Application Note

Mapping BER and Signal Strength of P25 Radio Systems

S412E LMR Master

September 9/11 and Hurricane Katrina were two pivotal events in the course of America's recent history. In addition to transforming the way the United States prepares for and responds to threats against the homeland and national disasters, these two events reinforced the need for interoperability between the U.S. military and civilian public safety agencies (e.g., police and fire). Project 25 (P25) is a suite of standards for digital radio communications that is specifically designed to meet this need.

Figure 1.

The lessons learned during the disasters have forced agencies to assess their requirements during disasters with the basic infrastructure in a state of failure. Interoperable emergency communications is integral to initial response public health and safety of communities national security and economic stability. Often one of the most serious problems is communication due to the lack of appropriate and efficient means to collect process and transmit important and timely information. Project 25 (P25) was initiated collaboratively by public safety agencies and manufacturers to address issues with emergency communications systems. P25 was a collaborative project to ensure that two way radios are interoperable.

While touting many benefits, the P25 standards pose interesting measurement challenges for installers and network managers of P25-compliant public safety communications systems. One key challenge lies in mapping bit error rate (BER) and signal strength (RSSI) measurements which are essential to diagnosing coverage problems and avoiding critical loss of communications. While general-purpose test equipment is currently available to measure P25 system components, these bench top, fully-featured laboratory design, development and compliance instruments are simply too expensive, not to mention big, bulky and very complicated to operate. Today's P25 radio system installers and network managers demand an alternate solution, one that offers a quick and easy, handheld approach to mapping BER and signal strength.

P25 Technology Overview

P25 standards govern the manufacturing of interoperable, digital two-way wireless communications products that are used by federal, state/province and local public safety agencies to communicate with other agencies and mutual aid response teams in emergencies. It was developed through the joint efforts of the Association of Public Safety Communications Officials International (APCO), the National Association of State Telecommunications Directors (NASTD), selected Federal Agencies, and the National Communications System (NCS). P25 was standardized and continues to be administered by the Telecommunications Industry Association (TIA) as ANSI/TIA-102. While developed primarily for North America, P25 technology and products have also been selected and deployed in other private system applications, worldwide.

P25 standards define the interfaces, operation and capabilities of any P25-compliant radio system. P25-compliant radios can communicate in analog mode with legacy radios and in either digital or analog mode with other P25 radios (Figure 2). Phase 1 radios are designed for 12.5-kHz channel bandwidths and use compatible 4 level FM (C4FM) modulation for digital transmissions. P25 radios must also operate in analog mode on either 25-kHz or 12.5-kHz channels. This backward compatibility allows P25 users to gradually transition to digital while continuing to use analog equipment. An open interface to the RF Sub-System, included in P25 radios, facilitates interlinking of different vendors' systems.

Figure 2. TIA Standard 102 covers P25 Phase 1

P25 digital radio systems can be either conventional or trunked, single-site or networked multi-site, simulcast or non-simulcast. P25 trunked systems can be either Phase-1 Frequency Division Multiple Access (FDMA) or Phase-2 Time Division Multiple Access (TDMA). Conventional P25 systems employ a relatively simple frequency-based talk-group allocation where each talk-group operates on a different repeater frequency pair or simplex frequency, possibly in combination with different Network Access Codes (NACs). NACs are the P25 digital equivalent of Continuous Tone Coded Squelch System (CTCSS or PL) tones used in analog FM systems to allow multiple talk groups on the same repeater or simplex frequency. This is the basis of "community" repeaters, popular before trunking technology came into widespread use. Here, users select the talk-groups or channels using the radio's channel selection knob or keys. In contrast, the management of a trunked system's operation, including radio talk-group assignment, is done by a control channel (Figure 3). Essentially, a group of traffic channels (repeaters) are automatically shared among a large number of talk-groups. As users request access, a controller in the system assigns the calls to specific traffic channels (repeaters) based on a talk-group priority list.

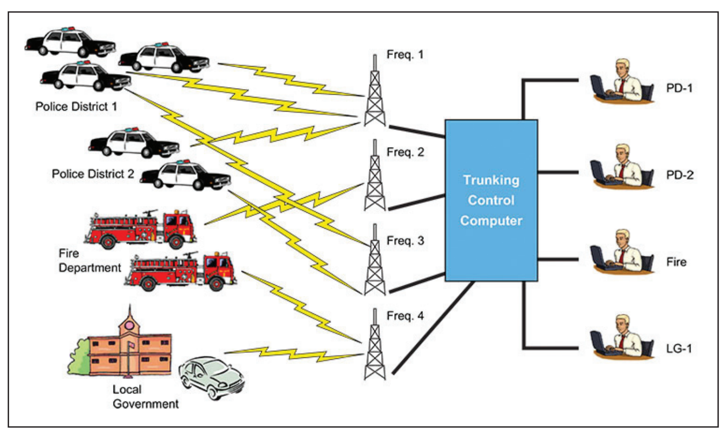

Figure 3. Channels are assigned with a P25 Trunked system

Each public safety organization must manage its own unique system. On trunking radios, users typically select the desired trunking system (zone) and the trunk group within a system (zone) with knobs and/or buttons.

