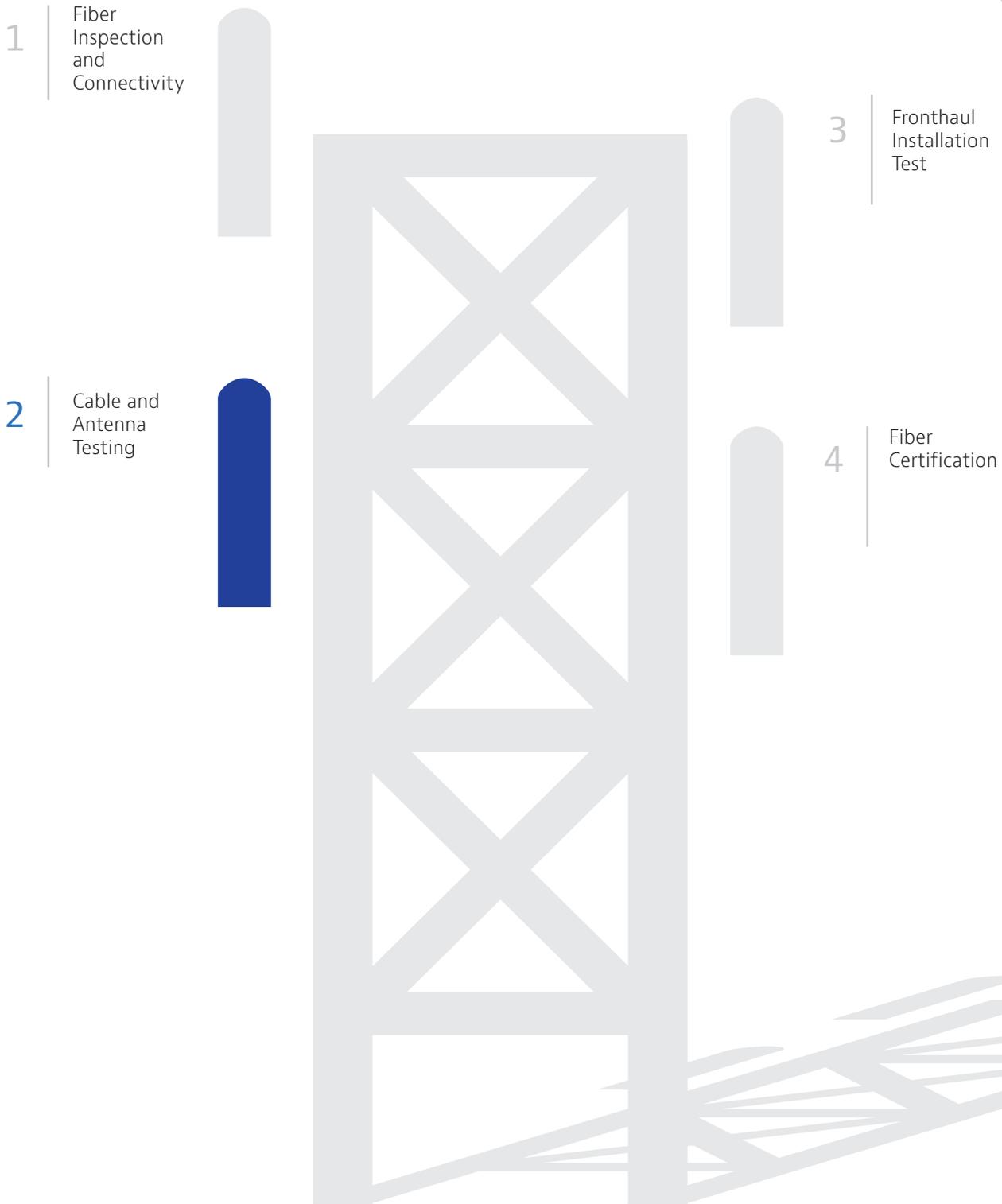


# Essentials of Fiber to the Antenna: Cable and Antenna Testing



## RF Cable and Antenna System Test

Today's distributed RAN architecture has significantly reduced reliance on coaxial cables. However, antenna and coax cable systems still play a vital role and certifying all the cables, connectors, antennas, and other active and passive components critical for optimal network performance. Coax line sweeping measures signal attenuation or insertion loss and return loss as a function of frequency. Once the measurements indicate an issue with the line, then sweeping is also used to estimate the physical location of a fault or damage along the transmission line using the distance-to-fault (DTF) measurement available on many RF and microwave signal analyzers.

### Keys Tests for Cable and Antenna Systems

It is a best practice to certify every connector, cable, antenna, and other passive component before a cable and antenna system is put in service. Before an antenna is installed, always perform a return loss (RL) test on the antenna, make sure every port on the antenna is tested, and if the RL is worse than the vendor specification, never use that antenna.

