STARLINK OPTICAL SIGNATURE CHARACTERIZATION

06.30.2020
Goal: darken satellite for all stages of mission
OPEN BOOK vs SHARK-FIN

On station, brightness is driven by antennas since the satellite is in the “shark-fin” configuration during sunset and sunrise.

During orbit raise, parking orbit, and deorbit, brightness is driven by the “open book” configuration for thrusting and drag and sunlight reflects off both the antenna and array.
KEY SOLUTIONS

ON STATION: Reduce reflections from antennas during sunset and sunrise

ORBIT RAISE: Change orientation to reduce reflection off both the antenna and array

As the v1.0 constellation grows, the number of satellites on station will grow, but the number of satellites orbit raising will stay similar to what it is today.
OVERALL MITIGATIONS

ON STATION
Add sun visor to mitigate chassis reflections
Adjust solar array angle so it is hidden behind the chassis

ORBIT RAISE
Roll satellite knife-edge to the sun to minimize reflect light onto the earth
ORIENTATIONAL ROLL
ANTENNAE MITIGATION DURING ORBIT RAISE

At sunrise, sunlight reflects off back of array, making the satellite more visible from the ground.
Rolling satellite makes sunlight bounce off smaller ‘knife edge’ of array, reducing reflection.
Ground-based observations of our initial test experiment showed we can significantly reduce brightness.
On station, sun shade blocks sunlight from antennas, preventing reflection.
On-Station Understanding
SUPPORTING OBSERVATIONS

Vera Rubin/DECAM observations presented earlier

Crowd sourced observations from SeeSat demonstrate variation in optical behavior

Understanding improved with successive observations
OPTICAL SIGNATURE MODELING

Typical phase-oriented radiant intensity predictions (McCue, 1971, Krag, 1974) are not sufficient for complex satellite geometries.

We employ non-sequential modeling with CAD geometry, and measured material properties (BRDF), to predict radiant intensity distributions.

Model grounding to observations (previous slide, and others) underway.

Mitigation target: >7\textsuperscript{th} magnitude, <44W/sr
Thanks for your attention!