Both conventional and trunked P25 Phase-1 FDMA systems use C4FM modulation, operate at a 9600-bps bit rate, and utilize the Common Air Interface (CAI) which specifies the type and content of signals transmitted by P25-compliant radios. Advanced Encryption Standard (AES) and Data Encryption Standard (DES-OFB) algorithms, along with other encryption algorithms are used for secure P25 radio transmissions. P25 standards also support over-the-air rekeying (OTAR) features that allow subscriber encryption key management through a radio network.

P25 Phase-1 FDMA and Phase-2 TDMA non-simulcast repeaters transmit the control channel using 4-level FSK (C4FM) modulation at 4800-Baud, 9600-bps. Phase-1 simulcast repeaters use a special CQPSK modulation optimized for simulcasting. The S412E offers a CQPSK demodulator for testing these repeaters. Phase-2 P25 repeaters use HCQPSK modulation for both simulcast and conventional applications and the S412E offers this modulation as well.

P25 coverage mapping is a key capability for diagnosing coverage problems in P25 public safety communications systems and ultimately, avoiding a critical loss of communications. An excellent way to map the BER/MER and signal strength of P25 systems is through use of the Anritsu LMR Master. This solution also supports P25 control channel measurements, along with measurements for most of the P25 system's components—all in one easy-to-use, battery-powered instrument. Such capabilities are absolutely critical to assuring robust and reliable communications with today's P25 radio communications systems.

A Better Approach

With digital communications systems like P25, multipath and fading can degrade communications, even when the signal strength is adequate (Figure 4). BER is the ultimate test of a digital communication system. At high signal strengths, greater than –90 dBm, there is a tight relationship between the BER and the signal strength. As the signal strength is reduced, it no longer predicts the bit error rate. Because of this, the P25 standard includes BER test patterns to allow mapping coverage of received BER. Handheld test equipment that can produce BER coverage maps are therefore critical as they provide installers and network managers with confidence that communications will be possible, even with local interference.

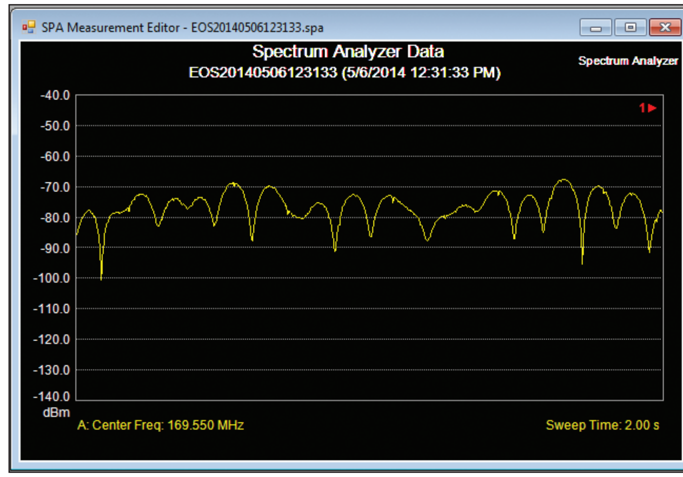

Figure 4. Power variations from multipath fading for vehicle moving 30 MPH

Most wireless communications systems are designed to provide coverage over a predetermined area and not interfere with distant systems using the same frequencies. Coverage estimation software must make assumptions about loss due to terrain, buildings and other factors. If the assumptions are not accurate, the actual coverage of a system will differ from the design. Mapping the coverage with a precision receiver provides the ultimate proof and can help separate interference issues from signal strength problems.

The Anritsu S412E LMR Master is Anritsu's second generation battery-powered Land Mobile Radio (LMR) tester for P25 coverage mapping plus also offers many of the tools needed to install, maintain and certify LMR systems including: a cable and antenna analyzer, spectrum analyzer, P25 signal generator, interference analyzer, power meter, channel scanner, P25 transmitter analyzer, P25 signal generator, transmission analyzer for 2-port devices, and GPS receiver. The S412E offers an NBFM mode to support testing of radios set to the legacy analog modulation (Figure 5). The NXDN and DMR digital radio protocols are also available as options to the S412E.

LMR Master supports P25 talk-out coverage mapping **for P25 Phase-1 and Phase-2 simulcast and non-simulcast systems** with BER measurements on 1011 Hz, O.153 (PN9), Voice, and Control Channel signals. GPS location and time are tagged for each measurement using the internal GPS receiver. Testing with 1011 Hz and O.153 patterns require a system channel be taken out of service for testing causing system disruption. The LMR Master also provides alternatives for testing without disrupting the signal: BER estimation from voice traffic (e.g., FEC and payload data) and a message error rate (MER) measurement from control channel traffic. Both BER and MER are measured down to realistic –115 dbm signal levels. Measurements may be extended to ~–125-dBm with an external low-noise preamp and filtering, as needed.

