



NTIA Efforts to Protect Meteorological Signals – Past, Present and Future

Real-Time LTE/5G Interference Classification and Mitigation to Protect Satellite Downlink Earth Stations

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ITS

Institute for
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Sciences

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The opinions expressed in this presentation are those of the presenters only, and do not necessarily reflect the views of NTIA, the U.S. Department of Commerce, or the United States Government.

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Agenda

- Introduction – NTIA / ITS Table Mountain Field Site and Radio Quiet Zone
 - Table Mountain Earth Stations
- The Radio Frequency Interference Monitoring System (RFIMS)
 - RFIMS History
 - Problem Statement
 - System Description
 - Central Monitoring System Result
- 1675–1695 MHz Band Studies
 - Data Collection System (DCS) Frequency-Dependent Response Investigation
- Direct-to-Cell (DTC) Investigation
 - Current Active DTC Satellites
 - Current Constellation views
- Closing Thoughts

Table Mountain Field Site and Radio Quiet Zone

■ Radio Quiet Zone

- Magnitude of external radio signals legally restricted
- Protection is codified in FCC Rules at 47 CFR 1.924(b), in the NTIA Redbook at § 8.3.20, and Colorado statute at § 30-11-601

■ Federal priority: spectrum sharing

- Advanced Communications Test Site and CRAIN over-the-air Test Range
- The world's only automated testing system to perform ITS-developed Radar Spectrum Emissions Criteria (RSEC) measurement procedures required for federal government system certification



