

Emulation for LEO Interference Analysis in FR3 Spectrum

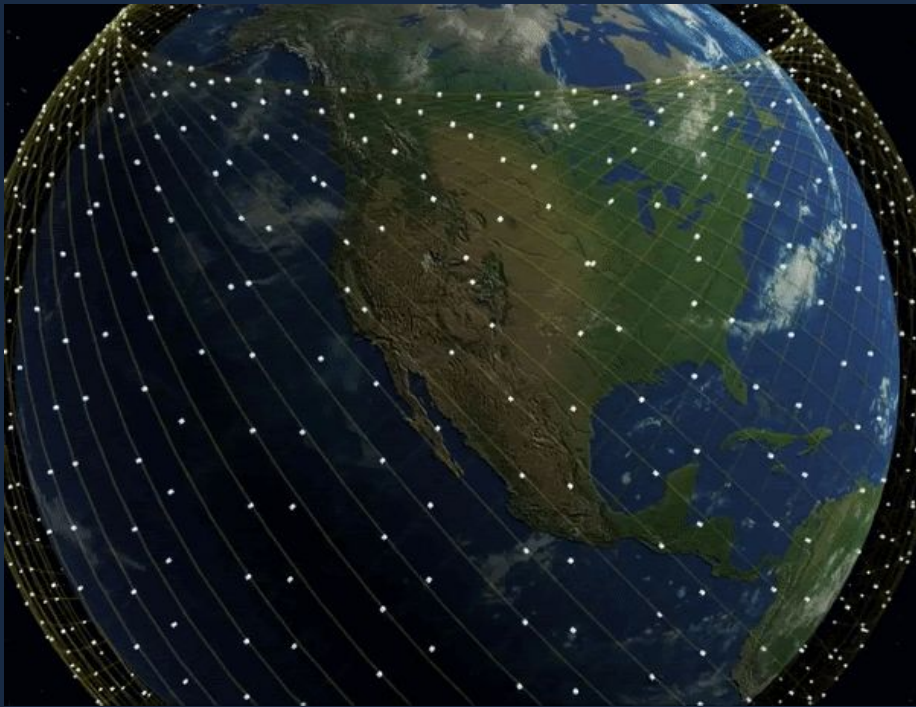
2026 Summer Internship

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Mentored by Rifat Bin Rashid and Rahul Mishra

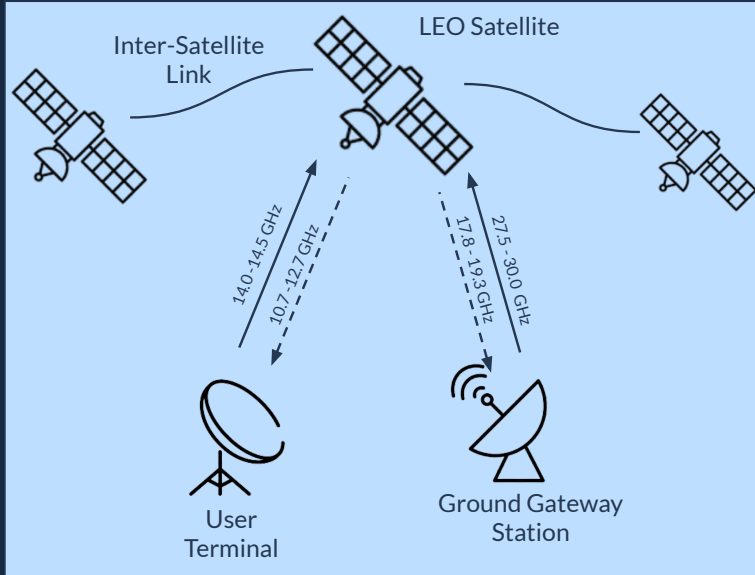
Under the Guidance of Ivan Seskar and Prof. Narayan Mandayam