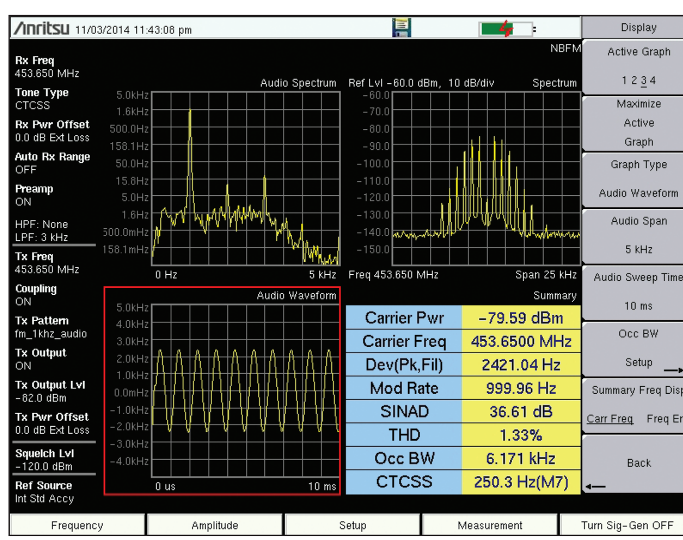

Figure 5. NBFM

System planners use coverage prediction software to design and locate transmitter sites. The predictions are based on estimates for loss and reflections from terrain, foliage, and buildings. System planners often augment the predictions with measurements on key roads and inside buildings. Predictions can be then improved by adjusting the loss and reflection coefficients based on measurement data (Figure 6 and 7). The S412E offers two output formats, .kml and .mtd, that can be accepted by the prediction software.

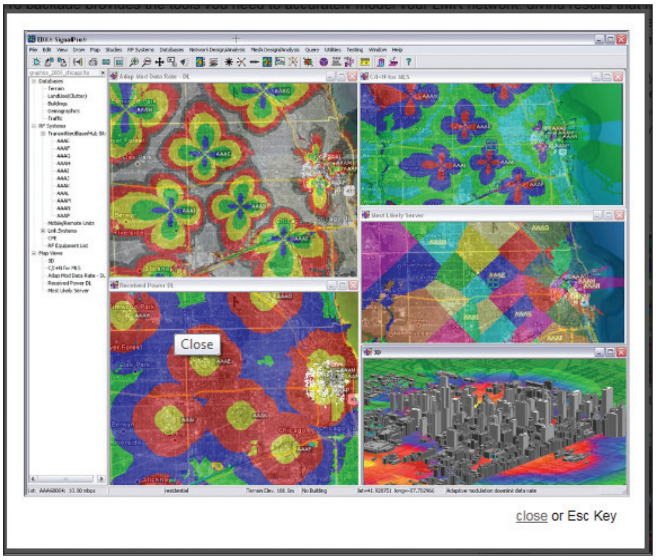

Figure 6. P25 System planners often use prediction software for repeater site design. Image compliments of EDX Wireless.

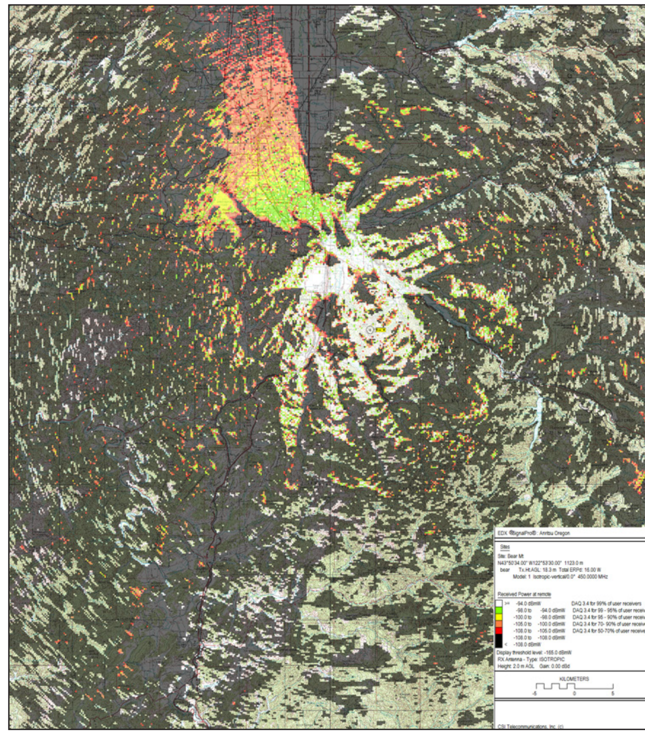

Figure 7. Signal strength predictions for the transmitter measured in this application note using EDX Signal Pro software (Compliments of CSI Telecommunication's, San Francisco, CA)

Coverage mapping is not limited to outdoors with GPS location data. Although not covered in detail here, walk-around P25 coverage mapping data collection inside buildings, tunnels, arenas, stadiums, etc can be done with the S412E pre-loaded with floor plan drawings. This is especially useful for mapping indoor Distributed Antenna System (DAS) coverage. Many government agencies are now requiring reliable inbuilding public safety radio communications, which can often only be met by DAS systems. Thus inbuilding coverage mapping is critical to ensure compliance with government mandated public safety communications requirements.

Map Types

Two types of Coverage Mapping techniques are available in the LMR Master: Graph type and On-Screen Map type. Graph type coverage mapping does not require pre-loading a map into the LMR Master (Figure 8). Graph type coverage mapping produces Google KML data points tagged with GPS location, BER, RSSI, Mod Fidelity, and time stamp data recorded at user specified sampling intervals. As the data is collected it is shown on split screen graphs. Map type Coverage mapping shows selected data on pre-loaded user maps on the LMR Master display while measurements are made. Post-processing the data on a PC allows customizing the coverage maps from the Graph type and Map type coverage data collected by the S412E LMR Master.

