Anritsu Advancing beyond

Remote Spectrum Monitor
MS27101A

Remote Spectrum Monitor MS27101A

Introduction

With the rapid expansion of wireless communications, the need for robust networks free of interference continues to grow. Capacity can be degraded by the presence of illegal or unlicensed signals that interfere with legitimate transmissions. These signals can be periodic or present at different frequencies over time, making the discovery and removal of these sources of interference a significant challenge.

Spectrum monitoring can serve to enforce compliance with government regulations. Police, fire fighters, air traffic control, railroads using positive train control (PTC), military, and emergency services must all have access to communications free of impediments and distortion. Compliance with spectrum regulations is often enforced by spectrum monitoring.

The Remote Spectrum Monitor MS27101A is designed for such applications as white space monitoring, harm claim threshold detection, in-building interference monitoring, positive train control (see figure 1), and research/university applications.
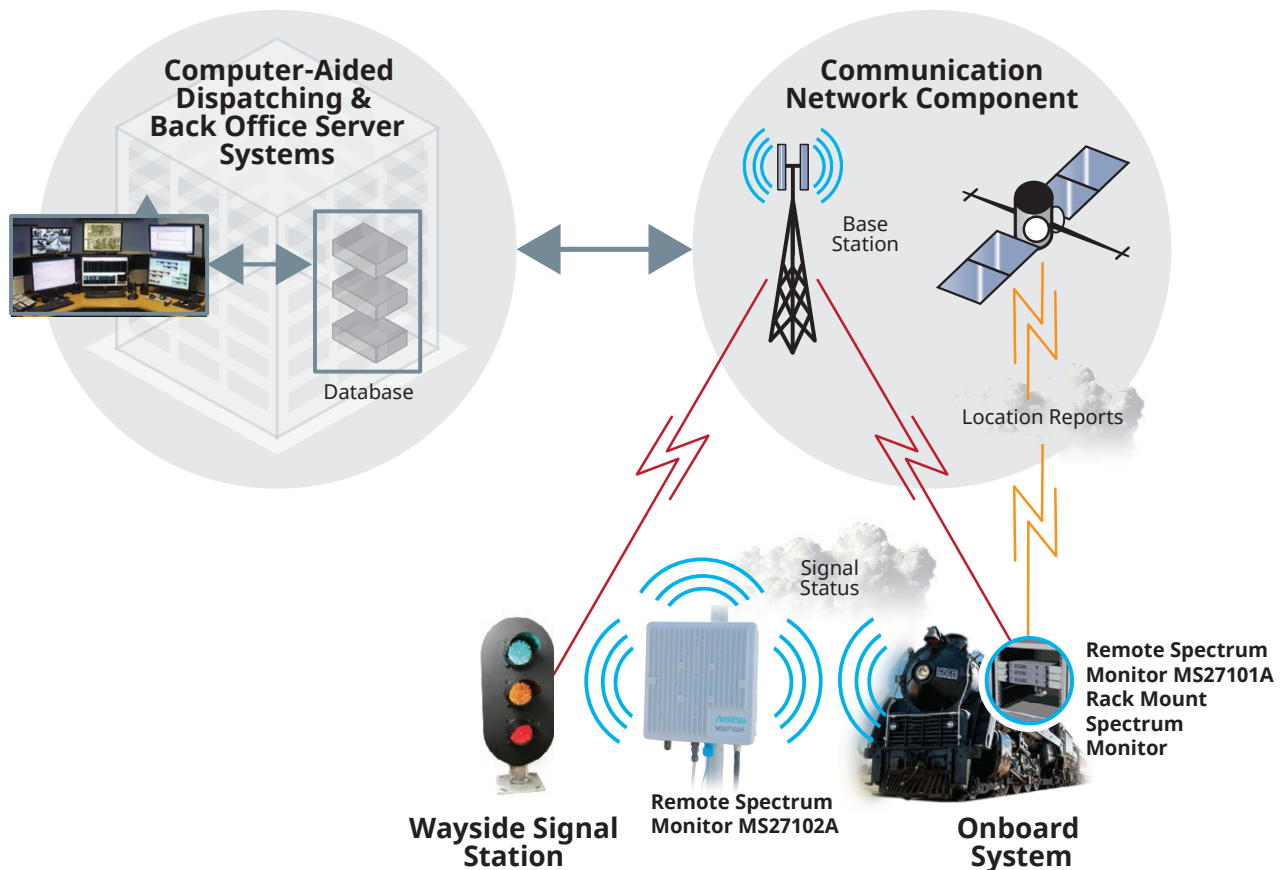

