MUSKRAT: LEO & MEO Spectrum Monitoring System

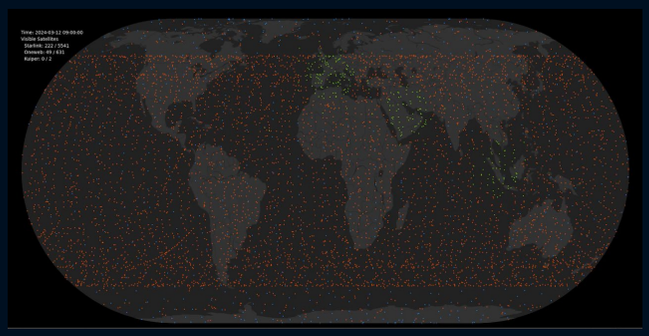
In just a few years, high-throughput satellite constellations have revolutionized global communications. Now comprising the majority of active objects in orbit, these satellites play a pivotal role not only in providing broadband internet access to remote and underserved communities but also in disaster management and defense applications. Their strategic importance cannot be overstated, establishing them as essential assets.

Groundspace focuses on developing innovative solutions for the radio spectrum challenges presented by these new satellite constellations.

Crowded skies

Traditional satellite monitoring approaches struggle to adapt to the scale of large satellite constellations due to:

- ***The number of satellites:*** Dozens, soon to be hundreds, of satellites may transmit to the same ground spot at any time. Their unpredictable scheduling makes monitoring difficult.
- ***Small beam size:*** Advanced constellations use phased array antennas to dynamically create narrow beams directed at users (e.g., Starlink's less than 14 km wide beams), meaning typical monitoring stations miss most transmissions.



Distributed monitoring network

To overcome the challenges in monitoring large satellite constellations, we developed Muskrat, a distributed network of maintenance-free, deploy-and-forget nodes. These small, interconnected nodes feature electronically steerable antennas and edge computing devices for local signal processing. They can be placed in fixed locations or mounted on moving vehicles for broader coverage.

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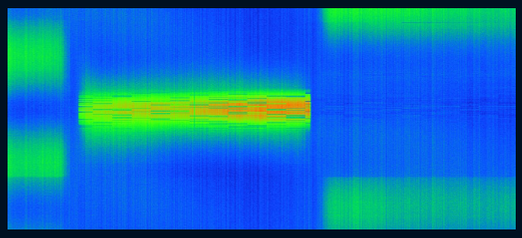
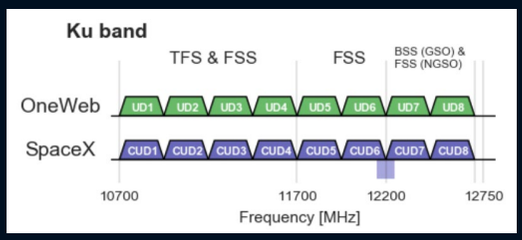


Interference detection and identification

Operating within a framework of significant technical and regulatory constraints, LEO & MEO constellations face a critical limitation: the scarcity of available radio spectrum. This scarcity necessitates the sharing of frequency allocations among LEO, MEO and GEO satellites. Muskrat helps satellite operators identify interference issues arising from the coexistence of multiple satellite constellations.

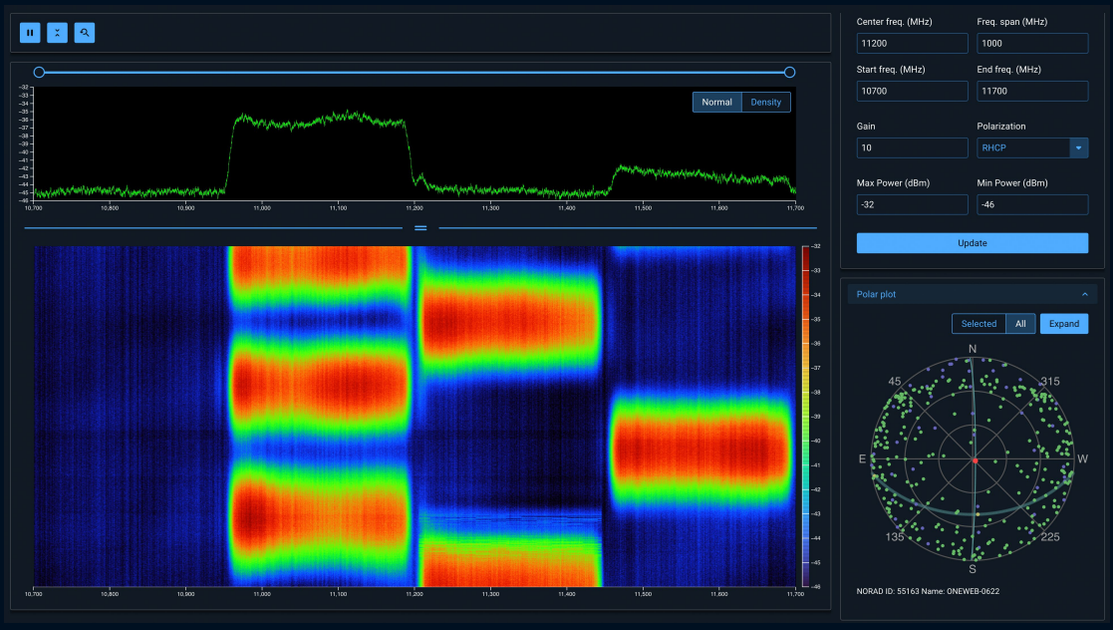


Regulatory compliance verification

Given the complex international and historical context, LEO and MEO satellite operations are governed by complex rules. Muskrat assists in monitoring satellite operators' adherence to licensing agreements and international regulations, functioning in both cooperative and non-cooperative modes.

Intelligence gathering

Several large satellite constellations scheduled for launch will soon provide their operators the capability to establish covert high-speed communications from any location on Earth, potentially without being detected. Muskrat can assist the defense and intelligence community in gaining a more comprehensive understanding of RF activity in LEO and MEO.



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