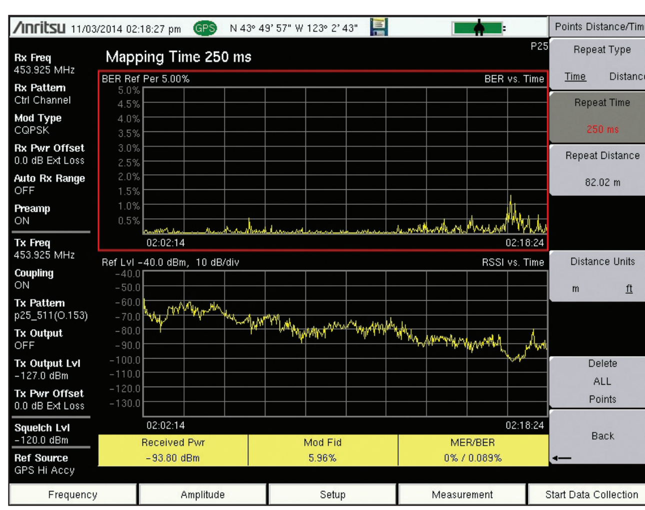

Figure 8. S412E screen shot graph map. Shown are BER (upper graph) and RSSI (lower graph).

On-Screen Maps

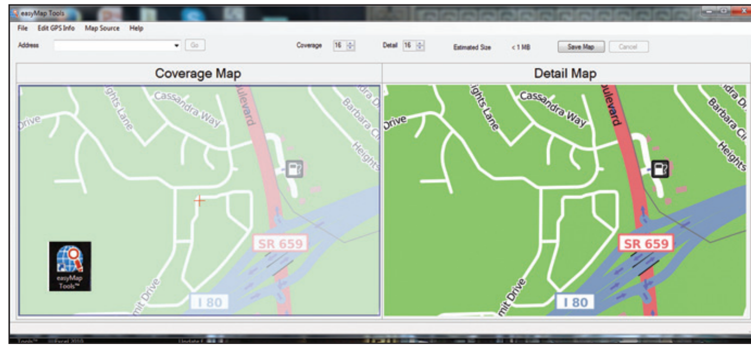

Figure 9. easyMap

Anritsu provides the easyMap software tool to easily create LMR Master drive coverage area maps using Google Map and MapQuest (Figure 9). easyMap can produce maps in two different file formats: .AZM is the new Anritsu zoomable map file type and .MAP is the legacy map file type. easyMap is freely downloadable from the Anritsu website, http://www.anritsu.com.

Anritsu's easyMap Tools on a PC are used to create AZM (.azm) and MAP (.map) files for use in the S412E LMR Master. A USB flash drive is required to transfer these maps from the PC to the LMR Master. The AZM map type is the new Anritsu Zoomable Map type. Anritsu's easyMap is located on the CD provided with the instrument. The latest version can be downloaded and installed from the Anritsu website (http://www.anritsu.com). The ideal image size would be close to 666 pixels x 420 pixels (1.6:1 ratio). The first step is to create the AZM (or legacy .map) file using easyMap Tools. Anritsu's easyMap Tools has the capability to capture a map directly from the source (Google or MapQuest) to the program. To do so enter the coordinates of the desired location in the Address box, select the map type to the right of the address box, then click on Go to download the map. Then on the Coverage Map panel (left box) click on the map (holding the left mouse button down) while moving the mouse to center the map as desired. Adjust the scroll bars to zoom the coverage area in/out as desired. The detail level (resolution) can be adjusted by zooming in/out in the right side Detail Map box. Watch the file size as a large coverage area with great detail will increase the AZM map file size substantially. Large highly detailed maps over about 5-MB in size will require pre-registration with Google or MapQuest for API keys. See the API reference for how to register with Google or MapQuest to receive registration keys. Once the map coverage and detail level requirements have been met and saved, transfer the map files to the S412E LMR Master using USB flash memory. The map files can be directly read by the LMR Master from the USB flash memory drive plugged into the LMR Master's USB socket. It is not necessary to manually copy the map files directly to the S412E's internal memory, as when the Recall a Map soft key is pressed the user can select the USB flash memory drive as the source.

Measurement Setup

The default BER and RSSI measurement ranges, shown on the screen during drive coverage mapping, with their color codings, are shown below:

Quality	Color	BER	RSSI
Excellent	Dark Green	≤ 1%	≥ –70-dBm
Very Good	Light Green	≤ 2%	≥ –80-dBm
Good	Yellow	≤ 3%	≥ –90-dBm
Fair	Orange	≤ 5%	≥ –100-dBm
Poor	Brown	> 5%	< –100-dBm

