SPECIAL REPORT

VENDORS RAMP UP MMWAVE FUNCTIONALITY, RTSA OFFERINGS IN SOLUTIONS

▲ Anritsu's Field Master Pro MS2090A RF spectrum analyzer.

By Mike Hockett, Editor-in-Chief

As one of the most important instruments for electrical test in a lab or in the field, signal and spectrum analyzers serve multiple purposes across a range of applications, from communications, to radar, to manufacturing and designing purposes in the field. Their features have grown alongside the advancement of digital technologies, and combined with the rise in adoption of portable and hand-held signal/spectrum analyzers, their demand is poised to surge over the next decade.

Various recent market reports all show strong growth for spectrum analyzers. On May 13 of this year, MarketResearchFuture shared a forecast of the market growing by 8.2% CAGR from 2018 to 2023, at which point its value will be $1.758 billion[1]. A day later, ResearchAndMarkets.com shared a report that valued the global spectrum analyzer market at U.S. $1.13 billion in 2017 and will reach $2.475 billion by 2026, growing at a CAGR of 9.1%[2]. Comparatively, Transparency Market Research reported in January of this year that the global market was worth $1.208 billion in 2017 and will hit $2.440 billion by 2026 at a rate of 7.8% in that span[3]. As one can see, forecasts vary some, but they all agree that spectrum analyzers will be a strong growth market for years to come.

Asked what technology trends he's seen lately, Anritsu senior product marketing manager Philip Belleau led off telling *Evaluation Engineering* in June, "Demands for data exponentially are growing with seemingly no end. Sub 6 GHz spectrum is somewhat overcrowded currently and is unable to provide sufficient bandwidth required for increasing data demands. Thus, mmWave is seen as the only viable solution as there are adequate blocks of available wide bandwidth spectrum."

"We've seen that more markets are opening up in mmWave—automotive radar, for example—and point-to-point radio links," added Anritsu product marketing manager Angus Robinson. "There is a movement toward wider vector signal analyzer (VSA) bandwidths, especially to support 5GNR measurements. Bandwidths of 100 MHz are now common, including greater than 400 MHz on premium benchtop instruments. We're starting to see real-time signal analysis (RTSA) being offered as an option in regular SPA/VSA for interference hunting."

To look more closely into what's driving developments in this signal/spectrum analyzers, we at *Evaluation Engineering* asked vendors to tell us what they're seeing as far as technology trends, vendor challenges, and customer demands, as well as what new solutions they've recently made available. Here's what they told us.

What's trending?

What technology or market trends are vendors seeing in the area of signal and spectrum analyzers?

Belleau, Anritsu: "Semiconductor technologies have continuously evolved and today are able to meet the requirements for efficient & cost-effective components/systems required to utilize the mmWave spectrum. This trend toward mmWave usage creates needs for cost-effective mmWave test equipment. New coaxial connectors have already been developed to support measurements >110 GHz,

▼ Anritsu's MS269xA signal analyzer.

however there are very few test & measurement instruments capable of operating >110 GHz, and most are banded waveguide, which makes broadband analysis of the devices difficult, if not impossible."

Jason Chonko, applications marketing manager at SIGLENT Technologies North America: "Function integration has been a growing trend. Engineers and technicians want to have tools that are flexible and that provide answers to their complex problems quickly. This trend includes integrating VNA capabilities for testing RF components, cable fault location, and modulation analysis into a benchtop platform. Armed with this flexibility, a technician or engineer can approach an unknown situation and have better confidence that the tool will be the only one needed to finish the job."

Dylan Stinson, USB RF product marketing manager at Tektronix: "A number of RF applications are demanding hardware and software that enable more sophisticated characterization of an increasingly busy RF spectrum. For example, the growing demand for unmanned aerial system identification technology forces government, military, and other customers to find drone signals in the same bands as pervasive commercial emitters such as Wi-Fi."

