How a 5G operator quickly isolated and resolved RF interference issues

success story

EXFO

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A mobile network operator (MNO) reported high uplink RSSI levels indicative of RF noise issues (interference or PIM) at one of their sites. Together with EXFO, the MNO implemented a new approach to quickly diagnose the root cause of those issues resulting in up to a 15% improvement in site KPIs—enhancing the MNO's network performance and generating significant cost savings via faster troubleshooting.

Since 4G LTE is the anchor to 5G NSA connections, operators need to pay careful attention to 4G markers such as RSSI levels.

Key challenges

Interference: expect the unexpected and don't always rely on historical trends

In a 5G non-standalone (NSA) architecture, the 4G/LTE core is used for the 5G uplink (UL). However, as frequency bands in 4G/LTE networks (sub-6 GHz) are getting overcrowded with more devices coming online that take up the finite amount of available space, we are seeing an increase in the number of interference-causing sources which can potentially degrade signal quality of the 5G network. This is requiring MNOs to take a closer look at spectral efficiency to maximize RF performance. By improving spectral efficiency, MNOs can use existing sites at full capacity through increasing both data speeds and usable bandwidth, in turn reducing the need for deploying new sites and saving valuable CAPEX and OPEX.

In addition, MNOs now need to go beyond scouting for the usual suspects and investigate other possible sources of interference that may be present across their 5G networks—sources they never considered but are having an unexpected negative impact on service delivery.

High received signal strength indicator (RSSI) level reported

Since 4G LTE is the anchor to 5G NSA connections, operators need to pay careful attention to 4G markers such as RSSI levels. In this case, the MNO's operations support system (OSS) noted a high uplink (UL) RSSI level—a flag indicating the presence of an RF noise issue on the 4G uplink affecting the non-standalone (NSA) 5G network. This flag was a trigger to launch troubleshooting actions to confirm whether PIM or interference was affecting a cell site. The challenge was to quickly and efficiently determine whether the interference was internal or external, pinpoint its root cause and swiftly move forward with corrective action.

The solution

Testing revealed a bigger picture

In partnership with EXFO, the MNO's maintenance team started troubleshooting this site by tapping into the fiber to analyze the RF spectrum over CPRI from live traffic using **EXFO's intelligent RF spectrum analyzer over CPRI test application (iORF) available on the FTB 5GPro test kit**, a complete, all-in-one 4G and 5G test solution.

In just **under two minutes**, iORF detected narrowband interference and confirmed that the interference was coming from an external source. The same test was then performed on the other two sectors of the cell site. The results showed matching interference patterns (see Table 1 for result details and Figure 1 for iORF analysis screen capture).

In just under two minutes, iORF detected that narrowband interference was coming from an external source.

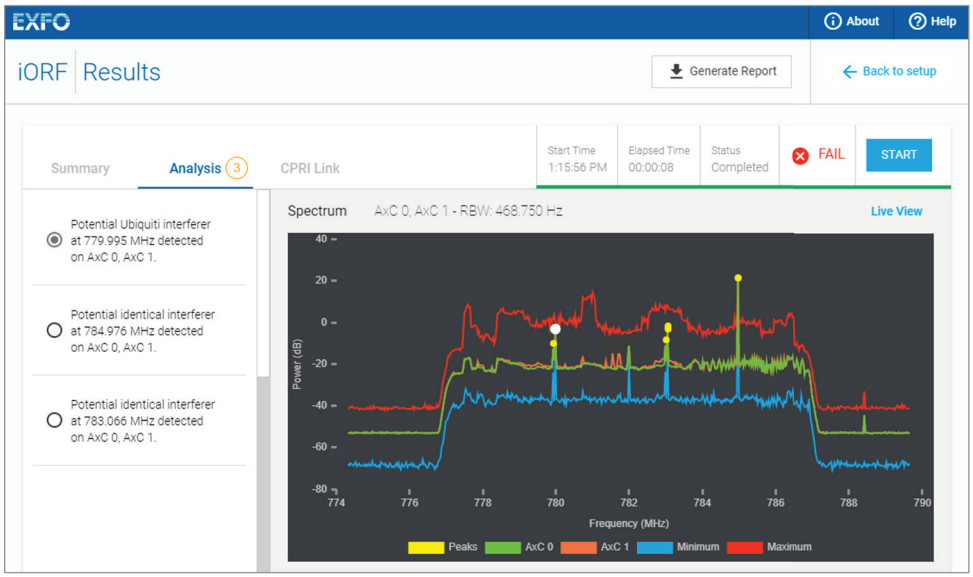

Figure 1. iORF analysis.

