



WHITE PAPER

# The Power of Proactive Radio Maintenance

Go Beyond a 'Fix It When It Fails' Approach by  
Identifying Problem Radios Before They Fail

## CASE STUDY

### A Georgia Department of Public Safety (DPS) Embraces a Proactive Maintenance Tool for Two-Way Radios

#### Background:

The department is responsible for nine divisions which include the Police Department, Fire & Emergency Services, 911 Emergency Communications, 800 MHz Radio System, Animal Control, the DPS Training Unit, Internal Affairs Unit, Administrative Division and the Public Safety Village. They have 5,000 radios on their land mobile radio (LMR) system.

#### Challenge:

The agency needed to find a different approach in determining which radios were significantly out of alignment and bring only those radios in for immediate service.

#### Solution:

They began using DiagnostX™ to detect problem radios by measuring their alignment characteristics and field performance long-range, over-the-air (OTA) in real time without any user intervention while remaining operational in the field.

The networked system enabled them to collect radio transmissions from multiple sites system-wide and view all the results in one consolidated management console.

Once the active radios had been evaluated on the network, DiagnostX then indicated the operational characteristics of each in a report based on user-defined thresholds.

#### Results:

By pre-identifying radio communication problems with DiagnostX, the department has experienced a higher level of radio system performance and reduced their maintenance costs annually.

## INTRODUCTION

First responders put their lives on the line each day to protect the public from harm, whether it is a routine traffic stop or an emergency situation. It is vital their radio equipment works properly to provide them with clear and reliable communication when they need it the most.

Approximately 15 to 20 percent of subscriber radios can drift out of alignment annually, causing them to fail at any time. Many public safety agencies have anywhere from 2,000 to 10,000 radios or more on their LMR systems. Technicians do not know which radios need to be aligned, and which ones are working well, without bringing **all** the radios in for testing. The common practice of testing all radios leads to spending hundreds of thousands of dollars in time and manpower each year.

This white paper explores a growing trend when it comes to radio maintenance and examines new possibilities available to ensure radios are kept operational ready at all times.

## HOW DO RADIO SYSTEM MANAGERS IDENTIFY RADIOS AT RISK OF FAILING?

Given the large number of subscriber radios on an agency's LMR system, managers determine if a subscriber radio is working correctly or not by scheduling them for routine maintenance or waiting for the user to complain of a problem.

The two-way radios public safety agencies use rely on an internal reference oscillator to maintain the radio 'on' frequency. Over time, these oscillators drift 'off' frequency, eventually causing the radios to fail.

In order to measure a radio's alignment, a technician has to physically connect an analyzer device to the radio. Every radio must be brought in to be checked, resulting in an expensive endeavor.



Photo Courtesy of Cobham AvComm

Due to budget constraints, many users skip these annual checks and rely instead on reactive radio maintenance. Adopting a 'fix it when it fails' policy, they leave the reliability of their communication lifeline to chance for first responders.

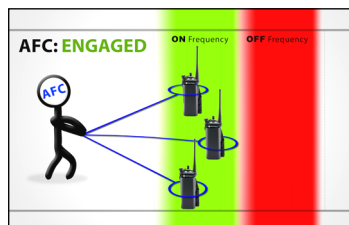
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"We strongly feel that no mobile-radio system can be better than its maintenance. The original installation can be of the best, but unless it is properly maintained, the operating costs, the technical performance, and the conformance with FCC regulations all will degrade as time goes on."<sup>1</sup>

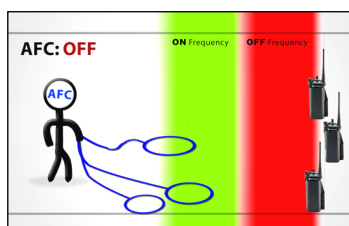
- Lampkin Laboratories

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How does AFC work?