Laura Sanchez and Johan Nilsson, spectrum analysis product managers at Rohde & Schwarz: "There is an increased need for higher measurement frequencies and wider bandwidth; this is because of new emerging technologies such as 5G NR, new space, and automotive radar. We have also seen a big change in the way satellites are tested. With the digital payload systems, customers are looking for a signal generator and analyzer-based solution with modulated signals, while a VNA-based solution was more common in the past."

Ross Smith, co-founder and CEO of RADX: "Demand for multichannel, synchronized RF recorders with high-performance RTSA on one or more channels. RTSAs with support for 14, 18, 26.5, 44, and 50 GHz frequency range and bandwidths up to 250, 500, and 1,000 MHz RTBW. Requirements for RTSAs with both very low 100% POI and very fine RBW."

Challenges

What key challenges are vendors or their partners facing in signal and spectrum analyzers?

Belleau, Anritsu: "With the trend toward mmWave usage, challenges faced by test & measurement vendors today are to develop cost-effective solutions which, in turn, enable the continuing development of these mmWave devices. Without test & measurement equipment capable of making mmWave measurements, and at prices that are within reach of most typical organizations, development of mmWave devices would be severely hindered, which would delay the advancements in technology required to support the exponential data demands."

▼ SIGLENT'S SDS1202X-E is part of its SDS1000X-E Series super phosphor oscilloscopes that recently received a firmware revision that enhances their 1 Mpt FFT capabilities.

Chonko, SIGLENT: "Keeping up. The development of new technologies and the price pressures associated with the IoT boom that is causing much of this growth in RF is simply difficult to manage. With no set protocol to focus on, vendors are stuck guessing which technologies to support. It's not unprecedented, but it keeps things interesting."

Robinson, Anritsu: "1) Delivering advanced feature sets in instruments with a user interface that can be learned quickly. 2) Segmentation of the market for interference hunting, wireless measurements, generic IQ analysis, and production test. 3) Increased mmWave frequency coverage for new 5G NR bands."

Sanchez and Nilsson, Rohde & Schwarz: "The demand for better connectivity is constantly increasing; the end-users require higher data rates, lower latency, and bigger capacity. As the spectrum is getting more crowded, higher frequencies in the mmWave bands are being used. For example, the automotive radar moved from the 24 GHz to the 79 GHz band, and there are possibilities of exploring even higher frequencies in the near future."

Stinson, Tektronix: "All test vendors face a similar challenge of presenting next-generation testing capabilities—higher bandwidths, sharper software, more advanced triggers, etc. to customers at prices that support their testing budgets."

Smith, RADX: "For us, it's addressing the highest frequency requirements of our customers, which—because we're based on COTS modular—limits us to about 44 to 50 GHz."

What are customers asking for?

What features or innovations are customers asking for in signal and spectrum analyzers?

Belleau, Anritsu: "This question has several answers, and it is heavily dependent on what the customer is attempting to develop and/or test. R&D and academia environments continuously push the limits of technology, and often with limited budgets, so their needs are generally closely related to what they can obtain in the market within their budget. So, cost-effective mmWave measurement products allow these customers to forge ahead and overcome new barriers. Production environments typically require minimal features at the lowest cost, smallest form factors, low power consumption, and simplicity in operation. General-purpose environments typically tend to lean toward multiple functionality—the instrument that can support various measurement capabilities like spectrum and signal analysis (IQ demodulation, etc.)

provides excellent flexibility for this type of environment."

Stinson, Tektronix: "Ruggedized, portable systems for field and range testing applications; Increased channel counts are of related importance to many customers; Recording capabilities that enable extended logging of real-time RF data at high bandwidths; Advanced triggers that allow real-time spectrum analyzers to detect spurious, intermittent, or anomalous signals that swept-tuned instruments will miss."

Sanchez and Nilsson, Rohde & Schwarz: "There is a general need for wider analysis bandwidths that go up to the GHz range, especially in radar and satellite applications. A good example is the flexibility to work with any kind of stimulus signals when characterizing components or systems in the aerospace industry. Customers that only tested with CW signals in the past are now working with digitally modulated signals, for example, when measuring error vector magnitude, etc. As always, features that automate measurements are in high demand."

