



GROUNDSPACE

Crowded Skies: Safeguarding the RF Spectrum in the Age of Satellite Constellations

Radim Badsí
CEO

Ground & Space, Connected

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WHO ARE WE



We design innovative systems for spectrum monitoring and management

- Founded in 2019
- Our rapidly expanding team includes experts on:
 - *Satellite Communications*
 - *Ground Segment Design*
 - *Software Development*
 - *Data Science*
 - *Computational Physics*

Our key values

Reliability

Resourcefulness

User Success

Knowledge
Development



DIRECT-TO-DEVICE



- Direct-To-Device (DTD) allows commodity mobile devices (such as smartphones and IoT devices) to connect directly to a satellite network
- Two types of DTD:
 - **Mobile Satellite Service (MSS)**
 - Requires compatible chipsets: *Globalstar (iPhone), Iridium Stardust*
 - **Supplemental Coverage From Space (SCS)**
 - Compatible with unmodified LTE/5G user terminals:
Starlink, AST SpaceMobile, Lynk Global
- This presentation focuses on the latter

Globalstar

 iridium®

SPACEX

AST
SpaceMobile

 LYNK

SUPPLEMENTAL COVERAGE FROM SPACE



- SCS DTD satellites are equipped with modems that function like a cellphone tower
- They are integrated into existing LTE/5G terrestrial networks
- SCS operators must establish partnerships with local operators and coordinate with local regulators
- The DTD satellite directs its beam towards the user
- The frequency allocations may vary from country to country

The SpaceX logo, featuring the word "SPACEX" in a bold, sans-serif font, with a stylized rocket ship icon to the right, all contained within a light blue rectangular box.

The AST SpaceMobile logo, with "AST" in large orange letters and "SpaceMobile" in smaller orange letters below it, all contained within a light blue rectangular box.

The LYNK logo, featuring a stylized globe icon to the left of the word "LYNK" in a bold, sans-serif font, all contained within a light blue rectangular box.



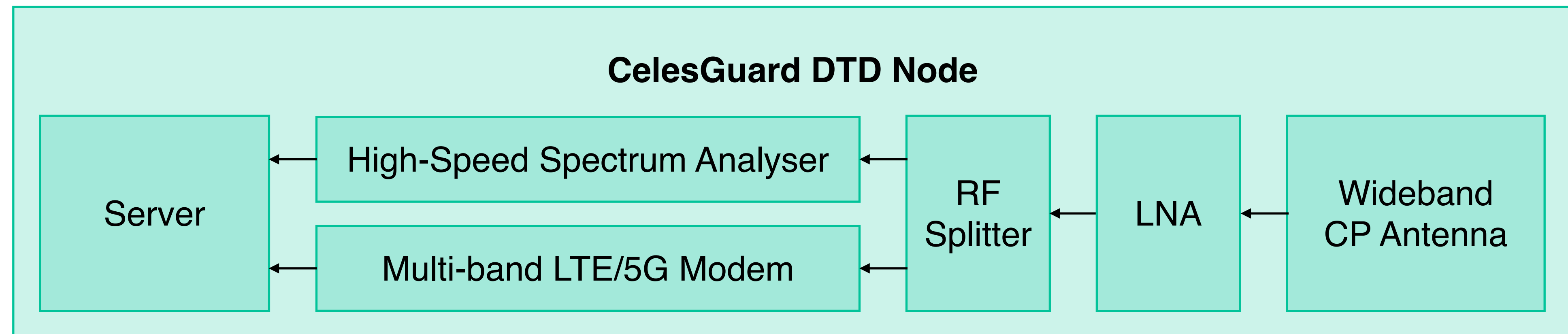
- We designed a system tailored to monitor DTD activity
- Leveraging the technology developed as part of our constellation spectrum monitoring system, CelesGuard
 - *Detects active DTD networks*
 - *Verifies frequency allocations*
 - *Detects out-of-band transmissions*