Figure 1. Positive Train Control (PTC) Application

Remote Spectrum Monitor MS27101A

In addition to interference detection, spectrum monitoring is also used to characterize spectrum occupancy. Government regulators and operators are often interested in determining the usage rate for various frequency bands. Monitoring these frequencies provides the information needed to optimize spectrum for maximum utilization. Spectrum can be re-purposed for other applications or multiplexed with other signals using cognitive radio techniques. Figure 2 illustrates spectrum occupancy measurement.
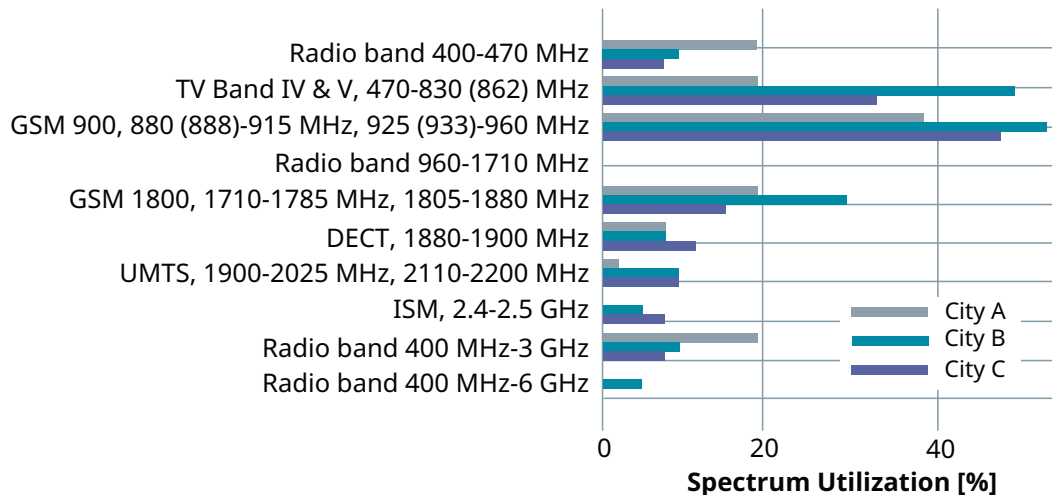
Figure 2. Spectrum Occupancy Measurement

Remote Spectrum Monitor MS27101A

Capable of sweeping at rates up to 24 GHz/s, the Remote Spectrum Monitor MS27101A allows capture of many types of signals. This includes periodic or transient transmissions as well as short "bursty" signals. Also featured is a high dynamic range, high sensitivity, and low spurious signals. This enables the Remote Spectrum Monitor MS27101A to reliably distinguish between low-level signals being observed and those signals generated by the monitor itself.

Key Facts

- 9 kHz to 6 GHz
- Sweep speed up to 24 GHz/s
- Integrated web server to view, control and conduct measurements via a web browser (Chrome and FireFox recommended)
- Remote firmware update capable
- Watchdog timer to insure long-term stability for remotely deployed monitors
- Linux operating system
- Low spurious signals for accurate signal discovery
- 20 MHz instantaneous FFT bandwidth
- Low power consumption < 11 watts

- Integrated GPS receiver for monitoring location and time synchronization applications
- Gigabit Ethernet available for high speed transmissions
- Interference analysis: spectrogram and signal strength
- Dynamic range: > 106 dB normalized to 1 Hz BW
- DANL: < –150 dBm referenced to 1 Hz BW, preamp On
- Phase noise: –99 dBc/Hz @ 10 kHz offset at 1 GHz
- IQ block mode and streaming with time stamping for TDOA applications
- Vision™ software optional for automated spectrum measurements, setting alarms and geo-locating signal sources

Designed For Remote Applications

With monitors potentially being deployed hundreds or thousands of kilometers from the control center, it is preferred that each monitor remain operational under all types of conditions. The Remote Spectrum Monitor MS27101A is designed for robust field deployments, with capabilities for remote power cycling, automated system recovery protocols, and firmware updates "pushed" to the monitor remotely.

