Whitepaper

A New Approach to Spectrum Monitoring Equipment

How Open and Interoperable Technologies Create Stronger Spectrum Analysis Solutions

thinkRF

Introduction

The wireless spectrum is the driving force behind many of the innovations we take for granted. Advanced wireless communications power mobile devices, enable streaming services such as Netflix, YouTube and Spotify, and have created an age where information and data are king. Future innovations, such as autonomous vehicles, smart cities, and the Internet of Things will place even more pressure on the limited wireless spectrum resources available to us.

As the world demands more from wireless signals and the march of innovation moves steadily onwards, reliable spectrum access will become even more critical in our day-to-day lives. To keep pace, the equipment that monitors the spectrum will need to evolve as well. Going forward, the ability to monitor, detect, and analyze increasingly complex and high frequency waveforms will be more important than ever before.

The way it's always been done is no longer good enough, and users can no longer depend on closed solutions with little flexibility. Instead, today's wireless landscape demands open, interoperable spectrum analysis solutions that make it possible to work with hardware, software, APIs, and programming environments from multiple vendors.

This whitepaper will explain why a proprietary, closed model no longer addresses today's spectrum environment, demonstrate the benefits of an open, interoperable approach, and provide examples of how these solutions could look in the field.

What's Driving the Need for a New Approach?

Today's spectrum environment is vastly different than even 10 years ago. The past decade has seen an incredible rise in the use of the spectrum with the rapid adoption of wireless devices, decreasing cost of mobile data plans, and the proliferation of the social and media driven web. Looking ahead, new technologies, such as 5G, will drive frequencies and bandwidths well beyond what are the norm today.

There are three factors that are driving the need for an interoperable approach to spectrum monitoring.

Increased Data and Bandwidth Usage

One of the most important challenges to overcome is the massive increase in the amount of data and bandwidth required by new technologies. IDC predicts that in the year 2025, 163 zettabytes, or 163 trillion gigabytes, of data will be produced worldwide.[i] That's at least 10x more than what was produced in 2016. In more understandable numbers, Intel estimates that a single self-driving car will consume about 4,000 GB of data *per day*.[ii] These high data, high bandwidth innovations will place huge demands on spectrum resources, which will need to evolve to handle such a load.

New 5G Standards Pushing High Frequency Waveforms

5G is one of the key technologies being deployed to enable faster and better mobile experiences. Researchers are currently testing and deploying systems that use waveforms well above traditional ranges of 6 GHz, including the 28 GHz band and others as high as 86 GHz.[iii] Much of the existing spectrum analysis equipment being used in monitoring today is unable to capture these signals, forcing users to look for new solutions that extend their performance.

Rapid Pace of Change

Innovation is happening at breakneck speed, and new technologies are constantly being developed, tested, and introduced. Of course, more use of the spectrum means more chances for interference, inadvertent or otherwise, that disrupts connectivity and leads to problems for users. And as mentioned, 5G standards have not yet been completely finalized, meaning there are still some unknowns for monitoring users. This constant change and innovation means that spectrum monitoring users need the flexibility to adapt and react to new requirements as quickly as possible.

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[i] Seagate, 2017 - https://www.seagate.com/files/www-content/our-story/trends/files/Seagate-WP-DataAge2025-March-2017.pdf
[ii] Network World, 2016 - https://www.networkworld.com/article/3147892/internet/one-autonomous-car-will-use-4000-gb-of-dataday.html
[iii] Fierce Wireless, 2016 - https://www.fiercewireless.com/tech/verizon-tells-fcc-to-move-fast-28-ghz-and-37-40-ghz-bands-to-promote-5g

The Way It's Always Been Done Is Not Good Enough

The debate between open and closed models is not a new one, nor is it limited to spectrum analysis solutions. Across all industries there is a constant push and pull toward one or the other. The truth is that both approaches offer benefits depending on the situation and the environment they are used in.