What is LEO

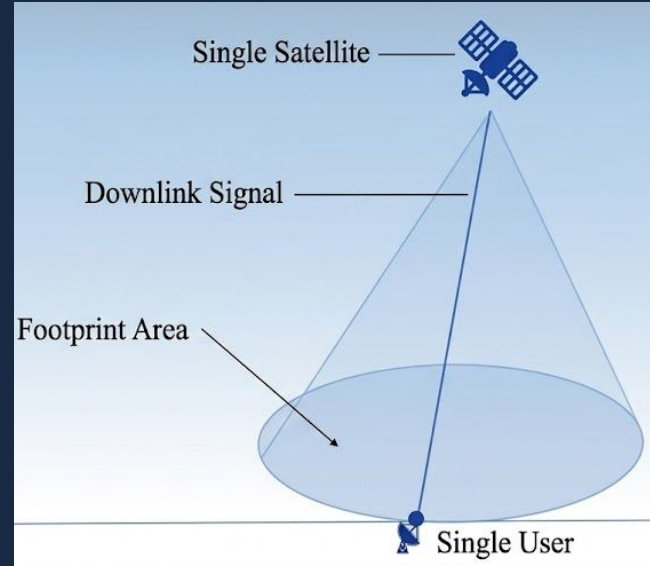


- Low Earth Orbit (LEO) Satellites
 - Interconnected constellations that provide continuous coverage.
- Starlink
 - 10,714 Deployed - July 1st, 2026
- Kuiper
 - 364 Deployed - July 1st 2026
 - 3,232 - Full Gen 1 Deployment
- ~30k-60k SAT in orbit about Earth in 2030

The Structure & Problem



- Use FR3 Spectrum for User Terminals (7.125 - 24.25 GHz)
- The International Telecommunication Union (ITU) is in charge of coordinating telecommunication networks & services.

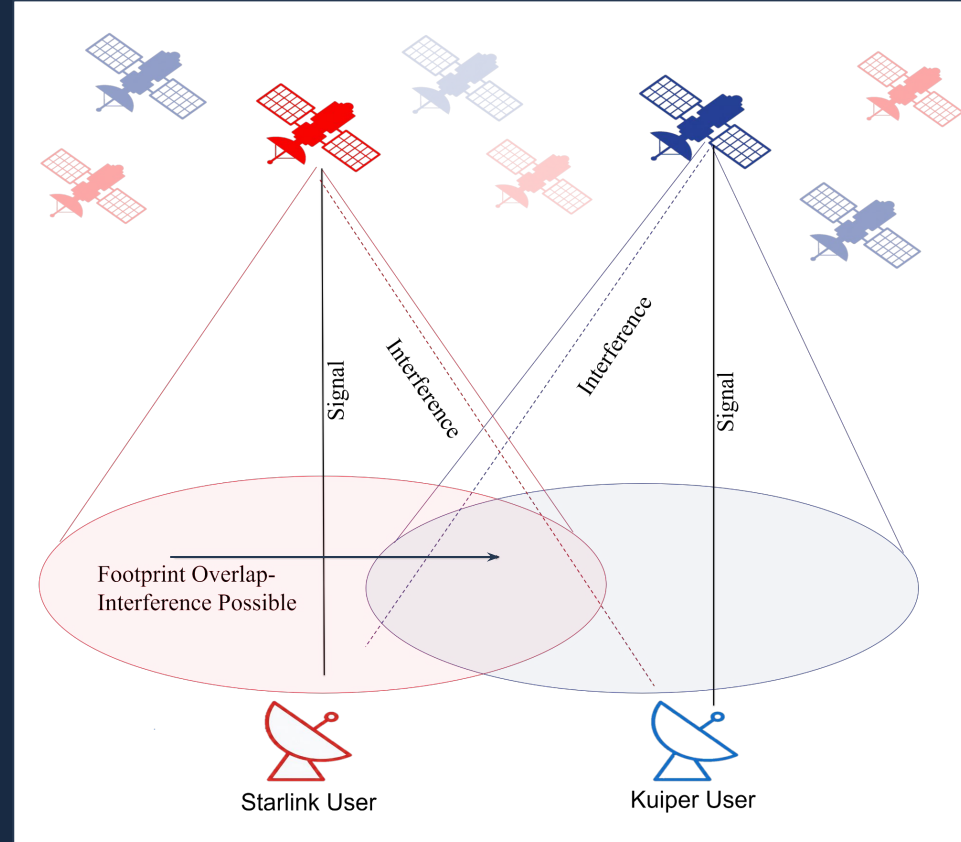


What happens when Footprint Areas Overlap?

