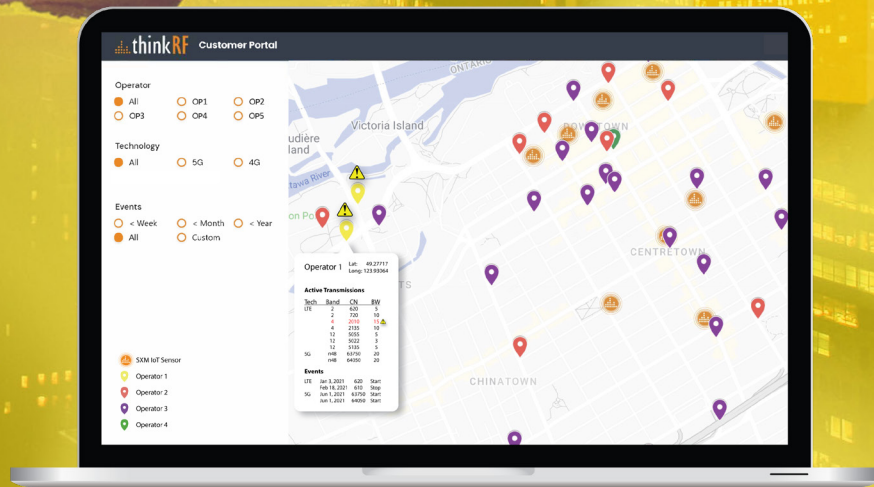
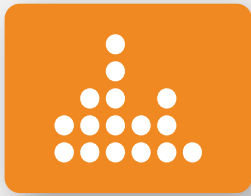


Real-Time & Continuous Competitive Intelligence

How Mobile Operators Can Monitor Competitive Networks in Real-Time



OVERVIEW



THIS ARTICLE will highlight the challenges of obtaining competitive intelligence and spectrum insights using traditional methods before introducing and explaining the advantages of networked RF spectrum monitoring.

What's needed is a new approach to RF spectrum monitoring that provides competitive intelligence through a continuous, real-time view of the RF spectrum environment.

TABLE OF CONTENTS

How Mobile Operators Can Monitor Competitive Networks in Real-Time	3
The Limitations of Current Approaches to Competitive Intelligence	4
A Better Approach Networked RF Spectrum Monitoring	6
Data-as-a-Service Competitive Intelligence at a Lower Cost	7
How MSOs Can Use Competitive Intelligence	8
Dynamic Network Optimization	
Experimental Deployment Tracking	9
Informed Spectrum Acquisition Strategies	
Internal Asset Analysis and Financial Evaluation	10
Introducing thinkRF SXM for Mobile System Operators	11
Better Competitive Intelligence for Stronger Performance	13

Real-Time & Continuous Competitive Intelligence

How Mobile Operators Can Monitor Competitive Networks in Real-Time

The RF spectrum provides tremendous value to society. As a critical and scarce public resource, the wireless spectrum impacts the way we live, work, and communicate.



WHAT'S needed is a new approach to RF spectrum monitoring that provides competitive intelligence through a continuous, real-time view of the RF spectrum environment. By harnessing the power of a single network of distributed sensors, mobile operators can easily access timely, accurate, and secure competitive intelligence data without making significant investments in equipment or conducting expensive drive tests.

With the widespread availability of connected devices and new network deployments using 5G wireless and other modern signal standards, mobile system operators (MSOs) increasingly require competitive intelligence and insights into the broader spectrum environment.

While operators have always had access to their own network data, it has traditionally been difficult and expensive to collect and analyze data on competitive infrastructure or new network deployments. Drive tests and

crowdsourced data can provide some limited visibility, but they fail to provide the level of insights needed when assessing spectrum strategies and maintaining an advantage in a rapidly evolving and highly competitive space. This article will highlight the challenges of obtaining competitive intelligence and spectrum insights using traditional methods before introducing and explaining the advantages of networked RF spectrum monitoring.

Real-Time & Continuous Competitive Intelligence

The Limitations of Current Approaches to Competitive Intelligence

Increased demand for limited spectrum resources, the widespread deployment of new, high-frequency signal standards, and the emergence of RF transmissions for critical public infrastructure have all increased the pressure on MSOs to better understand the evolution of the spectrum environment.