For many years a closed, proprietary model has been the norm for spectrum monitoring. Users would incorporate hardware, software, radios, interfaces, antennas, and whatever else they needed from a single vendor. This meant that everything would be vertically integrated together, ensuring consistent measurements across deployments, a single point of support, and usually lower upfront costs due to packaged pricing.

Essentially the entire solution was based on one vendor's products, and there was limited to no ability to integrate with other solutions. At a time when monitoring was centralized, static, and homogenous, this approach was viable. But over the years, monitoring has shifted to be more distributed, diverse, and complex. Users tied to a single vendor are now feeling limited in what they can do to keep up with advances in wireless technology.

One of the simplest explanations for this feeling is common across industries and products. The fact is that no single vendor can be best at all aspects of what you need. The vendor with the best hardware for a specific application may not have the software that does everything you require, or vice versa. Moreover, a proprietary model

Benefits of a Proprietary Approach

- Single point of contact for support requests
- Equipment and software typically integrate easily with minimal work by users
- Reduced upfront cost through bundles or package pricing
- User familiarity and comfort
- Similar interfaces and reduced training requirements

Weaknesses of a Proprietary Approach

- Vendor lock-in that leads to a lack of flexibility and adaptability
- Inability to get the best solutions possible, stuck with vendor's strengths and weaknesses
- Tied to development cycle and roadmap of vendor, further limiting flexibility
- Loss of measurement consistency and test setups if multiple vendors are used for different applications
- Increased rework, integration work, and complexity if multiple vendors are used
- Higher long-term costs

quickly becomes tied to the vendor's development cycle and product road map. If something is required that isn't part of the vendor's plans, you could be left without it, or in the best-case scenario, stuck waiting until they get to it. With traditional spectrum analysis solutions costing well over $100,000, purchasing new equipment or replacing current hardware entirely just to get the functionality you need may not be an option, leaving you without key capabilities.

As monitoring becomes more complex, the various applications are becoming more finely tuned and specialized. In a proprietary approach, it's very difficult to meet these specific requirements using only one vendor.

Going forward, these weaknesses will prove too much for users. What's needed, instead, is an open and interoperable approach that allows users to incorporate multiple vendors and build a solution that best meets their needs.

What Does an Open, Interoperable Approach Look Like

It is possible to use equipment and software from multiple vendors even when they employ a proprietary model. However, you quickly lose measurement consistency, test setups, and other functionality between equipment. You also open yourself up to significant rework, integration work, and redundancies across deployments.

Clearly this is not the ideal way to overcome the problem of vendor lock-in. Instead, an open, interoperable approach increases flexibility, versatility, and adaptability. Through SCPI commands or other standards, you're able to mix and match from multiple vendors while maintaining measurement consistency, test setups, and user familiarity. This approach makes it possible to extend the capabilities of existing hardware, maximize your initial investment in hardware or software, prolong the useful life of equipment, and build better monitoring solutions than would otherwise be possible.

There are three components of interoperability that create truly open solutions: hardware, software, and APIs and programming environments.

Hardware

Interoperable hardware uses open standards such as SCPI controls to integrate directly with other equipment, regardless of the vendor. Through these standards you're able to integrate spectrum analyzers, receivers, downconverters, or any other equipment to extend performance without replacing the original equipment entirely.

For example, many existing spectrum analysis solutions only capture signals below 6 GHz. This is fine for Wi-Fi or LTE signals but does not meet the requirements for the more complex waveforms being deployed for 5G. Instead of buying a whole new suite of analyzers, a large capital investment, you could extend the frequency range by integrating a compact and lightweight RF Downconverter. This lets users in the field capture 5G signals at a lower cost and without requiring any additional training.

Software

As each use case requires different analysis capabilities and specialized functionality, the software that you require will vary greatly depending on your application. For example, the software capabilities needed by a technical surveillance countermeasures (TSCM) professional to find illicit listening devices will look completely different than what a regulator out in the field needs to map coverage areas or identify interference sources.