Frequency band	Sector 1		Sector 2		Sector 3	
	Interference level					
780 MHZ	Moderate	−70 dBm	Low	−72 dBm	High	−55 dBm
785 MHz	High	−55 dBm	Moderate	−64 dBm	Low	−66 dBm
783 MHz	Low	−68 dBm	No interference found		Low	−68 dBm

Table 1. iORF interference test results.

The issues affecting this cell site also impacted many other sites—and finding the source of the interference became a state-wide issue for this MNO. To provide the best possible signal quality and network performance, it was critical to quickly pinpoint and resolve these issues, in order to:

- optimize utilization of available spectrum;
- minimize dropped calls, increase throughput and improve session success rates;
- create better traffic throughput and increase traffic volume;
- maximize cell utilization with increased number of users instead of under-utilizing resource blocks because of PIM or interference.

The next step was to use EXFO's 5GPro Spectrum Analyzer to locate the source by hunting for interference around the cell site.

Interference hunting to find source of interference

The MNO's team then switched over to EXFO's **5GPro Spectrum Analyzer**, available on the same FTB 5GPro test kit. The same center frequency used in the analysis performed with iORF was entered into the RTSA (real-time spectrum analyzer) mode of the 5GPro Spectrum Analyzer. A directional antenna was then connected to the EXFO unit, and interference hunting began.

The issues affecting this cell site also impacted many other sites—and finding the source of the interference became a state-wide issue for this MNO.

As the team got closer to the source of the interference, the amplitude grew, which meant they were on the right path to finding the culprit (see Figures 2, 3). The source of the interference was located and identified as UHF-based monitoring devices that created **interference at 780 MHz, 783 MHz and at 785 MHz** (see Figures 2, 3). There were two identical UHF devices that were typically used for audio applications, located at two different locations. The devices in question were non-licensed devices operating on six channels between 780 MHz and 789 MHz (within the MNO's frequency band) and available for purchase at any major retailer. Table 2 below demonstrates the characteristics of the interference-causing devices.

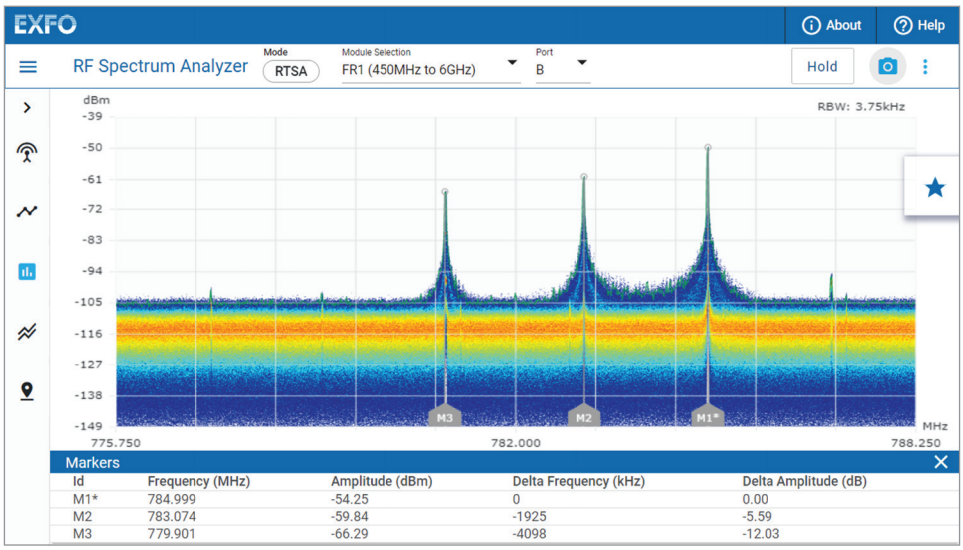

Figure 2. 5GPro Spectrum Analyzer – RTSA mode.