Smith, RADX: "Built-in RF record capabilities so an external recorder is not required; RTSAs with more demodulation and analysis capabilities; Ability to zoom into a region to look for small amplitude, frequency-agile signals."

Advantages/disadvantages of configuration

Spectrum and signal analyzers come in a variety of configurations, such as traditional benchtop instruments, handheld instruments with display, USB instruments, and PXI modules. What do vendors see as the advantages and disadvantages of each?

Belleau, Anritsu: "There is a continuing trend towards USB instruments, in particular. They bring a cost-effective advantage since they do not require the internal microprocessor, memory, display, and so on. USB instruments are generally extremely portable, and many make direct connections to the device under test, which eliminates errors caused by cables, etc. PXI modules, and variations of PXI modules, also offer some advantages, particularly in cases where multiport, simultaneous measurements are required. They do typically require a mainframe chassis, which makes them somewhat challenging to be moved from one location to another. Due to the physical form factor of the PXI module itself, there are often performance tradeoffs in order to have the product fit within its constraints. Traditional benchtop instruments are gradually being replaced by these more modern USB and PXI equivalents, although for absolute highest performance requirements, benchtop analyzers are still required and will continue to be until such time that the USB or PXI based instruments are able to fully match the performance of the benchtop instruments."

Chonko, SIGLENT: "Benchtop instruments generally deliver the best performance for the investment. This is mainly due to the heavy use of high-volume parts in their designs. Handhelds are very useful for field measurements, but they are usually higher cost with lower performance, due to the design challenges and more specific components required for battery-powered operation. USB instruments offer the lower cost and higher performance of a benchtop instrument in a somewhat more portable form factor, but they require a computer, software, and ultra-fast USB connection for full performance. PXI instruments and other modular products are very similar to benchtop instrumentation, but they don't have displays or the ability to operate "on their own." They require a somewhat costly mainframe and controlling computer. They are very well suited to fixed installation tests in manufacturing or long-term R&D tests."

Sanchez and Nilsson, Rohde & Schwarz: "While modular architecture may appear cost-efficient at first, there are hidden expenses for customers in terms of additional software development, training, and application support. Additionally, the suppliers of PXI modules do not always provide specifications that are thorough enough. A majority of customers prefer benchtop instruments. They are easier to configure, customers can start making measurements right away, and integration in measurement systems can be done easily via GPIB or LAN."

Multifunction vs. dedicated instrument

Today, digital oscilloscopes can perform fast fourier transforms (FFTs), and many now have dedicated spectrum-analyzer channels. What are the advantages and disadvantages of using the spectrum-analysis capabilities of an oscilloscope or other multifunction instrument vs. a dedicated signal or spectrum analyzer?

Belleau, Anritsu: "Digital oscilloscopes fundamentally measure signals in the time domain. This limits their upper frequency measurement capability, since higher frequency measurements require higher direct measurement bandwidth and higher bandwidth analog-to-digital converters (ADC). As ADC bandwidths increase, the number of bits (ADC resolution) typically decreases, so dynamic range is reduced. Higher direct measurement BW also goes hand-in-hand with higher noise, which also limits dynamic range. Higher bandwidth oscilloscopes are also significantly more expensive. Also, performing FFT's on wide bandwidth signals requires significant processing power, so updates of the FFT spectrum are generally slower than what is available from a dedicated signal or spectrum analyzer."

Chonko, SIGLENT: "Integrated FFT/spectrum analyzer functionality on an oscilloscope definitely increases its usefulness. Simply having access to frequency domain data can be useful when analyzing EMI, modulated signal analysis, and tracking harmonic signal content. Unfortunately, oscilloscope front ends are not as sensitive, nor do they provide the same dynamic measurement range as a standalone spectrum analyzer. Filter characterization, VSWR, and full electromagnetic compliance troubleshooting require the large dynamic measurement range that is based on traditional spectrum analyzer designs."

