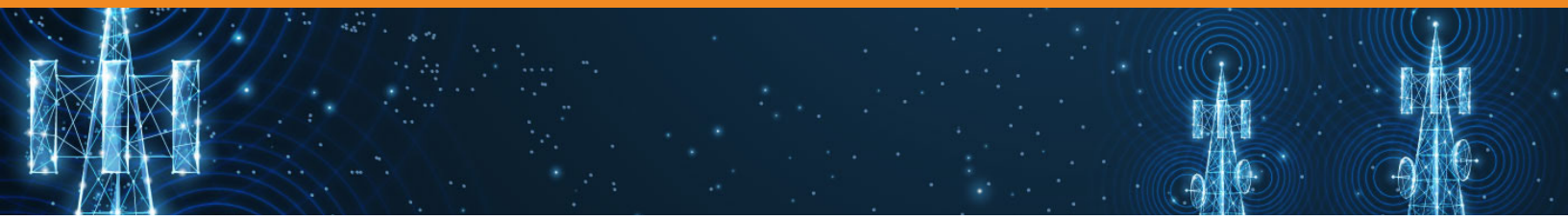
ADDRESSING CHALLENGES IN EFFECTIVE NATIONAL SPECTRUM MANAGEMENT

Equitable and Effective Access to Spectrum

In the face of escalating demands for spectrum, it is now more crucial than ever for regulators to manage national spectrum resources efficiently to ensure equitable and effective access. This urgency is driven by a confluence of factors including the proliferation of mobile broadband, the surge in telecommuting, the advent of machine-to-machine communication, and the burgeoning appetite for online entertainment. Moreover, emerging technologies such as 5G, Internet of Things (IoT), and fixed wireless broadband compete for allocation within an already limited spectrum space.

Regulators are adapting to the evolving landscape by implementing best practices in spectrum management. Central to this effort is the monitoring of current spectrum to pinpoint areas where efficiency can be improved. Spectrum monitoring is a linchpin for regulators enabling them to manage the compliance of spectrum users with current regulations, resolve interference issues, and assess the use of different frequency bands. As new technologies compete with incumbent services across the spectrum, a proactive and modern approach to monitoring becomes increasingly indispensable.



Key Components of a Complete Spectrum Strategy

Spectrum regulators must balance many demands as they create a spectrum management strategy. Among the components to be considered are:

LICENSE COMPLIANCY:

- Are existing licensees adhering to the terms and conditions specified in their licenses? If not, should fines or other measures be taken?
- Are unauthorized users occupying licensed spectrum?

SPECTRUM EFFICIENCY:

- Are licensees achieving maximum utility out of the limited spectrum resource? How can they be encouraged to improve?

CROSS BORDER COORDINATION:

- How effective are existing international agreements in limiting cross border interference? How can coordination be improved?

SPECTRUM SHARING AND TRADING:

- Where spectrum is not being effectively used, how can it be shared or traded with others?
- How effective are existing sharing and trading policies working to achieve objectives?

LICENSE RENEWAL AND EXPIRY:

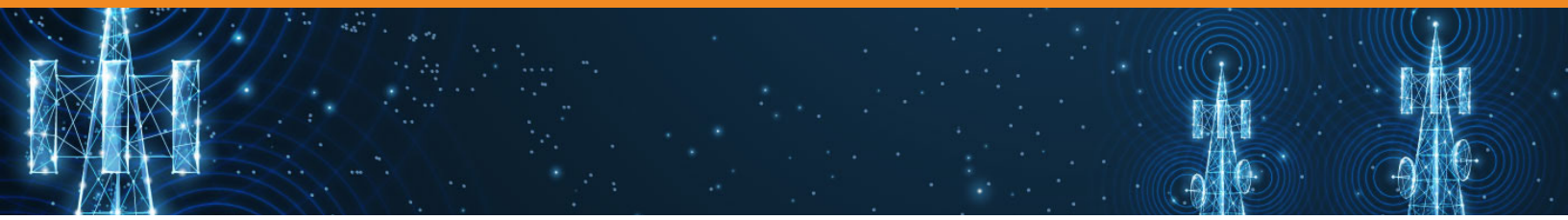
- Should existing licences be renewed, and if so, should additional terms or conditions be applied?

SPECTRUM AUCTION MANAGEMENT:

- When allocating new licenses or releasing new spectrum which operators have made best use of previous licenses and most likely to achieve policy objectives?

EQUITABLE USAGE:

- Are the social and economic equity objectives for spectrum policies being met? Is this public resource being used and distributed in a fair and equitable fashion?



Traditional Approaches to License Monitoring & Enforcement

Spectrum regulators today rely on a variety of tools to evaluate license usage across their regions:

SELF-REPORTING BY LICENSEES WITH PENALTIES:

This is probably the most popular method of monitoring and enforcing licenses. Despite the administrative burden, it tends to be the least expensive option. However, it does not entirely leave the regulator free from having to do periodic spectrum audits especially in response to complaints by competitors or users. Legal application of penalties requires empirical on-site measurements generally through expensive drive-tests.

