

A Journey Across India to Hunt for Interference with VIAVI CellAdvisor

RF interference in cellular networks is one of the most common problems impacting the performance of a radio access network (RAN). Identifying and rectifying interference issues in a mobile environment is a challenging but critical task. Mobile users near the interference source will experience degraded call success rates, increased dropped calls, decreased battery life, poor voice quality, and reduced data throughput. Detecting, locating, and finally eliminating these sources of RF interference are critical in maintaining good user experience throughout the network.

The overall process for troubleshooting interference is a bit involved and requires a certain level of RF expertise. To locate an interference source, a mobile service provider should take the following steps.

1. Key Performance Indicator (KPI) analysis to identify the general vicinity of the interference/performance issue.
2. On-site RF analysis of the group cells involved in the exercise with a test instrument such as the VIAVI CellAdvisor™ Base Station Analyzer, to determine whether the interference is internal or external
3. If the interference is external, conduct a drive test with an interference hunting solution such as VIAVI InterferenceAdvisor™, to quickly identify the source area of interference.
4. Conduct a point test with VIAVI AntennaAdvisor or similar solution to isolate the source of interference.
5. Initiate the process of removing the source of interference.

Without the right set of tools the process of interference hunting can become very difficult. VIAVI has been working with service providers to ensure that as technology evolves and network management becomes more complex, our solutions continue to simplify the tasks of troubleshooting and maintaining radio access networks.

This case study discusses some of the interference challenges faced by a Tier One mobile operator in India, and how a joint task force of the service provider (SP) and VIAVI engineers was successful in eliminating interference issues at multiple locations using VIAVI CellAdvisor with RFoCPRI and InterferenceAdvisor solutions.



Case 1: TDD Interference Hunting

In January of 2016, the SP was experiencing performance issues in the northeastern region near Siliguri-Naxalbari-Kurseong-Darjeeling sectors. The SP suspected that external interference was degrading VoLTE performance and capacity. It was later identified as a cross-border, 5 MHz WiMAX signal overshooting into the SP's service area, impacting a cluster of sites in that area. (Note that all the affected sites had ground-based towers with antenna centerline present at 50m or higher.) Unfortunately, due to the terrain, interference could not be detected using existing tools, as the interfering signals were not visible at the ground level. VIAVI CellAdvisor with RFoCPRI was able to quickly detect and identify the cause of interference as a 5 MHz WiMAX signal at the BBU location on the ground. CellAdvisor also helped identify some of the key sources of interference in the region like defense radar transmissions and other spurious sources.



Figure 1: RFoCPRI testing

Case 2: External source of PIM

During the same month, another high-profile interference use case was identified in New Delhi causing high drop calls. VIAVI visited the “Niryat Bhavan” site, where the victim cell site was sharing a location with multiple service providers on a rooftop. After some testing on the rooftop, the team determined that the antenna and transmission line of another service provider was potentially generating intermodulation products, which were causing interference in the FDD Band 3 of the victim service provider. A few months later, the other service provider replaced the antenna and transmission line, and the VIAVI customer was able to confirm that the source of interference was external due to intermodulation signals generated by the other service provider’s faulty equipment. A post-replacement verification visit showed elimination of the interference source; this was also validated at the OSS by reviewing the RSSI stats.



Figure 2: External PIM due to hardware issues caused by cable and antenna system

Case 3: Oscillating Repeater

In April of 2016, VIAVI engineers, working along with the SP team, were able to hunt down an oscillating repeater in New Delhi’s Arjun Nagar area. The repeater was causing performance degradation on all the three sectors of SP 1800 band cell-site.

Case 4: Intermodulation

The SP approached VIAVI for help identifying multiple RF performance issues in Bengaluru in August of 2016. The team suspected some form of interference impacting the cell-site performance. After testing with CellAdvisor with RFoCPRI, the team identified another case of interference caused by intermodulation; after quickly identifying the root cause of the performance degradation, the problem was resolved.