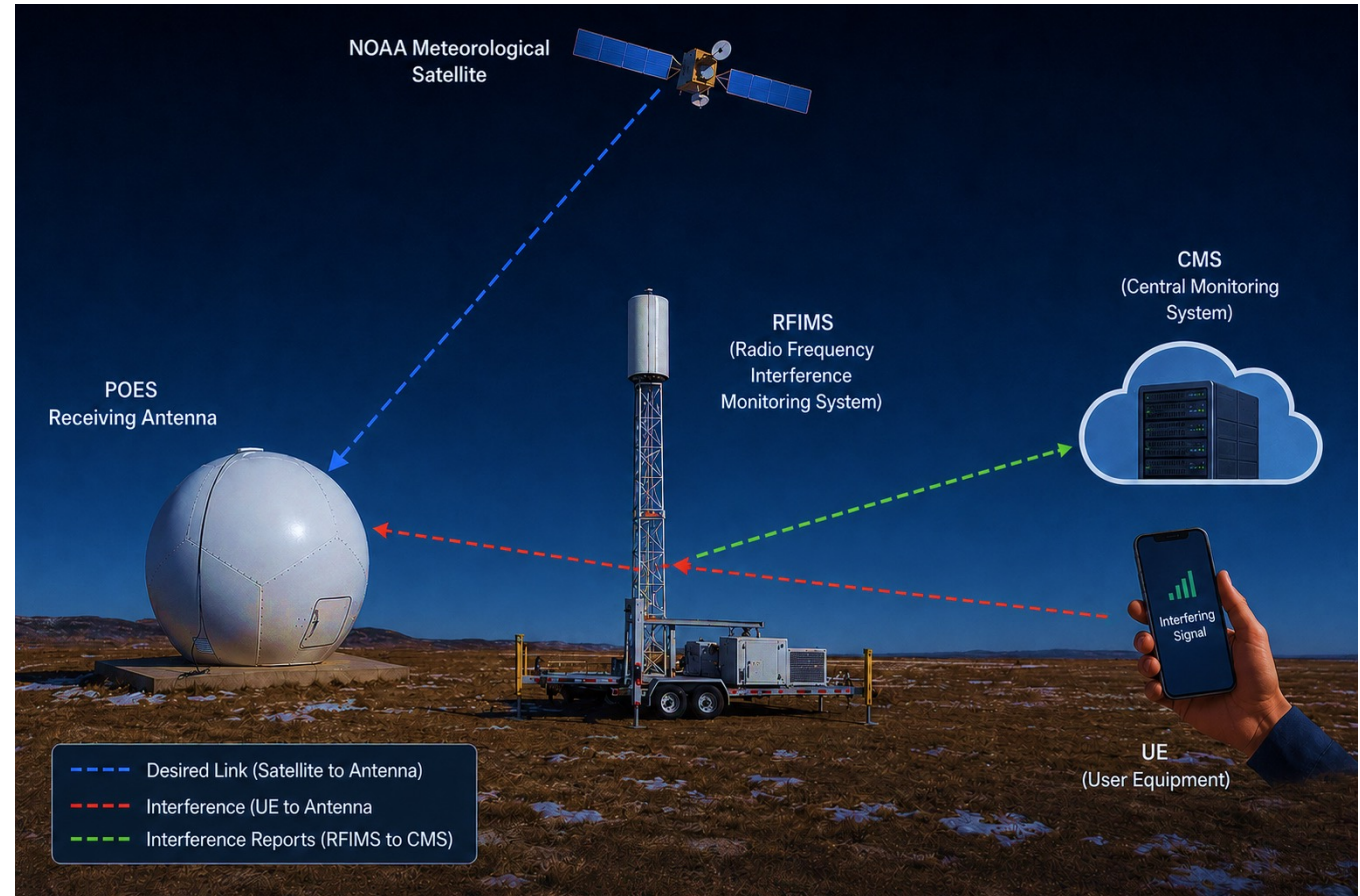
Table Mountain Earth Stations

- ITS Table Mountain Field site hosts complete receiving stations for
 - Polar-orbiting Operational Environmental Satellites (POES) / Meteorological Operational satellites in “polar” orbits (MetOp)
 - High Rate Information transmission service and Emergency Managers Weather Information Network (HRIT/EMWIN)
 - DCS (Data Collection System)
 - GOES Rebroadcast (GRB)
- Sandbox environment, data is not used for real-time NOAA operations
- This site provides a testbed for interference studies, receiver testing and LTE / 5G Signal emulation



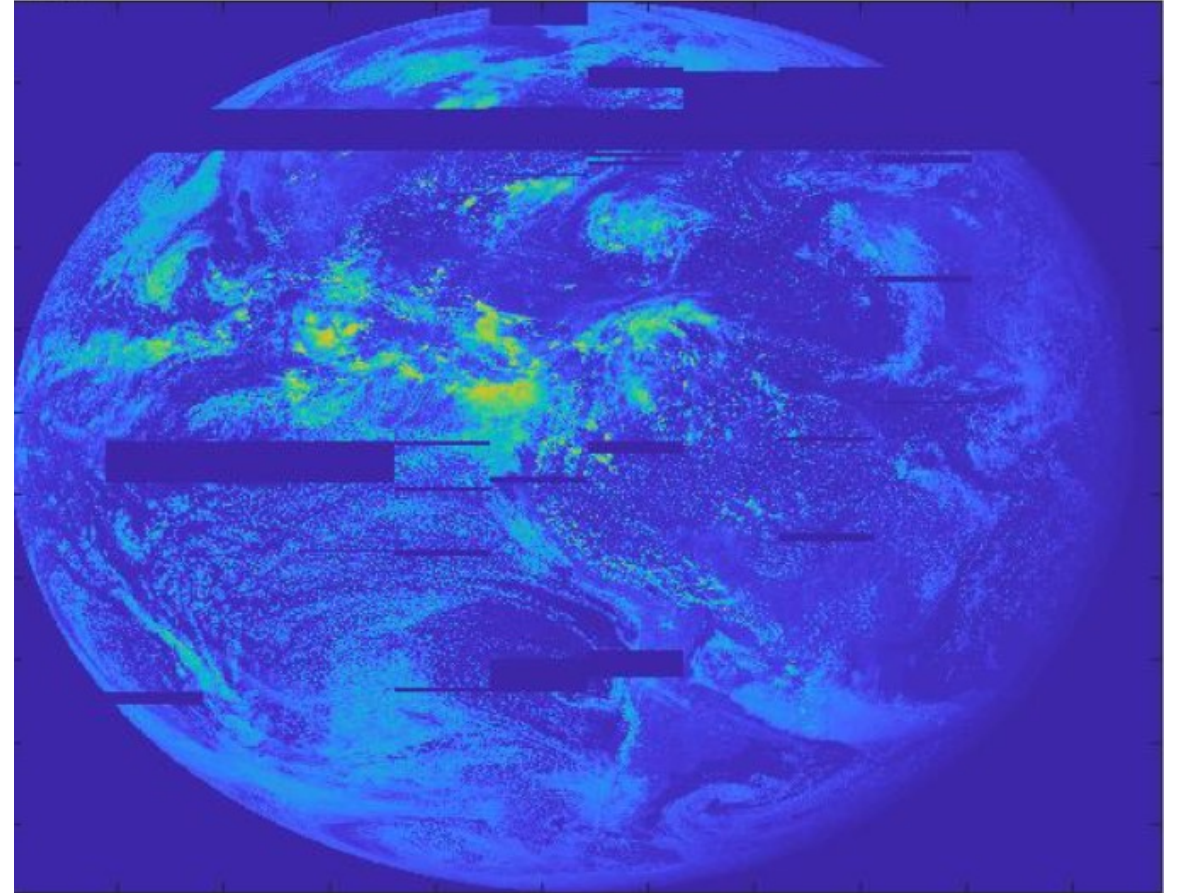
The Radio Frequency Interference Monitoring System (RFIMS)

