

# Amdocs Passive Intermodulation (PIM) Hunting and Mitigation



Communications service providers are deploying increasing numbers of high-speed data networks to satisfy insatiable customer demands for seamless connectivity. Yet the increased amount of spectrum in new frequency bands often leads to passive intermodulation (PIM), which impacts coverage and increases dropped call rates.

## What is PIM?

PIM appears when new frequencies are created by mixing two or more signals in an active or passive, non-linear device (which can be either internal or external to the antenna system). When unwanted signals fall inside an operator's uplink band, they raise the system noise floor, causing the system to invoke higher error protection and decreased modulation complexity. This results in significantly lower data throughput, impacting the quality of network performance and ultimately, the customer experience.

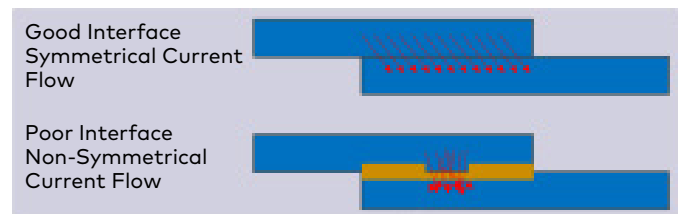


Figure 2: Non-linear Junctions rise

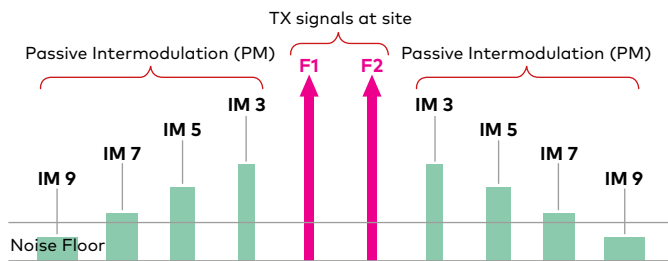


Figure 1: PIM products

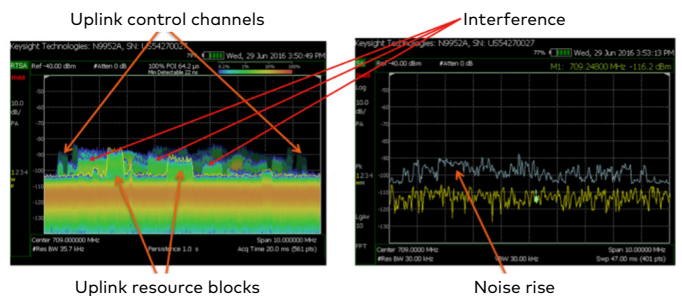


Figure 3: RSSI noise rise

### Internal PIM sources between transmitter and antenna:

- Manufacturing defects
- Loose/overtightened connectors
- Passive components
- Combiners
- Feeders
- Jumpers
- Adapters/connectors



Figure 4: Internal PIM sources

### External PIM sources beyond the antenna:

- Metal flashing on parapet walls in front of antennas
- Metal components in a rooftop deck and cable trays in front of antenna
- Air handling equipment in front of antennas
- Rusty metal objects near antennas
- Metal shavings near antennas
- Steel support frames for stealth enclosures



Figure 5: External PIM sources

### PIM also increases need for additional cell sites

PIM levels are directly proportional to transit (TX) power of the involved frequencies. As PIM interference levels increase, you need to reduce (TX) transmit power of one or two of the offending carrier channels/frequencies on the cell site. As a result, in addition to the reduced coverage, it increases number of cell sites needed to provide coverage to the same area.

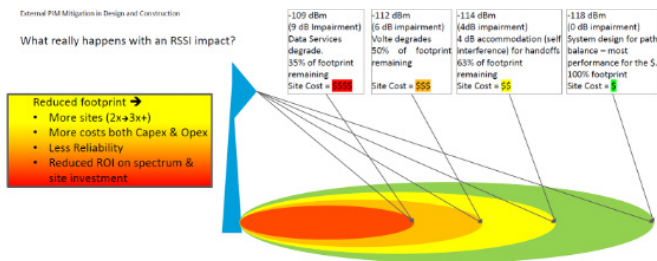


Figure 6: Cost of reduced Coverage

Dollar Spend ROI	% footprint remaining (Theory Freespace)	typical square miles for 30' site (ATOLL RURAL)	typical square miles for 60' site (ATOLL RURAL)	typical square miles for 100' site (ATOLL RURAL)	typical square miles for 250' site (ATOLL RURAL)
\$	100% (0 dB)	254 (100%)	349 (100%)	406 (100%)	516 (100%)
\$\$	-37% (-4 dB)	130 (-49%)	190 (-45%)	223 (-45%)	272 (-47%)
\$\$\$	-50% (-6 dB)	89 (-65%)	132 (-61%)	160 (-61%)	190 (-63%)
\$\$\$\$	-65% (-9 dB)	52 (-80%)	77 (-76%)	96 (-76%)	113 (-78%)

Resolving internal PIM enables you to decrease dropped calls and increase throughput.

