ANRITSU. Pasive Intermodultaion (PIM).

Rollout of 5G Creates PIM Issues for Contractors, Mobile Operators.

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Passive intermodulation (PIM) is a growing concern for engineers and RF technicians responsible for installing and optimizing a 5G network. The reason mitigating PIM is so important is its negative impact on capacity, data rate, and reliability – all key selling points of 5G. A sound testing strategy that addresses new PIM concerns due to additional co-located sites with more antennas is necessary to achieve established key performance indicators (KPIs) associated with 5G, as well as existing 4G LTE base stations.

As networks grow more complex, crowded and noise-limited, the risk for PIM grows. Much of the current concern is attributed to the rollout of C-band (between 3.7 GHz and 3.98 GHz) used in 5G.

Non-RF components that surround base stations can cause PIM problems on 5G signals. Table 1 lists some common internal and external PIM causes.

Internal PIM	External PIM
Antennas	Tower modules and components
Cables	Bolts
Connectors	Brackets
Diplexers	Nearby metallic objects and obstacles
Duplexers	Air conditioning vents (Rooftop)
Loose Connections	Billboards
TMAs	Rooftop Lighting

Table 1: Common causes of PIM.

Mobile operators are passing the responsibility to achieve and maintain established performance specifications to network contractors. Failure to document and verify these designated benchmarks can result in mobile operators withholding or delaying payments to contractors.

Old Issue, New Problems

PIM has been a thorn in the side of installers and mobile operators since the first wireless network went live. As a refresher, PIM is created when two or more frequencies are mixed in a non-linear fashion in a passive circuit. Network performance is lowered, as PIM interferes **with uplink receive frequencies** of an LTE or 5G network and generates significant intermodulation signals. Improved network capacity and coverage are achieved when PIM is not a major factor in signal transmission, so networks KPIs are met.

The rollout of 5G adds multiple frequency bands and carriers within those bands to the overall RF spectrum. A higher risk for crossband PIM is created, as a result. The potential for PIM is greater due to co-locations and the integration of multiband combiners for higher power applications – common in macro systems. Higher-order modulation techniques, smaller channel spacing, and multiple transmissions using a single 5G antenna also increase the possibility of PIM.

Higher frequencies and bandwidth are necessary for high-band and wideband LTE and 5G networks. The high-powered signals generated by these base stations can cause added interference issues, including PIM.

Non-RF Elements Create PIM

Contractors and installers must pay particular attention to reducing PIM throughout the RF path. Unfortunately, it can reappear in non-RF installation elements. External PIM is more of a challenge, as 5G technologies and infrastructure are introduced into networks. If PIM reduces sensitivity by as little as 1 dB in the uplink, wireless coverage can be reduced by as much as 11% in a macro network.

With the deployment of LTE and 5G networks, the drive to eliminate metal from tower tops has been accelerated significantly. Specifically, metal cable hangers and grommets are being replaced by hangers made of polymer materials, as they can significantly reduce PIM on top of towers.

PIM Test Solutions

Field engineers and technicians responsible for installing 5G and/or maintaining legacy networks must have the proper understanding of PIM, as well as the test tools to accurately measure base stations. Anritsu provides the tools and education to mitigate PIM.

One test solution is the **PIM Master MW82119B** 40-watt, battery-operated, high power portable, passive intermodulation analyzer (figure 1). A rugged design and enhanced portability enable PIM testing at the "top-of-the-tower," helping operators achieve maximize RF performance from their towers. It is compatible with the Smart Aligner Android application, so users can generate site close out reports to submit to mobile operators to verify results.

Figure 1: Anritsu PIM Master is an essential test tool for field technicians.

Additionally, the PIM Master™ B-series PIM analyzer features Site Master™ line sweep capability. With the Site Master option included, the PIM Master fully certifies cable and antenna system performance, measuring PIM, Distance-to-PIM, Return Loss, VSWR, Cable Loss and Distance-to-Fault with a single test instrument.

Understanding PIM is also critical for contractors who are installing 5G. Anritsu offers **PIM Master Certification**, an intense one-day instructor led training course. Attendees gain valuable hands-on experience using the PIM Master analyzer and demonstrate the knowledge they've acquired in a written and practical exam. Everyone who passes the PIM Certification Course receives a Certificate of Completion.

To learn more about PIM, its causes, and test solutions, visit the **Passive Intermodulation technologies page**.