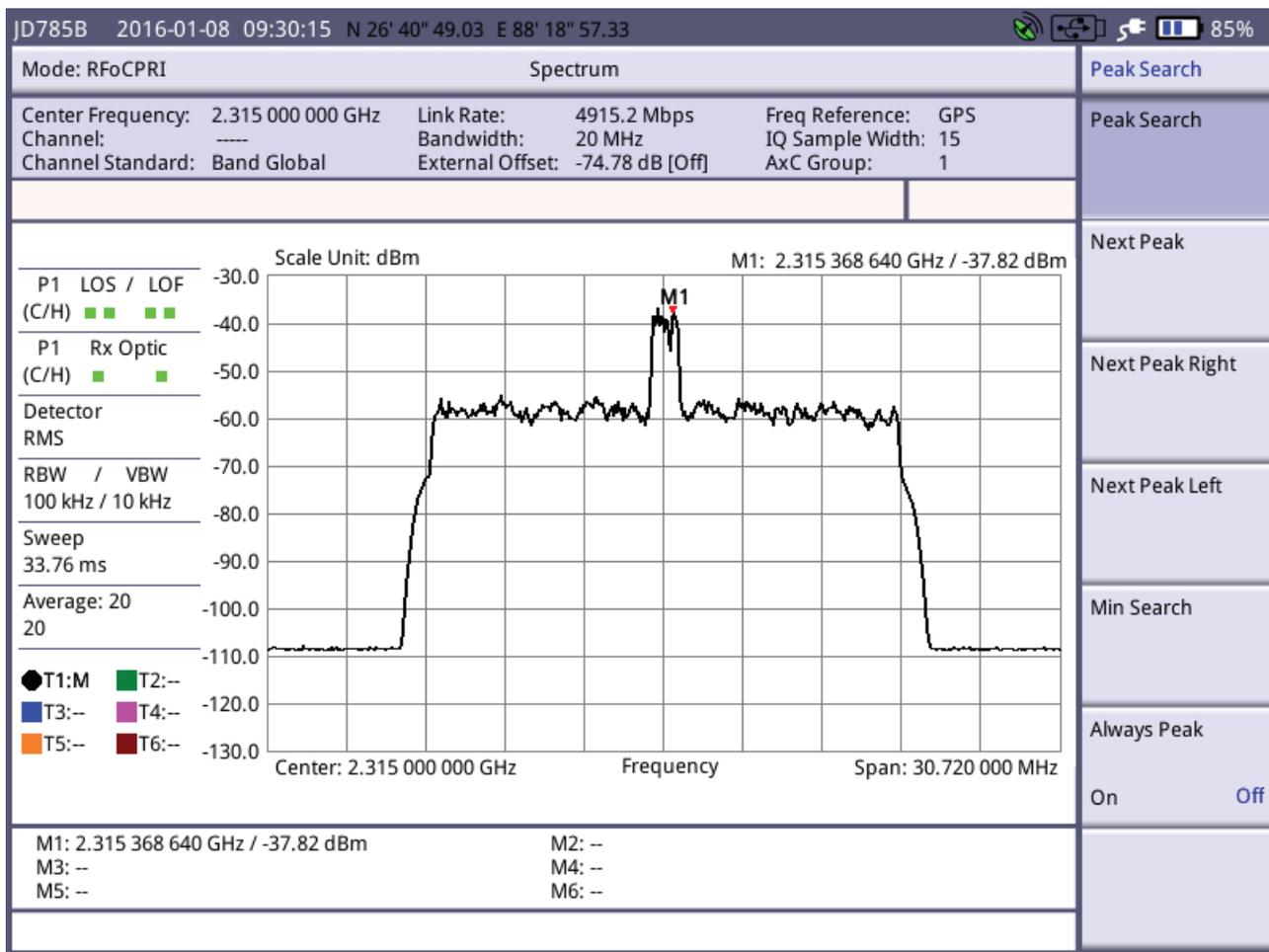


Figure 3: Interference observed by CellAdvisor

Case 5: Increase in RF Noise Floor

During the same time frame, the service provider observed spurious signals generated by a security system that were responsible for increasing the RF noise floor, causing performance degradation. This was a tricky scenario, as identifying a source of interference takes a long time and a lot of RF expertise. However, with the help of the VIAVI InterferenceAdvisor solution, the team was quickly able to isolate and locate the source of interference. InterferenceAdvisor is the VIAVI best-in-class interference locating solution, enabling one engineer to quickly and easily identify an interference source, even in urban environments. Unlike other solutions in the industry, it is fully automated and offers interference area indication, with voice prompts and navigation guidance. InterferenceAdvisor not only saved time in isolating and locating the interference source, it also provided visibility previously unavailable to field engineers.



Figure 4: AntennaAdvisor used to identify interference source

Case 6: Multiple RF Performance Issues

In September of 2016, the service provider invited VIAVI to Chennai, where their field team was struggling to identify the source of interference that was causing performance issues in multiple areas of the network. Conventional interference hunting tools were not up for the job. The VIAVI team, armed with our interference hunting solution, joined forces with field teams and visited four different cell sites in the span of just five days, during which the team was able to uncover the root cause for the interference issues: a security system that was generating spurious signals, a faulty remote radio head, faulty cable TV splitters at multiple locations, and complex intermodulation issues at a co-located site. This series of tests once again demonstrated the VIAVI leadership in providing a comprehensive interference management solution, including RFoCPRI interference detection, InterferenceAdvisor automated interference hunting solution, and AntennaAdvisor point solution.