MSOs need competitive intelligence to see what their competitors are doing and take proactive steps to stay ahead. It includes insights into competitive infrastructure, experimental deployments of new technologies or signal standards, and spectrum utilization rates. Better visibility allows MSOs to shape their spectrum strategies and make more informed decisions based on real-world data.

Until now, MSOs have had two main approaches to gaining competitive intelligence – drive testing and crowdsourced collection of user-generated data.

Drive testing is a tried-and-true method that captures a snapshot of spectrum data at the time and location of the test. A team of network engineers drives a vehicle equipped with spectrum monitoring and analysis tools, captures data along a predetermined route, and conducts analysis to characterize the network and understand its performance, coverage, propagation, and reliability.

While effective in certain situations, the nature of drive testing limits its usefulness for ongoing data collection or continuous monitoring. In addition to the high costs of conducting the test, it is difficult to spot trends, capture short-duration or sporadic signals, or identify changes in spectrum usage or competitive infrastructure deployments until another drive test is performed, a minimum months but generally years later.

MSOs take advantage of crowdsourced collection of user-generated data to understand the competitive environment. Through applications installed on end-user devices, third-party benchmarking companies collect network data and aggregate it for use by MSOs.



Real-Time & Continuous Competitive Intelligence

The Limitations of Current Approaches to Competitive Intelligence

Though crowdsourced data offers a continuous and less expensive alternative to drive tests, it also suffers from some significant limitations. There is typically a 6-to-8-month gap between the time a new spectrum, technology, or configuration is deployed to when it is reported by the crowdsource devices. This means the data available to MSOs is outdated and lags what's happening in the market.

Further, mobile phones are constrained by the bands they are designed to support, and they may not be able to collect data on the broader deployment environment. For example, a phone parked on band 4 will not report on activity in other bands, particularly newly deployed bands, let alone other channels within band 4. Potentially even worse, a phone operating on one carrier's LTE network will not see any deployments in 5G, and newly deployed standards must be widely adopted by devices before data can be tracked and aggregated.

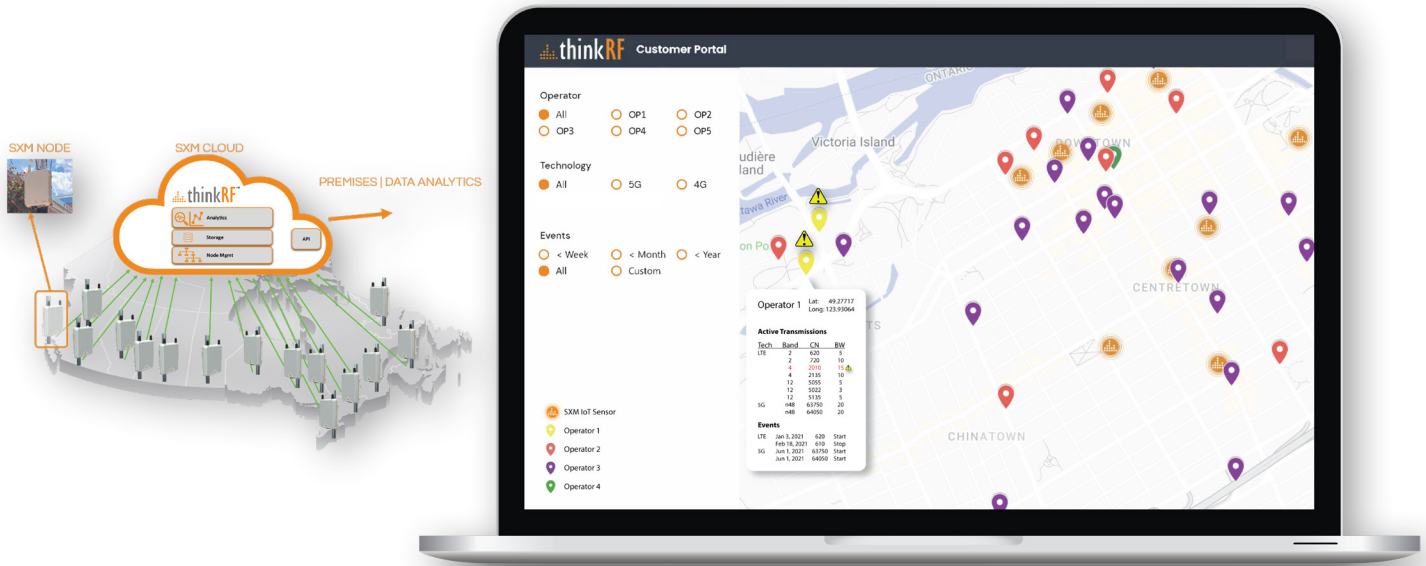
Finally, the crowdsourced data generally lacks insights into other emerging RF technologies, such as spectrum sharing, MIMO beamforming, and license-assisted access, among others. At best, a three-year-old phone may report on the presence of three-year-old technologies. More likely, since most consumers don't buy flagship phones, the compatible technologies will be much older.