CELESGUARD DTD HARDWARE ARCHITECTURE



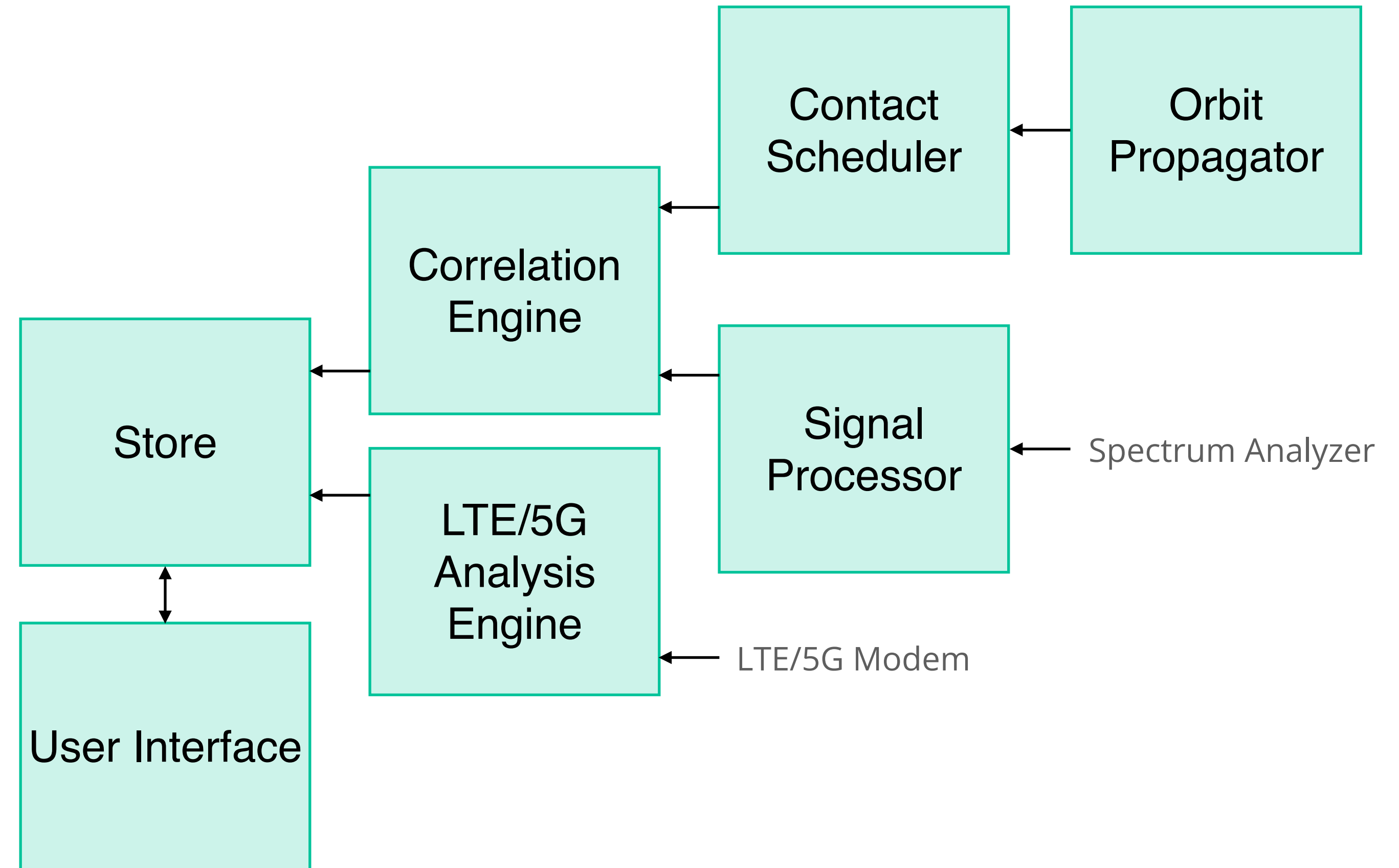
- CelesGuard DTD nodes are self-contained and compact
- CelesGuard DTD supports all current SCS DTD bands
 - *and is easily extensible*



CELESGUARD DTD SOFTWARE ARCHITECTURE



- CelesGuard DTD provides both interactive and unattended operational modes
- It records:
 - *Wideband spectrum displays (waterfalls)*
 - *useful for the identification of out-of-band transmissions*
 - *Detected PLMN IDs (unique identifiers of LTE/5G networks)*
- DTC LTE/5G networks are identified by correlating the RSSI (Received Signal Strength Indicator) of the network with the distance to the satellite



INITIAL RESULTS



- Test campaign conducted in the US
- Passive listening (Rx)
- We can receive intermittent signals
 - Gaps in coverage
- We can identify individual networks



FURTHER WORK



- Monitor for foreign networks
 - *Plausible interference scenario*
- Active communications (Tx & Rx)
 - *Attempt to steer the spacecraft's antenna towards our monitoring station*