Case 7: Using Band Pass Filters in Interference Hunting

In March of 2017, VIAVI engineers visited the service provider in New Delhi to demonstrate the effectiveness of using UL Band Pass filters in interference hunting. The service provider's local team suspected interference was caused by intermodulation at co-located towers. However, they were not convinced about the source, as the noise floor was spread out. By adding a band pass filter to block bands outside the band of interest, the team was able to reduce the noise level and find the interfering signal more easily, and was ultimately able to confirm the issue to be a high RSSI environment around the site.

Case 8: TDD Gated Sweep

About a month later, the service provider was seeing high interference peak at the OSS-LSMR for physical resource blocks (PRB) 49-50 on the TDD band of the Gamma sector of one of their cell sites in Mumbai. VIAVI and the SP used the CellAdvisor Base Station Analyzer with RFoCPRI gated sweep and TDD downlink signal analysis, and was able to identify the cause as internal interference originating within the radio hardware system. The case was raised with the equipment vendor for resolution.

Case 9: Internal PIM

In May of 2017, the SP asked VIAVI for help to evaluate 850/1800 MHz and 2300 MHz band sites for interference. The service provider's teams were having difficulty identifying the root cause of the interference issue. VIAVI and the SP's field team visited four sites in Ahmedabad and Surat and identified that internal Passive Intermodulation (PIM) from the radio transceiver path as the cause. The problem was later rectified by replacing fiber and jumper cables. Interestingly, the 850 MHz and 2300 MHz band sites were reporting high RSSI while there were no external sources of interference, so it was assumed to be a case of intercell interference. The issue was reported to radio equipment vendor for resolution.

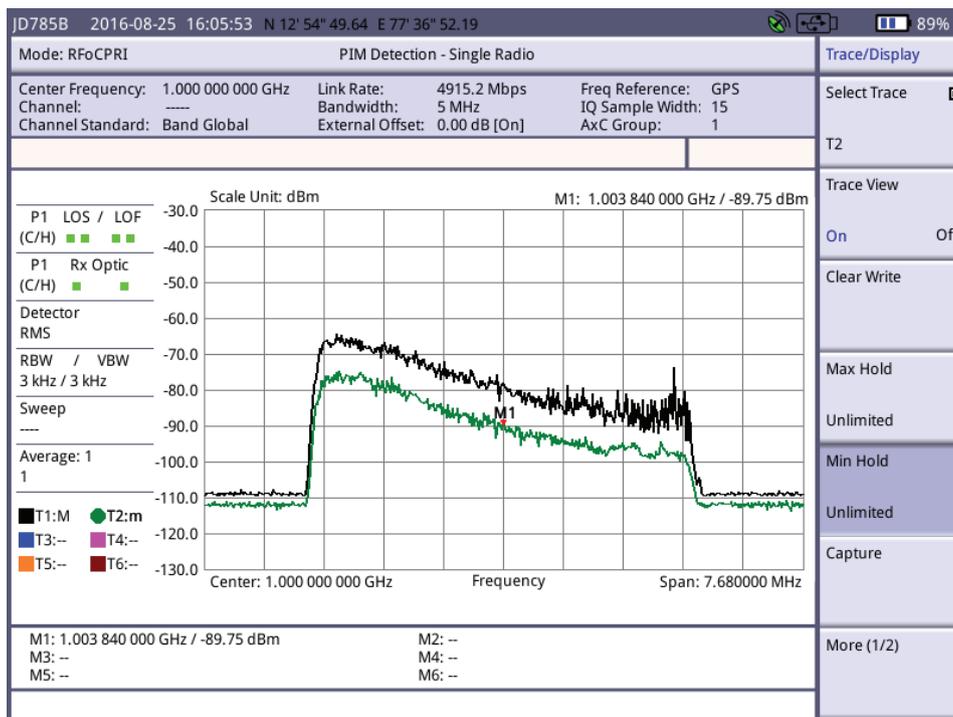


Figure 5: PIM observed by CellAdvisor

Case 10: Close Coupling Between Antennas

In May of 2017, in another unique case of interference hunting, the service provider invited VIAVI to help troubleshoot a performance degradation issue in the northeast section of Arunachal Pradesh. The SP team suspected the interference was caused by another service provider's signal transmission into their TDD band. With the help of CellAdvisor Base Station Analyzer with RFoCPRI, the team was able to identify 'Close Coupling' between the two service provider antennas as the cause. Specifically, there was improper spatial distance between the two services service antennas, causing high RSSI at the cell site. The team also observed that such cases would exist any time there are small guard bands assigned between two radio transceiver systems, as these two issues can cause high coupling factor. At yet another site, the VIAVI team observed a closely placed small cell raising the noise floor of the affected macro cell. RSSI stats improved when the small cell was turned off.