Combined, these limitations create a blurry and incomplete view of the spectrum environment and the competitive infrastructure deployed by other operators. Actionable intelligence is hard to come by. When optimizing network deployments, assessing spectrum strategies, and maintaining competitive advantages, MSOs require a new approach that provides more complete insights and enables more informed strategic decision-making.

Limitations of Traditional Approaches to Competitive Intelligence

- ⦿ Expensive and time-consuming
- ⦿ Inaccurate, incomplete, or limited scope of data
- ⦿ Outdated or obsolete when made available to MSOs
- ⦿ Inconsistent data points, time and location-dependent
- ⦿ Difficult to spot trends or conduct ongoing analysis
- ⦿ Reactive approach with limited usefulness to strategic decision-making

A Better Approach | Networked RF Spectrum Monitoring



To ACQUIRE truly actionable competitive intelligence, MSOs require real-time monitoring that is pervasive, ubiquitous, and continuous.

A networked spectrum monitoring system uses a distributed network of fixed and mobile nodes (data collection sensors) that are permanently deployed in the field. Units collect and process RF domain data and upload it to the cloud, where it is stored, analyzed, and made available to users

depending on their requirements. Continuous, real-time monitoring of cellular protocols and underlying RF activity allows MSOs to assess where, when, and if a new spectrum, technology, or configuration has been deployed by a competitor. With accurate and up-to-date insights, MSOs can identify changes to the spectrum environment, track and respond to trends, and understand the evolution of competitive infrastructure when evaluating their performance and determining their spectrum strategies.

Data-as-a-Service

Competitive Intelligence at a Lower Cost

Capital procurements can be a significant barrier to building infrastructure and capturing a truly comprehensive view of the spectrum. Across a wide geographic area, hundreds or thousands of nodes are required to ensure complete coverage.

Rather than purchasing, deploying, operating, and maintaining these nodes themselves, MSOs can instead gain direct access to the data and insights through a flexible pricing model tuned to user demands.

This *Data-as-a-Service (DaaS)* approach enables MSOs to access real-time competitive intelligence without investing in equipment, hiring and training staff, or conducting ongoing maintenance.

Through a cloud-based platform and open APIs, MSOs gain a cost-effective and flexible solution that is tailored to the data and locations most relevant to their business.



Advantages of a Networked, DaaS Approach

- ⦿ Continuous, ubiquitous, and pervasive coverage
- ⦿ No capital investment
- ⦿ No site acquisition or installation costs
- ⦿ No need for ongoing maintenance
- ⦿ Pricing models scaled to usage
- ⦿ Always operating with the latest RF scanning and analysis technology
- ⦿ Access to real-time, accurate data

How MSOs Can Use Competitive Intelligence

Real-time competitive intelligence allows MSOs to understand what competitors are doing and take steps to maintain a competitive advantage. Access to real-time data across a wide geographic area allows MSOs to define their spectrum strategies, determine where and when competitors are deploying new infrastructure, and better understand the technologies they are using.

A range of applications and opportunities become available once MSOs have access to a more complete view of the spectrum environment.