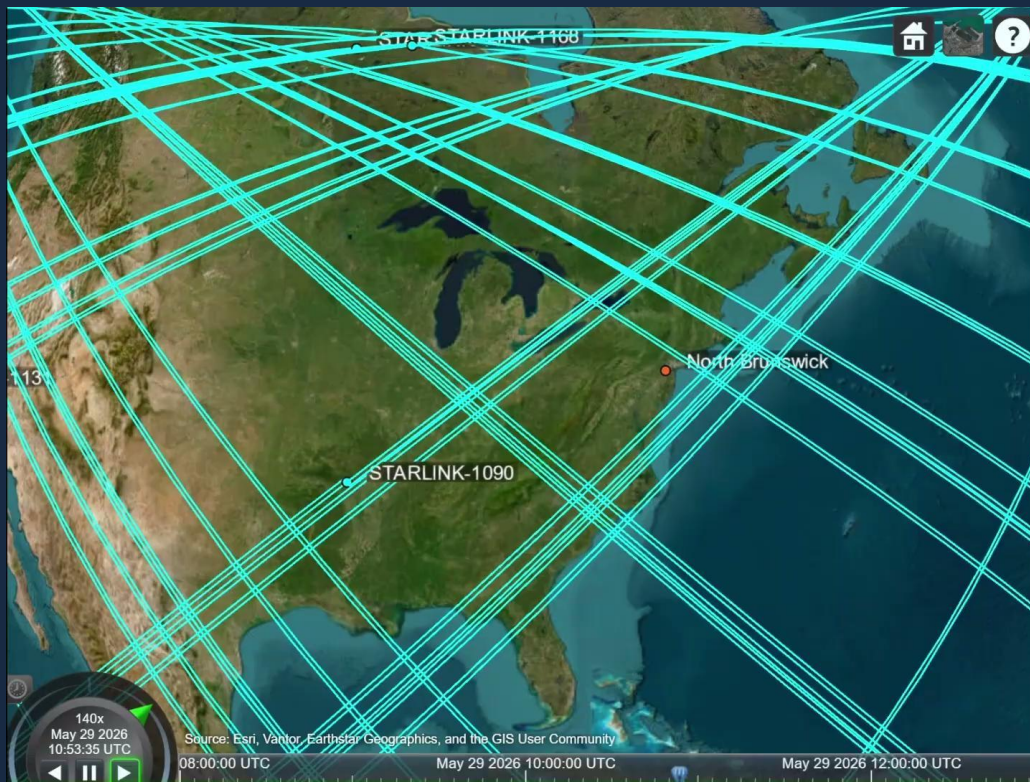
- Interference occurs
 - Same time, frequency, & location.
- Existing Systems:
 - Shielded INR -12.2 dB.
- Newer Systems:
 - Must not exceed INR Shield.

Project Goals

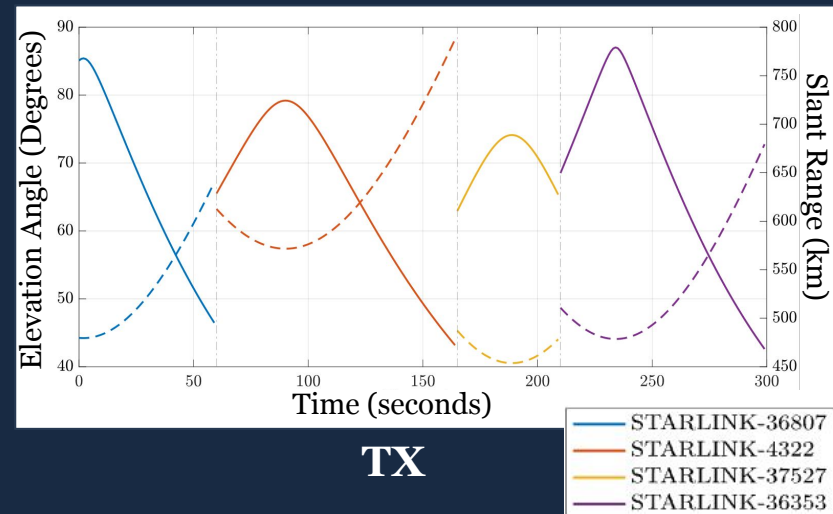
- Model interference in multi-beam, multi-SAT mega constellations.
- Measure metrics on signal quality and interference for both systems.
- Develop a protective scheduler to minimize LEO-LEO interference.