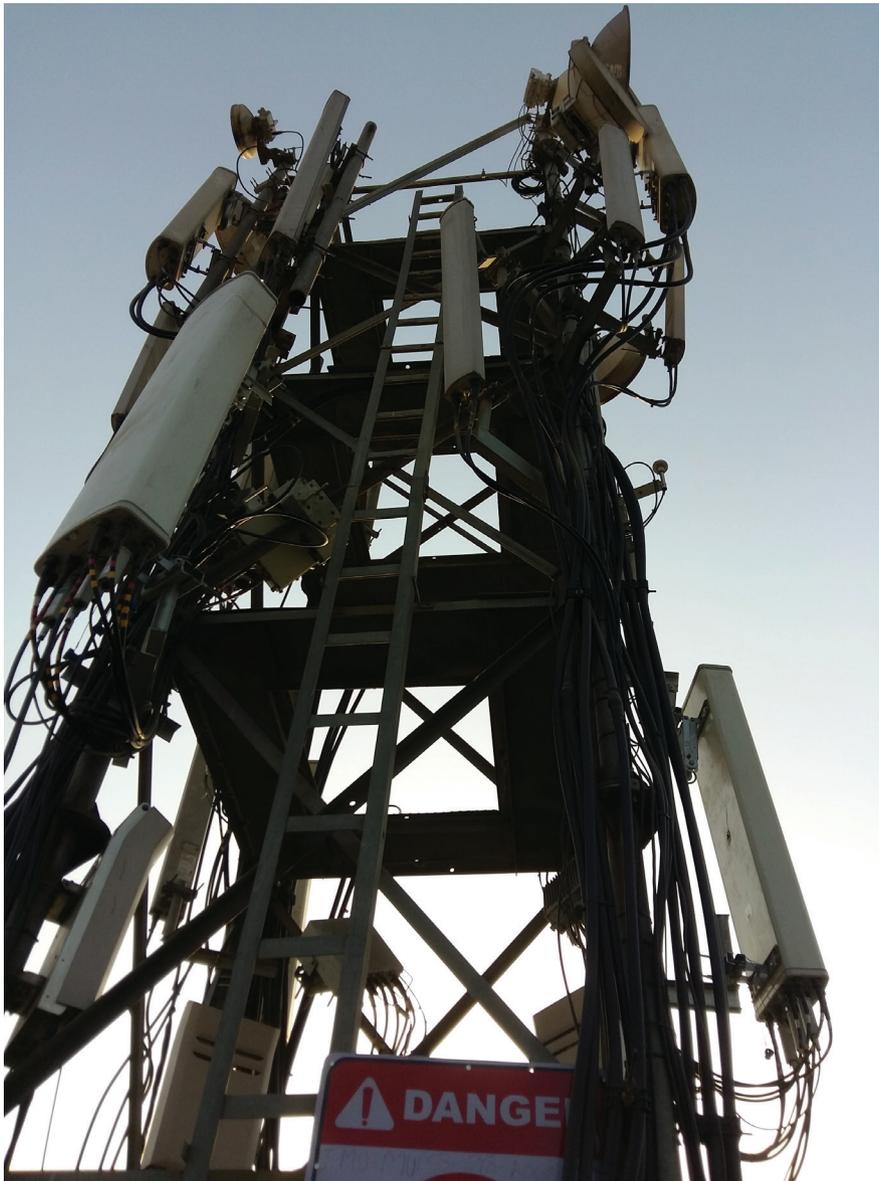


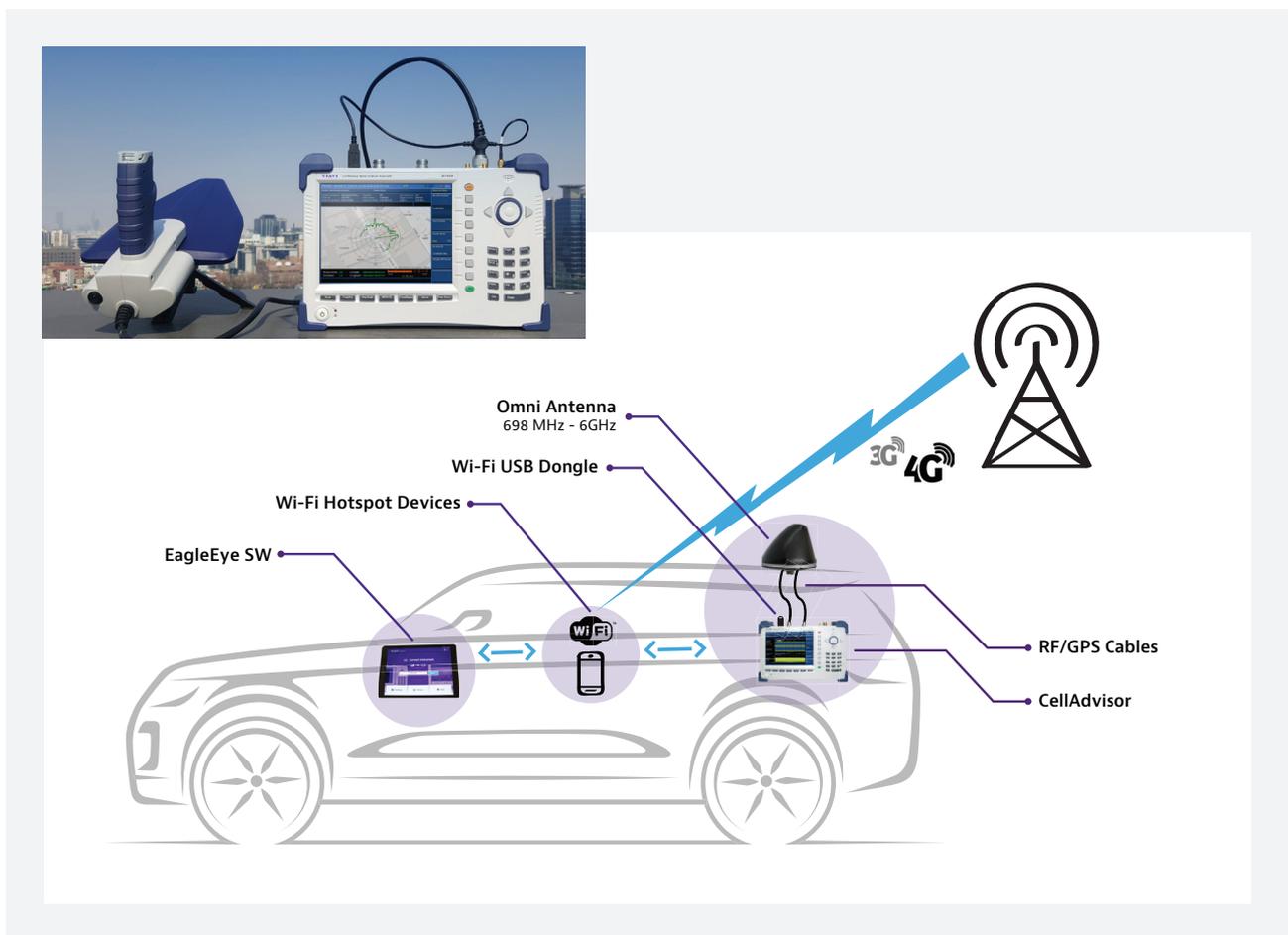
Figure 6: Close proximity of antenna co-location

Conclusion

Service providers spend billions of dollars acquiring RF spectrum to increase network capacity and offer exceptional quality of service to their customers. Unfortunately, interference reduces coverage area by desensitizing the receiver and increasing the noise floor. The throughput rate also suffers when interference lowers the signal-to-noise ratio (SNR), preventing the use of higher modulation coding schemes and efficient resource block allocation as the scheduler attempts to avoid impacted spectrum. This can frustrate customers and can cause potential churn.

To maximize their network investments and reduce customer churn, service providers need to eliminate interference as quickly as possible. As RF engineers and technicians know all too well, this is easier said than done. Thanks to the presence of illegal, unlicensed or unintentional signals, interference can show up in the network intermittently or persistently at different frequencies over time. Having the right set of tools and training greatly helps in reducing the time and effort it takes to identify, detect, and locate interference.

VIAMI solutions has been working with service providers to develop solutions that can significantly improve the entire process of interference hunting. VIAMI interference hunting solutions, powered by CellAdvisor Base Station Analyzer, significantly reduce the time, manpower, and money to hunt for any kind of RF interference.



VIAMI Interference Hunting Solution