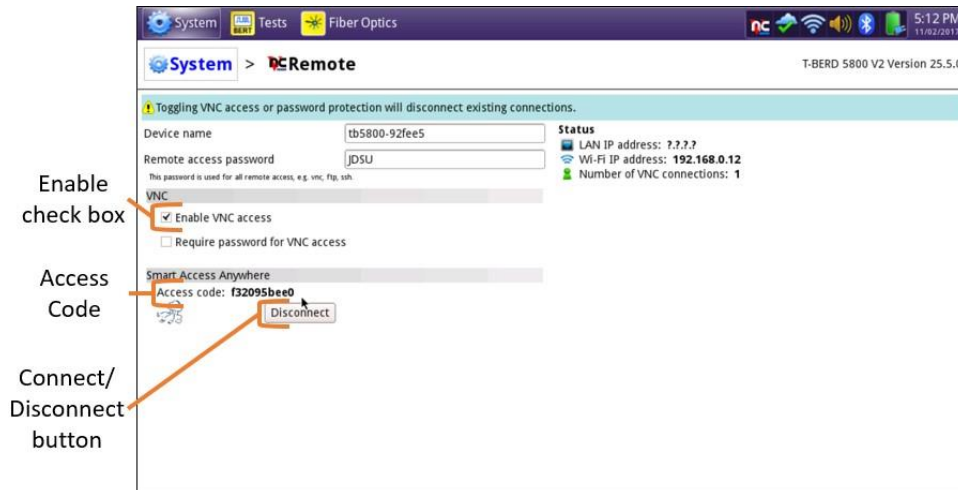


Figure 4: VNC Remote Settings

8. Tap on the **Enable VNC access check box** to enable remote access. Optionally tap on the **Require password for VNC access** check box and enter a password in the **Remote access password** text box.

9. To establish a remote connection to the T-BERD or ONA via the internet, tap on the **Connect** button under **Smart Access Anywhere** to register with the VIAVI SAA server and obtain the access code. Once the unit is connected, note the **Access code**. The access code must be used when the T-BERD or ONA is on a private network, such as a Wi-Fi Hotspot or Wireless LAN.

Operating the T-BERD 5800 or ONA-800 from a Tablet or Smart Phone with Smart Access Anywhere:

Install SAA from the Google Play store or Apple App Store

Android Devices

<https://play.google.com/store/apps/details?id=viavi.smartaccessanywhere>

Apple Devices

<https://apps.apple.com/us/app/smart-access-anywhere/id1217839834>



1. Launch the VIAVI SmartAccessAnywhere application and enter the T-BERD or ONA Access Code or IP Address in the text box labeled “**Access code or local IP address**” and press the “**Connect**” button.

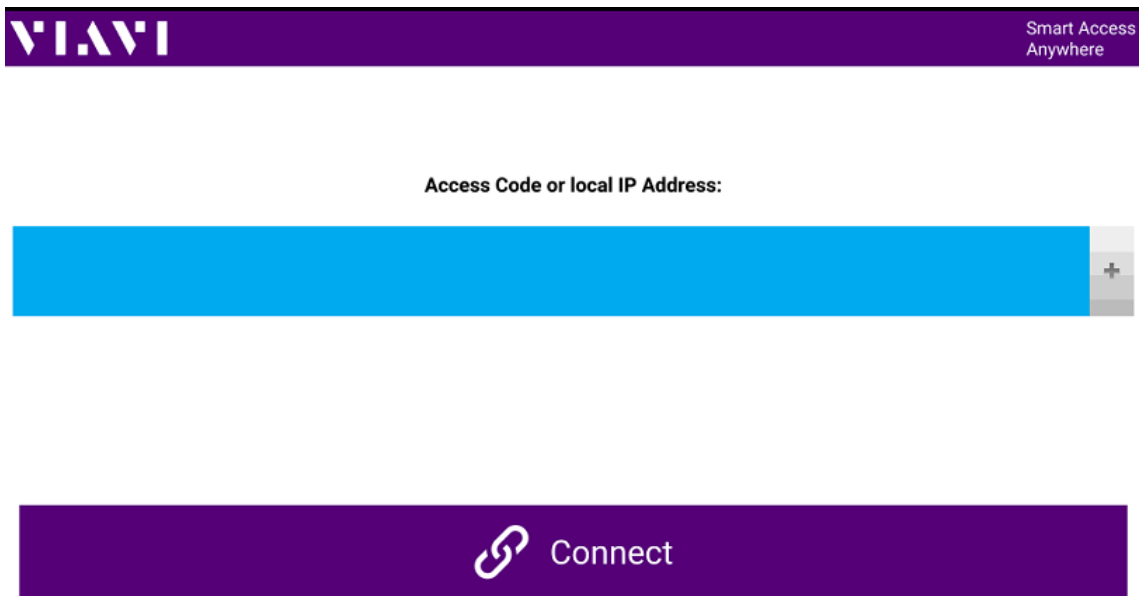
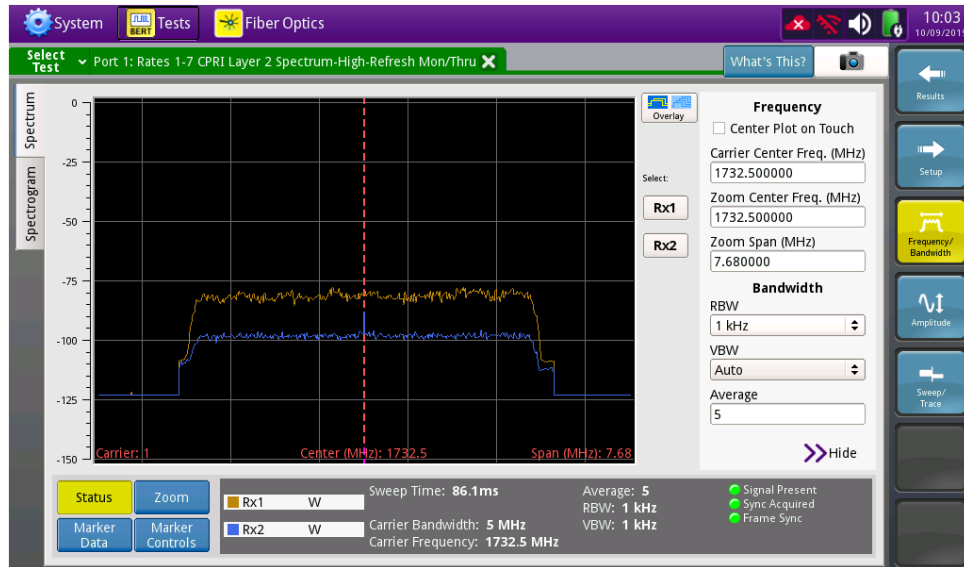


Figure 6: SmartAccessAnywhere Information Screen

- Click the **Remote Screen Page** icon to gain access to T-BERD or ONA user interface, where you can configure tests, run tests, or perform any other remotely



Figure 7: SmartAccessAnywhere Remote Screen Page



You can now view and/or control the TBERD or ONA from your hand-held device.

Appendix M: Technical Support - Viavi

Technical support is provided by:

- Phone: 1-844-GO-VIAVI (1-844-468-4284)
- Email: tac@viavisolutions.com

Regularly new firmware updates for the TBERD 5800 or ONA are released, and it is recommended to keep the instrument in the latest firmware to provide all the enhancements and bug fixes.

- For firmware updates on the tb5800 go to: <https://5800v2.updatemyunit.net/>
- For firmware updates on the ONA-800 go to: <https://ona-800.updatemyunit.net/>