In the event of an application error or power fluctuation which causes an ongoing interruption in monitor communication, a re-boot policy is implemented to bring the remote monitor back to its previous state. Under these conditions, the current firmware is automatically reloaded and on-line operation is restored. Instrument settings are also restored to their previous state.

A "Golden" firmware image is also placed on each unit in a secure location in memory. If for any reason the firmware in the unit becomes corrupted, a Golden Image is used to bring back full operation of the monitor. This feature is particularly useful for remote firmware updates.

Remote Firmware Updates

There are several stages or "checks" performed when a new firmware package is downloaded remotely into the instrument. Once a new firmware image is downloaded to the monitor, various tests are performed to insure the code was properly transmitted without error. The code is then transferred into probe memory and installed. If there are any issues with this process or the new firmware does not work correctly, the Golden Image automatically replaces the downloaded firmware to keep the remote monitor operational. See figure 3 for the remote firmware update policy.

The Golden Image feature provides the user with assurance that the monitor stays in operation when changes are made to the code. Any bug fixes, updates, or user requested features can then be remotely sent to the spectrum monitor and safely incorporated.
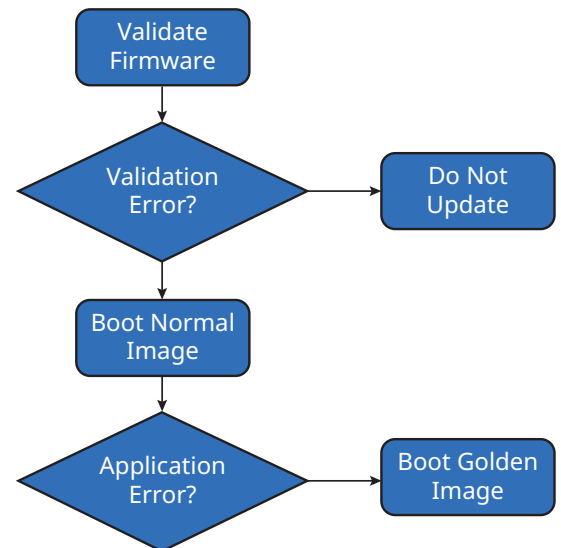
Figure 3. Remote Firmware Update Policy

Integrated Web Server

The Remote Spectrum Monitor MS27101A features an integrated web server. Using an internet browser (Chrome and FireFox are supported), a user from anywhere in the world can log in to the spectrum monitor and control any of its features. This includes such parameters as frequency settings, resolution bandwidth and video bandwidth (RBW/VBW) control, reference level configuration, and many other settings relevant to the user's spectrum monitoring application. Trace data, spectrograms and other measurements can be viewed inside the browser window. A key advantage in using the web server is that it is platform agnostic. Any electronic device capable of rendering a browser will work with the web server.

Users can utilize their PC/laptop, tablet, or even smartphone to view the spectrum and change instrument settings. PCs/laptops, tablets, or even smart phones can be used to view spectrum and adjust remote instrument settings. Figure 4 shows the measurement data displayed on a smartphone. Figure 5 shows the screen shot displayed on a PC/laptop. The Remote Spectrum Monitor MS27101A features Gbit Ethernet, allowing fast transfers of measurement data and control information.

