



ADVANCED TECHNOLOGY

INTERFERENCE FROM THE CABLE NETWORK TO THE BTS – A PROPOSED DETECTION METHODOLOGY

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A DISCUSSION ON AN IMPROVED METHOD TO PROACTIVELY MONITOR THE WIRELESS BTS FOR CABLE TELEVISION NETWORK GENERATED INTERFERING SIGNALS

OVERVIEW

This paper introduces a new remote monitoring concept for the wireless BTS. A technique is described whereby cable television signals that leak from the network and impact BTS performance, can be detected at levels below the BTS noise floor and before they affect the BTS service quality. Repair can be performed proactively ensuring QoS is maintained. A field proven signal correlation process is employed which utilizes reference samples from the cable network and BTS Rx signal samples from the LTE antenna.

Interference from QAM and OFDM signals egressing from cable television HFC networks can be a problem for the wireless BTS when operating at frequency bands co-channel with those carried over the cable network – frequencies less than 1.2GHz. The presence of these interfering signals can and has proven on occasion to result in decreased wireless network performance. The cable industry is very aware of this issue and many operators have made significant investment in new leakage equipment that operates at LTE frequencies such that they can monitor and mitigate these interfering signals.

But despite efforts from the operators to mitigate leaks from the network, reality is that a substantial quantity of high frequency leaks exist in every cable network. Operators do attempt to prioritize those leaks to be repaired, but in general it is a challenge for the operator to know exactly which of the numerous leaks will be the one that impacts the wireless operator's network performance. Additionally, detection by the operator is always after the fact – and any newly detected leak could already be causing disruption to the BTS transmission and reception. Driveouts for signal leakage are typically only performed once a quarter, and from the perspective of the wireless operator more real-time feedback is desirable.

In the future, this issue will continue to grow as the cable networks migrate from QAM signal format to OFDM. Inherently, the OFDM signal has high level harmonics of pilot carriers contained within the spectrum, with more energy contained at the harmonic frequencies. This contrasts with QAM signals where all of the energy within the channel is spread out evenly. The energy contained within these harmonics are more pronounced and potentially more disruptive as compared to QAM signal transmission – this will result in greater signal levels hitting the BTS, likely resulting in more leak sources requiring mitigation.

In this abstract, we introduce a new alternative technique for the wireless provider to proactively monitor for the presence of ingress within the BTS, from signals originating in the nearby cable network. While the ability to monitor noise floor levels in the BTS already exists, there is benefit in enhancing the monitoring with a technique and technology capable of detecting signals well below the BTS noise floor, and alarm on the existence of QAM or OFDM cable network signals before the interferences affect the performance of the BTS. This technology can function as a form of predictive monitoring, alarming before the amplitude of the interference reaches a critical level. Mitigation of the leak can be accomplished before a degradation in service occurs and before the BTS noise floor is impacted – thereby ensuring the quality of service of the wireless provider. Additionally, this new technique will provide confirmation that the interfering signal originated from the cable network, and will also provide information as to the originating location of the interference to assist in quickly repairing the integrity deficiency at the cable network.

Cable operators throughout the world utilize the QAM Snare signal leakage detection technology as the most accurate, most sensitive, and most widely deployed high frequency leak tracking and mitigation solution. The QAM Snare technology is based on a signal correlation technique, where reference signal samples are captured at the headend, and transmitted to a field detector that captures off-air signals at the same frequency using an antenna. These two signal sets are correlated, and when there is correlation – with certainty the signal captured at the headend, which then traveled through the fiber and coaxial network to a leak location, and then which traveled over free space to the detector antenna – is the exact same signal that originated from the headend. Time delay data from the correlation function is then used to exactly calculate and pinpoint the GPS location of the leak. This same technology can easily be adapted for implementation within the BTS. There are many possible approaches that could be practical, one approach being the placement of a small module located at the BTS as shown in Figure 1.