- FCC AWS-3 (1965–1710 MHz) Auction – January 2015 to DISH Networks
- AWS-3 Band shared with polar meteorological satellite
- NOAA commissioned RFIMS and NTIA/ITS acts as subject matter experts
- RFIMS 01 installed at Table Mountain Radio Quiet Zone in 2021



RFIMS Problem Statement

- UE uplink transmissions generate radio-frequency interference (RFI)
- Resulting RFI degrades received satellite imagery



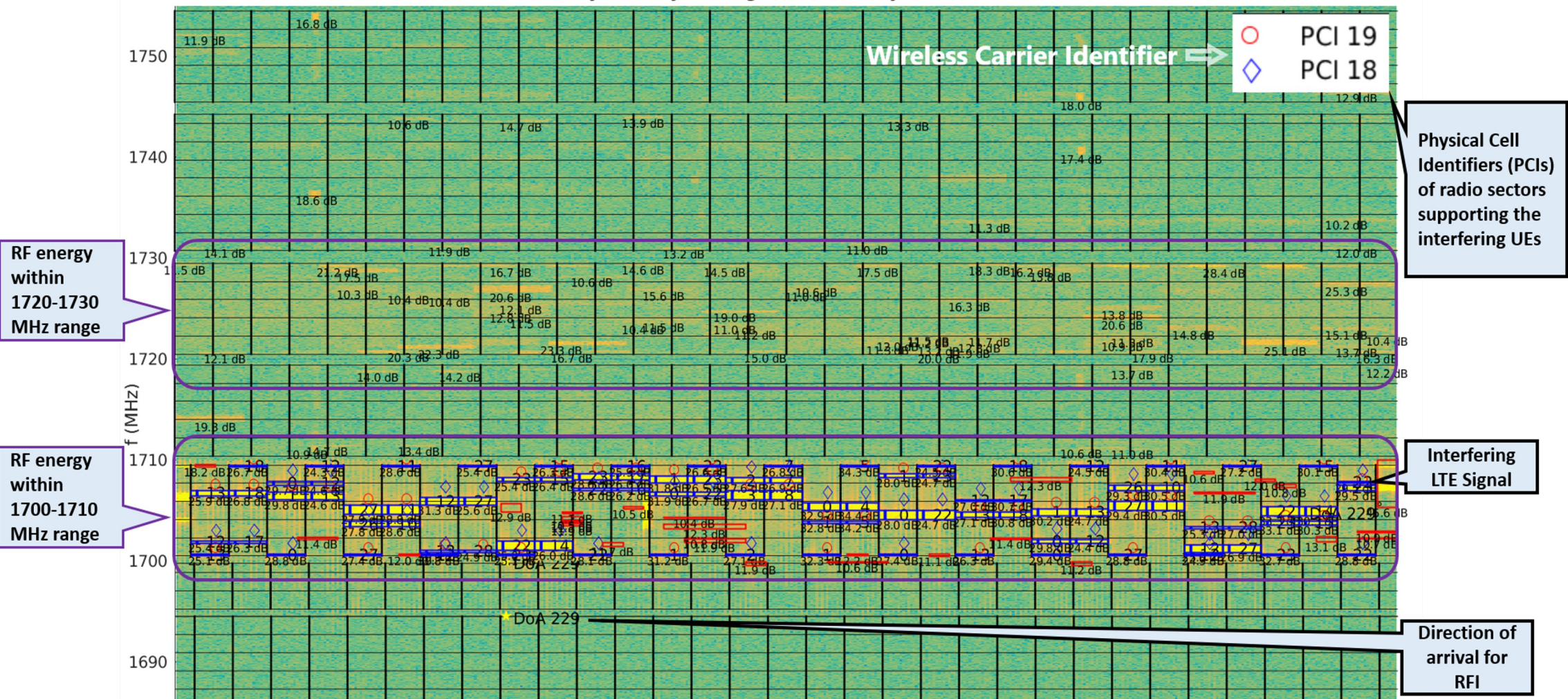
RFIMS System Description

- Beamformed antenna array
- High-speed digitizer, base station identification processing from uplink
- Central Monitoring System (CMS) – not shown