Emulating Starlink on Grid

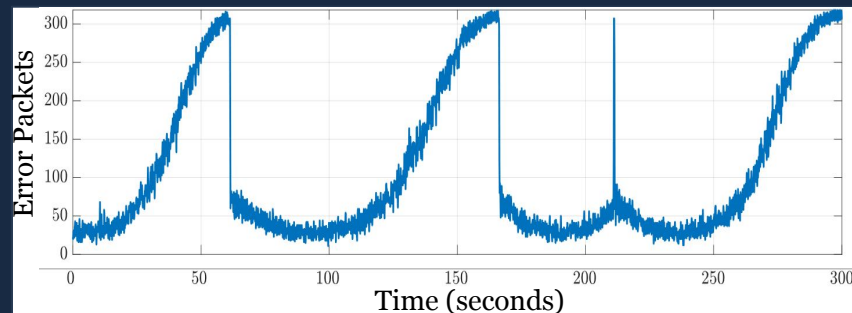


Simulation of Selection

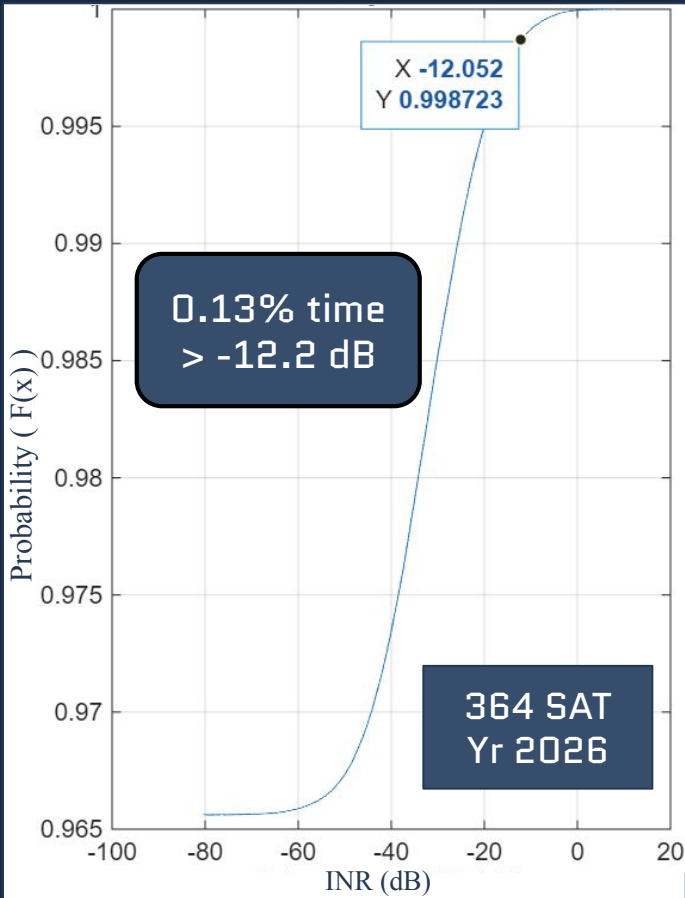


TX

RX

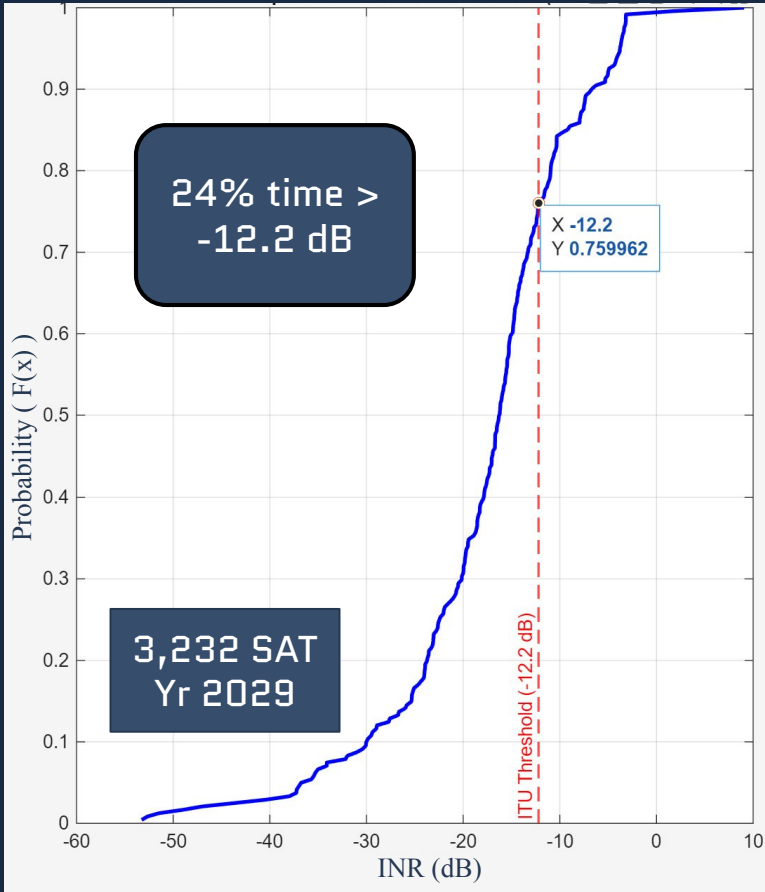


Kuiper Gen1 Full Deployment Impact