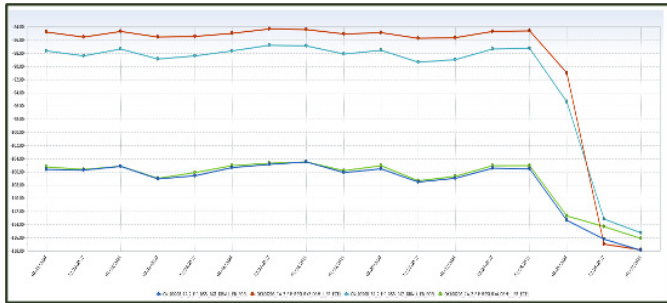


Figure 7: Uplink Noise Rise Reduction

## The solution

Amdocs PIM Hunting and Mitigation rapidly identifies and mitigates all forms of PIM interference. We achieve this through a comprehensive process that comprises PIM tools, guidelines, mitigation and analysis. Our onsite team consists of on-site project managers, field engineers and multiple tower crews, backed by a remote team of RAN engineers, who are available 24/7 to assist with PIM testing and site evaluation throughout the entire process.

The Amdocs Network Workflow Management tool tracks and provides reports on all work, ensuring everything remains on track and within budget. Once the work is complete, we provide a report detailing the actions taken and validating site performance.

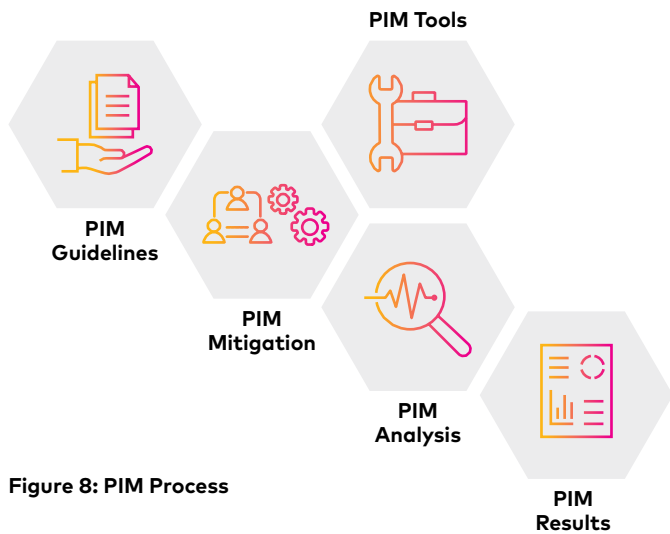


Figure 8: PIM Process

# Amdocs PIM Hunting and Mitigation service offering:



## How it works

### Site identification and assignment

Amdocs engineers identify sites with possible PIM using tools such as Amdocs Network Performance Management or Amdocs Network Optimization Suite. We then validate PIM using the PIMCert tool, which determines if the source of RSSI noise rise is external PIM, internal PIM or an external interferer.

PIMCERT Dashboard - B12																				
Cell Details			Noise Floor				Loaded				Delta									
Index	Cell	Leakid Band	B1	B2	B3	B4	PUSCH	PUSCH	B1	B2	B3	B4	PUSCH	PUSCH	B1	B2	B3	B4	PUSCH	PUSCH
1	BH010G0201	B00	-110.7	-116.5	-102.4	-102.4	-100.3	-108.7	-111.3	-113.9	-112.3	-113.5	-120.7	-120.2	3.0	4.1	3.1	3.1	4.3	4.3
1	BH010G0201	B12-B14 B11	-110.7	-116.5	-102.4	-102.4	-100.3	-108.7	-111.5	-111.5	-113.2	-114.4	-120.7	-120.6	3.0	3.2	4.4	3.1	4.4	4.3
2	BH010G0201	B00	-111.6	-111.7	-112.5	-112.2	-111.4	-114.3	-112.1	-112.3	-112.7	-110.2	-114.2	-114.2	3.1	3.2	3.3	3.1	3.3	3.1
2	BH010G0201	B12-B14 B11	-111.6	-111.7	-112.5	-112.2	-111.4	-114.3	-112.5	-112.3	-112.9	-112.3	-120.9	-114.4	3.1	3.2	3.3	3.1	3.3	3.1
3	BH010G0201	B00	-111.9	-112.2	-116.8	-112.8	-111.2	-111.9	-111.7	-112.5	-113.7	-111.1	-111.9	-112.1	3.1	4.0	3.7	3.1	4.1	4.3
3	BH010G0201	B12-B14 B11	-111.9	-112.2	-116.8	-112.8	-111.2	-111.9	-111.7	-112.5	-113.7	-111.1	-111.1	-112.2	3.0	4.1	3.7	3.1	4.1	4.3

Figure 9: PIMCert Table

## Site hygiene

Once PIM sites are identified, the PIM project team of field engineers and tower crews perform a site clean to eliminate all known sources of external PIM, and then repeat the PIM validation process to determine if more PIM mitigation is required.