Similarly, for the cable system, a return loss test should be performed first. A general rule of thumb is if the RL is better than  $-20\text{dB}$  (1% of the energy is lost), then run an insertion loss (IL) test for the cable system to see if this is within the design limits of the cell site in test. If the RL value is above the  $-15$  or  $-20\text{dB}$  limit (per service-provider-defined limit) anywhere across the sweep range, use the DTF test to troubleshoot and identify the questionable component and repair or replace as necessary. Repeat the return loss test, and verify the reading is below the  $-20\text{ dB}$  threshold across the entire sweep range.

Following are the four key measurements required to validate a cable and antenna system.

### Return Loss

Return loss is the loss of power in the signal returned/reflected by a discontinuity in a transmission line. This discontinuity can be a mismatch with the terminating load or with a device inserted in the line, and is a measure of how well devices or lines are matched. If the impedance match is good, all the energy will be transmitted through and nothing should be reflected.



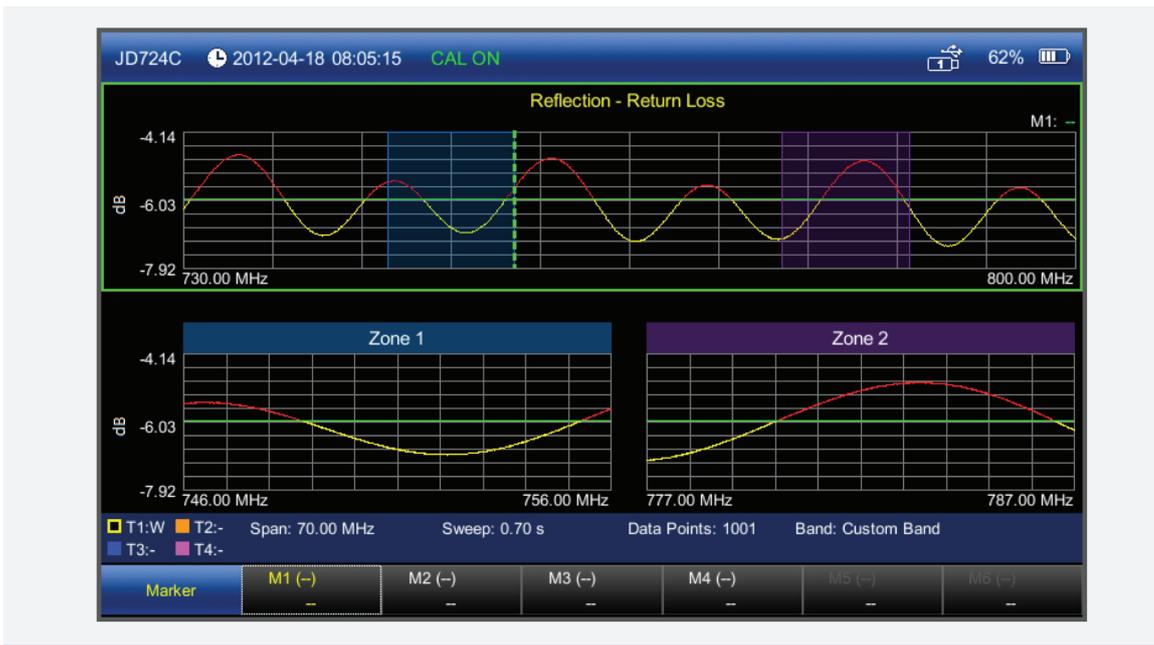


Figure 1: Return Loss with zoom zones for detailed view

## VSWR

Just like return loss, the VSWR test also indicates how well the cable and antenna system is matched. VSWR stands for Voltage Standing Wave Ratio. Also referred to as Standing Wave Ratio (SWR), it is a measure of how efficiently RF power is transmitted from the power source, through the transmission line, and into the load.