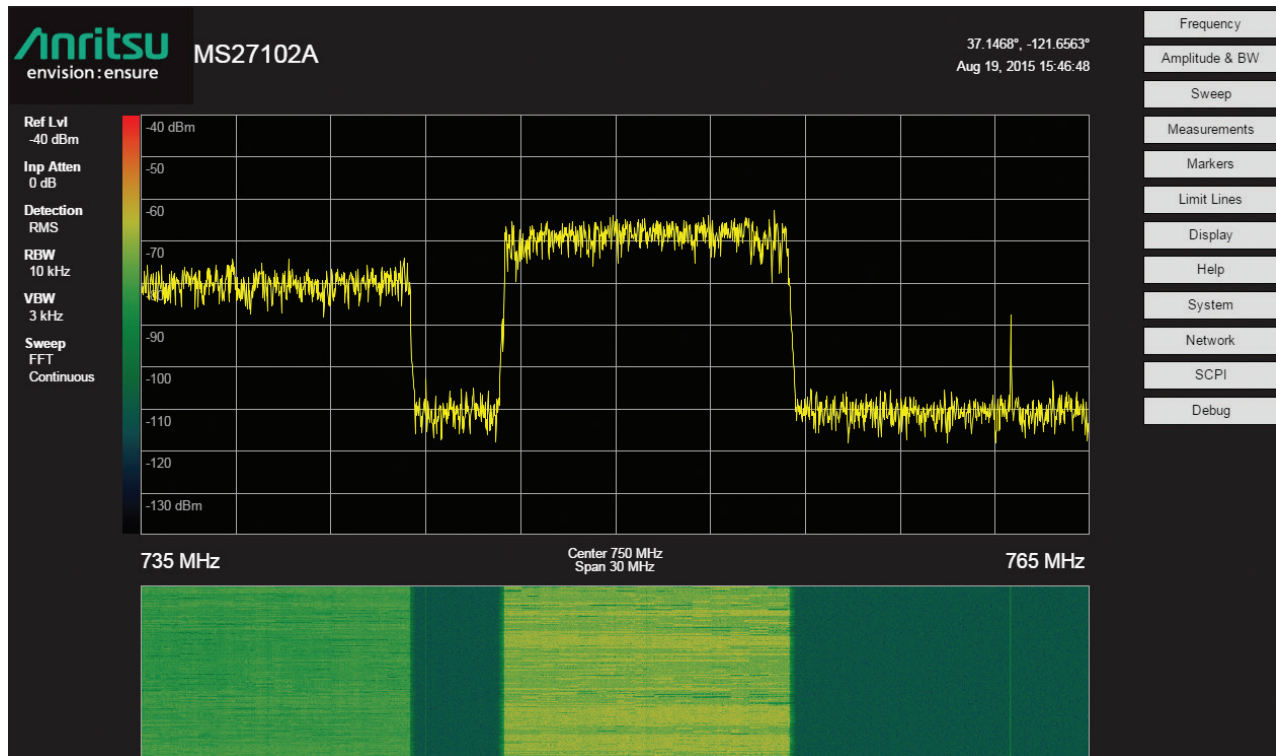*Figure 4. User Interface Shown on Smartphone Browser*

Figure 5. Remote Spectrum Monitor MS27101A Screenshot

Remote Spectrum Monitor MS27101A

Hardware

The Remote Spectrum Monitor MS27101A is designed for indoor deployment. Ports include power, RF Input, Gbit Ethernet, two USB ports, External Ref In, and GPS antenna. The operating temperature ranges from –40 ⁰C to +55 ⁰C.

The Remote Spectrum Monitor MS27101A typically consumes less than 11 Watts. The low power used facilitates use of the spectrum monitor powered by solar cells for remote locations.

Optionally available is a bracket kit for the Remote Spectrum Monitor MS27101A. Brackets are provided for placing the Remote Spectrum Monitor MS27101A in a standard rack-mount configuration. Additional brackets are also available in the kit for combining two Remote Spectrum Monitor MS27101A monitors to fit into a standard rack-mount cage. Figure 6 shows the contents of the rack-mount bracket kit. Figure 7 illustrates the combination of two spectrum monitors using these brackets.
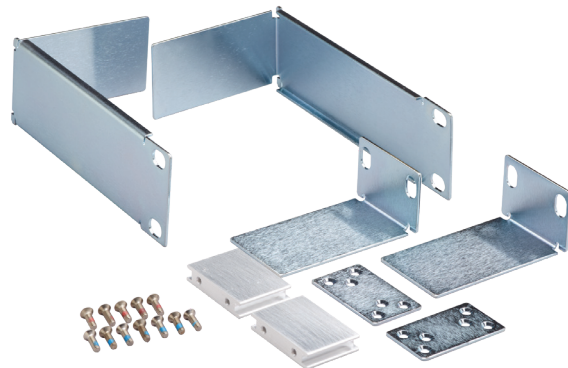

