Testing Optical Feeds in Wireless Systems

Remote Radio Units (RRU) and Distributed Antenna Systems (DAS)

MT9090A Network Master Platform

Optical Time Domain Reflectometer (OTDR)

By Stephen Colangelo

Background

Since optical fibers feature less loss than traditional coax cables, many equipment vendors are transitioning to optical feeds as a way to extend the distance from the amplifier or between components. Although this may not seem like a major change, working with optical fibers requires very different tools and procedures.

This application note covers the proper methods for cleaning and testing optical feeds. The examples below are for the Ericsson RBS 3418/3518 radio base station with RRU 22 xx40 remote radio units however the process should be similar for other models and vendors as well as distributed antenna systems.

Selecting the Right Testing Tools

There are several methods and tools for testing optical fibers:

1. **Power Meters and Lights Sources** simulate Tx and Rx and provide very accurate results however they require access to both ends of the fiber which may not be possible due to the mounting location of the RRU. They also can not isolate problems within a fiber.
2. **OTDRs or Fault Locators** use sort of a “radar” within fiber to graph all of its characteristics. They are the workhorse for optical testing since they provide details of each characteristic (connector, bending stress, etc.) as well as the overall characteristics. Not all OTDRs and Fault Locators are created equal however so it is important to select a tool that features very high resolution, short deadzones and is very easy to use. Short-range fault locators like the Anritsu Network Master MT9090A are the perfect tool for this application. Since this product was designed specifically for testing short fibers, all testing parameters are fixed which greatly simplifies operation. A testing sequence is also built-in to guide novice users.
3. **USB-based Connector Inspection Microscopes** provide a safe, effective way to inspect the cleanliness and condition of optical connectors. The USB interface provides a method to interface with a test set and display the image on the screen. It also provides a method to save the image for review by managers or inclusion into reports.
4. Assortment of connector tips, cleaning supplies and testing jumpers for connection to the fiber.

Locating Optical Feeds

With most radio base stations, the optical feed cable is a duplex cable that plugs directly into one of the sector ports of the transmission card. NOTE: there may be multiple RRU cables plugged into each RBS so care should be taken not to disconnect an RRU already in service. Proper cable labeling is recommended.

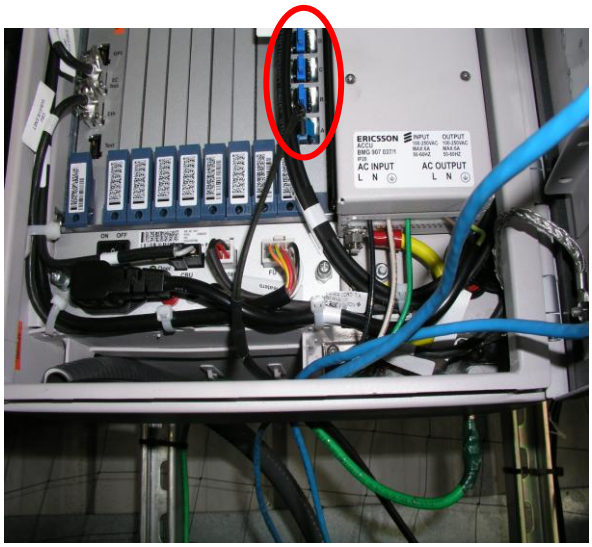


Figure 1 – an RBS with a single RRU optically connected

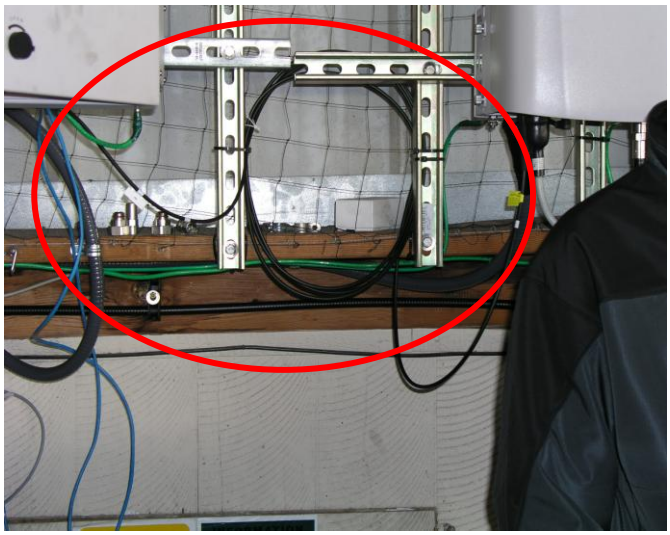
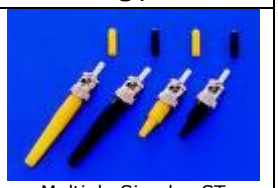
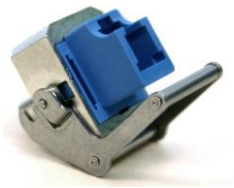
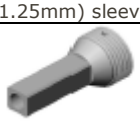