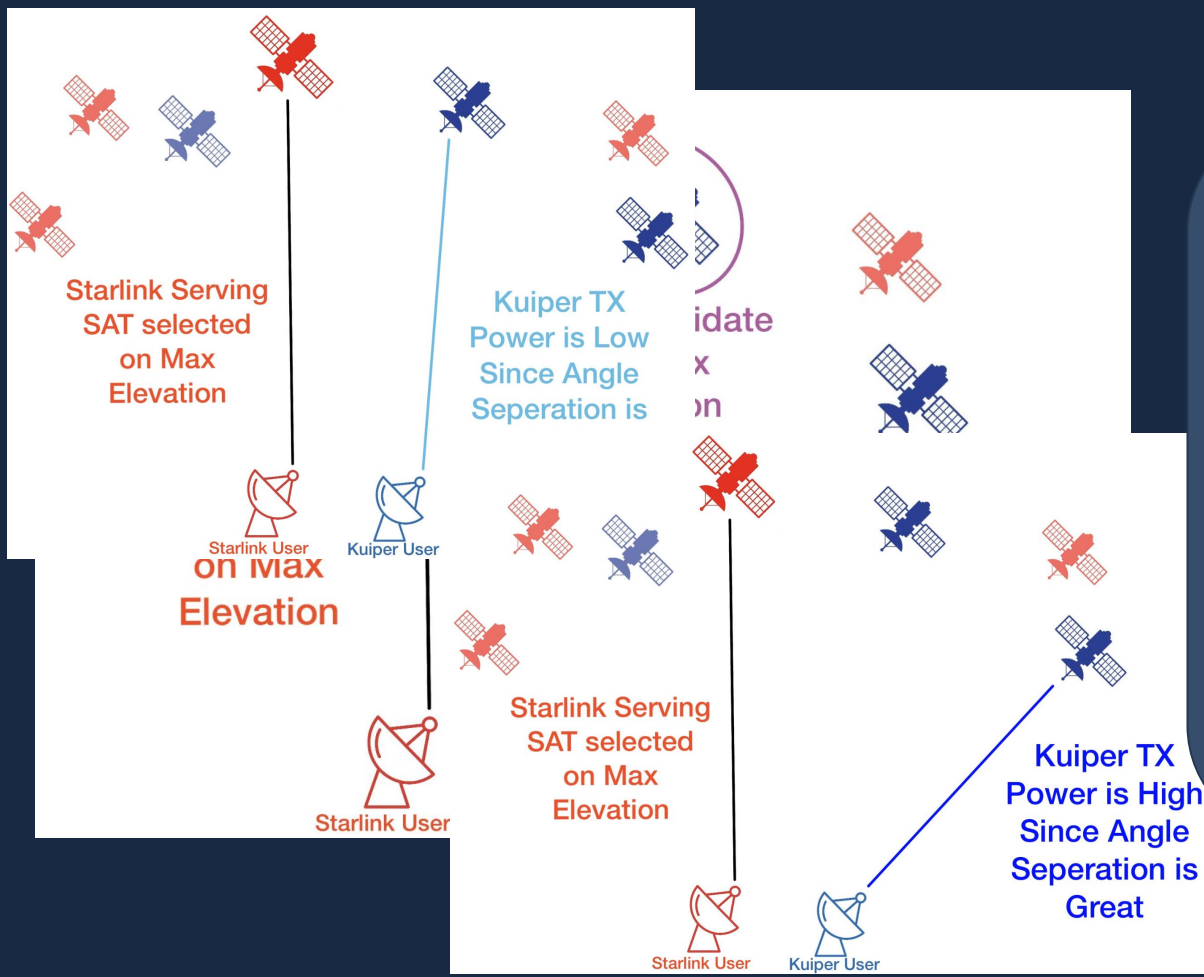
CDF Graph of Current Kuiper Deployment

Full Deployment crosses ITU Threshold Value significantly more.



CDF Graph of Full Gen 1 Kuiper Deployment