Figure 6. Remote Spectrum Monitor MS27101A-001 Rack-Mount Bracket Kit

Figure 7. Two Remote Spectrum Monitor MS27101A Probes Joined Together with Bracket Kit

Key Applications

- Spectrum Monitoring usage surveys (white space)
- Harm claim threshold (monitor spectrum for signals "de-sensing" receivers)
- PTC
- Spectrum occupancy and frequency band clearing
- Fast and efficient detection and elimination of interference sources
- Monitor jails/prisons for illegal broadcasts
- Satellite earth station monitoring
- Security at military facilities, national borders, utilities, airports, and other sensitive sites where monitors are positioned indoors

- Spectrum monitoring associated with lab RF testing
- Government regulators enforcing spectrum policy
- Geo-location of interference signals
- Maintain history of spectrum activity
- University and lab research
- Generate records of interference events for potential legal action

Signals of Interest (SOI)

The wide variety of signals to be monitored fall into several categories. Each of these types of signals will be examined in some detail. These include:

- Intentional interference (including illegal or unlicensed broadcasts)
- Accidental interference
- Occupancy

Intentional Interference

Illegal AM/FM and video broadcasts are found in many parts of the world. These signals can be generated by pirated broadcast equipment or over-powered CB radios. Additionally, jammers are sometimes used for applications such as preventing students from cheating on tests, stopping employees from taking phone calls on company time, or to prevent prisoners from making illicit calls from prisons. Mitigating this type of interference has become a high priority with government regulators.

Accidental Interference

A wide variety of accidental interference can be seen in the spectrum. A common problem is cable TV leakage. This type of leakage exists both from cable signals leaking into the outside environment as well as from outside signals leaking into the cable system. This problem has been enhanced with the proliferation of cable into frequencies used by broadcasters and cellular operations (such as the 700 MHz LTE band).

Digital enhanced cordless telecommunications (DECT) phones also cause a problem, particularly when people bring their wireless phones along when moving from one country to another. DECT frequencies vary in different countries, providing the potential for interference when transported. Figure 8 shows the frequency bands for various DECT phones based on country of origin.

Other sources of interference include cellular signals (due to antenna tilt or azimuth errors), repeaters oscillating, wireless microphone problems, power equipment, and many others.
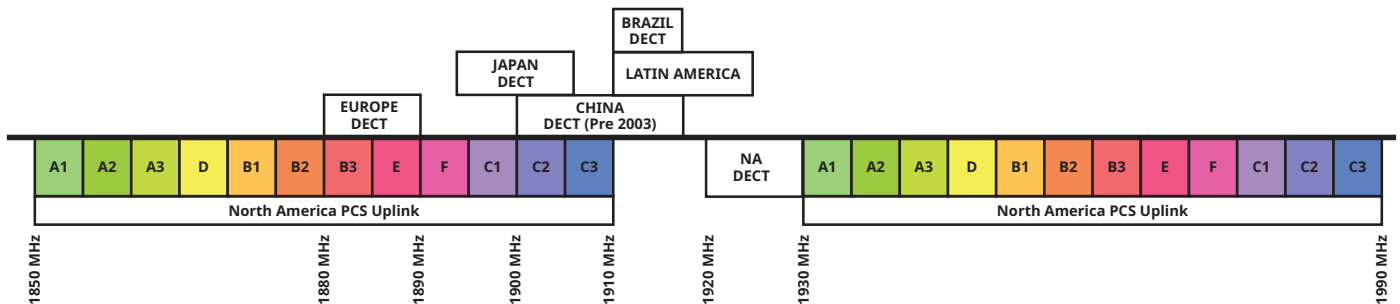

Figure 8. International DECT Phone Frequencies Operate in US Cellular Bands

Remote Spectrum Monitor MS27101A

Occupancy

With the rapid demand for available spectrum from both public and private sectors, new ways are being investigated for making more efficient use of various frequency bands. A lot of the spectrum is potentially underutilized, providing the opportunity to re-purpose existing spectrum with additional applications.