Figure 10: Site hygiene

## PIM hunting and mitigation

If further PIM interference reduction is required, the PIM project team performs PIM hunting and mitigation. This includes searching for external PIM sources, locating them and eliminating them if necessary. If the PIM source cannot be immediately eliminated, an RF design adjustment may be required.

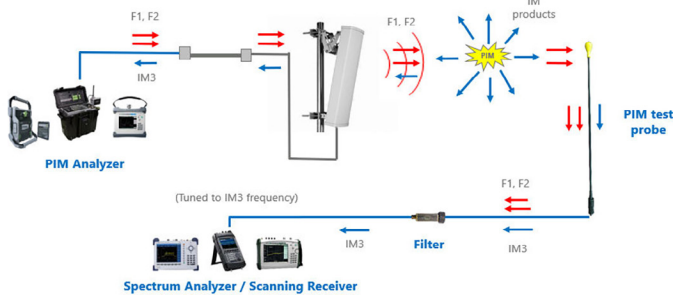


Figure 11: PIM hunting process

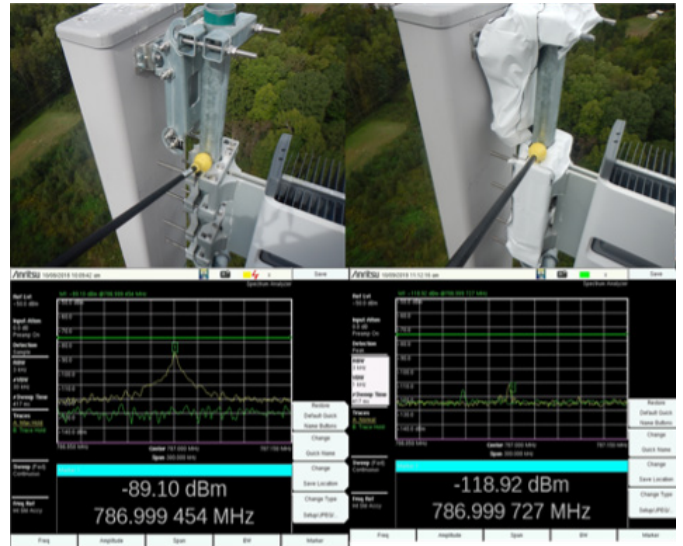


Figure 12: PIM mitigation tape

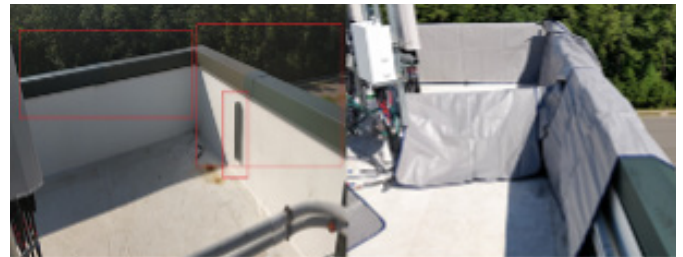


Figure 13: PIM mitigation PIM blanket

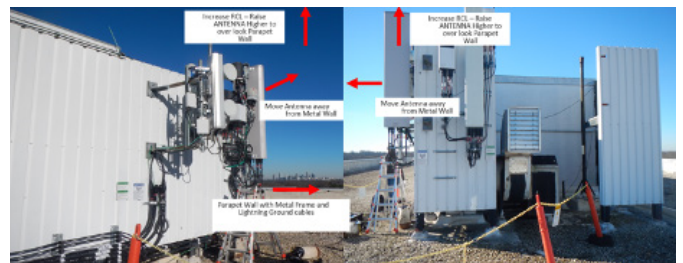


Figure 14: PIM mitigation design change

## Benefits

- Timely and efficient identification and mitigation of PIM sources
- Increased site coverage due to lower noise floors and higher carrier output powers
- Improved customer experience with higher data throughput and increased coverage
- Flexible and scalable deployment model offers minimal risk solution for MNOs concerned about solution scalability

## Why Amdocs

Amdocs has a proven track record supporting projects throughout all phases of network rollout and acceptance – including but not limited to RAN, transport and core design, provisioning and troubleshooting services, pre/post launch optimization, provisioning, triage and so on – for multi-vendor, multi-technology heterogeneous networks.

With an experienced network provisioning team staffed by professionals in the area of transport, core, as well as RF engineers, our strength lies in adapting to our customers' needs and requirements, while orchestrating various support teams/vendors to ensure timely delivery.

As a preferred OEM vendor for Tier-1 and Tier-2 service providers across the globe, our vast complex configurations integration experience and holistic approach to network management ensures you can deliver faster, within budget and with the highest levels of quality.

Partner with us to benefit from our proven tools, processes and time-tested methods, as well as customized services for all major network equipment providers and technologies, so you can be confident in your ability to meet your customer experience goals.

For more information on our network planning services, visit [Amdocs Mobile Network Services](#).