SEEING WITH RADIO

GEOLOCATION USING RADIO FREQUENCY POSITIONING OPENS UP A NEW WORLD OF INTELLIGENCE FOR DEFENCE ORGANISATIONS, ARGUES **JOHN SERAFINI**

Sound decision-making is a necessary skill in the defence and security markets. Difficult decisions could save lives and lead to mission success. To ensure the best possible outcome, decision makers need to have comprehensive, accurate data informing their choices.

Although we live in the 'age of information', many traditional data channels are still heavily used – such as satellite imagery and the Automation Identification System (AIS) for locating vessels. However, today there are more potential sources of new information than ever before, if we can only find a way to understand them.

The electromagnetic spectrum – radio frequency (RF) signals specifically – are one such type of data. RF is becoming a hallmark of modern society. RF signals pour out of devices commonly used for communication, navigation and digital operations. When identified, they can provide critical, new information and complement other data sources. By geolocating RF signals, a new data profile of the Earth emerges.

By detecting and geolocating RF signals, defence agencies can gain and verify methods of intelligence. Ultimately, the geolocation of RF signals can help defence organisations and agencies see greater mission success through more accurate data.

Consider AIS. It's a voluntary reporting system for vessels used to build maritime domain awareness. As the system relies on voluntary and accurate reporting from vessels, it is possible to circumvent AIS and operate in secret. Vessels engaged in smuggling, piracy, illegal fishing and human trafficking operations often deactivate AIS transponders to become 'dark ships'. However, AIS represents only a fraction of the total RF energy generated by vessels. By tracking a larger variety of RF signals to complement AIS, organisations can create a more accurate and comprehensive view of vessel traffic and activities.

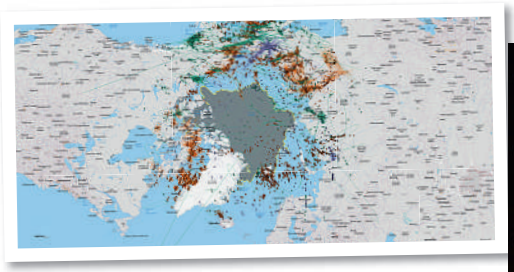
Translating RF signals

RF signals have traditionally been difficult to locate and visualise without expensive, time consuming, on-site processes. At HawkEye 360, we realised that if we made RF signal geolocation more accessible, we could intelligently report on this important resource and help create a safer world.

That's the mission that we set out to pursue when we founded HawkEye 360 in 2015. Today, we're the first commercial company to use formation flying satellites to create a new class of RF analytics. We use precise mapping of commercial RF emissions to help clients in maritime, crisis response, government, defence and telecommunications gain new insights and make more informed decisions.

We decided to use small satellites because we could deploy them quickly and at a more reasonable cost. Our satellites fly in formation in low-earth orbit using a unique propulsion system that enables our cluster to gain better geometric and Doppler diversity on the ground signals it seeks to detect. In the next few years, our fully operational constellation of 18 highly capable satellites will achieve routine revisits of less than an hour.

Our proprietary algorithms make it possible to parse all the data from our satellites and tie it to other contextually relevant information. Our algorithms include creating time-difference of arrival (TDOA) and frequency difference of arrival (FDOA) techniques to geolocate signal emitters. Without our algorithms, customers would have a hard time deciphering the data we collect in a useful way.



RF detection during the summer of 2019 demonstrated increased activity in the Arctic. HawkEye's dataset shows that what was once a land of pure ice is starting to show new patterns of life

HawkEye 360's first cluster of Pathfinder satellites. In the next few years, the fully operational constellation of 18 satellites will achieve routine revisits of less than an hour

RF signals for the defence market

For the defence market, HawkEye 360 offers global signal awareness for a variety of geospatial intelligence applications. Our satellite constellation can identify a wide variety of RF emitter types – across most of 144MHz to 15GHz – for an effective means of monitoring oceans or land. At HawkEye 360, as a commercial operator, our data is unclassified for easy sharing in joint operations.

With the analysis and geolocation of RF signals, defence organisations can enrich imagery and intelligence analysis, assess potential threats, and geolocate emitters in GPS denied environments, among other things. Ultimately, this additional information can help defence forces more effectively plan and execute mission objectives.

Consider the following use cases in which RF data can be used to benefit defence and security applications.

Uncover new patterns of life

The Arctic has long capped the earth as one of the few territories unclaimed by any single nation. However, melting ice has opened new corridors ripe for shipping and resource exploitation. As a result, several countries have expressed interest in the northern territory.

RF detection last summer demonstrated increased activity in the Arctic. Our dataset shows that what was once a land of pure ice is starting to show new patterns of life. Large concentrations of commercial maritime VHF were noted, with many vessel routes not visible on traditional AIS. Analysis of a single day of vessel geolocations showed a strong Russian presence in the region, followed by the US and Norway, and with a few signals from ships registered in countries such as Panama, Liberia and the Marshall Islands.

Detect anomalous behaviour

While satellite imagery can provide a bird's eye vantage point, it has its limitations. It can be obstructed by things such as cloud cover, thick tree foliage or other geographical features. When patrolling borders, this can create blind spots.

With RF signal detection and analysis, defence agencies can better evaluate potential threats in all weather and environmental conditions and therefore keep borders safe. For example, in the rural woods of Canada, trees provide the perfect coverage for activity on the ground. But, by detecting commercial UHF push-to-talk radio signals, observers can pick up on anomalies and unusual behaviours for the remote region.

Secure sensitive maritime regions

In October, a North Korean fishing vessel suspected of illegal fishing sank after colliding with a Japanese Fisheries Agency patrol ship. While this was an isolated incident, maritime actors in the Sea of Japan region are working to improve security and combat illegal fishing and smuggling that result in a loss of billions of dollars annually.

However, not everyone on the sea wants to be noticed. In maritime regions, such as the Sea of Japan, RF detection of commercial X-band navigation signals can help authorities locate vessels that may have turned off AIS. With a more accurate view of the waters, authorities can find ships engaging in suspicious activities that are trying to hide, improving security for everyone else on the water.

At HawkEye 360, we believe in turning the invisible into solutions for a better world. As technology becomes more sophisticated, relying solely on traditional sources of data is not enough. With RF analytics, we offer clients actionable insights so they can make the hard decisions in securing their waters, in watching their borders and in building a safer world.

John Serafini is chief executive officer at HawkEye 360 (he360.com)

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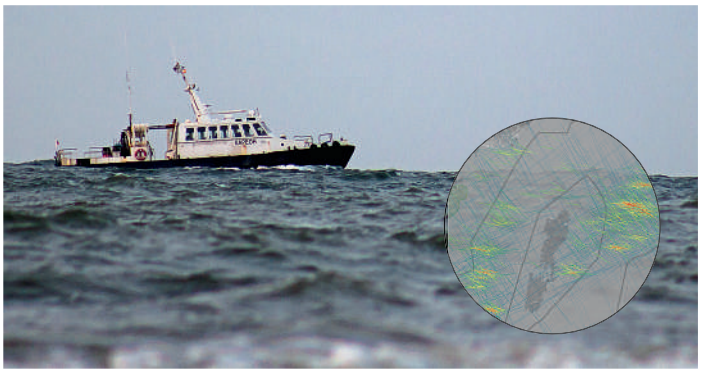

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