Figure 2 – typical optical feed placement between RBS and RRU

Identifying Optical Connector Types

Several connector types are available for optical feeder cables. The most common are shown below with each available in either **SIMPLEX** (one fiber) or **DUPLEX** (two fibers) configurations.

	SC	LC	FC	ST
Connector Image	 Simplex SC	 Duplex LC	 Simplex FC	 Multiple Simplex ST
OTDR Adapter	 P/N: J0619B	 P/N: J1413A or J1270	 P/N: J0617B	 P/N: J0618D
Microscope Adapter to view optical feed cable	 Universal tip with larger (2.5mm) sleeve	 Universal tip with smaller (1.25mm) sleeve	 Universal tip with larger (2.5mm) sleeve	 Universal tip with larger (2.5mm) sleeve
Microscope Adapter to view optical RBS card connector	 SC bulkhead tip	 LC bulkhead tip	 FC bulkhead tip	 ST bulkhead tip

** NOTE: not all tips shown are included with base kit*

Verifying Connector Cleanliness and Condition

It has been said that up to 70% of all troubleshooting and system errors are the result of dirty or damaged connectors. When dealing with optical fibers, connector condition and cleanliness are two of the most important factors. Dirty or damaged connectors will reduce the quality of transmissions and cause large amounts of light to be reflected which may potentially damage transmitters. By using proper cleaning and inspection techniques, system turn up errors can be virtually eliminated and network reliability greatly increased.

Typical testing procedure using a **USB VIDEO INSPECTION PROBE (VIP):**

- Locate and remove the optical feeder cable from the RBS.
- Clean both the optical feeder connectors and the internal jack using approved company cleaning procedures. HINT: always dry clean first – only use wet cleaning methods for removing embedded dirt.
- Connect the microscope to the USB port of the test set.
    - Anritsu Model MT9090A features plug and play so the application will launch automatically.
    - Anritsu Model MT9083A requires pressing the TOP MENU key and selecting VIP.
- Select and install the proper scope tip for the feed cable based on the connector identification chart.
- Plug the feed cable into the microscope probe and verify the condition.

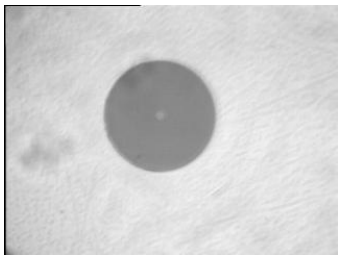


Figure 3 – a properly cleaned connector in good condition

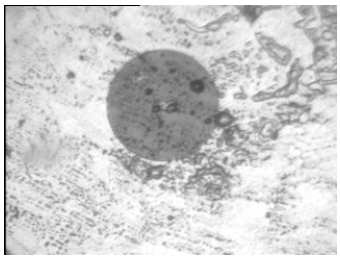


Figure 4 – a dirty connector

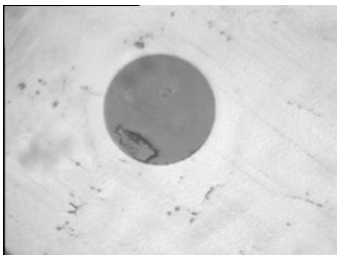


Figure 5 – a chipped connector

NOTE: The small, lighter colored dot in the center is the fiber core and of most importance.

- If good and clean, repeat for second connector if duplex.
- If it is still dirty, re-clean and re-inspect. If cleaning does not help, replace the optical feed cable.
- Select and install the proper scope tip for the RBS internal jack based on the connector identification chart in the previous section.
- Plug the microscope probe into one of the internal card ports and verify the condition.
- If good and clean, repeat for second port.
- If it is still dirty, re-clean and re-inspect. If cleaning does not help, it may require RBS card replacement.
- Disconnect the microscope USB cable if desired to extend battery life.