Spectrum occupancy measurements quantify the amount of use of frequency bands over a given period of time. Remote spectrum probes are used to monitor a band of frequencies, recording spectral history as a function of time.
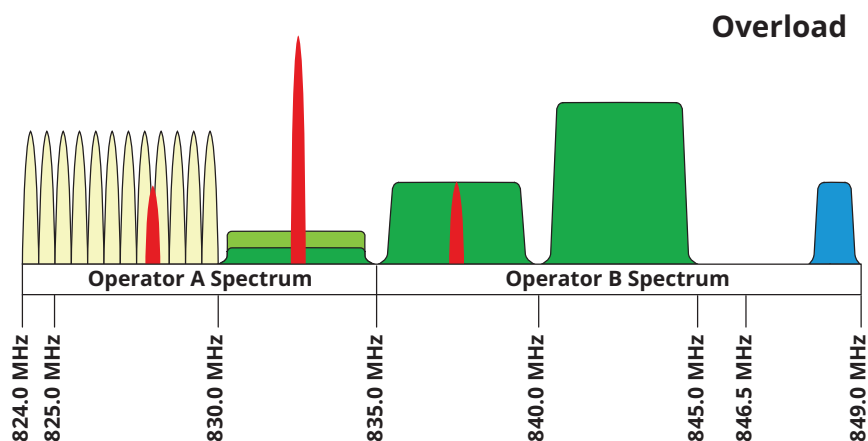

Figure 9. Malfunctioning Repeaters May Block Licensed Transmission

Performance

The Remote Spectrum Monitor MS27101A is able to sweep the frequency spectrum at rates up to 24 GHz/s. This enables the user to capture intermittent or pulsed signals. Additionally, the spectrum monitors has an instantaneous FFT bandwidth of 20 MHz.

A typical use case for this feature is the real-time capture of the entire FM radio band (88 MHz to 108 MHz in most countries). The user can perform multiple FFT captures of FM signals, storing the data for later playback and analysis. Unlicensed signals can then be identified using this information.

Multiple spectrum sensors can also be deployed to extend the RF monitoring capabilities and for geo-location of SOI. Using three or more probes, Anritsu's optional Vision™ software can be used to position an interferer signal or illegal broadcast. Additionally, IQ measurements are time stamped using the probe's GPS receiver. This enables the user to employ their own software using Time Distance of Arrival (TDOA) capabilities to find interferers, given each monitor IQ measurement is precisely time stamped.

Communications

Communications with the Remote Spectrum Monitor MS27101A are conducted via wired Ethernet. Each monitor is shipped with a pre-programmed static IP address. See Anritsu's Ethernet Configuration Guide for further details. Alternatively, a USB cellular modem can be used for communicating with the Remote Spectrum Monitor MS27101A. Although 3G modems can be used, a 4G modem is recommended for its high throughput rates.