- Radios have crystal oscillators that drift over time
- Crystals are directly impacted by the voltages applied to them which make them resonate
- Controlling voltages are affected by aging of electronics, battery power, temperature, environment and mounting conditions
- The effect of these variables can be seen in the drift or detuning of oscillators which contribute to the degradation of radios
- AFC can temporarily control and correct the oscillator drift of the radio until it is turned 'off'



- Within limits, AFC attempts to correct these variables, masking a hidden problem until total communication failure occurs

The radio maintenance challenge system managers face is straightforward: How do they identify a particular radio at risk of failure and service it, when they do not have the time or money to provide preventive maintenance (PM) for every radio?

The answer lies with new technology. There have been substantial technological advancements that have changed the traditional approach to radio maintenance for LMR systems.

One advancement took place when Motorola introduced Automatic Frequency Control (AFC) to the LMR market in 2003 with its XTS/XTL 5000 radios.

Another advancement is the automated testing and alignment feature of the widely used service monitors in the industry, first from General Dynamics in 2003 and later from Aeroflex in 2008.

These advancements, however, still did not address the question of which radios are at risk of failing.

## THE ANSWER IS DIAGNOSTX

The development of a long-range, over-the-air (OTA) radio waveform analyzer began when LocusUSA started researching OTA radio waveform capture in early 2002. By late 2009, Locus launched DiagnostX, a hardware and software technology that evaluates radios long-range, over-the-air while they are deployed in the field. DiagnostX can also identify radios receiving a temporary correction from AFC.

DiagnostX provides a breakthrough technological advantage by constantly monitoring and evaluating all active radios on a LMR system. This ensures minimum hardware and personnel downtime and assures peak operational readiness.

The over-the-air radio waveform analyzer system can be installed at any system site at the receive antenna multi-coupler, or it can use any other receive antenna.

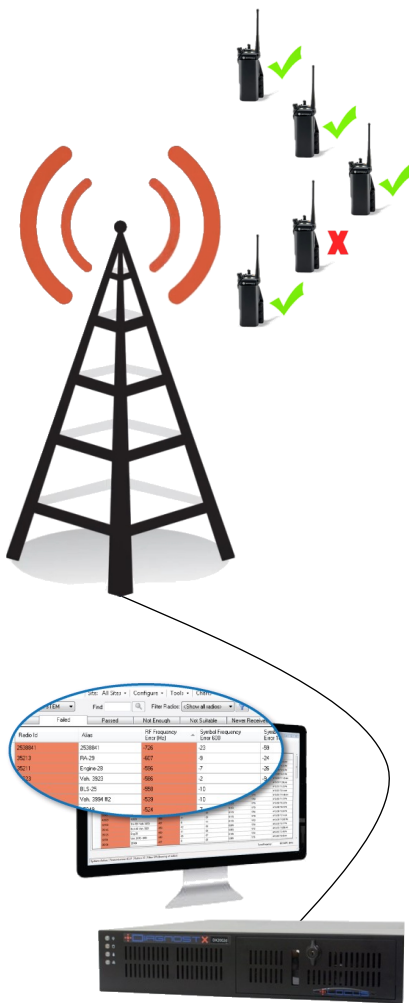
DiagnostX has an intelligent RF (radio frequency) receiver that scans the radio network's downlink (outbound) control channel frequencies to identify the frequency in use. Once the active downlink frequency has been identified, the system monitors the corresponding uplink (inbound) frequency and analyzes all control channel transmissions.

After tuning to the uplink (inbound) control channel frequency, DiagnostX monitors and characterizes all transmissions, distinguishing 'suitable' from 'non-suitable'. Once a captured transmission is established to be suitable, an analysis is performed on the waveform and it is compared to:

- Mathematical representations of ideal waveforms
- Waveform specifications (FCC and protocol standards)
- Signal intelligence algorithms

"Now we can look at, analyze, and manage our entire inventory of radios across a broad network of independent users without actually having to touch the radios." <sup>2</sup>

- John Daly, Collier County, FL



DiagnostX evaluates all active radios on a LMR system and identifies the ones that are out of alignment

The analysis of the received waveforms indicates the operational characteristics of each radio. User-defined thresholds determine the radio's conformance to FCC requirements and protocol specifications. The radio metrics are interpreted and displayed in real-time on an easy to navigate, information-rich user interface, the DiagnostX Viewer.