Verifying Fiber Properties – Loss, Length and Placement

Since optical fibers are made of glass, greater care must be taken during the handling and placement compared to traditional coax. If a fiber is spooled too tightly or creased, it may crack or at least suffer from high loss - much like when a garden hose is kinked. The excessive bending or kinking of an optical fiber is typically known as a ***macrobend***. Common causes of macrobends are bending the fiber too sharply near the connector, pinching it in the door of the equipment or installing a tie wrap too tight. The good news it that most macrobends can just be straightened out without any permanent damage – again, much like a garden hose.

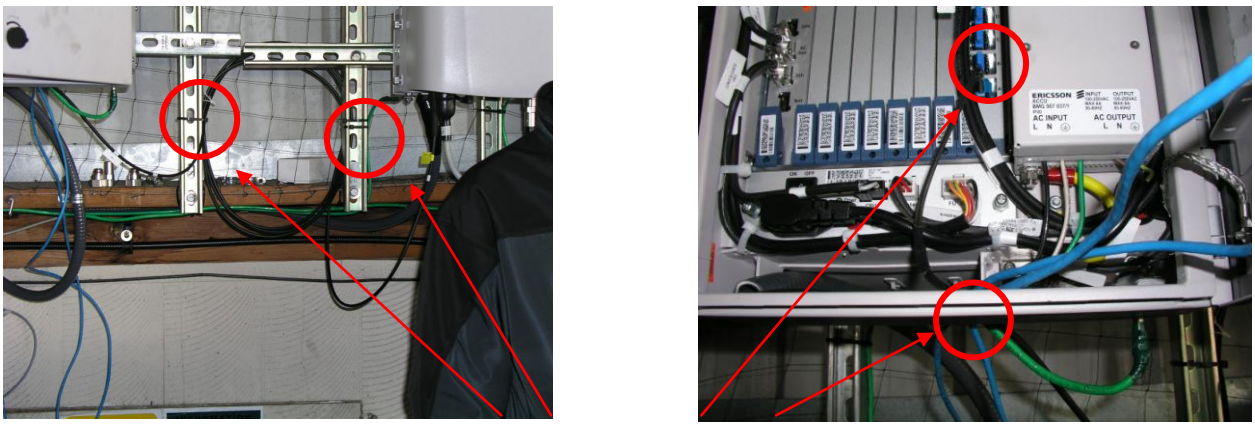


Figure 6 - High losses can be introduced from macrobends caused by tie wraps or sharp bends.

Loss – a loss of signal strength can greatly affect the quality of data transmitted. As such, the amount of loss should be kept to a minimum. Since most of the optical feed cable lengths are short (<1000ft), the majority of the loss will come from the connector matings. A typical rule of thumb is that each connector pair mating can have 0.5dB of loss. As such, a typical short optical feed will have an acceptable loss of 1.0 to 1.5dB (2 connectors x 0.5db each + the fiber loss). Since these cables are pre-terminated from a continuous strand of glass, there should be no other points of loss in the fiber cable.

Conclusion

With the right tools and testing procedures, proper installation and maintenance of optical feed cables can be achieved with fewer errors and improved Quality of Service (QoS).

Anritsu Field Optical Solutions

MT9083 ACCESS Master Series The ACCESS Master MT9083 is the first all-in-one tool that does not compromise performance. It features extremely high resolution to see those closely spaces splices and connectors, while still being able to certify 100+ km spans- quickly and accurately. Whatever your work, construction or maintenance, long haul or intra-building, Anritsu has an MT9083 model for your needs.	
MT9090A Network Master The MT9090A Network Master is a palm-size, field modular platform designed for first level fault isolation. Its small size, simple interface, rugged/sealed design and low price make it just right for large-scale technician deployment. Test modules include OTDR, Ethernet and CWDM channel analysis.	
CMA50 Optical Loss Test Set All-in-one light source, power meter, visual fault locator and optical return loss meter for optical fiber construction and maintenance. They are offered with common calibration wavelength and connector options to meet any testing requirement from FTTx networks to long haul telephony links to multimode LAN, and CATV.	
CMA5 Optical Power Meter and Light Source The CMA5 Series Power Meters are ideal for attenuation and power throughput measurements on point-to-point fiber optic links. The CMA5 Series Light Sources provide an economical and stable laser source for use in point-to-point attenuation measurement. They feature a rugged design, built to withstand the difficult testing environment of fiber optic cable installation and maintenance.	

Anritsu

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