This is where integrated software applications can be a game changer for users. The added flexibility means you can leverage the power, performance, and deep analysis capabilities of leading spectrum analysis software without being locked-in to the vendor's hardware as well. Perhaps the hardware is too large, bulky, or expensive for your needs, or maybe you need a specific functionality, such as networkability, that isn't available with the vendor's equipment. Whatever the reason, interoperability gives you more choice when building a solution that aligns with your specific needs.

APIs, Standards, and Programming Environments

The final component of an interoperable solution is a rich suite of APIs and programming environments that allow you to use industry leading software or your own third-party application. These APIs further increase the versatility of the solution and make it possible to build custom applications designed around your unique specifications.

For full integration, standards such as SCPI Commands and VITA VRT make it possible for equipment to communicate and share information. Leveraging these standards creates a more open environment for users to mix and match the hardware components, software applications, and other accessories.

The Way Forward in an Evolving Wireless Landscape

The way we use the wireless spectrum is constantly evolving, and the pace of change is accelerating as new technologies and signal standards are deployed around the world. Adapting to these new realities means taking a new approach to spectrum analysis. The way it's always been done is no longer enough to be successful going forward.

An open, interoperable approach to spectrum analysis provides increased flexibility, lowers the cost of increasing performance, and makes it possible to build a solution around your specific needs. It allows you to adapt more quickly and be on the forefront of testing and deploying standards such as 5G wireless without completely replacing existing equipment. And it removes the limitations that come with vendor lock-in and being tied to the development cycles and product roadmaps of a single vendor.

Benefits of an Interoperable Approach

- No vendor lock-in
- Increased flexibility and versatility to adapt to new requirements
- Lower long-term costs as you're not stuck with one vendor
- Not tied to one vendor's development cycle
- Measurement consistency and test setups are maintained across deployments
- Investments in equipment are maximized by extending the useful life
- No need to fully rip and replace existing suite of solutions

Weaknesses of an Interoperable Approach

- Some integration work required
- Not all software vendors support this approach yet, meaning you're still tied to their hardware
- Purchasing from multiple sources
- Multiple points of support

Tying it all Together with Software-Defined Spectrum Analysis

An interoperable approach means that hardware and software from multiple vendors can be integrated together to create a stronger solution than possible with a single vendor. Software-defined spectrum analysis solutions are very complementary to this and clearly the way forward. Through compact, versatile, and high-performance units, these software-defined solutions can easily be integrated to extend the capabilities of other equipment without adding significant size, weight, power, or cost.

In a software-defined spectrum analyzer, the software runs over top of a thin, broad layer of hardware to provider greater flexibility and versatility. An inexpensive PC can then be connected to provide the necessary computing power. Being based in software, these analysis solutions are easily upgradable and can be modified for various environments, signals of interest, and applications, all without replacing the hardware itself.

This versatility and flexibility aligns well with an open approach, making software-defined spectrum analysis solutions a natural starting point for users looking to take advantage of the benefits of interoperability.

Open and Interoperable Solutions from ThinkRF

ThinkRF solutions are designed and built for monitoring applications such as signals intelligence, TSCM, regulatory monitoring, and public safety. Each of these use cases have their own unique requirements, and benefit from incorporating multiple vendors. ThinkRF solutions can be used with a number of leading software applications, and the open, standards-based hardware can easily be integrated with third-party equipment to extend performance. Aerospace and defense companies, spectrum regulators and wireless communications providers use the remotely deployable, PC-driven and easily-upgraded platform to replace traditional lab equipment for wireless spectrum analysis.

ABOUT THINKRF

ThinkRF delivers a new category of Software-Defined Spectrum Analysis solutions that monitor, detect, and analyze complex waveforms in today's rapidly evolving wireless landscape.

Remotely deployable, PC-driven and easily-upgraded, the ThinkRF platforms offer greater versatility, better performance, and additional capabilities for monitoring, signals intelligence (SIGINT), technical surveillance counter measures (TCSM), test and measurement, and 5G applications.

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