## DIAGNOSTX IMPROVES RADIO PERFORMANCE BY IDENTIFYING AND SOLVING COMMUNICATION ISSUES

- Determines whether communication problems are on the subscriber radios or on the network
- Evaluates all active radios on the system, 24/7/365, without user intervention
- Identifies both problem radios and properly functioning radios
- Generates detailed reports for each radio in real time that can be shared between departments
- Enables management to proactively contact departments, groups or individuals to schedule service
- It is non-intrusive to the network and operates over long range (5+ mile radius for 3W portables)
- Portability allows it to be moved to multiple sites if required for additional area coverage

By identifying radios with operational problems and addressing them, an agency will experience a higher level of system performance and reduce maintenance costs by 50% or more. Servicing only those radios that are out of alignment will free up more time for technicians to focus on system issues that need attention.

## AN AFFORDABLE SOLUTION

Public safety agencies often find it challenging to obtain capital funding approval for purchasing products. To address this challenge, LocusUSA has introduced DiagnostX as a *Managed Service*.

The new service enables LMR managers to have all of the benefits of the DiagnostX system and more:

- The service includes monitoring equipment from LocusUSA, who manages the data from their Network Operations Center
- All active radios will be evaluated for performance and alignment, over-the-air, without user intervention
- Comprehensive reports will be sent to the system manager showing alignment characteristics by radio ID, identifying their status as **Failed**, **Passed** or **Never Received** based on pre-defined thresholds
- LocusUSA will tune radios in need of alignment on a contractual basis

#### **DiagnostX is Protocol and Frequency Band Specific**

- Protocols: P25, DMR, NXDN, TRBO, Legacy
- P25 System Metrics
  - ◆ Frequency Error
  - ◆ Symbol Error 600 & 1800
  - ◆ Modulation Fidelity
  - ◆ Average Symbol Deviation
  - ◆ Emission Mask Conformance
  - ◆ BER, RSSI & SNR
  - ◆ Reserve Gain at the Multi-coupler (dBm)
- Available Frequency Bands
  - ◆ VHF 136-174
  - ◆ UHF 380-430
  - ◆ UHF 450-470
  - ◆ UHF 470-512
  - ◆ 700, 800, 900 MHz

It is a cost-effective way to identify radios in need of service, while well-aligned ones can remain in the field.

The DiagnostX technology is still available as a capital purchase, while a DiagnostX scan may now be acquired with existing maintenance or operational funds.

## **CONCLUSION**

Currently, the only way for public safety agencies to determine whether a radio is functioning to specification is to bring the radio in for annual maintenance or wait for a user to report a problem. This means scheduling thousands of radios for costly annual service checks that require hundreds of technician man-hours. It also means taking radios out of the field, where they are needed most.

Regardless of the challenge associated with dwindling budgets and personnel cuts, the bottom line for these agencies is its commitment to protect and serve - both the public and the first responders who risk their lives on a daily basis. DiagnostX has proven to be a powerful tool for ensuring that police, fire and EMS personnel can feel confident that their radios will work whenever and wherever they are needed.

To learn more, go to [www.locususa.com](http://www.locususa.com) or to schedule a webinar demonstration, contact LocusUSA at (321) 727-3077 or [sales@locususa.com](mailto:sales@locususa.com).

## **ABOUT LOCUSUSA**

LocusUSA is an engineering and software development company specializing in RF capture for radio analysis and location. The ability to capture and analyze the actual waveform of a radio transmission led to the development of DiagnostX. This patented technology measures the alignment and operating characteristics of a radio, long-range, over-the-air in real-time without user intervention.

The increasing market acceptance of Locus's patented technologies is helping to ensure the optimal performance of LMR systems throughout the United States and Canada.

#### **References**

- [1] Lampkin Laboratories, Inc., Bulletin No. 35959-5K, 1959.  
[2] Know Before You Go, Urgent Communications, April 2012.