Sanchez and Nilsson, Rohde & Schwarz: "Both products are aiming at different

markets. However, if we try to compare both in terms of spectrum measurements, we see that a clear advantage of signal analyzers lies in their larger dynamic range, which allows measuring digital signal modulation accuracy with the best EVM performance. Spectrum analyzers typically also outperform oscilloscopes when it comes to spectral purity or sensitivity, which is especially important for fundamental measurement such as phase noise and noise figure tests. The advantages of oscilloscopes are their wide analysis bandwidth and the coherent multichannel capability."

Smith, RADX: "DSOs are great for standard spectrum analyzer applications, but not so much for RTSA. We think of a DSO as a "convenience" spectrum analyzer, like the screwdriver on a Swiss Army Knife. It's good in a pinch, but if you need to build a fence, you probably want a real screwdriver (or a Makita)."

▲ One of RADX' Trifecta-SSD COTS 8TB, 16TB, and 31TB PXIe SSD Raid Modules.

Now on the market

Here are the signal and spectrum analyzer solutions that vendors told us they've recently made available, and what some of those solutions' key features are.

Robinson, Anritsu: "In February of this year, we launched the Field Master Pro MS2090A RF spectrum analyzer. The MS2090A delivers performance never previously available in a compact, hand-held instrument. With continuous frequency coverage from 9 kHz to 54 GHz, it is specifically designed to meet the challenges of a full range of other wireless technologies in use today, including 5G, wireless backhaul, aerospace/defense, satellite systems, and radar. The Field Master Pro MS2090A delivers the highest levels of RF performance available in a handheld, touchscreen spectrum analyzer."

Smith, RADX: "We recently launched our Trifecta PXIe SSD RAID Modules, which enable PXIe-based spectrum analyzer and RF recorders to store up to 128 TB of wideband data in a PXIe chassis-based system. Trifecta dramatically reduces the cost of high performance SSD RAID storage and eliminates the need for an external RF recorded in most instances. We're also in the process of launching two new products: LGT12xx, which is a 1, 2, 4, 8, or 16-CH, 6 GHz, precision synchronized, RF record and playback system that supports

up to 1 GHz MHz of RTBW and record/playback bandwidth; and LGT13xx, which adds RF up and down conversion to the LGT12xx to extend the upper frequency range to 18 GHz."

Chonko, SIGLENT: "recently released a new firmware revision for our popular 4-channel SDS1X-E oscilloscope series that enhances the 1 Mpt FFT capabilities of the scope platform to make it feel more like a spectrum analyzer. One nice application is measuring the modulation index of an AM signal. The SIGLENT SSA3X series of spectrum analyzers has also received some updating with a new frequency/amplitude search feature in the marker table to help provide more flexibility, as well as new offset capabilities."

Stinson, Tektronix: "Tektronix recently 1) Upgraded its flagship RSA7100 real-time spectrum analyzer with time qualified triggers in response to Mil/Aero customer feedback and improved control and throughput of IQ data for record and playback applications; 2) Introduced 802.11ay optimized analysis software for our performance DPO70000SX Series Oscilloscope with EVM performance to support development of next-generation wireless standard products; 3) Expanded the popular RSA500 Series of advanced, ruggedized portable spectrum analyzers with 18 GHz and 13 GHz field portable models."

Sanchez and Nilsson, Rohde & Schwarz: "We have recently launched two new product lines dedicated to 5G NR testing. The R&S FSVA3000 signal and spectrum analyzer offers high performance at a mid-range price and is used to test BS in the lab. The R&S FSV3000 is the fastest instrument on the market for 5G production testing. We have also launched new R&S FSW models, which outperform the competition by offering a wider demodulation bandwidth and dynamic range combined with the best phase-noise performance on the market."

Cherisa Kmetovicz, FieldFox product marketing at Keysight Technologies: "We are launching a new line of future-ready analyzers to address the ever-increasing demands of 5G, satellite communications, signal monitoring, and electronic warfare applications. The new-generation FieldFox handheld microwave analyzers offer six combination models (N991xB) and six signal analyzer models (N993xB) covering frequency ranges between 4 and 26.5 GHz." EE

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