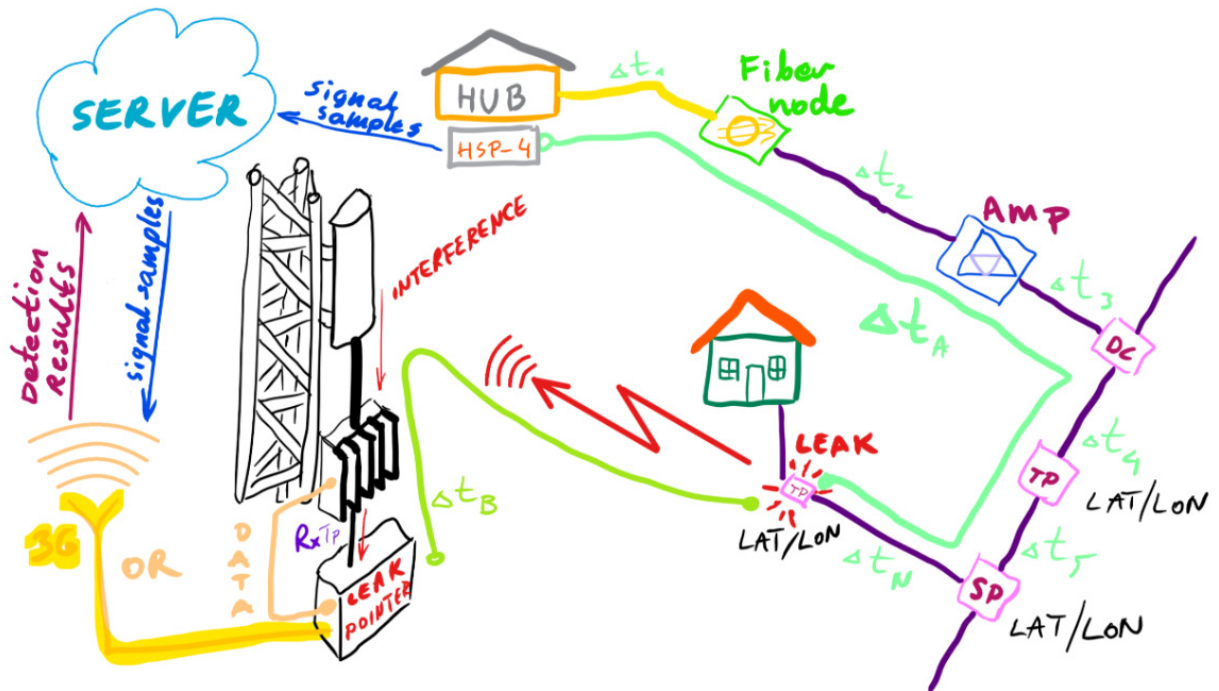


Figure 1

The Ingress Pointer Module would receive reference samples captured from the cable network headend via a wireless connection or over IP. The module would then correlate the cable reference samples with samples acquired from the LTE Rx antenna utilizing BTS Rx test points. The correlation process would determine if signals originating from leaking cable network devices are detected within the BTS. Detection results are then ported to a website accessible by both the LTE provider and the cable operator, and repair is scheduled by the cable operator when the detected level exceeds some threshold.

In an alternative approach, software only implementations could be possible where cable signal reference samples are captured at either the CATV headend or newly deployed Remote Phy nodes built to the DOCSIS 3.1 standard. Signal samples can be captured in software and transmitted to a remote server for offline processing for detection of signal leakage. If time stamped samples of the LTE Rx signal were made available from the BTS processor, these could be used to potentially eliminate the need for any hardware installed at the BTS. There are many options and mixtures of approaches that can be worked out through cooperation between stakeholders, assuming that demand for such a solution is demonstrated.

There is an obvious obstacle towards adoption of this technology that the wireless industry will likely raise, that being why should they have the burden to invest in BTS monitoring equipment to detect interferences into their licensed spectrum – interferences that should not exist within their purchased bandwidth. We however see room for discussion in this area for both wireless and cable network operators. There could be additional benefit for the cable operator in using this data as a replacement or supplement to their status quo process, which has operational benefits in the form of better prioritization of those leaks needing to be repaired. Perhaps a logical starting point as to the benefits of such an approach could be within those companies that operate both wireless and wired cable businesses in the same geographical area – where they are in fact the same company.

We present this abstract to stimulate thought and discussion on the subject. From a technology perspective there are no uncertainties, it is simply a repackaging of technology that already exists and has been proven to work in widespread deployments throughout the world. The question is to cable operators and to wireless network operators, if there is perceived benefit in more proactively monitoring of the wireless BTS for ingressing signals originating from the cable television HFC network.

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