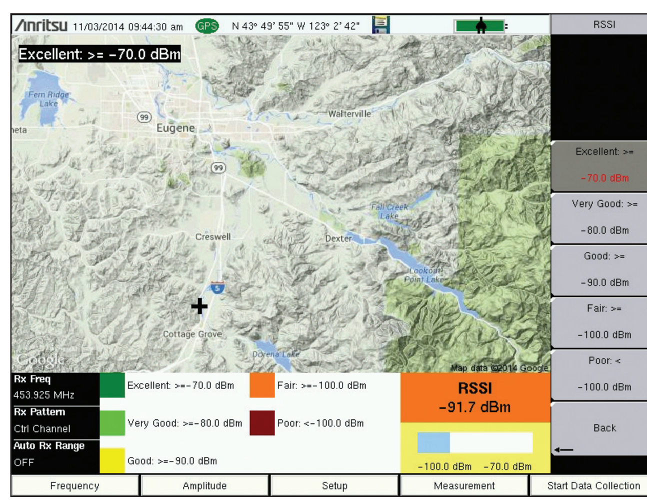

Figure 10. Colors

The user may customize these ranges to suit their particular needs. From the P25 Coverage Mapping soft-key menu, touch the Mapping Type soft-key to select the desired type (BER, RSSI, or Mod-Fi) and then the Legend Setup soft-key. Then use the Excellent through Poor soft-keys (Figure 10) to customize the ranges as desired. Repeat for other Mapping Types as needed.

Getting Started

To begin mapping connect a GPS antenna to the S412E, then turn the GPS receiver on by pressing Shift + System (8), and then the GPS soft-key. If not already in the P25 Analyzer application, press the Menu hard-key, then the P25 Analyzer icon on the touch screen. In the GPS sub-menu, you can turn the GPS on or off, view GPS info, change the GPS Voltage, or reset the GPS. After a minute or two, the S412E should be tracking at least four GPS satellites (Figure 11).

Be sure that your USB flash drive with the desired AZM or MAP files is installed in the S412E's USB socket. Next, in the P25 Coverage Mapping Menu, push the Save/Recall Points/Map soft-key, then the Recall a Map soft-key. At this point a file directory screen is displayed. Note that the default file type is AZM. Change that to MAP if you are using .map files instead of .azm files. Scroll down to the USB memory drive, select it, then press Enter. Then navigate to the desired .azm or .map file you want to load and then press the Enter key to load it. After a second or two the map should appear on the screen.

With the map on the screen and the GPS tracking four or more satellites, the instrument automatically pinpoints your location relative to the map.

Next, connect your receive antenna with known gain to the LMR Master. The gain and cable loss can be compensated with the S412E RX Power Offset soft-key in the Amplitude menu (Figure 12).

Amplitude setup is dependent on your environment. The Ref Level can be manually fixed with the preamp fixed on or off depending on the Ref Level setting. Or, the Auto RX Range can be enabled for dynamic Ref Level setting based on signal strength. In an urban environment with many strong signals it may be best to use a fixed Ref Level. If the Ref Level is set to –40-dBm or lower, the preamp will be enabled. If the Auto RX Range is enabled, the Ref Level will dynamically adjust and the preamp will be automatically enabled if the adjusted Ref Level is –40-dBm or less. For rural environments with less spectrum congestion and fewer strong signals, the Auto RX Range can be set on or off as desired. If set to off, the Ref Level can be fixed at a lower level, e.g., –50 or –60-dBm and thus the preamp will be automatically enabled. This will provide maximum sensitivity with an ~ –124-dBm noise floor. Typically, the S4121E receiver will exhibit a –117-dBm sensitivity for a 5% BER in this configuration. Similar to actual P25 LMR radios. But strong nearby signals can degrade the performance, causing a higher BER than an actual radio would have. Thus these competing factors need to be balanced. The user should be aware of the nearby signal envrionment to avoid strong near-field weak far-field signal problems. In some cases it may be necessary to use front-end filtering, particularly in congested spectrum urban areas.

For P25 Phase-1 systems, select Setup. Then press the Mod-Type soft-key. Select C4FM for non-simulcast systems or CQPSK for simulcast systems. Next, press the RX Pattern soft-key. For trunking systems scroll down and select Ctrl Channel. Next, in the Setup screen set the Squelch Lvl to the desired value. Typically –120-dBm which is the lowest squelch level available and is about 4-dB above the internal noise floor with the preamp enabled. This has no affect on drive coverage data collection, i.e., P25 Coverage Mapping does not use the squelch setting. The squelch setting is used by the P25 Analyzer to set its threshold.

Figure 11. GPS Menus

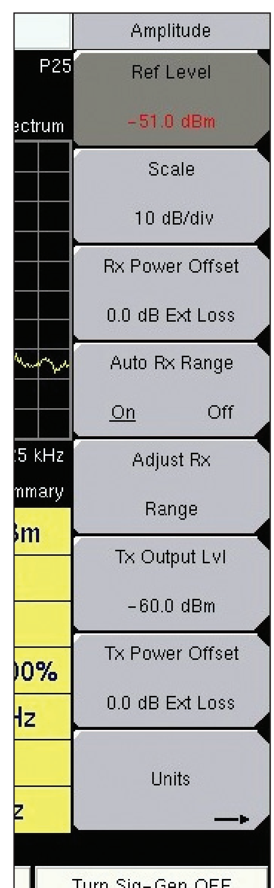

Figure 12. Auto range menu

Starting and Stopping Coverage Map Data Collection, Saving the Data.

Before starting data collection, the time or distance sampling interval should be set. If time sampling is desired, select an initial time sample period of 0.1 to 1-sec. If distance sampling is desired, select 3 to 30-mtrs. Sample interval parameters will vary based on the vehicle speed, city streets, highways, rural roads, etc. Use the soft-key Point Distance/Time Setup in the P25 Coverage menu. Select the Repeat Type (Time or Distance), then either Repeat Time or Distance Units and Repeat Distance as desired (Figure 13).