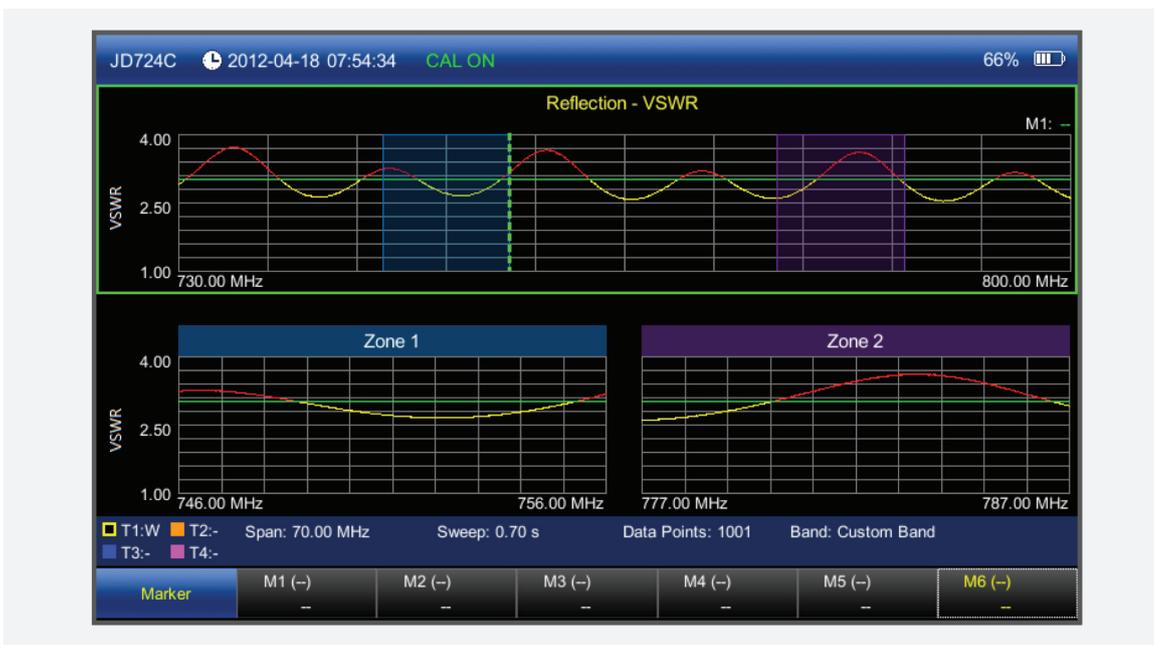


Figure 2: VSWR with zoom zones for detailed view

## Distance to Fault (DTF)

DTF measurements, typically expressed in units of reflection coefficient, return loss, or VSWR as a function of distance, are used to find common faults in cable and antenna systems. It measures the distance-to-fault along the various system components of the transmission line to determine the location(s) of excessive reflections measured. Basically, a built-in source sends signals through the antenna and cable system and looks for reflection back to pinpoint the fault location caused by poor connections, damaged cables, or faulty antennas.

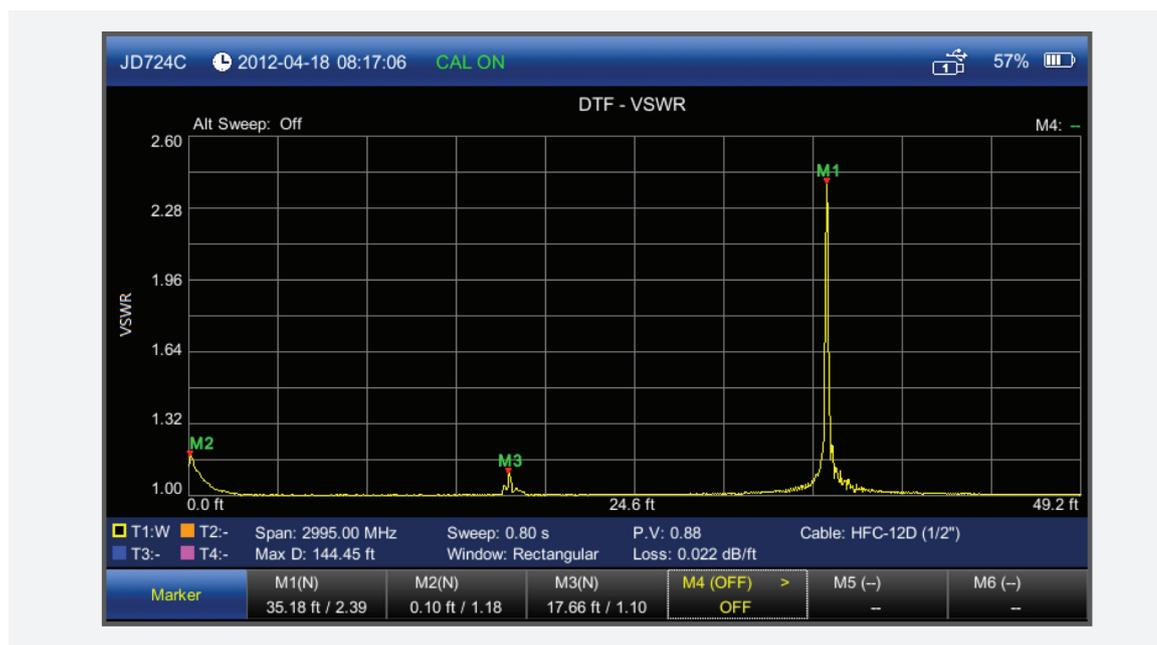


Figure 3: Distance to Fault measurement (VSWR)

## Insertion Loss Test

Insertion loss is incurred by simply inserting the object (cable, connector, etc.) into the path of the RF signal between the source and the intentional radiator. There are three main causes of insertion loss; reflected losses, Dielectric Losses and Copper losses.