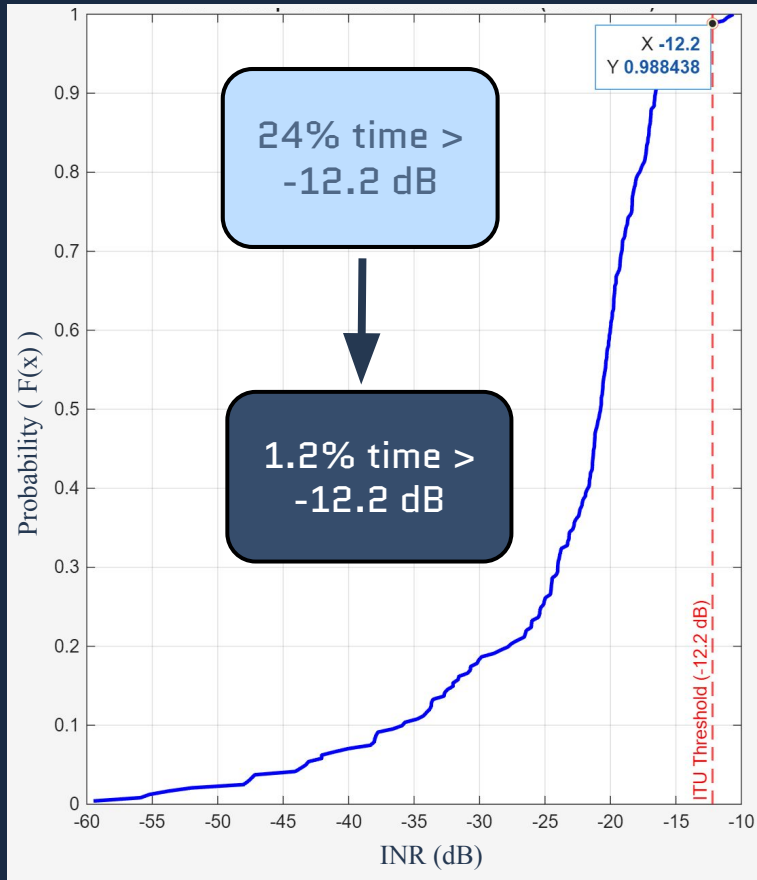
Mitigation Techniques: Power & Angle Control



Power Control Scheduler

- Findings:
 - Dynamic Kuiper TX power decreases percentage of time crossing -12.2 dB.
 - Costs Kuiper users signal quality.