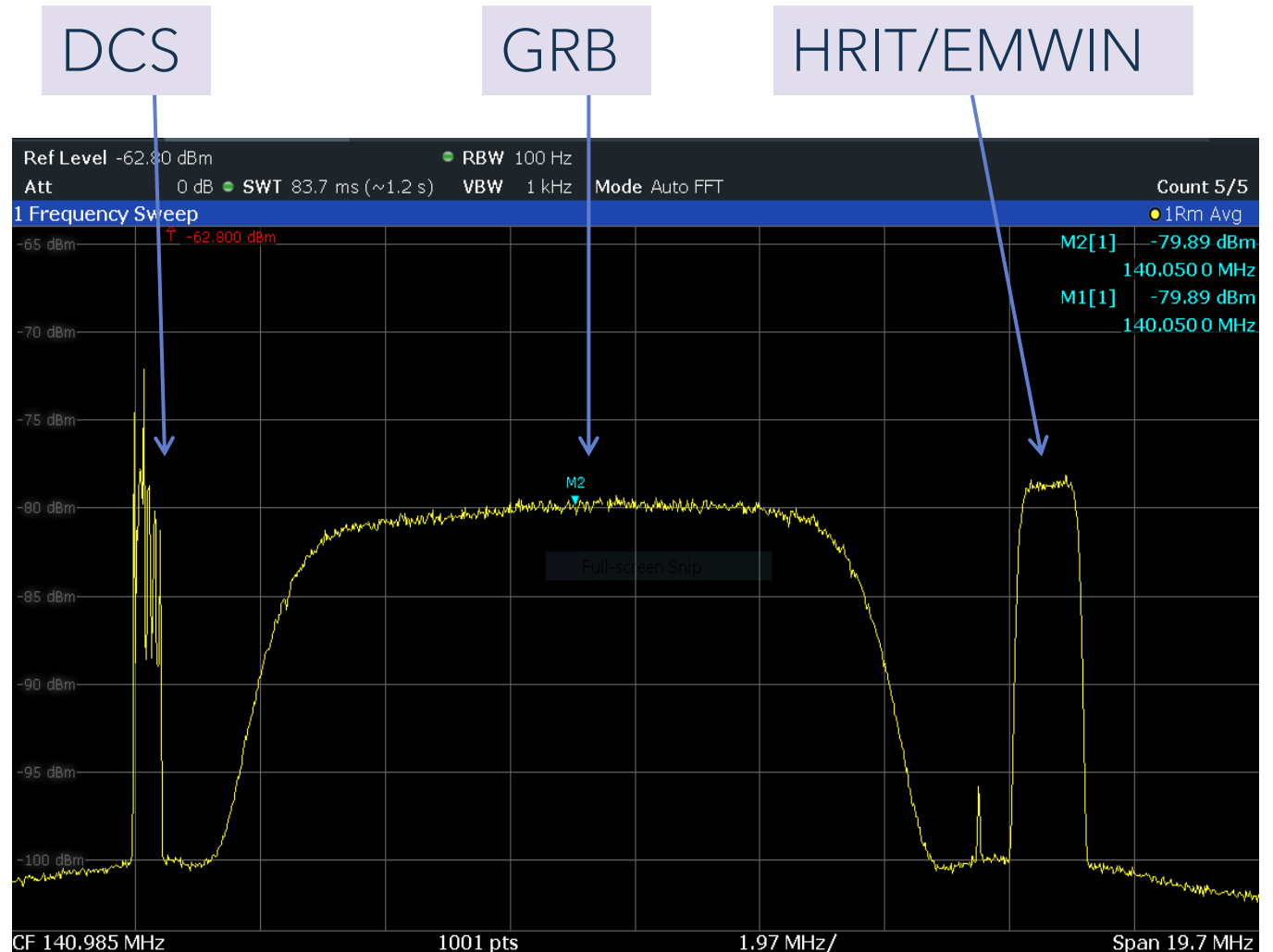
Central Monitoring System Result

Classify/Identify Staring Beam, 20-May-2021 17:42:34



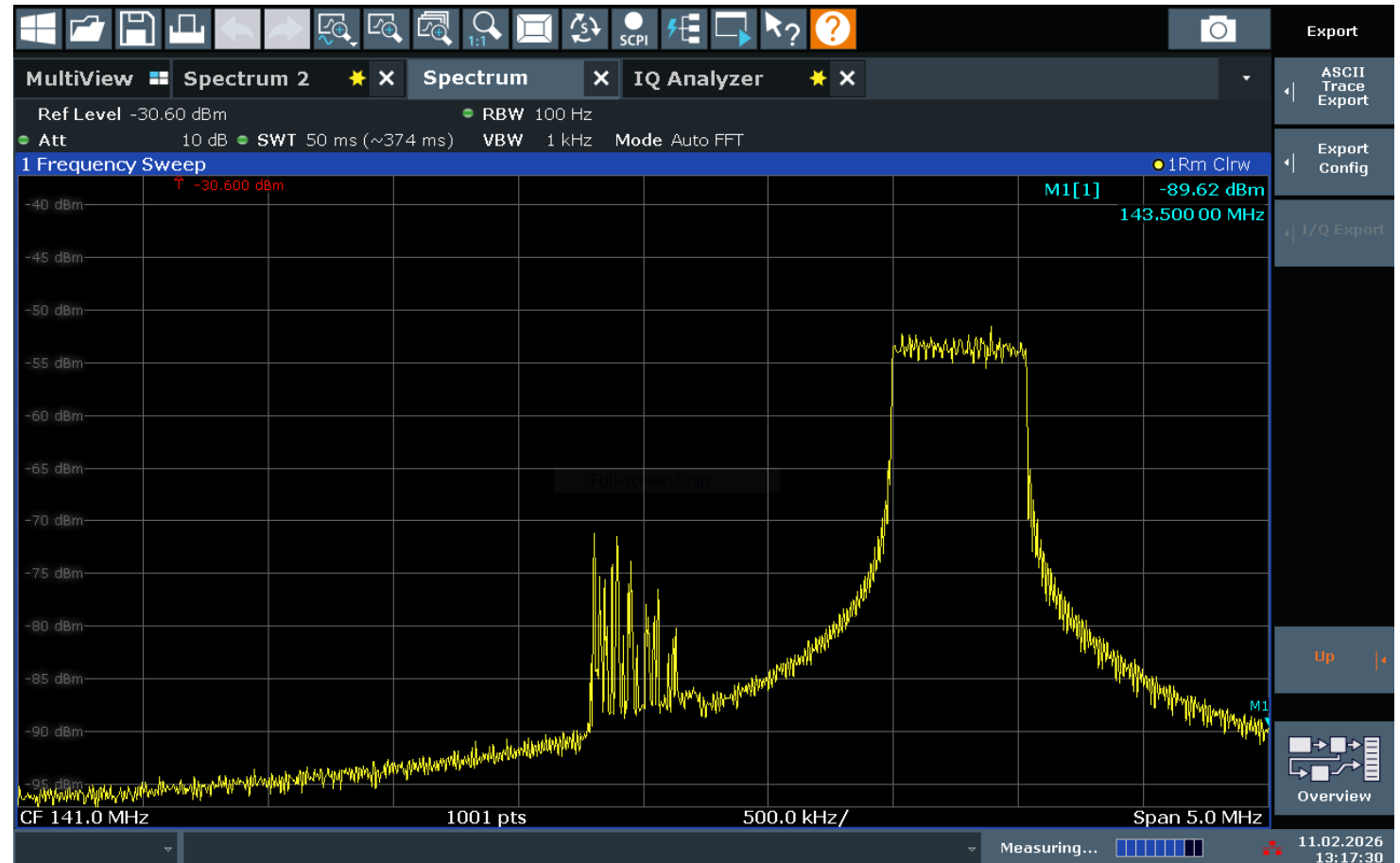
1675-1695 MHz Band Studies

- DCS
 - No effective alternative delivery – biggest concern
- GRB
 - Internet delivery
- HRIT/EMWIN
 - Internet delivery