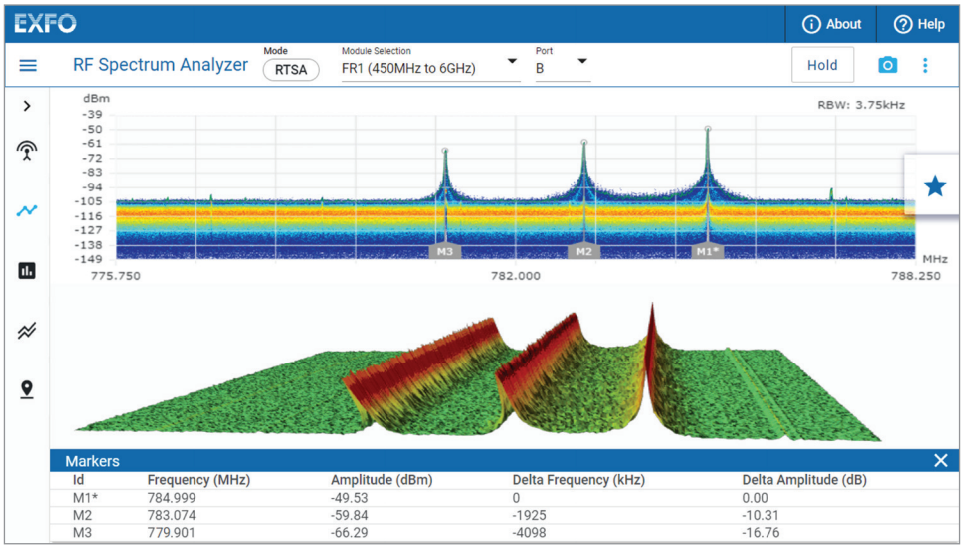

Figure 3. 5GPro Spectrum Analyzer – 3D spectrogram of RTSA mode.

Challenges

- 4G LTE interference was affecting 5G network performance
- Identify the type of interference causing high levels of UL RSSI (interference, internal PIM, or external PIM)
- Identify the location of the sources of the interference
- Swiftly move forward with corrective action

Solution

- FTB 5GPro complete all-in-one 4G and 5G test solution– includes iORF test application for quick and easy identification of RF over CPRI issues including external interference
- 5G Pro Spectrum Analyzer– provides visibility into 4G/LTE and 5G RF environments with the industry's only modular solution

Benefits

- Quickly flagged presence of narrowband interference
- Identified root cause of interference
- Site KPIs improved by up to 15%
- Enhanced network performance
- Significant cost savings including reduction of costly truck rolls

Interferrer	UHF-based monitoring device
Output power	≤10 dBm
Number of channels	6 CH1 780.00551 MHz CH2 783.00552 MHz CH3 785.00553 MHz CH4 786.80553 MHz CH5 788.00553 MHz CH6 789.00553 MHz
Over-the-air test interference signal level	–20 dBm
RF over CPRI interference signal level	–50 dBm
Interference bandwidth characteristics	Unmodulated channel: 30 kHz Modulated channel: 200 kHz

Table 2. Characteristics of interfering UHF-based monitoring device.

The UHF devices suspected of being problematic were removed and replaced by devices operating at different frequencies. **Once the operator requested that the user take the interfering devices out of service, interference ceased at 780 MHz, 783 MHz and 785 MHz. The results confirmed that the root cause of the interference issue was the UHF-based monitoring devices.**

Results and conclusion

Jump in KPI performance

After solving this site's interference issues, there was visible improvement in the RF spectrum. KPI values were re-measured, and the analysis showed that the site experienced up to a **15% average improvement** in the KPIs listed below over all three sectors:

- noise level per cell;
- bit error rate;
- retainability: RRC and ERAB drops;
- user throughput: uplink and downlink throughput speed and volume;
- cell utilization;
- number of connected users.

Improvements in the spectrum

EXFO's complete 4G and 5G test solution, the FTB 5GPro test kit, enables maintenance engineers and cell technicians to do more, faster and with first-time-right results. In this case, it delivered the following benefits:

- With the iORF test application, the MNO was able to quickly determine if the interference on the 4G/LTE uplink of their 5G NSA network was internal or external. Tapping into the CPRI link at ground level helped the MNO to pinpoint the root cause of the issue, significantly reducing the time-to-diagnose the issue and avoiding unnecessary expenses, such as tower climbs.
- The 5GPro Spectrum Analyzer quickly, easily and accurately identified the source of the RF interference and resolved the issue before there was any major impact to the quality of service or subscriber QoE.