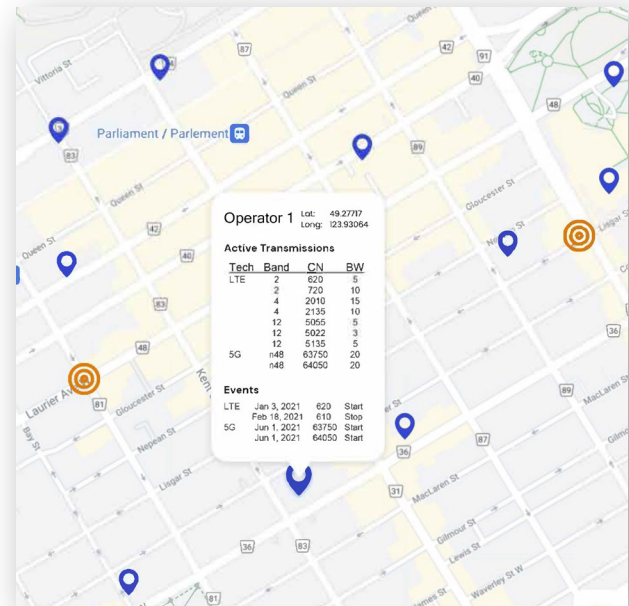


Dynamic Network Optimization

With the ongoing deployment of 5G wireless and other signal standards, MSOs can use competitive intelligence data to monitor new infrastructure deployments, compare utilization rates, and identify growth opportunities.

By combining information about their own network with the added daily insights about competitive deployments, MSOs can adjust their networks in real-time to optimize performance. For example, MSOs may realize they are overservicing an area and turn off cells or features to reduce costs, or they may identify a new competitive deployment and turn cells or features on to provide a better customer experience.

These decisions can be made dynamically based on the current conditions in the field,



allowing for far more control and fine-tuning than if they relied solely on drive testing or crowdsourced data.

How MSOs Can Use Competitive Intelligence

Experimental Deployment Tracking

Operators typically deploy new spectrum or technologies experimentally before opening them up to commercial use. Because they are invisible to end-user devices, these experimental deployments will not show up in crowdsourced data. MSOs are unable to take steps to respond until they see changes in user behavior.

Competitive intelligence allows MSOs to see when competitors are doing something new and proactively determine a response. Not only can MSOs track where competitors are deploying new infrastructure, but they can also identify the technologies and standards they are using, such as 5G wireless, MIMO beamforming, spectrum sharing, or new bands.



Informed Spectrum Acquisition Strategies

The value of spectrum resources has increased dramatically as operators compete to acquire low, mid, and high-band spectrum for 5G wireless and other network deployments. Since 2021, MSOs in the United States alone have invested more than **\$100 billion on spectrum assets** in the 3.45 - 3.55 GHz band and 3.7 - 3.98 GHz C-band.

COMPETITIVE INTELLIGENCE allows MSOs to evaluate how a competitor is using their existing spectrum assets and gain a better understanding of the value of potential spectrum to competitors.

MSOs can then use these insights to inform their own spectrum acquisition strategies and make predictions about how competitors will bid in future spectrum auctions.

For example, a competitor who is currently underusing their current spectrum assets in a region may be less likely to bid on additional spectrum, whereas an operator who has maxed out their current capacity may need new spectrum to ensure continued growth. Knowing this, MSOs can take steps to prevent them from winning new auctions.

How MSOs Can Use Competitive Intelligence

Internal Asset Analysis and Financial Evaluation

While MSOs have data about their own network, it is very difficult to determine the real value of spectrum assets or evaluate how effectively those assets are being used. Competitive intelligence allows MSOs to make financial judgments about their existing and future spectrum assets in specific locations by comparing them against competitors. With more access to data, MSOs can conduct analysis and develop their own metrics based on their business strategy.

These applications, and others that are enabled by competitive intelligence, demonstrate how MSOs can use data to make more informed decisions, provide better service to customers, and make the right investments to maintain their competitive advantage.



Spectrum eXperience Management

Introducing thinkRF SXM for Mobile System Operators

Leveraging the proven capabilities of thinkRF Real-Time Spectrum Analysis solutions, thinkRF Spectrum eXperience Management (SXM) is a subscription based DaaS solution that empowers MSOs to stay ahead of competitors and understand the evolution of competitive network deployments.