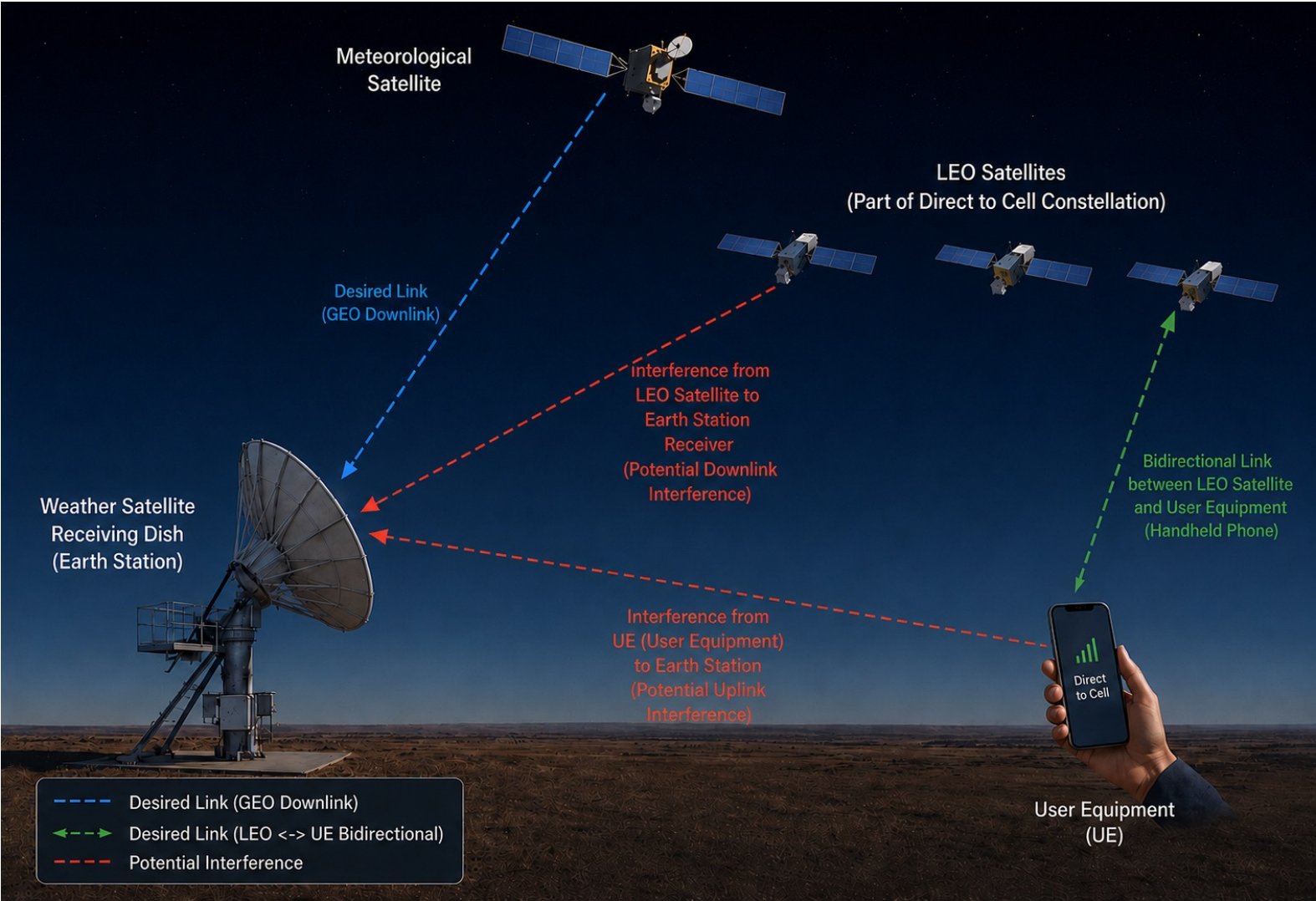


DCS Frequency-Dependent Response Investigation

- 5G cellular waveforms are injected directly into receiver
- 4 downlink sites need to be protected from interference
- Results develop an “interference protection criteria” for mobile operators