Figure 4: Insertion Loss Test view

The following table describes the distinct role of each test, as well as the VIAVI enhancements that provide unique, valuable advantages:

| Cable and Antenna System Test | Description                                                                                                                                                    | VIAVI Advantage                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|-------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Return Loss/VSWR</b>       | Indicates how well the cable and antenna system is matched                                                                                                     | <ul style="list-style-type: none"> <li>Install and commission cell sites with one instrument and carry less equipment in the field</li> <li>With more accurate, consistent tools and centralized data reporting, testing can be done more quickly with fewer reworks</li> <li>TestWizard solution reduces field setup and testing time</li> <li>Cloud-based StratSync drives consistency, simplicity, and reliability with centralized testing scripts and tool configuration, improved workflow, asset tracking, and real-time results reporting.</li> <li>VIAVI test solutions are approved by major service providers</li> </ul> |
| <b>DTF</b>                    | DTF measures the distance-to-fault along the various system components of the transmission line to determine the location(s) of excessive reflections measured |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| <b>Insertion Loss Test</b>    | Insertion loss is the loss of signal power resulting from the insertion of a device in a transmission line and is usually expressed in decibels (dB).          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |

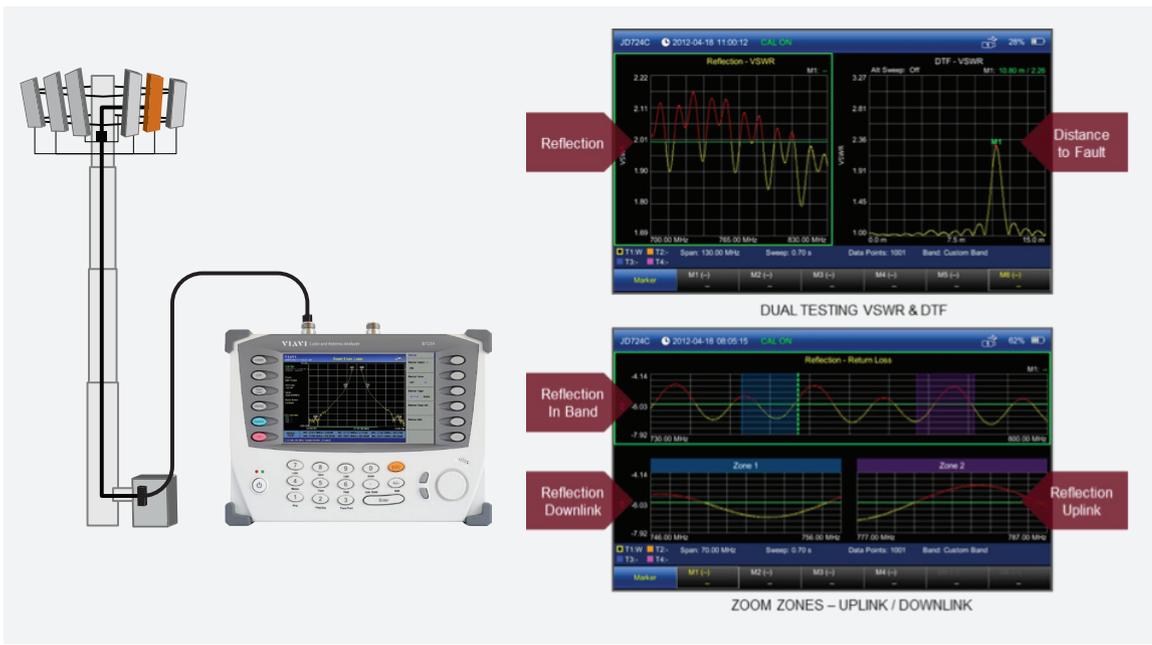


Figure 5: Cable and Antenna Test

## Conclusion

As cell sites continue to evolve from a typical macro architecture to fiber-to-the-antenna (FTTA) and centralized RAN, or C-RAN, architecture, service providers and their partners are being challenged to find efficient and cost-effective ways to install, commission, and optimize them. Installation teams need tools that can help them run a much wider spectrum of tests with fewer tools to purchase, learn, and carry.

VIAVI CellAdvisor™ Cable and Antenna Analyzer offers a comprehensive solution to validate every component in the cable and antenna system, and helps technicians to complete jobs fast, correctly, and on time.