All commands and inquiries with the Remote Spectrum Monitor MS27101A are done with SCPI commands. Anritsu provides a user manual listing each SCPI command along with its corresponding description and command syntax.
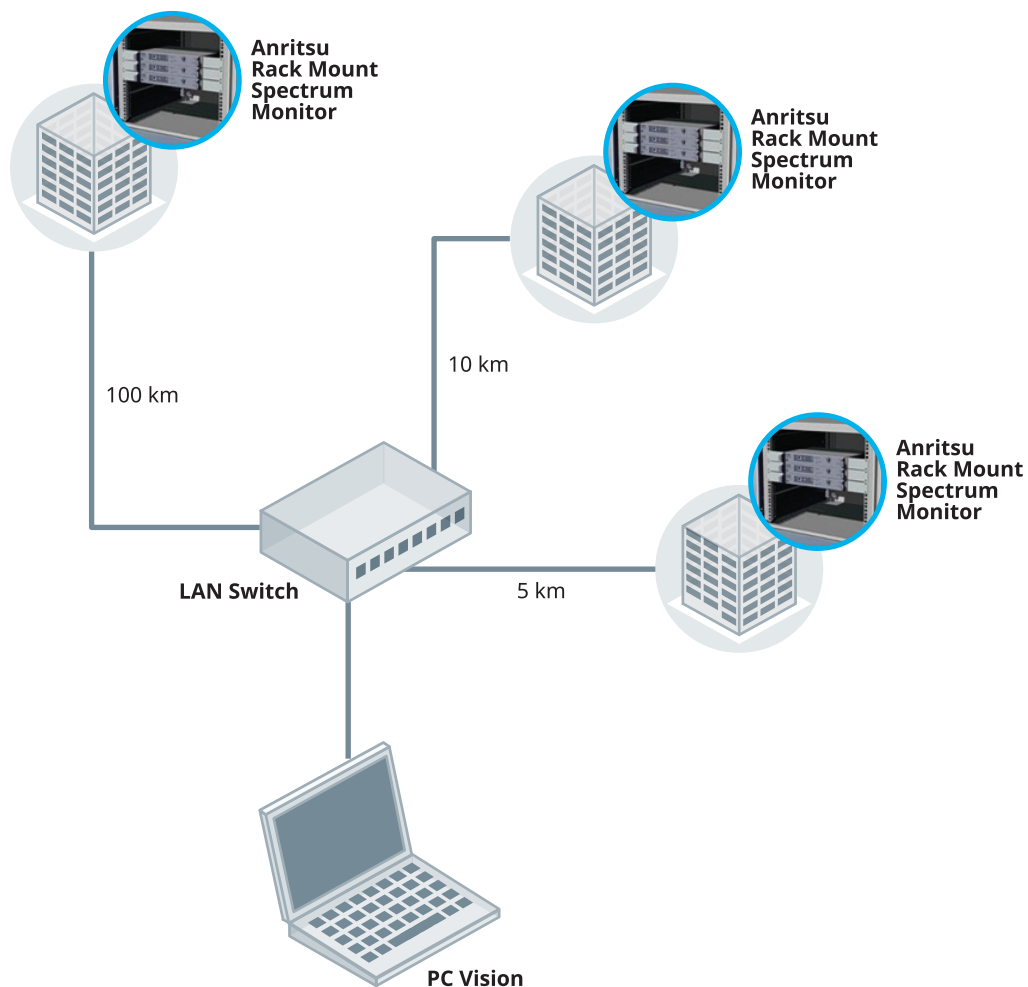

Figure 10. Remote Spectrum Monitor MS27101A Indoor Spectrum Monitoring System

Anritsu Advancing beyond

Specifications are subject to change without notice.

- **United States**
Anritsu Americas Sales Company
450 Century Parkway, Suite 190, Allen, TX 75013 U.S.A.
Phone: +1-800-Anritsu (1-800-267-4878)

- **Canada**
Anritsu Electronics Ltd.
700 Silver Seven Road, Suite 120, Kanata,
Ontario K2V 1C3, Canada
Phone: +1-613-591-2003
Fax: +1-613-591-1006

- **Brazil**
Anritsu Eletronica Ltda.
Praça Amadeu Amaral, 27 - 1 Andar
01327-010 - Bela Vista - Sao Paulo - SP, Brazil
Phone: +55-11-3283-2511
Fax: +55-11-3288-6940

- **Mexico**
Anritsu Company, S.A. de C.V.
Blvd Miguel de Cervantes Saavedra #169 Piso 1, Col. Granada
Mexico, Ciudad de Mexico, 11520, MEXICO
Phone: +52-55-4169-7104

- **United Kingdom**
Anritsu EMEA Ltd.
200 Capability Green, Luton, Bedfordshire, LU1 3LU, U.K.
Phone: +44-1582-433200
Fax: +44-1582-731303

- **France**
Anritsu S.A.
12 avenue du Québec, Immeuble Goyave,
91140 VILLEBON SUR YVETTE, France
Phone: +33-1-60-92-15-50