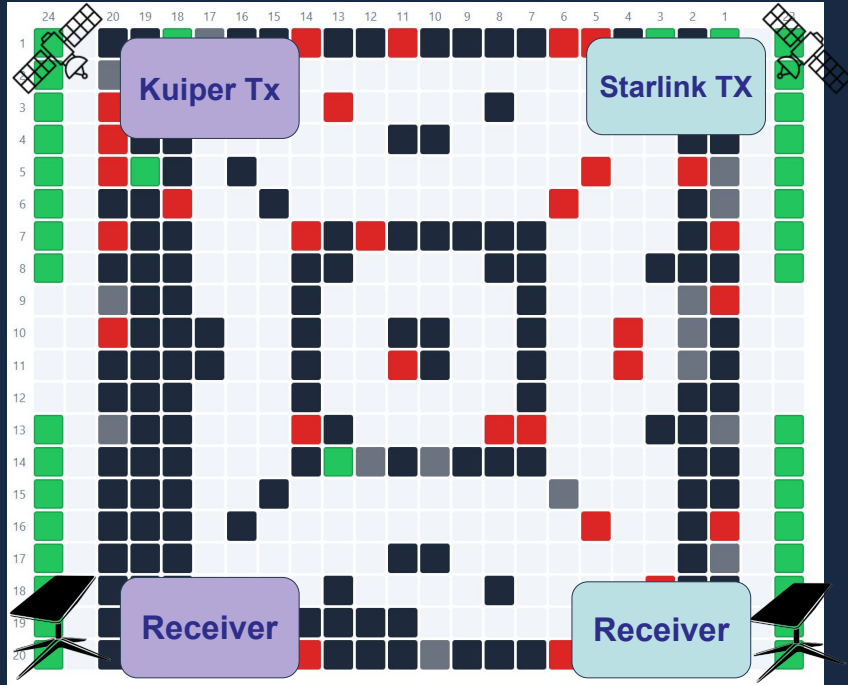
Mitigation Effective: Kuiper Impact Lowered



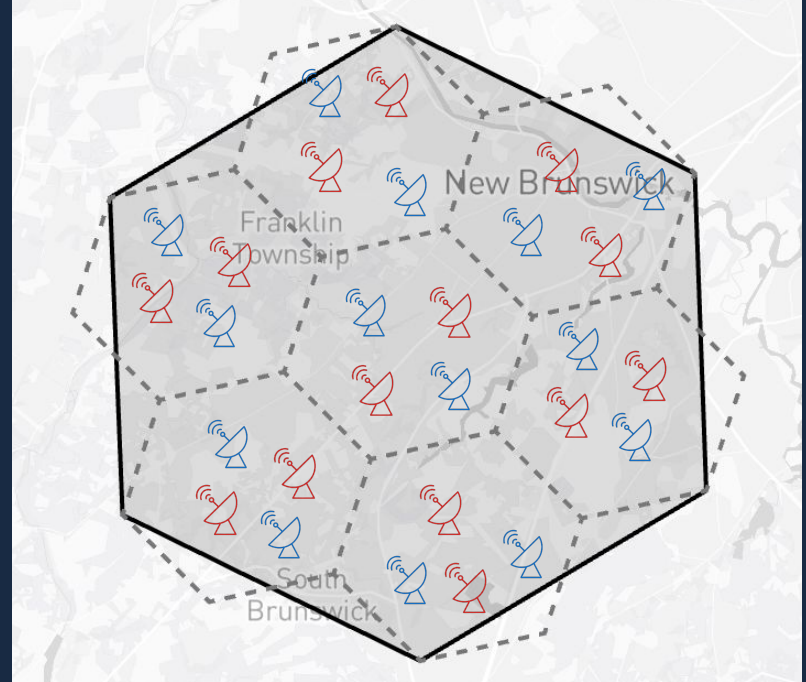
- Percentage of time crossing -12.2 dB decreased.
- Kuiper user maintains good quality signal.

CDF Graph using Angle Separation & SNR Floor

Future Work: Emulation & Multiple Users



- Validate MATLAB simulation findings in hardware.



- Considering what happens with multiple users.