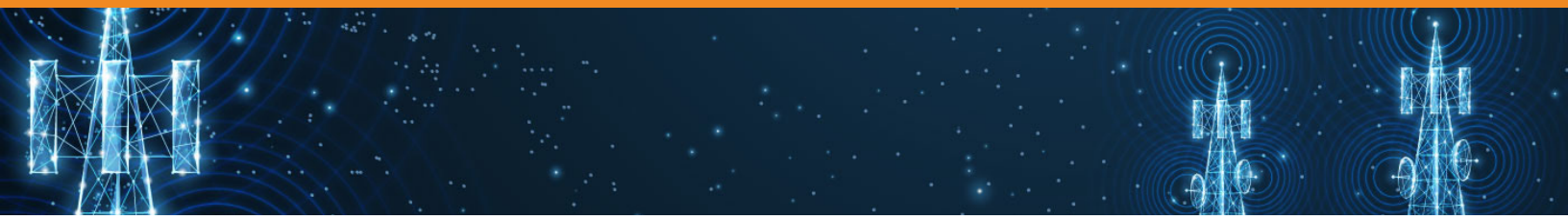
CROWD-SOURCED DATASETS:

A cost effective method of evaluating network coverage, crowd-sourced datasets can not generally be used to evaluate specific usage of spectrum licenses, since their data often has gaps in time or location and may be ambiguous in determining whether specific spectrum licenses are in use to deliver service. Further, these datasets rarely meet the empirical threshold necessary for imposing penalties..

ON-SITE DATA SPECTRUM DATA COLLECTION:

This provides a clear, empirical analysis of what spectrum licenses are being used, by which operators and for what services. Data collection requires a well-trained RF technician operating sophisticated spectrum and network analysis equipment. The cost and complexity of these campaigns severely limit the frequency and location of these measurements.

In the end, despite the importance to society of effective and efficient spectrum usage, national regulators are often blind in managing this critical resource.

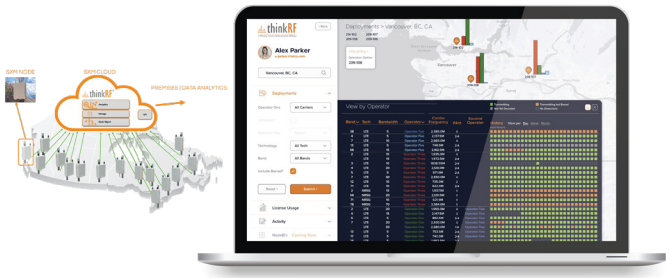


The Solution

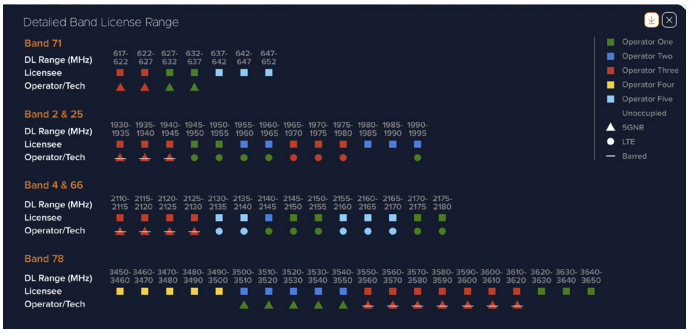
thinkRF's Spectrum eXperience Management (SXM) system provides continuous and autonomous monitoring of cellular infrastructure. Based on thinkRF's line of award-winning real-time spectrum analyzers, integrated with powerful signal analysis and IoT edge processing, SXM provides 24/7 identification, characterization and monitoring of all base stations in the area, whether they are accessible by UEs or not.

With no configuration required, an SXM node will scan all FR1 bands, identifying any 3GPP channels and their associated base stations. Each identified channel is monitored for power, signal quality, and so forth. When new base stations or channels emerge, those are also detected and characterized.

Each SXM node runs as a self-operated IoT edge device. No local operator involvement is required. As data is collected, it is fed to a central cloud where further analysis and integration with additional datasets is performed. Resulting insights can be viewed anywhere through a web-based dashboard or integrated into other data lakes through a REST API.



A SAMPLING OF COLLECTED PARAMETERS
Base Stations: Operator, nodeB ID, radio type, TAC,…
Channels: Frequency, PCI, bandwidth, online, stand alone, TDD frame structure…
Dynamic RF (per channel): Signal power, RSRP, RSRQ, SINR, Occupancy…



SXM Spectrum License dashboard comparing licenses with actual usage by operators. Note how "MSO C" is using all their available spectrum license, while "MSO D" has left their band 71 license unused while "MSO E" hasn't deployed anything in the valuable n78 band.