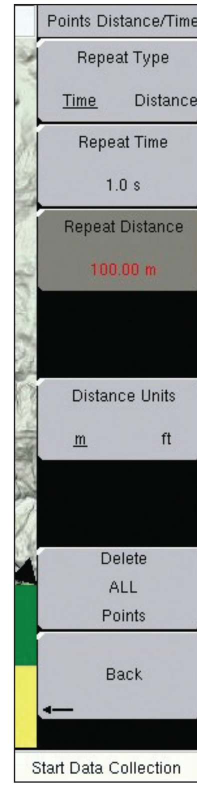

Figure 13. Distance time menu

The S412E directly stores measurements in up to three file types: KML file format is for use with Google Earth, MTD file format is a tab delimited spread sheet compatible format, and JPG for screen-captured coverage map files. Once the KML (etc) file is saved, the USB flash memory can be moved to a PC. The user then clicks on the KML file name with Windows Explorer, which in turn activates Google Earth and displays the measurement locations. Measurement locations are shown by colored push pins. Individual pins can be selected to show the measurements at that location. MTD file data can be processed in a spread sheet as needed.

Once all the parameters have been selected, the map loaded, etc, data collection can start by by pushing the Start Data Collection soft-key in the screen's lower right corner. Before doing this, however, it is best to review the control channel signal in the P25 Analyzer. The default P25 Analyzer setup has the Linear Constellation in the upper left corner of the screen, the Spectrum Graph in the upper right corner, the Eye Diagram in the lower left corner, and the Summary Table in the lower right corner. Review them, especially the Summary Table, to ensure that the instrument settings are correct with the control channel signal at the proper level, BER, Mod-Fi, etc. If the instrument's Ref Level, preamp setting, etc are incorrect the displayed signal may be too weak or overloading the instrument, resulting in a poor BER and Mod-Fi. In an overloaded situation there may be an ADC overloaded warning message advising an increase in the Ref Level setting. ADC overloads can be minimized by enabling the Auto RX Range control, as discussed previously for the amplitude Ref Level setup.

After reviewing the P25 Analyzer (Figure 14) and ensuring all settings are correct and the control channel signal is what it should be, proceed to starting the data collection by touching the P25 Coverage soft-key and then the Start Data Collection soft-key in the screen's lower right corner. As data collection proceeds, the number of data points collected will be updated on the screen at periodic intervals. Drive the coverage route. When done, press the Stop Data Collection soft-key.

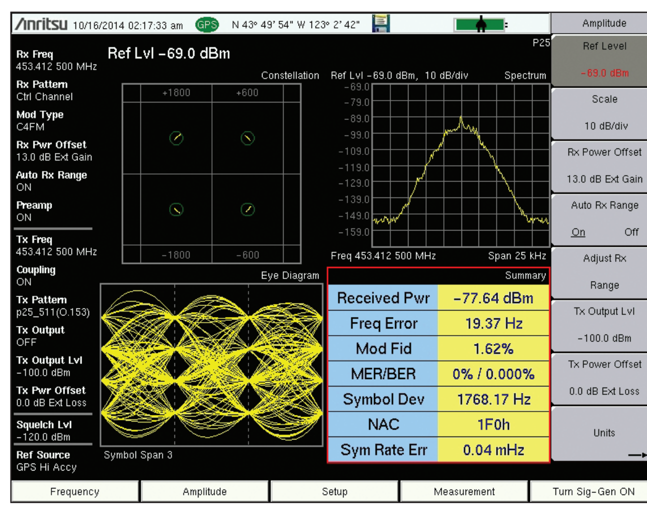

Figure 14. P25 Analyzer display screen

Now it is time to save the data to the USB flash memory drive. It is possible to save the data to the S412E's internal memory if a USB flash memory drive is not available. But then the data must be later copied to a USB flash memory drive or transferred to a PC using MST. Although not discussed in detail here, it is possible to start and stop data collection, save intermediate results to the USB flash drive, delete or retain data points from the previous data collections, etc. But then the data must be later copied to a USB flash memory drive or transferred to a PC using Anritsu's Master Software Tools (MST). MST is on the CD provided with the LMR Master. The latest version is also available from the Anritsu website http://www.anritsu.com. Further, although not recommended, the S412E will retain collected data points through a power off/on cycle even though they were not stored to the internal memory disk or the external USB flash drive.

To save the KML coverage data, touch the P25 Coverage soft-key, then the Save/Recall Points/Map sub-key, then the Save KML Points sub-key. Then touch the Change Save Location sub-key to select the USB flash memory drive as the destination. Scroll to the USB flash memory drive and then touch Set Location. This will automatically return to the previous screen. Use either the Quick Name soft-keys or manually enter the desired file name using the keyboard, then press Enter to save the KML data file. Repeat as necessary to save the Tab Delimited and JPG screen-capture data file types. After the last save operation, wait 30-sec before removing the USB flash memory drive to transfer the files to a PC for post processing.

Analyzing the Data

After Data Collection is complete (Figure 15), the previously saved KML data points can be recalled later by the instrument to be used once again. This is particularly useful when it is desired to change the underlying map, append additional drive coverage routes, etc. For viewing the data collected however, it is recommended that the data be saved as a tab delimited file (.mtd). A tab delimited file can be opened with notepad or Excel for easy viewing and report generation.