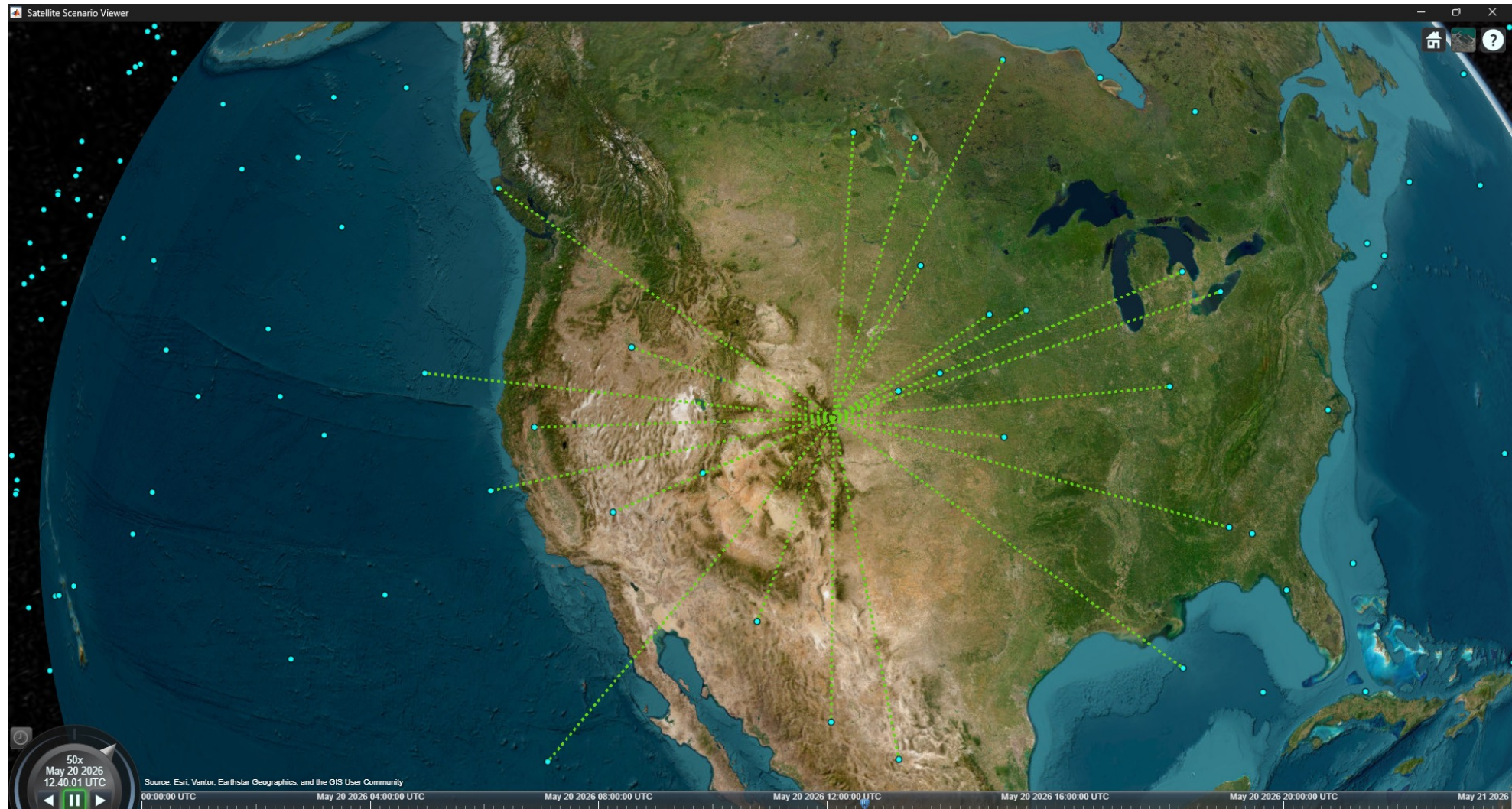
Direct-to-Cell (DTC) Investigation



Current Active DTC Satellites

- 634 Satellites at this time located at an altitude of 350 km
- Effective isotropic radiated power (EIRP) is 88 dBm
- Line of sight visibility 24/7 – 25 satellites on average at Table Mountain
- Current band is 1995 MHz, but 1675–1695 is being contemplated

DTC Seen from Table Mountain



DTC Seen from EUMETSAT



Closing Thoughts

- We gratefully acknowledge the support of NOAA for the RFIMS portion of this presentation.
- In the past, the RFIMS Project was able to determine base-station IDs from handheld user equipment transmissions and alert cellular service providers to take steps to eliminate interference to POES and MetOp satellite downlink transmissions.
- The present Band Studies work is concerned with protecting real-time DCS transmissions from harmful interference and determining the radio Protection Zone parameters.
- The future Direct-to-Cell Investigation tries to analyze and model the effects of LEO high-power transmitter “base stations in the sky” to better prepare for their interference effects on satellite-based and terrestrial radio systems.