EFFORTLESS

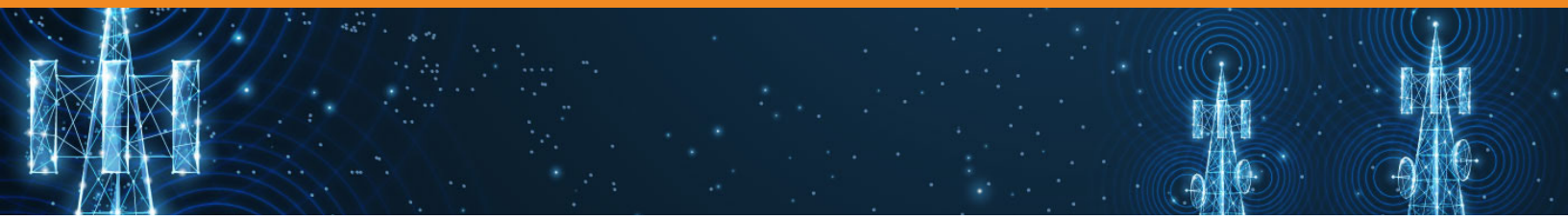
No training or expertise required. Simply power up SXM to receive license usage and characterization directly to your desktop.

RELIABLE

Employing a spectrum analysis approach provides an empirical analysis, unambiguously identifying who is doing what with their spectrum licenses.

COMPLETE

Avoiding dependence on 3GPP protocols or configurations, ensures comprehensive data collection, regardless of operator, network status, or technology.



Canada's National Spectrum Regulator Addressing Challenges Effectively

Canada's spectrum landscape encompasses hundreds of distinct license regions hosting a multitude of mobile and fixed wireless spectrum licensees. Tasked with safeguarding these valuable assets, the national regulatory body confronts several pressing challenges:

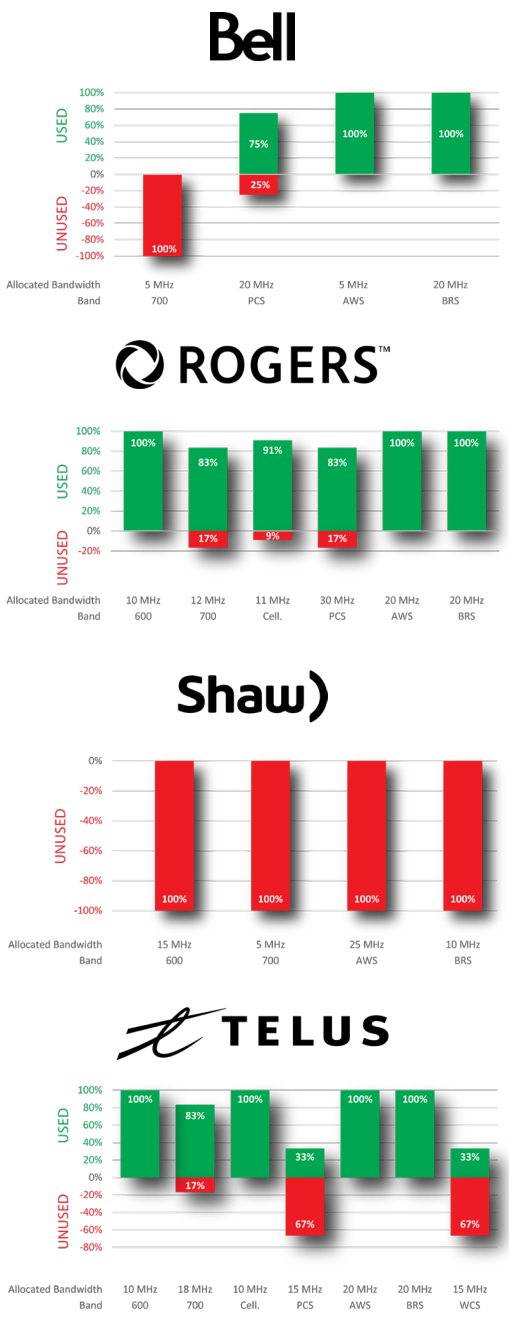
1. Some mobile operators have received concessions such as reduced terms or fees for spectrum licenses to encourage competition. How effective has that policy been?
2. Mobile spectrum is known to be sitting unused in many rural and exurban communities. Should previously allocated mobile licenses be reallocated to fixed wireless or other applications? If so, which licenses offer the most promising potential for reallocation?
3. Discrepancies exist between reported license usage and actual subscriber experiences and competitive reports. What is the truth?

Traditionally, addressing these questions necessitated extensive RF drive-tests nationwide, a costly and resource-intensive endeavor.

Instead, the regulator adopted an innovative approach by deploying SXM nodes in its fleet of vehicles across the country. Each time those vehicles visited a location, regardless of the reason, the node would characterize the local infrastructure and feed it back to the central cloud where it was aggregated together with data collection from all other vehicles. This continuously growing data set of spectrum usage across the country is centralized and analyzed in a dashboard empowering and simplifying informed decision-making.

The chart at the right illustrates one such site, an exurban location just outside a major city. At a glance, license usage is summarized, particularly highlighting the fallow spectrum allocated to Shaw Communications. This, together with many other sites across the country is providing unambiguous, empirical data enabling the regulator to make informed decisions regarding spectrum reallocation and expansion.

Carrier Allocated Bandwidth Actual Use



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