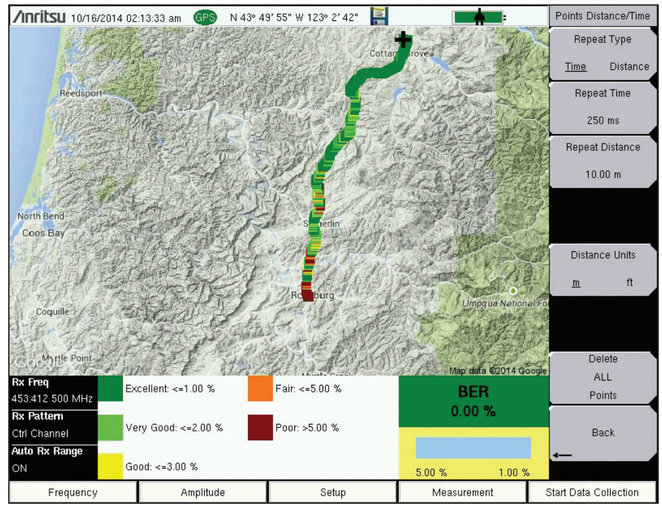

Figure 15. JPG from S412E screen

When saved as a tab delimited file (.mtd), the points recorded by the instrument can later be opened by a program such as Excel, to be viewed and analyzed (Figure 17).

Once opened, looking at the file from top to bottom, the first things you see are the rows 1-16. It has basic information, such as the file mode, model, serial number, and date the mapping was done. The actual data below is divided into columns. Columns A-F is only relevant when coverage mapping with GPS, but the columns G-AE pertain to both coverage mapping methods.

The columns Y-AH show the threshold values designated by the user earlier. At the very end, in the column AI and AJ, errors, if any, are listed. There are three possible values: ADC over range; saturation; and none. The colors shown by the instrument provide easy viewing for the user when determining signal strength, but by viewing the file as a tab delimited file, the actual raw data can be seen and then be opened by other software programs for analysis and report generation.

Figure 16. Google Earth

With Google Earth, you can open a saved KML file transferred from the device to your computer. Simply double-click the KML file and Google Earth will run and show the points in a Digital Orthophoto Quadrangle (DOQ) format. You can click on the points to see both the colors for easy analyzing, as well as the more specific values given by a tab delimited file.

	A	B	C	D	E	F	G	H	I	J	K
4											
5	<APP_DATA>										
6	#Pt	GPS Statu	Longitude	Latitude(Y	Altitude	UTC Date	UTC Time	System Date	System Ti	Measurement	
7	Point# 1	GPS Locke	-123.055	43.7976	180 meter	10/6/2014	3:00:35	10/5/2014	20:25:45	RSSI(dBm)	-77.78
8	Point# 2	GPS Locke	-123.055	43.7976	180 meter	10/6/2014	3:00:39	10/5/2014	20:25:49	RSSI(dBm)	-77.95
9	Point# 3	GPS Locke	-123.055	43.7976	180 meter	10/6/2014	3:00:43	10/5/2014	20:25:52	RSSI(dBm)	-78.1
10	Point# 4	GPS Locke	-123.055	43.7976	180 meter	10/6/2014	3:00:47	10/5/2014	20:25:56	RSSI(dBm)	-78.2
11	Point# 5	GPS Locke	-123.055	43.7976	180 meter	10/6/2014	3:00:51	10/5/2014	20:26:00	RSSI(dBm)	-78.6
12	Point# 6	GPS Locke	-123.055	43.7976	180 meter	10/6/2014	3:00:55	10/5/2014	20:26:04	RSSI(dBm)	-78.44
13	Point# 7	GPS Locke	-123.055	43.7976	180 meter	10/6/2014	3:00:58	10/5/2014	20:26:08	RSSI(dBm)	-79.19
14	Point# 8	GPS Locke	-123.055	43.79759	180 meter	10/6/2014	3:01:02	10/5/2014	20:26:12	RSSI(dBm)	-75.53

	L	M	N	O	P	Q	R	S	T	U	V
4											
5											
6											
7		BER(Perce	0		MODFID(F	1.4	Setup:	Mapping	BER	Frequenc	453.412
8		BER(Perce	0		MODFID(F	1.36	Setup:	Mapping	BER	Frequenc	453.412
9		BER(Perce	0		MODFID(F	1.44	Setup:	Mapping	BER	Frequenc	453.412
10		BER(Perce	0		MODFID(F	1.43	Setup:	Mapping	BER	Frequenc	453.412
11		BER(Perce	0		MODFID(F	1.42	Setup:	Mapping	BER	Frequenc	453.412
12		BER(Perce	0		MODFID(F	1.44	Setup:	Mapping	BER	Frequenc	453.412
13		BER(Perce	0		MODFID(F	1.27	Setup:	Mapping	BER	Frequenc	453.412
14		BER(Perce	0		MODFID(F	1.8	Setup:	Mapping	BER	Frequenc	453.412

Figure 17. Example Excel image

Column A- the point number
Column B- the status of the GPS
Column C- the longitude
Column D- the latitude
Column E- the Altitude
Column F- the UTC date
Column G- the UTC time

Column H- the system date
Column I- the system time
Column J- RSSI
Column K- RSSI
Column L- Blank
Column M- BER
Column N- BER