Real-time competitive infrastructure data allows MSOs to gain complete visibility into the RF spectrum environment, while flexible pricing means users can subscribe only to the data and locations most important to their business without the need for major capital expenses.

Data collected from the distributed network of sensors is stored hierarchically in a centralized cloud and insights are provided through advanced analytics. Site records store information about each identified base station, such as the operator, location, and cells associated with it. Cell records store information associated with each



identified cell, such as the channel number, frequency, bandwidth, technologies, and shared operators. Finally, cell Tx history stores dynamic information associated with each cell, such as changes in occupancy, signal strength, quality, and noise levels.

Spectrum eXperience Management

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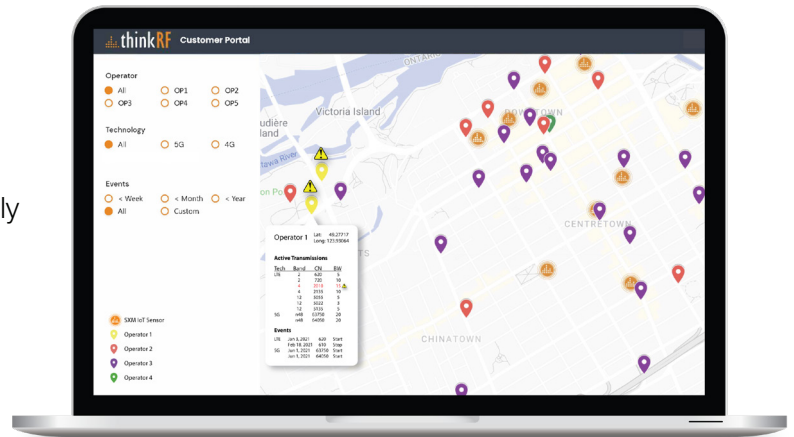
The thinkRF SXM solution features automated spectrum monitoring of all bands of interest. Important parameters are logged without the need for human expertise or intervention, and each node includes advanced RF signal analysis to autonomously detect, identify, and demodulate the downlink channels of all 4G and 5G transmissions.

The location of transmission sources can be determined using a variety of techniques, allowing data to be mapped and visually compared against known competitor transmitter locations.

Event triggers and notifications automatically alert users to changes in transmissions, power, or quality outside of set thresholds. All data is accessible through a range of reporting options, and users can view the data within the dashboard, export it, or

access the SXM database directly to combine it with existing data and produce new and unique insights.

Compared to drive testing or crowdsourced data, the thinkRF SXM solution provides significant advantages by improving visibility into the spectrum and enhancing competitive intelligence.



Advantages of a Networked, DaaS Approach

- Continuous, real-time access to RF spectrum insights
- Reduced need for expensive and time-intensive RF drive tests
- More informed strategic decisions on spectrum acquisitions and network deployments
- Improved user experience and proactive approach to interference monitoring
- Mitigated risk of competitive threats and more time to respond to new deployments
- Reduced capital expensed for monitoring and analysis equipment

Better Competitive Intelligence for Stronger Performance

The RF spectrum plays a vital role in connecting consumers, businesses, and society. As this critical resource becomes more ubiquitous, MSOs must ensure they have real-time, accurate, and complete visibility into the spectrum environment and competitive network infrastructure.

thinkRF SXM empowers MSOs through a cost-effective and flexible Data-as-a-Service solution so that they can mitigate the risk of threats, optimize network performance, and maintain a strategic advantage in this highly competitive and rapidly evolving market.

Join the #Spectrumrevolution



Real-Time & Continuous Competitive Intelligence

How Mobile Operators Can Monitor Competitive Networks in Real-Time



ABOUT thinkRF

thinkRF is the leader in software-defined spectrum analysis platforms that monitor, detect and analyze complex waveforms in today's rapidly evolving wireless landscape. By providing more flexibility, greater coverage, increased functionality and better ROI, thinkRF solutions are ideal for regulatory and intelligence monitoring, telecom deployment optimization and RF application development. With open APIs and proven integrations, thinkRF offers the only compact and networkable spectrum analyzer that can be deployed without a PC and the best price to performance on the market.

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.

For more information, visit www.thinkrf.com.