- **Germany**
Anritsu GmbH
Nemetschek Haus, Konrad-Zuse-Platz 1,
81829 München, Germany
Phone: +49-89-442308-0
Fax: +49-89-442308-55

- **Italy**
Anritsu S.r.l.
Spaces Eur Arte, Viale dell'Arte 25, 00144 Roma, Italy
Phone: +39-6-509-9711

- **Sweden**
Anritsu AB
Kistagången 20 B, 2 tr, 164 40 Kista, Sweden
Phone: +46-8-534-707-00

- **Finland**
Anritsu AB
Technopolis Aviapolis, Teknobulevardi 3-5 (D208.5.),
FI-01530 Vantaa, Finland
Phone: +358-20-741-8100

- **Denmark**
Anritsu A/S
c/o Regus Winghouse, Ørestads Boulevard 73, 4th floor,
2300 Copenhagen S, Denmark
Phone: +45-7211-2200

- **Russia**
Anritsu EMEA Ltd.
Representation Office in Russia
Tverskaya str. 16/2, bld. 1, 7th floor., Moscow, 125009, Russia
Phone: +7-495-363-1694
Fax: +7-495-935-8962

- **Spain**
Anritsu EMEA Ltd.
Representation Office in Spain
Paseo de la Castellana, 141. Planta 5, Edificio Cuzco IV
28046, Madrid, Spain
Phone: +34-91-572-6761

- **Austria**
Anritsu EMEA GmbH
Am Belvedere 10, A-1100 Vienna, Austria
Phone: +43-(0)1-717-28-710

- **United Arab Emirates**
Anritsu EMEA Ltd.
Anritsu A/S
Office No. 164, Building 17, Dubai Internet City
P. O. Box – 501901, Dubai, United Arab Emirates
Phone: +971-4-3758479

- **India**
Anritsu India Private Limited
6th Floor, Indiqube ETA, No.38/4, Adjacent to EMC2,
Doddanekundi, Outer Ring Road, Bengaluru – 560048, India
Phone: +91-80-6728-1300
Fax: +91-80-6728-1301

- **Singapore**
Anritsu Pte. Ltd.
11 Chang Charn Road, #04-01, Shriro House, Singapore 159640
Phone: +65-6282-2400
Fax: +65-6282-2533

- **Vietnam**
Anritsu Company Limited
16th Floor, Peakview Tower, 36 Hoang Cau Street, O Cho Dua Ward,
Dong Da District, Hanoi, Vietnam
Phone: +84-24-3201-2730

- **P.R. China (Shanghai)**
Anritsu (China) Co., Ltd.
Room 2701-2705, Tower A, New Caohejing International
Business Center No. 391 Gui Ping Road Shanghai, 200233, P.R. China
Phone: +86-21-6237-0898
Fax: +86-21-6237-0899

- **P.R. China (Hong Kong)**
Anritsu Company Ltd.
Unit 1006-7, 10/F., Greenfield Tower, Concordia Plaza,
No. 1 Science Museum Road, Tsim Sha Tsui East,
Kowloon, Hong Kong, P.R. China
Phone: +852-2301-4980
Fax: +852-2301-3545

- **Japan**
Anritsu Corporation
8-5, Tamura-cho, Atsugi-shi, Kanagawa, 243-0016 Japan
Phone: +81-46-296-6509
Fax: +81-46-225-8352

- **Korea**
Anritsu Corporation, Ltd.
5FL, 235 Pangyoyeok-ro, Bundang-gu, Seongnam-si,
Gyeonggi-do, 13494 Korea
Phone: +82-31-696-7750
Fax: +82-31-696-7751

- **Australia**
Anritsu Pty. Ltd.
Unit 20, 21-35 Ricketts Road, Mount Waverley, Victoria 3149, Australia
Phone: +61-3-9558-8177
Fax: +61-3-9558-8255

- **Taiwan**
Anritsu Company Inc.
7F, No. 316, Sec. 1, NeiHu Rd., Taipei 114, Taiwan
Phone: +886-2-8751-1816
Fax: +886-2-8751-1817

List Revision Date: 20210610

Anritsu utilizes recycled paper and environmentally conscious inks and toner.