Column O- Blank
Column P- ModFid
Column Q- ModFid
Column R- Setup
Column S- Setup
Column T- Setup
Column U- Frequency

Column V- Frequency
Column W- Rx Pattern
Column X- Rx Pattern
Column Y- AH- Level threshold settings
Column AI- Error Status
Column AJ- Error Status

To install Google Earth, go to the web site: http://earth.google.com/. Download the program and then install it to your computer. Additional help may be found through the Help pull-down menu. When Coverage Mapping with the GPS option, the KML files can also be opened by Google Earth (Figure 18). KML data points in the Google Earth image can be opened up with a mouse pointer and click to show the RSSI, BER, Mod-Fi, etc for each selected data point (Figure 18). This is very useful for quickly examining poor spots in an otherwise good coverage area.

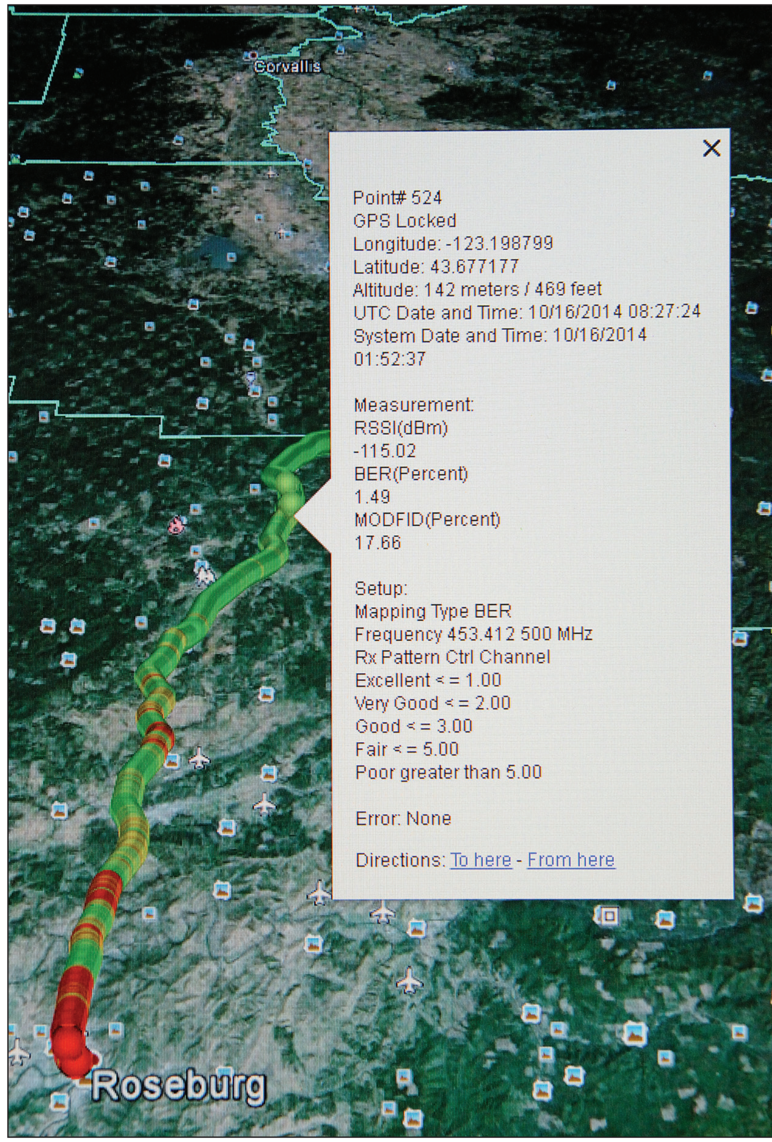

Figure 18. Mouse pointer/click data point display

Summary

P25 digital radio systems are being deployed for public safety communications extensively in North America. Many major cities and counties have deployed P25 radio systems. Rural counties have formed regional multi-site networked P25 systems. State P25 networked radio systems also exist. The National Park Service has also deployed mixed-mode P25 digital/analog multi-site radio systems in various national parks. Verification of radio coverage is critical to fixing coverage holes, acceptance and deployment. To support these needs, Anritsu has developed the S412E LMR Master battery powered test set with built-in P25 Coverage Mapping as an option.

This application note describes an easy and convenient way to quickly and accurately perform P25 Coverage Mapping without the need for a companion PC in the field. This greatly simplifies P25 Coverage Mapping and makes walk-around P25 Coverage Mapping possible without using a backpack to carry multiple instruments, including a PC. The collected data is then easily moved at a later time to a PC for detailed analysis, producing coverage maps, comparison with software produced coverage maps and report generation. This makes Coverage Mapping suitable for both drive coverage and walk-around coverage mapping outdoors and inside buildings, tunnels, arenas, etc.

Anritsu also provides LMR Master options for Coverage Mapping of the NXDN, DMR, LTE and legacy analog NBFM radio systems.

Reference

1) Google Maps API Keys: GoogleMapsAPIInst-26AUG2014.pdf
http://www.anritsu.com/en-US/Downloads/Software/Drivers-SoftwareDownloads/DWL10636.aspx

2) MapquestAPI Keys video: http://www.anritsu.tv/en-us/easymaptools-mapquest-key

Notes

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